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Delivery Mistake on Goods from Warehouse Using Failure Mode and Effect Analysis (FMEA) Approach (Case Study on Pt Propan Raya ICC)

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Abstract:- Warehousing is one of the important roles in a manufacturing industry. Any discrepancies in the warehousing system will have an impact on overall production costs. No exception in the handling and delivery system. This study was focus on the factors that caused a mistake in the delivery process from the warehouses, with a case study at PT. Propan Raya ICC. The factors that cause errors in the delivery of goods from the warehouse were identified using a Fishbone Analysis and FMEA methods. The impact of those mistakes is the company need to redeliver the goods to the customer, and finally result in several additional costs. The costs are include cost of re-arrangement, loading and unloading product returned from/to the trucks / containers, costs for trucking / expeditions in order to withdraw/resend of goods from shipping department, any costs due to re-scheduling of sales from sales department that need to be informed to the customer.

Keywords:- *Error Shipping, Warehouse, Fish Bone Analysis, FMEA Analysis.*

I. INTRODUCTION

PT Propan Raya ICC is a company engaged in the chemical industry of Cat which has several warehouses scattered throughout the major cities in Indonesia, such as Surabaya, Medan, Pekan Baru, Makasar and so on with the main warehouse in Cikupa Tangerang area of 10 hectares with a stock amount of 700,000 sqm then the distribution of the main warehouse to branch warehouse or distribution directly to the customer becomes very vital.

So far many complaints from sales and customers regarding the too frequent warehouse parties make mistakes in delivering goods, this error can be wrong items, excess items, less items, quantity is not in accordance with the letter of the road/DO (goods less or more), goods wrong items and so forth.

The data below is a list of misdelivery of goods from the warehouse and has been complained by the sales party on the internal side of the company as well as external parties from the customer (data taken 1 last year), as follows:

Month	Shipping Amount	Defect amount	% Defect
January	565	377	66.7%
February	1109	367	33.1%
March	255	128	50.2%
April	469	188	40.1%
May	774	271	35.0%
June	3213	1297	40.4%
July	2276	956	42.0%
August	1042	459	44.0%
September	1903	529	27.8%
October	1146	591	51.6%

Table 1:- Delivery amount of goods and amount defect
Source: Data processed (2020)

Table 1. shows that the number of defects or error rates at the time of shipment of goods that occur is very high at PT. Propan Raya ICC. The number of shipments with a very significant percentage of defects that occurred in January was 66.7%.

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II. LITERATURE REVIEW

A. Defect

Defect is a failure to give what the customer or consumer wants. Understanding Damaged Products according to Mulyadi (2007: 302), is a product that does not meet established quality standards, economically cannot be repaired into a good product. FMEA is a way in which a part or process that may fail to meet a specification, creates a defect or discrepancy and its impact on the customer, if the failure mode is not prevented or corrected. (Kenneth Crow, 2002).

B. FMEA

According to John Moubray (1997) FMEA is a method used to identify forms of malfunction and to ascertain the effect of failure related to each form of failure. Meanwhile, according to Roger D. Leitch, the definition of FMEA is technical analysis which, when done correctly and in the right time, will provide great value and help the decision making process of the engineer during the design and development. This analysis can be called a bottom up analysis such as checking the initial production process and considering system failure which is the result of all the different forms of failure. FMEA can usually be carried out conceptually and in the initial stages of the design of the system with the aim of ensuring that all possible failures have been considered and appropriate efforts to overcome them have been made to minimize all potential failures. (Kevin A.Lange, 2001).

According to Degu and Moorthy (2014), FMEA has 4 key parameters to prioritize corrective actions, namely:

- Severity is the seriousness of the effect of failure

	Classification Code	Example
10	*Dangerously High*	Injury or death
9	*Extremely High*	Not obey the rules
8	*Very High*	In effective treatment
7	*High*	High consumer dissatisfaction
6	*Moderate*	Potential ineffectiveness
5	*Low*	Customer complaints
4	*Very Low*	Low effectiveness
3	*Minor*	Interference for customers
2	*Very Minor*	*Minor effect*
1	*None*	There is no effect

Table 2:- Severity
Source: Rakesh et al (2013)

III. METHOD

A. Research Type

This type of research is descriptive qualitative, namely research that aims to describe or describe the characteristics of a situation or object of research conducted through data collection and analysis of qualitative data. This study was used to test the FMEA concept integrated with Fishbone as a system in examining the factors that cause delivery errors in the warehouse to be PT Propan Raya ICC.

