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Implementation of the Lean Concept Combined with the House of Risk Approach

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Abstract:- Lean is a technique that uses DMAIC phases and some Lean Six Sigma tools to enhance a company's performance. The most significant forms of flaws were warp disintegration defects (23,9%), slub feed fiber defects (19,4%), warp slub fibers (17,1%), and close feed defects (14,1%), according to the study's findings, which also revealed a known process cycle time of 61,28%. DPMO is calculated to be at 21,208 and is at the level of 3,53 sigma according to the calculation findings. Additionally, using the fishbone diagram, it was possible to identify the causal elements for faults, which include human factors, machine factors, environmental factors, and raw material factors. Some wasteful results of the observation are rework, delay, and motion. The House of Risk (HOR) approach reduces the risk of any problem. The recommendation of the control plan is to prepare a schedule of maintenance with a logbook for maintenance and monitoring of the machine by the operator on a regular basis and do the training.

Keywords:- *Lean, DMAIC, HOR.*

I. INTRODUCTION

Modern commerce and industry have advanced and developed, changing how consumers view and select items. Consumers are a crucial component in company competition and defense, claims Tiza (2019). When choosing products, shoppers must consider quality. For businesses to succeed and to satisfy customers, high quality is crucial (Nasution, 2018).

In addition to the competitive price factor, according to Sari (2021), quality has an influence on purchase decisions. Continuous improvement systems reduce defects (Syahrullah, 2021). Quality improvement and process improvement in overall production systems must be carried out if a company wants to produce quality products. According to Ratnadi (2020), a company needs quality control to reduce costs and defective products. Poor performance is caused by a company's management system's inability to set targets (Marpaung, 2022). The influence of good quality management can shorten the time required and require relatively less cost (Halim, 2019).

A quality company is one that has a good production system with controlled processes (Hardiyanti, 2021). The problem faced by companies is the increase in the number of defective products during the production process, which affects the product quality and leads to a decrease in sales (Elfanda, 2021). This is related to the production process and balanced production speed (Nugrianto et al., 2020). To compete in the current market, according to Sunardi & Suprianto (2020), companies must always strive to improve efficiency. The focus should be on minimizing defects and waste from the entire process optimally (Sunardi & Suprianto, 2020).

As part of a continuous effort to reduce defects (Ono et al., 2020), the Lean Six Sigma methodology, which combines Lean and Six Sigma, is being used (Sarman & Soediantoro, 2022). Lean is a continual endeavor to eliminate waste and raise the value-added of products (goods and/or services) to deliver value to customers (customer value), whereas Six Sigma is a set of tools used to identify, analyze, and eliminate causes of variation in processes (Gaspersz, 2007).

A business in the textile sector that creates integrated products. It employs semi-automatic machinery with human operators in the production process. There are still numerous manufacturing. These flaws lower the value of the fabric grade and lower the company's profit margin. Therefore, in this study, the researcher employs the House of Risk (HOR) method to map the occurring risks and the lean six sigma method to analyze the problem's sources. The importance of hazards and financial constraints should be taken into account when selecting risk mitigation measures (Dadsena, 2019).

II. LITERATUR REVIEW

A. Lean

Continuous improvement efforts are at the heart of lean (Gaspersz, 2008, p. 6). reducing waste, boosting the value-added of goods and services, and to offer customers value (customer value). According to the APICS Dictionary from 2005, Lean is a business philosophy founded on: reducing the use of resources (including time) in various company activities by identifying and eliminating non-value-adding activities in supply chain management, manufacturing, or operations (for services), as well as design and production, which are directly related to customers.

B. Six Sigma

Six Sigma is a continuous improvement effort to (Gaspersz, 2008): Reduce process variation in order to Improve process capability and Achieve zero defects in products or services, with a target of minimum 3.4 DPMO (Defects Per Million Opportunities). Provide value to customers (customer value).

When products or services are processed at a Six Sigma level of quality performance (process capability), a company can expect 3.4 failures per million opportunities (DPMO), which means 99.99966% of what customers expect will be present in the products or services.

