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PRODUCT DEFECT REPAIR STRATEGY USING FMEA AND AHP FOR CUT RAG TOBACCO PRODUCTION

Danis Harianto*[1], Julianus Hutabarat[1], Fuad Achmadi[1]

[1*]Industrial Engineering Master Program, National Institute of Technology, Malang, Indonesia.

ABSTRACT

CRT (Cut Rag Tobacco) is a mixture of tobacco with other ingredients that will be used as the contents of cigarettes. Complaints collected during January-September 2019 obtained the biggest complaint, namely the presence of FM (Foreign Matter) contained in the CRT produced by PT.ABC. Complaints from consumers must be addressed so that consumer satisfaction is guaranteed. To find complaints that have the highest priority that must be addressed immediately, the FMEA method is used. After knowing the priority of disability that must be corrected then for decision making use AHP for decision making so that decision making is more structured and on target. From the FMEA, improvements were made to reduce FM bamboo boxes contained in raw material chopped which is used to produce clove cigarettes. Anticipation of the production process itself is already there with a sorter machine which is expected to eliminate bamboo boxes from tobacco whose effectiveness is still below 80%. Therefore it is necessary to make improvements so that later the sorter machine can reject FM bamboo boxes. From the results of the selection of priority improvements and comparisons of each category of improvement, namely the effectiveness of reject FM bamboo box, processing time, effectiveness of reject tobacco and cost. The choice of reject FM bamboo box category is highest with 50.11%, and the highest value for the effectiveness of reject bamboo box FM is upgrading the smart sorter machine because it can increase the effectiveness of reject bamboo box FM by 91.44%.

KEYWORDS

AHP, Cut rag tobacco, FMEA and Reject.

Author for Correspondence:
Danis Harianto,
Industrial Engineering Master Program,
National Institute of Technology, Malang, Indonesia.

Email: harianto.itn@gmail.com

INTRODUCTION

Primary Manufacturing Department (PMD) is a department that produces CRT (Cut Rag Tobacco) or making a blend (one type of tobacco mixture for a type of cigarette) tobacco complete with fillers such as re-processed tobacco handles (stem), cloves, flavor and Other components used for the

manufacture of a cigarette are at PT.ABC. The following types of complaints were received by the PMD department from January to September 2019.

Complaints Data from Consumers One method used to find a solution is to use the FMEA (Failure Mode and Effect Analysis) method. FMEA according to Blanchard (2004)[1-5] is an inductive analysis method to identify the most potential product and / or process damage by detecting opportunities, causes, effects, and priority improvements based on the level of importance of the damage to be dealt with immediately[6-9]. Analytic Hierarchy Process (AHP) can solve complex multi-criteria problems into a hierarchy. With hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic[10,11.]

The purpose of this study is to find out and analyze the types of product defects that are the biggest complaints from consumers during January-September 2019 in the PMD department. To find out the types of critical disabilities that must be addressed immediately this department uses the FMEA method. Analyzing the factors that influence the product defects that occur in the PMD department. Determine the most effective strategy to deal with product defects that occur in PMD using AHP.

RESEARCH METHODS

This study uses instruments consisting of data provided by the company, the results of observations, and an analysis of the causes of disabilities that occur in the department[12]. This data will be used to determine the improvements that must be made to the PMD department to reduce complaints from consumers. Secondary data[13,14] in this study is data provided by the company, both in the form of tables and figures, and complaints reports from consumers, or the effectiveness of sorting machines so far. Primary data[13,14] is data obtained from observations, as well as verifying machines that are objects for improving the quality of PT. ABC.

RESULTS AND DISCUSSION

All instrument test processes in this study were carried out by manual calculation with the help of Microsoft Excel to simplify the calculation. From research conducted by using Complaints data from consumers during January - September 2019, the results show that all Complaints come from FM (Foreign Matter) which are further analyzed in order to facilitate prioritizing improvements based on the type of FM. Of the most types made from Organic as much as 53%, then 33% inorganic and Synthetic 14%, with details of organic Foreign Matter namely, bamboo boxes, ropes, grass, straw 4 times, Paper 16 times, Beam 2 times, Wood chips 1 time, Lumping tobacco 2 times, Lumping Stem 1 time, Gumtape (paper insulation) 1 time, Uncut Stem (stem material that is not cut perfectly) once.