B. Operational Definition and Variable Measurement

Variable is an attribute or nature or value of people, objects or activities that have certain variables determined by researchers to be studied and drawn conclusions (Sugiyono, 2012: 59). Each variable must be clearly defined, so as not to cause a double interpretation. Each variable should be defined conceptually and operationally so that it is easier to find the relationship between one variable with another and more measurable. There are two variables in this study, namely the level of error (defect) and Factors causing the occurrence of sending errors. The high defect error rate is the reference for this study based on the number of defects to the number of shipments. And look for the root of the problem from the cause of the sending error that occurs in the warehouse (Sugiyono, 2012: 59).

- *Operational definition*

Based on the concept definitions of research variables, the operational definitions of each research variable can be seen in the operational table.

Variable	Dimension	Indicator	Types of data
1. Error rate of delivery	1. Error frequency	a. Shipping amount	Secondary
	2. Send an error type	b. Incorrect amount of defects	Secondary
	3. Total shipments	c. defect number less/ more items	Secondary
2. Factors causing Wrong delivery	1. Human	a. Negligence	Secondary
	2. Material	b. The number of internal goods preparation is large	Secondary
	3. Machine	c. Lorry less preventive care	Secondary
	4. Methode	d. Operator not follow the rules	Secondary
	5. environment	e. The condition of the warehouse is hot, noisy, dirty & dusty	Secondary

Table 3:- Source: Gasperz 2008

- Occurence, which is the possibility that these causes will occur causing failure.

Classification	Possible failure	Code	Example
	100/1000	10	
Very High	50/1000	9	Inevitable Failure
	20/1000	8	
High	10/1000	7	Repeated Failure
	5/1000	6	
	2/1000	5	
Moderate	1/1000	4	Occasional Failure
	0.5/1000	3	
Low	0.1/1000	2	Few Failure
Remote	0.01/1000	1	Failure Ulikely

Table 4:- Occurance
Sources: Shivakumar et al (2015) and Rakesh et al (2013)

- Detection, namely the possibility that the current control will detect the cause of failure.

Ranking	Classification	Criteria
1	Extremely Likely	Can be fixed before the original form or control is almost entirely detected
2	Very High Likelihood	Can be fixed before the design is released or the possibility of detection is very large
3	High Likelihood	Allows for repair or a large detection possibility
4	Moderately High Likelihood	Design control is quite effective
5	Medium Likelihood	Design control has workmanship opportunities
6	Moderately Low Likelihood	Design control might be missing a problem
7	Low Likelihood	Design control is very likely to miss the problem
8	Very Low Likelihood	Design control has a small chance of detecting an unproven and unreliable design, a small chance of detecting
9	Extremely Unlikely	There are no design techniques available, control will not detect

Table 5:- Detection
Sources: Rakesh et al (2013) and Parsana an Patel (2014)

- Risk Priority Number (RPN), which is obtained by multiplying the severity (S), occurence (O) and detection (D). The RPN presents priority processes or product improvements.

C. Population and Samples

- *Population*

The population of the research is defect the paint warehouse which is at Cikupa. However, due to time constraints, the sample taken is the data of sending errors coming from branches and agents according to the characteristics of the type of defect and the cause of the error also originating from the process of preparing the goods from January 2018 to October 2018

- *Samples*

This data was taken from January to December 2018 and specifically at the PT Propan Raya ICC warehouse located in Tangerang area itself, based on the highest loading-unloading activity every day, when compared to other warehouses scattered throughout Indonesian territory.