A method or technique for dramatic quality control and improvement implemented by Motorola since 1986 (Pyzdek, 2002). Some notable successes of the Six Sigma program include an average annual productivity improvement of 12.2% (Pyzdek, 2002). However, in Pareek's research (2018), Motorola found that Six Sigma metrics and methodology were not enough to drive breakthrough improvements in the organization. They ensured that Six Sigma metrics and methodology were used to enhance opportunities directly related to business strategies. Currently, Six Sigma is also used as a management system to implement business strategies.

C. DMAIC

DMAIC is used to optimize business processes. The achievement of zero faults performance is the aim of these techniques (Gaspersz, 2007).

D. House of Risk

House of Risk (HOR) is a model and method used to proactively manage risks in a systematic order based on their impact (Gulo et al., 2020). HOR aims to measure the level of risk and prioritize the most potential risk sources. This method provides risk mitigation and identifies the causes of risks based on the severity of their occurrences. This approach is used to reduce the emergence of risks (Amanda, 2021).

III. RESEARCH METHODOLOGY

The research steps taken in solving the problem can be seen in the research flow chart as shown in the following diagram

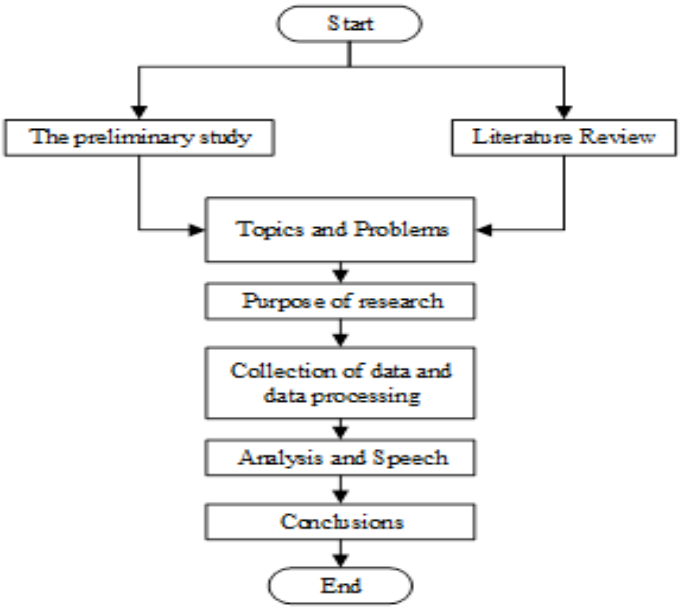

Fig. 1: Flow of Research Methodology

IV. RESULTS AND DISCUSSION

A. Define Phase

Map of business process is the flow of business processes from the beginning to the end of the fabric process:

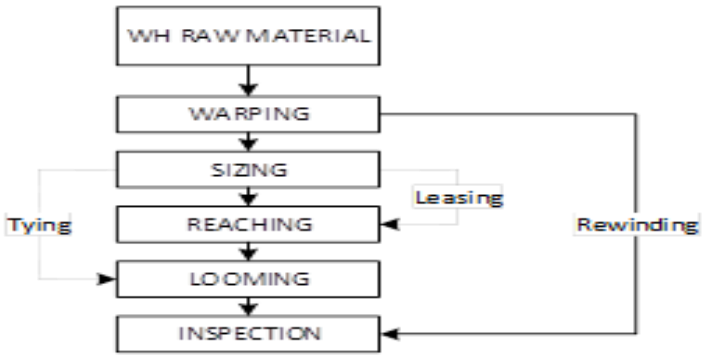

Fig. 2: Map of Business

The weaving process is the process of weaving the wire into raw fabric or semi-finished fabric, where the raw material is feed wire and warp wire. In this process, the final result is called gray.