The largest number of FM is paper 16 times, but the cause of the FM has been known, namely paper originating from a trial process on consumers who enter a wooden crate (a place for packing clove blends) that is empty and then returned to PMD, when arriving at PMD not there is a proper checking of wooden crate so that when tobacco filling is out of sight and sent back to the consumer, the consumer is asked to check the wooden create before returning it to the PMD department and give an "empty" label on each wooden create that has been inspected. Foreign Paper Matter that has been detected from where it came from, the status for the Complaints has been resolved, therefore it is not continued in the next process. Therefore, the type of FM that was analyzed then only 7 types of FM, which then performed an FMEA analysis to determine priority improvements[15].

From the FMEA analysis it was found that the highest priority value for improvement was related to FM from bamboo boxes with an RPN value of 112, then tobacco lumping 42, then lumping stem 21, uncut stem 7, the last block of wood, wood chips, gumtape 3. The results placed for FM handling of bamboo boxes first because it has the largest RPN value[16-18].

The use of this bamboo box material has become a tradition in the Madura community to store chopped tobacco which is difficult to remove or change. The

distinctive taste and aroma of tobacco which is not found in other regions of tobacco, this makes sliced tobacco from Madura a target of cigarette manufacturers throughout Indonesia. Companies must accept what they are from farmers or do not get the supply of tobacco if the company asks farmers to use other places to store their tobacco.

After finding the results for the priority of consumer complaints that must be immediately addressed by looking at the highest RPN, after that proceed to the selection of alternative improvements that can be done by the company. To make it easier to see alternatives and criteria for improvement, a hierarchical structure begins with a general purpose, followed by criteria and alternative choices[19].

From the above hierarchy there are 3 alternative improvements and there are 4 attributes that affect the improvement. The choice for improvement must be chosen based on the company's interests. To find out the results of the repairs will be verified by sorter machines with 3 types of alternative repairs.

From the results of the comparison in Table No.2 then the manager plan will give weight related to the improvement category that will be selected with the following values:

The selection of criteria from Table No.5 calculations can be simplified as in Table No.4.

Effectiveness of sorting machine for reacting FM bamboo boxes> 50%, and after calculating the value of CR = 0.0931 Because CR (Consistency Ratio) <0.100[20,21] then the results are consistent, then selected for improvement with the effectiveness value of the sorter machine the highest of alternative improvements that have been made above as follows:

From Table No.5, the selection of improvements is to update the Smart sorter engine with a weight of 64.34% which is an alternative improvement[22].

Table No.1: FMEA calculation for each severity, occurance and detection and RPN value

S.No	FM Type	Severity	Occurance	Detection	RPN
1	Bamboo Box	7	4	4	112
		The choice of high value is because consumers will feel a decrease in quality that is torn in their production cigarettes	The selection was moderate because there were 4 complaints related to this FM	The choice of moderate FM is due to the fact that it is contained in Raw Material making it difficult to overcome even though there is already a sorter machine with 75% effectiveness	
2	Wood beam	3	1	1	3
		Selection 3 or low because if there is a block of wood will be known before entering the cigarette machine because the heavy material process will reject	Election is impossible because there was only one complaint during 2019	The choice of detection is very high because the PMD department does not use wooden beams or wooden pallets	
3	Wood chips	3	1	1	3
		Selection 3 or low because if exposed to wood chips will be known before entering the cigarette machine due to the heavy material process will reject	Election is impossible because there was only one complaint during 2019	The choice of detection is very high because the PMD department does not use wood chips or wood pallets	