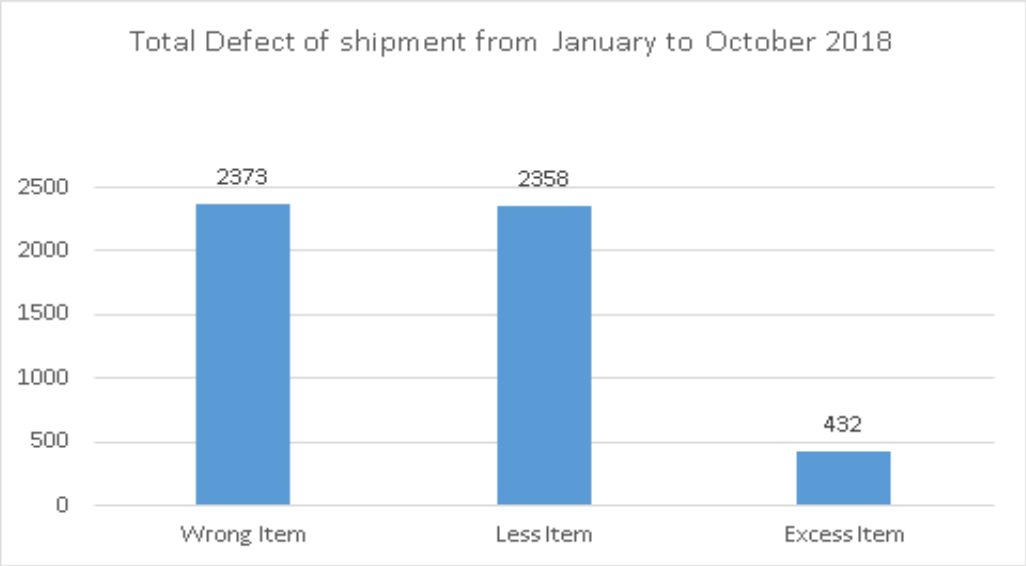

Fig 1

From fig 1 it can be seen that during the period January-October 2018 the defect of the wrong item and the shortage of the item looks very significant when compared to the defect of the excess item. Therefore the impact of item errors and lack of these items is the thing that results in the items received by the customer there are some products that cannot be used, and also the quantity that is not in accordance with the order that was ordered before. Based on this phenomenon, further analysis is needed to make changes.

D. Data Collection Method

➢ *Types and Sources of Data*

This type of research is descriptive qualitative, namely research that aims to describe or describe the characteristics of a situation or object of research conducted through data collection and analysis of qualitative data. Research.

➢ *Data Analysis Method*

The descriptive qualitative analysis method used is FMEA. According to Mikulak, et. al (2008), there are 10 steps in carrying out FMEA. The steps to make FMEA are as follows:

TABLE IV: MFMEA Worksheet for PVC Pipe Production Unit of Amhara Pipe Factory P.L.C.

Sub-system	Function	Potential Failure Mode(s)	Potential Effect(s) of Failure	S	Potential Cause(s) of Failure	O	Current Design / Machine Control(s)	D	RPN / Rank	Recommended Action(s)
Mixer	To mix the raw materials homogenously	Premature Bearing failure Crushing of key	The respective production line is disrupted	7	Undue vibration of the equipment	3	Replacing bearing Replacing key	8	168 / I	Providing vibration isolation with elastic pads; laying foundation beds
		Burning of motor coil			Overload due to coagulation		Rewinding motor coil			Monitoring of Hot chamber temperature
Helical Spring Conveyor	To transport Mixer unit output to Extruder unit	Breakage of spring	Disrupts further processing	5	High inertia torque	4	Welding the broken spring	1	20 / V	Limiting the radius of curvature
		Feed motor failure			Overload due to coagulation					Monitoring of Cold chamber temperature
Extruder	To get the requ. pipe dimensions	Burning of mandrel and sleeve heaters	Prolonged uneven temperature distribution causing scrap	8	Improper handling of die sets	3	Replacing resistors	5	120 / II	Use of material handling equipment for die sets
Vacuum Pass	To prevent pipe wrinkling	Noisy operation	Reduced vacuum pressure causing pipe wrinkling	3	Accumulation of foreign particles	2	Cleaning of vacuum pump, when noisy	1	6 / VI	Supplying clean filtered water for recycling
Cooling Pass	To cool the pipe	Leakage of water	Reduces the cooling effect	2	Poor maintenance of pipe joints	2		1	4 / VII	Periodic maintenance of cooling pipes
Haul-off	To pull the extruded pipe	Accelerated wear and tear of rubber gripper	Disrupts further processing	6	Inadequate gripping and slippage	3	Replacing damaged grippers	2	36 / IV	Periodic grease lubrication of the chain sprocket
		Breakage of roller chain					Replacing broken pins			
Planetary Cutter	To cut and chamfer the pipe	Breakage of screw shaft	Necessitates manual cutting	6	Stress concentration in screw shaft shoulder	7	Replacing the screw shaft	1	42 / III	Avoiding abrupt change in screw diameter
Belling	To bulge the pipe	Burning of 0.5 A	Delivery affected till repair	1	Variation of supply voltage	6	Changing fuse	1	6 / VI	Using 1 A fuse