B. Measure Phase

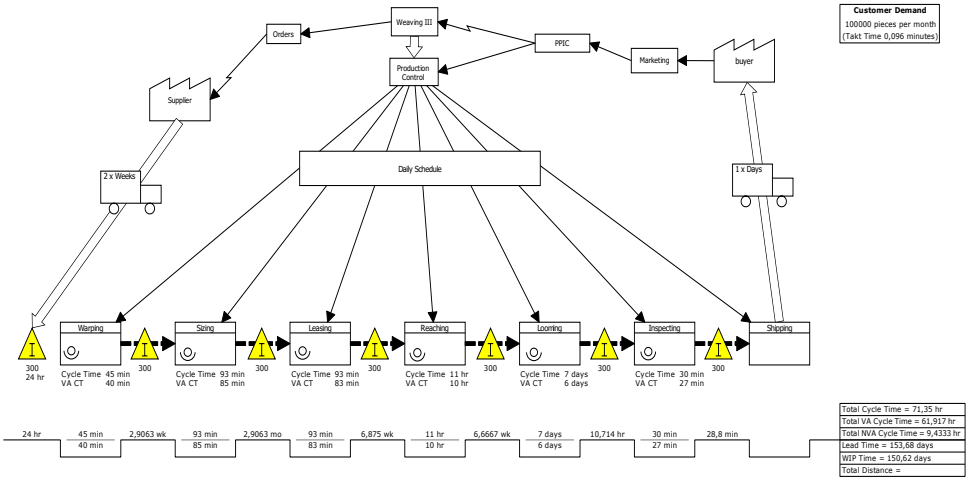

Fig. 3: VSM

Total Cycle Time: 71,35/hr; Total VA: 61,91/hr; Total NVA 9.43/hr; Total Lead Time :153,68/days.

C. Analyze Phase

The analytical step, especially the Fishbone diagram, was established during this phase. These techniques are employed in the creation, filtering, and understanding of the causal chain underlying the incidence of problems. Analysis of the Results.

There are several defects that frequently cause damage, among them the defect made by Grey, which has a rupture of the warp and is hence characterized by connection wires and a small amount of holes. In the category of wire defects, there are wire from the direction of the feed in question that are lead and are not at all flat. The cause of defect is the same as the cause of the defect; the only difference between the two is the type of wire; wire is a wire that leads to lengthening, whereas the wire of feeding is a one which leads the side. The term "fast feed defect" refers to the defect that results from the machine fitting process, and the description of the defekt in question is fiber towards feed too close to its distance.