4	*Lumping tobacco*	7	2	3	42
		The choice of high value is because consumers will feel a decrease in quality that is torn on cigarettes if there is lumping tobacco	The selection was low because there were 2 complaints related to this FM	Tobacco lumping is caused by a buildup of material attached to the cylinder dryer, for that it is usually done once a week cleaning	
5	*Lumping Stem*	7	1	3	21
		The choice of high value is because consumers will feel a decrease in quality that is torn on cigarettes if there is a Lumping Stem	Election is impossible because there was only one complaint during 2019	Lumping stem due to the addback process there is a stem material that is sandwiched in a corner and accumulates therefore every time after 1 blend is cleaned.	
6	*Gumtape (paper insulation)*	3	1	1	3
		Selection 3 or low is due to the fact that the block of wood will be known before entering the cigarette machine because the heavy material will reject	Election is impossible because there was only one complaint during 2019	The selection of detection is very high because the PMD department does not use Gumetape for production processing.	
7	*Uncut Stem*	7	1	1	7
		The choice of high value is because consumers will feel a decrease in quality that is torn on cigarettes if there are uncut stems	Election is impossible because there was only one complaint during 2019	very high selection due to stem material through the process of cutting or chopped when it passes it should not participate in the next process because there is an airlock	

Table No.2: Simplification of decision making between treat improvements

S.No			Eff reject FM Besek	Waktu Proses	Eff Reject Tambakau	Kerugian Biaya
1		**Average (EFF%)**	**79.42%**		**2.42%**	
	Troughput 4000kg/h	SD	1.28%	Satu *Blend* Memakan waktu 1 jam 36 menit	0.63%	Biaya proses produksi lebih Rendah dan tidak ada biaya perbaikan
		Max	81.33%		3.43%	
		Min	77.33%		1.56%	
2		**Average (EFF%)**	**85.17%**		**2.34%**	
	Troughput 3000kg/h	SD	4.00%	Satu *Blend* Memakan waktu 2 jam 8 menit	0.45%	Biaya proses produksi lebih tinggi karena proses produksi lambat dan tidak ada biaya perbaikan
		Max	92.00%		2.86%	
		Min	80.00%		1.69%	
3		**Average (EFF%)**	**91.44%**		**3.3%**	
	TOMRA (*Smart Sorter)*	SD	2.7%	Satu *Blend* Memakan waktu 1 jam 36 menit (kemungkinan bisa dinaikan	0.7%	Biaya proses produksi lebih Rendah dan tidak ada biaya perbaikan sebesar 35,000 *pounds*
		Max	93.3%		4.0%	
		Min	87.3%		2.4%	

Table No.3: Weighting among repair keriteria

S.No	Determination of Weight Between Criteria
1	FM Reject: Processing time = 3, FM Reject is somewhat more important than Processing Time
2	FM Reject: Tobacco Reject = 5, FM Reject is quite important from rejecting tobacco
3	FM Reject: Repair cost = 3, FM Reject is somewhat more important than Processing time
4	Processing time: Tobacco Reject = 3, Processing time is more important than reject tobacco
5	Processing time: repair costs = 3, Processing time is more important than repair costs
6	Repair costs: Tobacco Reject = 3, Repair costs are more important than reject tobacco

Table No.4: Selection of criteria for improvement

S.No	*Criteria*	**Priority weight**
1	Eigen vector sorter machine effectiveness	50.11%
2	Eigen vector processing time	26.30%
3	Eigen vector effectiveness of reject tobacco	7.68%
4	Eigen cost vector	15.91%

Table No.5: Priority alternative improvements from sorter machine effectiveness criteria

S.No	Alternative Improvements	Percentage of Priority Selection
1	*Troughtput* 4000 kg/day	7.38%
2	*Truoghput* 3000kg/day	28.28%
3	*Smart sortertomra*	64.34%