Table 6:- Sources: Degu and Moorthy (2014)

➢ *Making Failure Mode and Effect Analysis (FMEA)*

After the causes of the occurrence of defects in the shipping process are identified, the next step in the analysis is to analyze potential process failures, and evaluate risk priorities to later help determine the appropriate action at the implementation stage.H3: Profitability is thought to have a negative effect on yield to maturity of bonds.

The data used to make the Failure Modes and Effect Analysis (FMEA) is taken from the analysis of the root causes documented in the Cause Failure Mode Effect (CMFE) diagram. To distinguish between modes failures (modes of failure), causes (causes of failure), and effects (effects of failure), then the last 3 boxes are taken and each analysis of the root causes of the problems respectively as cause of failure, modes of failure, and effect of failure. The weighting figures used in the Failure Modes and Effect Analysis (FMEA) were obtained from the results of subjective discussions of related parties including warehouse operators, checkers and marketing.

In this identification the amount of RPN (Risk Priority Number) can be determined based on 3 criteria, namely:

- Severity, i.e. identify the level of seriousness due to a damage seen from the point of view of the whole existing system.
- Occurrence, which is to identify the level of frequency of damage.
- Detection, which identifies the possibility or probability that a damage can be found.

✓ Conduct a review of the process or product
✓ Brainstroming about failure mode
✓ List the potential effects of the existing failure mode
✓ Determine the severity value
✓ Determine the value of occurrence
✓ Determine the detection value
✓ Determine the RPN value
✓ Determine the priority actions that must be Taken
✓ Implement these actions to minimize the
✓ existing risk
✓ Recalculate the RPN

➢ *Analyzing the Defect Report with the CFME (Cause Failure Mode Effect) Method and the Causal Diagram (Fish Bone Diagram) Method*

Root cause analysis is a method used to clearly clarify the root cause of a problem. The root cause of this problem can be identified by asking why there are no more biased answers that need to be given to the question. This method will help to identify problems in the process under study clearly. By finding the root of the problem, in the end the action taken will be right on target by eliminating each root cause of the problem.

In this study the process of identifying the root cause of the problem is outlined in a CFME diagram. The CFME method is used before making a Failure Modes and Effect Analysis (FMEA). CFME is the development of a causal diagram and is used to detect the root causes of problems. CFME results will facilitate the creation of FMEA.