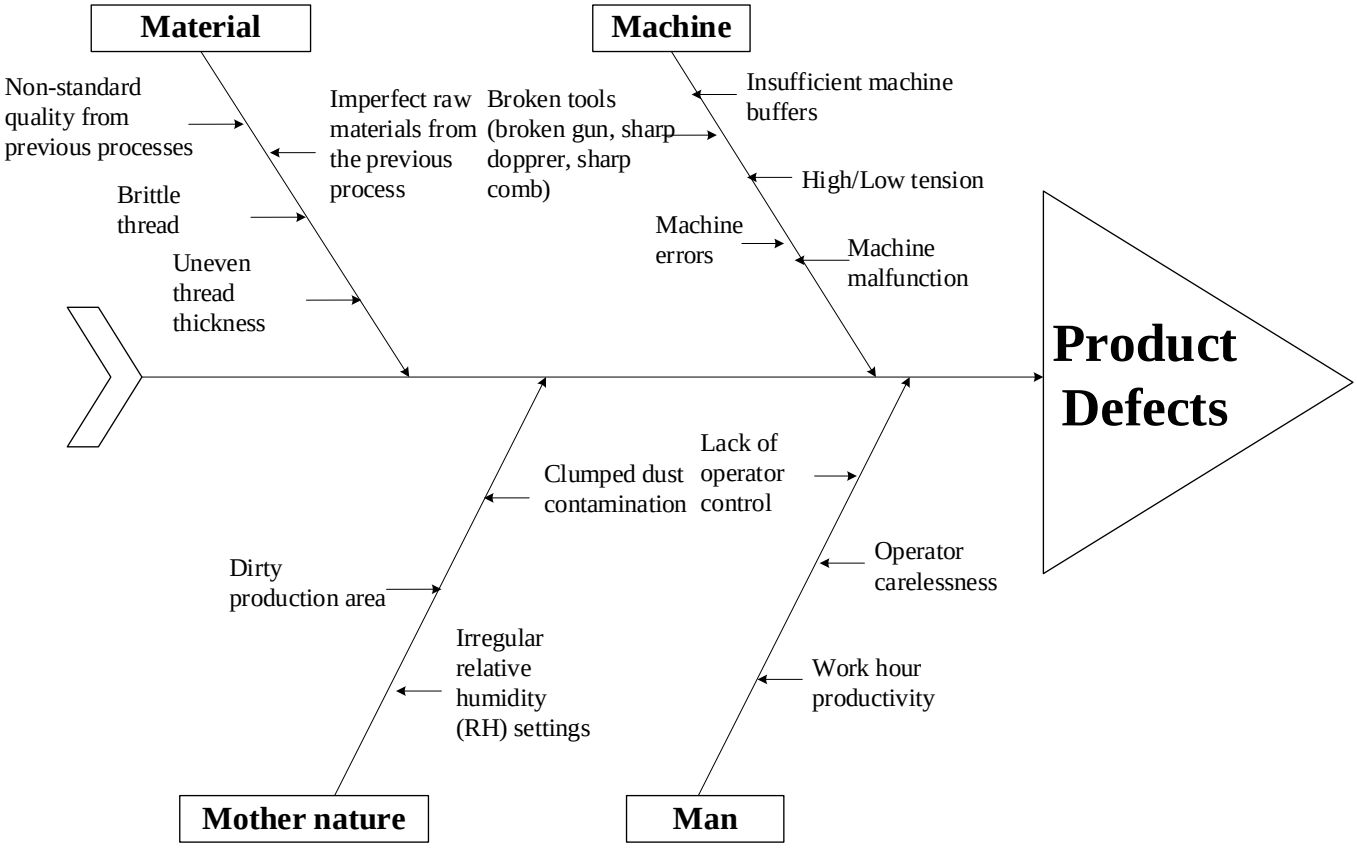

Fig. 4: Diagram Fishbone

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D. Improve Phase

The improvement stage is the stage in which a plan of improvement proposals is established to prevent the cause of a product defect from recurring. The proposed repair plan is done by prioritizing product flaws in the previous Fishbone diagram. Continued to make mitigation using the House of Risk (HOR) method, below is the identification of the risk of product defects most often occurring as follows:

Table 1: Risk Event

No	*Sub Process*	*Risk Event*	*Code*	*Severity (S)*
1	Planning of machinery	A machine buffer and an administrative system that fully, systematically, seamlessly, and simply traces all purchasing records are in place to enable the procurement of machinery.	E1	3
2	Planning of production	Production machinery condition is not good, requires routine logbook maintenance	E2	9
3	Planning of raw materials.	Not in accordance with the standard of good wire raw materials	E3	9
4	Delivery of raw materials.	The accepted raw materials.	E4	9
5	Accepted material inspection.	Materials received defective.	E5	9
6	Implementation of production process	Use of equipment and machinery is not in the first condition	E6	5
7	Implementation of production process	Raw materials contaminated dust and liquid from the machine	E7	9
8	Implementation of production process	Production process errors cause defect / defect	E8	8
9	The Production Environment	Non-sterile production environment conditions allow for output defects.	E9	6
10	There is no layout and SOP covered through the process so that errors can occur.		E10	6
11	Product Quality Inspection	There is a potential error in product quality checking due to environmental impact	E11	4
12	Quality inspection of machines.	Engine inspection when changing the shift has no disappointment first	E12	5
13	Delivery of Products to Customers	Delivery process potentially contaminated with dust and dirty fluids	E13	4
14	Return of raw materials to suppliers.	There are unidentified defects.	E14	6

After the identification of frequently occurring product defects, the following is the risk agent (Risk Agent) level table, which can be seen in Table 2.

Likelihood / Probability				
	3 High	E1, E11, E13	E2, E3, E4, 35, E7, E8, E6, E9, E10, E12, E14	E2, E3, E4, 35, E7, E8, E6, E9, E10, E12, E14
	2 Medium		E1, E11, E13	E2, E3, E4, 35, E7, E8, E6, E9, E10, E12, E14
	1 Low			E1, E11, E13
		1	**2**	**3**
		Low	Medium	High
		Severity / Impact		

Fig. 5: Risk Map

From the risk map image above are known 11 High: E2, E3, E4, E5, E6, E7, E8, E9, E10, E12, E14 and 3 Low: E1, E11, E13. Table of 2. level of opportunity. (Risk Agent).