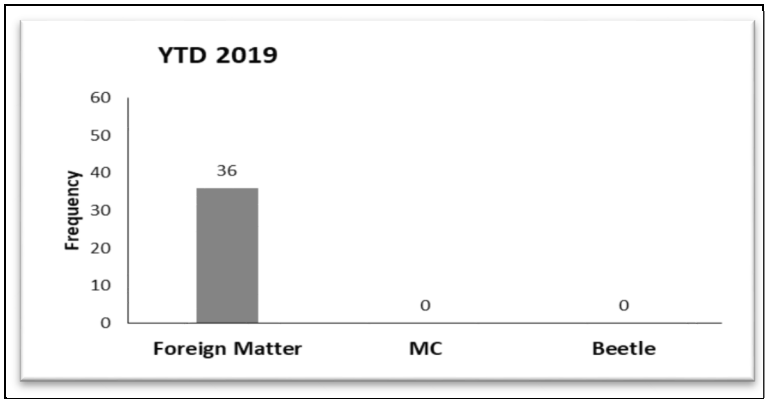

Figure No.1: Complaint Data from Consumers

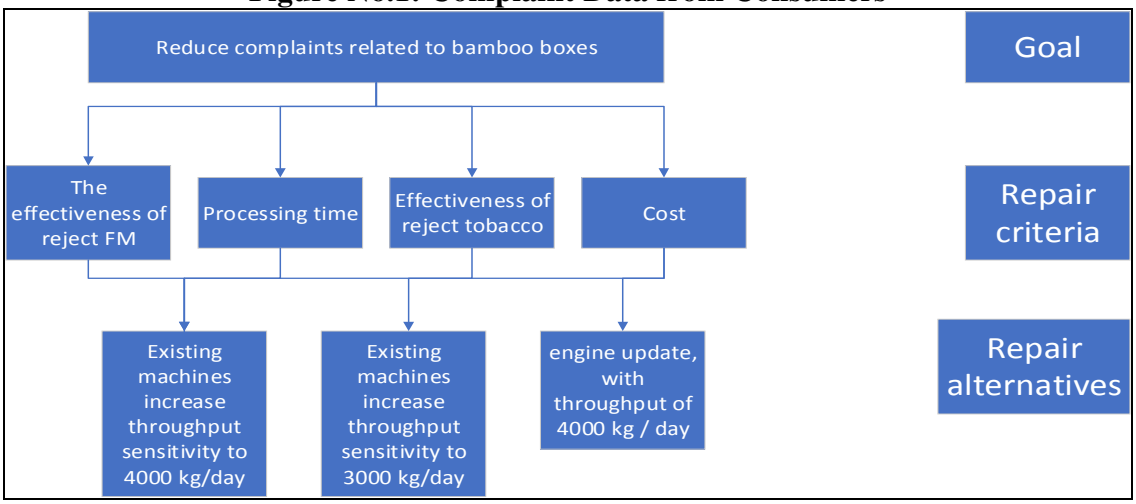

Figure No.2: Selection Hierarchy Improvements

CONCLUSION

The types of FM that were complaints from consumers were bamboo boxes 4 times, paper 16 times, wooden blocks 2 times, wood chips 1 time, lumping tobacco as much as 2 times, lumping Stem 1 time, gumtape (paper insulation) 1 time, uncut stem (stem material that is not cut perfectly) 1 time. For the most complaints, there were 16 papers, but for this type the cause was already known, therefore the researcher did not include the complaint to make it a priority for improvement. After analyzing the FMEA it was found that the largest RPN value was related to bamboo FM boxes with a value of 112.

Analysis of the factors causing this product defect is because the bamboo box is a place to collect chopped tobacco after being cut and farmers from Madura do so as a tradition that is difficult to change. The company cannot force farmers to use other places because other companies accept this tobacco as it is, besides that Madura tobacco is very typical which is the target of all cigarette factories in Indonesia.

Selection of alternative improvements using the AHP obtained for the criteria of priority chosen is the effectiveness of the sorter machine to react tobacco with 50.11. Then after verification on the sorter machine, it was found that the alternative results were improved by updating the sorter machine to a smarter with the effectiveness of reject FM 64.34% of the other alternatives.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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