IV. RESULTS AND DISCUSSION

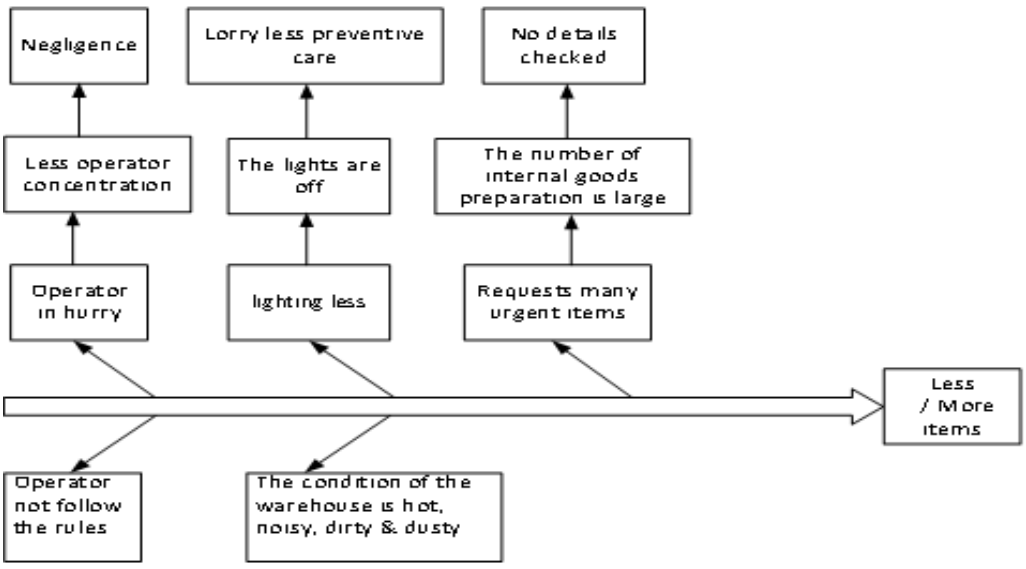

Fig 2:- Method of Cause and Effect Diagram (Fish Bone Diagram)
Source: Data processed (2020)

Figure Pareto diagram 3

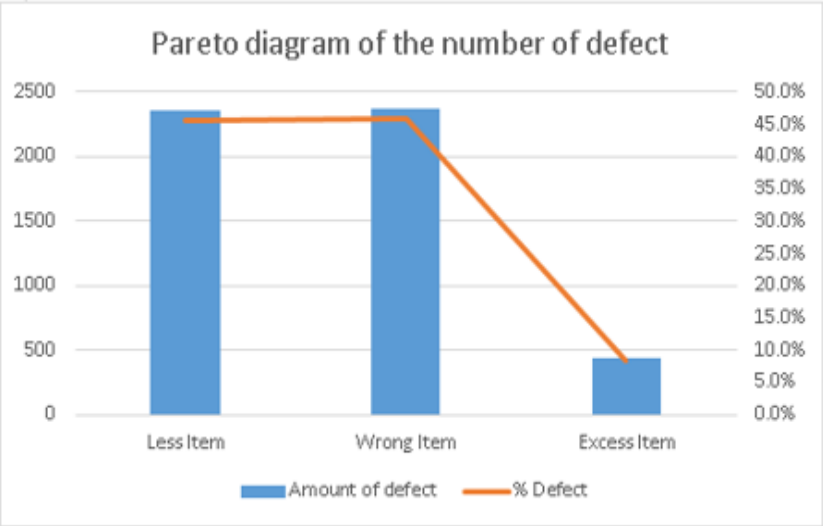

Fig 3:- Research Model

Error Criteria	Process	Potensial Failure Mode	Potensial Effect Failure Mode	Potensial Cause Effect Failure	S	O	D	RPN	Ranking
Less Item	Expenditures of goods	Error in the number of items being prepared is lacking	The number of items prepared is lacking	Difference in stock of goods	6	8	7	336	2
		Goods left in the transit warehouse	Item not sent	Goods become scattered	4	8	9	288	5
		Lack of components	Item incomplete	Component left behind	4	7	6	168	8
Wrong Item	Expenditures of goods	Item color error	The colors prepared are different	Difference in stock of goods	4	8	8	256	6
		Address error	Sent address does not like you are listed document	Not following the rules	6	7	7	294	4
		Error item code	Goods not according to request	Difference in stock of goods	5	9	9	405	1
Excess items	Expenditures of goods	Wrong number of prepared more	The amount prepared is more	Stock warehouse to minus	4	9	9	324	3
		Goods sent without documents	Item no documents	There is no administrative transactions	6	6	6	216	7

Table 7:- FMEA type of sending error
Source: Data processed (2020)

Research conducted found that defects that occur in shipping goods have 3 types of defects, namely wrong items, more items, less items. From the Pareto diagram, it was found that the biggest defect criterion was the defect of wrong items with a percentage of 46%, followed by defects of less items 45.7%, more items 8.4%. Based on the Pareto diagram, an analysis was carried out using a causal diagram to defect the wrong items and less items, more items.

In the cause and effect diagram for misdirected defects found 5 main problems from human, machine, method, material, and environmental factors, namely lack of discipline of warehouse operators, rushed operators or lack of concentration, absence of periodic maintenance systems in lorry, urgent demand for goods a lot, the number of PBI a lot, and the work environment is not conducive.