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Table 2: Risk Agent

Code	Risk Agent	Occurance (O)
A1	The company does not have advanced or automatic information and management systems for machine maintenance	5
A2	There is no work instruction for each stage visually	5
A3	Uncertainty when raw material inspection is accepted	5
A4	There is a system of hygiene inspection of equipment and machinery before use is not maximum.	8
A5	Errors in the production process that cause dirty contamination of dust and liquid	3
A6	Limitation of processing room and noise	8
A7	Uncertainty of the supplier related to the raw materials sent	5

From the risk agent table, there is a scale of 3-8 and there are 7 high risk and 1 moderate chance of occurrence. Risk incidents that have a scale of more than 3 indicate that such incidents result in an impact that should be considered because they belong to a serious category so that they need to be handled with sufficient effort.

Table 3: HOR 1

Risk Event (Ei)	Risk Agent (Ai)						Saverity
	A1	A2	A3	A4	A5	A7	
E1	9					9	3
E2	3	9				9	9
E3			3				9
E4			3				9
E5			3				9
E6				9			5
E7					9		9
E8						9	8
E9						9	6
E10			3				6
E11				9			4
E12		3					5
E13					3		4
E14		9				3	6
Occurance	5	5	5	8	3	5	
ARP	270	750	495	648	243	1260	
Rank	6	3	5	4	7	1	

Table 4:

Risk Agent	**ARP**	**%**	**%Cuml**	**Risk**
A7	1260	26%	25,8%	High
A6	1224	25%	50,8%	High
A2	750	15%	66,1%	High
A4	648	13%	79,4%	High
A3	495	10%	89,5%	Medium
A1	270	6%	95,0%	Low
A5	243	5%	100,0%	Low
	4890	100%		

Based on the above table, it can be concluded that the highest ARP values have values 1260, 1224, 750, 648 meaning that the risk of the agent has primary priority in performing risk management over other risks. Below is a picture of the Pareto risk agent chart from the table, as follows:

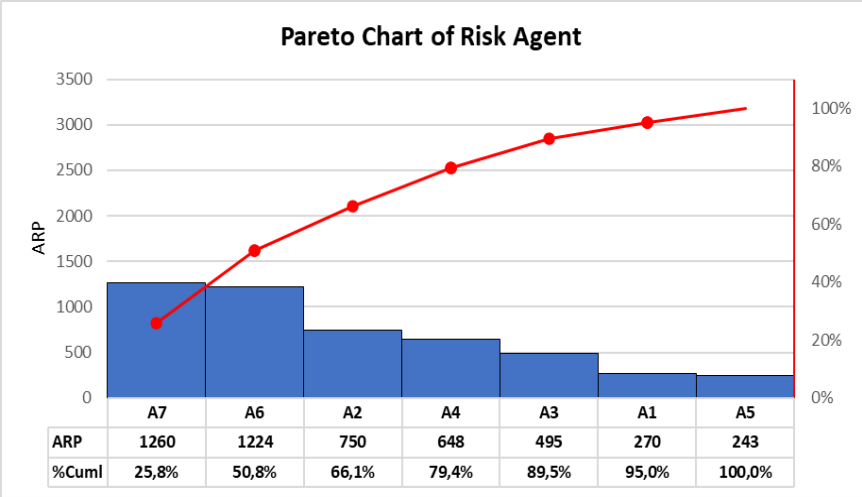

Fig. 6: Pareto Chart of Risk Agent

From the data can be drawn conclusions as well as preventive measures to reduce the level of product defects with the aim of minimizing risks, so that the resulting product can be increased and defects of products can be avoided.