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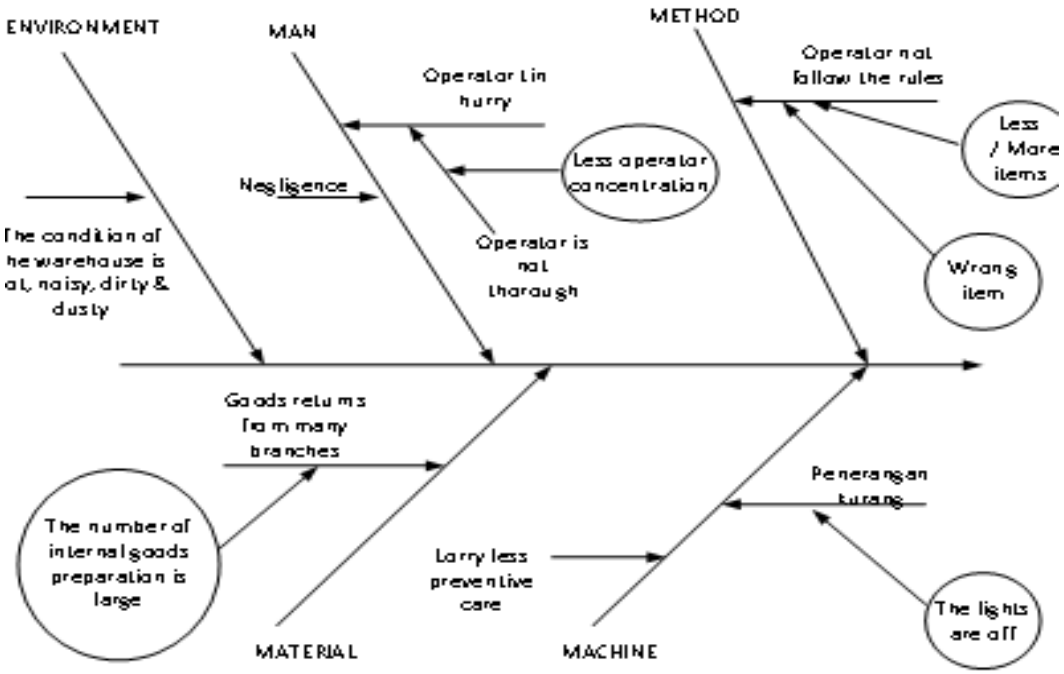

Fig 4:- Fishbone diagram

Based on the description in the previous chapters, and from the results of the analysis of the error data sending goods for 1 year using the FMEA technique method, it can be concluded that:

1. After identifying the factors that cause errors in shipping goods from the warehouse of PT Propan Raya ICC using the Five Whys technique, as follows:

- Human factors, the root of the problem are operators who lack discipline, operators lack concentration, operators rush, operators are not thorough, operators do not follow the SOP.
- Material Factors, the root of the problem is that many goods return from the branch, a large number of PBI.
- Engine Factor, the root of the problem is the lack of bright lighting and some lights that go out, there is no intensive maintenance for Lorry that is used daily.
- Environmental factors, the root of the problem is the condition of the warehouse is hot, noisy, dirty, dusty.

2. The main cause of the wrong delivery of goods from the warehouse is Warehouse operators because they do not follow the SOP when preparing goods (lack of discipline) that causes the wrong items, less items, more items, although there are other factors that influence.

In the causal diagram for Defect more / less item 5 main problems of human factors, machines, methods, materials, and the environment, namely the operator is less thorough, the operator lacks concentration, less lighting, lights are off, no intensive care on lorry, and the number of goods returned from the branch.

In addition to using cause and effect diagrams, an , 6 important points of quality control have been successfully carried out, namely lack of operator discipline, rushed or inaccurate operators, lack of concentration, operator negligence, operators not running SOP.

3. The proposal or improvement effort that must be done by the company, namely regarding changes in warehouse employees working hours, making standard SOPs, changing the pattern of sending promotional items from H-1 to H-3 and n from the Human Resources Training Department providing training in the form of product knowledge:

V. CONCLUSION

The advice given is divided into two, namely suggestions related to the results of research and suggestions for further research. Suggestions related to the results of the study are:

1. Provide periodic training for each warehouse operator to skill up the operator so that quality and competent resources are available.

2. Continual improvement to reduce defects needs to be done continuously in order to achieve zero defects so that priorities in customer satisfaction can be realized

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