Table 5: HOR 2

Risk Agent (Ai)	Proactive Action (PA)					ARP
	PA1	PA2	PA3	PA4	PA5	
A7	9	3				1260
A6		9				1224
A2			9		3	750
A4				9		648
Total Effectiveness of Action (TEk)	11340	14796	6750	5832	2250	
Degree of Difficulty performing Action (Dk)	3	3	5	1	2	
Affectivences to Difficulty Ratio (ETD)	3780	4932	1350	5832	1125	
Rank of Priority	3	2	4	1	5	

Table 6:

Proactive Action	ETD	%	%Cuml
PA4	5832	34,3%	34,3%
PA2	4932	29,0%	63,2%
PA1	3780	22,2%	85,5%
PA3	1350	7,9%	93,4%
PA5	1125	6,6%	100,0%
	17019	348%	

Based on the above table, it can be concluded that the highest ETD value has a value of 5832, 4932 meaning that the risk of the agent has primary priority in performing risk management over other risks. Below is a graphic image of Pareto Proactive Action, as follows:

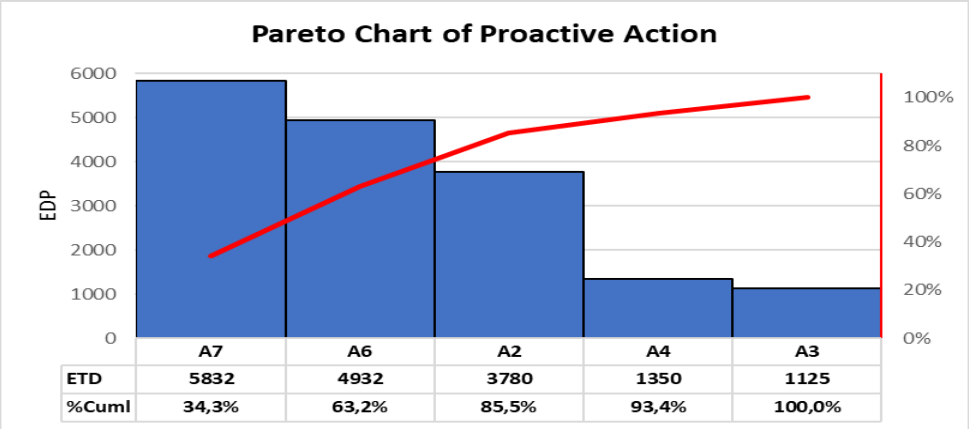

Fig. 7: Pareto Chart of Proactive Action

Table 7: Risk Mitigation

Code	The Mitigation
PA2	Making a logbook maintenance machine
PA1	Training employees on good production processes.
PA4	Check and clean equipment and machines regularly once a week to prevent dust and fluid contamination by implementing the implemented 5S
PA5	Provide high-standard storage of materials and products
PA3	Expand the production area to prevent dirt, dust and fluid contamination as well as operator workloads on work machines to be evaluated

From the table above can be known the mitigation of risks that can be done as an effort to prevent product defects, namely at the code PA4, PA2, PA1.

E. Control Phase

The control stage is an advanced stage of the improvement stage, at the control stage a proposed control plan contains general guidance on the control of improvement efforts. This stage proposal is based on library study, discussion and direct observation of production processes and the environment. Some of the recommendations in the control plan are:

- Create a schedule of maintenance plans and create a productive time form of the condition of the machine periodically.
- Conduct monitoring and inspection before the production process and seek better raw materials.
- Using quality tools if necessary in the interests of the company to improve the quality of products that will indirectly improve the qualities of humans, machines and the environment.

V. CONCLUSION

From the results of research and processing using the Lean approach with the DMAIC methodology as an attempt to identify waste and reduce the number of product defects and House o Risk (HOR) in this study, the following conclusions were drawn. There are four types of dominant defects. Using a fishbone diagram, the causes of defects are mechanical, environmental, raw materials and human factors. Waste or non-value-added activity such as Rework, Motion, Delay. From the calculation of HOR 1 obtained the highest ARP values A7: 1260, A6:1224, A2:750 and A4:648 while, for HOR 2 obtains highest ETD A7 : 5832, A6:4932. With mitigation efforts to prevent product defects are found in the codes PA4, PA2 and PA1.

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