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APPLICATION OF CONTINUOUS IMPROVEMENT TOOLS FOR THE RELIABILITY OF SHIPMENTS CONTROL

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ABSTRACT

The purpose of this study is to analyze the shortcomings of existing logistics flows through the use of a very powerful tool of continuous improvement known as FMEA. The FMEA can be used in multiple areas and is thereafter applied to logistic processes in a heavy industry (process) for risk management failures related to the preparation of shipments. The analysis of results and the use of other quality tools, allowed us in one hand to identify existing risks and deficiencies and in other hand to reduce risk by identifying the major causes of those risks and deficiencies and suggesting improvements.

Key words : FMEA process logistics, reliability, Diagram of ICHIKWA, control cards, heavy industry.

1. INTRODUCTION

Supply chain management is a central and important area of academic research due to its impact on process industries competing in today's global economy [1]. Logistics and quality control is often a service to ensure good physical flows in the company using the flow of information. The quality approach offers a variety of tools to help during all steps of a problem resolution (method analysis, statistics, monitoring-control).

SCM and Quality should be adopted for the continuous improvement in every part of industry. As SCM exists in purchasing, manufacturing, planning, marketing, distribution within and beyond the company borders [2].SCM is brief form of TQM philosophy and both tools are activated for the business progress with customer satisfaction [3].

The objective of this study-conducted in an industrial company operating in the area of heavy industry- is to analyze the dysfunctions on existing logistics flow (Shipments Control Process) through the use of the FMECA method and other simple quality tools.

2. CONTEXT AND HYPOTHESES

The first stage of the work, not covered by this article, presented a detailed description of the logistics' processes REGARDING the control of shipments coming mostly from other logistics' processes and the identification of the key inputs and outputs, before proceeding with the analysis of the site.The Shipment is the main "output" of the control of shipments process, to make this process reliable, it is important to analyze its failure. It will be necessary to determine the components or attributes of a shipment that can present failures and that would be interesting to analyze by the FMECA grid.

2.1 The FMECA

Failure mode, effects and criticality analysis (FMECA) is a method of predictive analysis of reliability. It systematically identifies potential failures of a device or process and then estimates the risks associated with the appearance of these failures to initiate corrective actions to the device. Through the assessment of the criticality of the consequences of failures, the FMECA allows to classify them by importance and to prepare a plan of actions to optimize and thus, reduce the criticality (actions on the probability of occurrence of failure and/or the seriousness of the consequence)

2.2 A NUMBER OF CONCEPTS ARE USED IN THE FMECA

- Assessment criterion: the criterion for assessing the way in which a function is completed or a constraint satisfied;
- Failure: failure is the termination of the ability of an entity to perform a function;
- Failure mode: a failure mode is the way by which a device or process becomes faulty, incorrect behavior of a subsystem or component due to a physical or procedural malfunction.
- Cause of failure: the initial event that could lead to failure.

- Effect of failure: the effect of a failure is, by definition, a consequence suffered by the user;
- Modes of detection: is the manner by which a user is likely to detect its presence before the failure mode is completed, i.e. well before the effect of the failure can occur.

2.2 Presentation of the method FMECA

Criticality: Criticality is a quantitative assessment of the risk constituted by the failure (mode - cause - effect - detection) scenario analyzed. Criticality is estimated from the combination of three factors:

- The frequency of occurrence of failure (Occurrence rating O);
- The seriousness of the consequences that failure generates (Severity rating S);
- The non-detection of the onset of the failure, before the latter produce unwanted consequences (Detection rating D).

Each of these criteria will be evaluated with a table of rating established on 5 levels for the Severity rating, and on 4 levels for the Occurrence rating and Detection rating. Tables 1, 2 and 3 are examples of the criticality rating scale. The risk priority number is calculated for each failure from the combination of the three preceding criteria and which equals:

$$\boldsymbol{RPN = O\ X\ S\ X\ D}$$

These numbers provide guidance for ranking potential failures in the order they should be addressed. In summary in this example a critical point exists if:

- The criticality of failure exceeds the predetermined threshold (here 12);
- The Occurrence rating is equal to 4;
- The RPN is greater than or equal to 4.

For each item, it determines in the FMECA check list (table 1) the following elements:

- Component: this column allows registering the designation of the component.
- Functions of the component: this column enters the function performed by the component in the normal operation of the studied system.
- Modes of failure: this column enters the failure mode that corresponds to the defect. The failure mode is expressed in physical terms.
- Causes: this column lists the causes that led to the appearance of the failure of the device or process through the failure mode of the component.
- Effects: this column enters the effects caused by the onset of failure modes. The effects are the events seen by the user of the device or process.
- Detection: this column enters modes of detection is of signs caused by the appearance of the failure, without that the failure can still generated the appearance of consequences.

2.4 Development of Hypotheses

In the light of the literature, we suggest the following hypotheses:

- H1: The Middle FMECA tools can be applied to the input of the process and considered as equipment.
- H2: The combination of several methods of quality management for further analysis.
- H3: Processes upstream of the shipment control process is determinant in the measure of reliability.

3. METHODOLOGY

3.1 Research Goal

The method of analysis will identify the sources of performance loss and determine the actions (improvement of reliability).

3.2 Sample and Data Collection

It is noted that various data were selected through interviews and meetings with staff of the company and direct observation during the preparation of the work.

Measures (table1) (1-still missing the detection column in the table 2 , the “Effects” column should be next to the “failure mode column” and each failure mode with one effect. 3-the calculation of the 2nd RPN is wrong, should be 16 instead of 20.4 we should not have different detection ratings for the same failure mode. 5-the effect for the 1st component is just an explanation of the failure mode, we should go deeper for the analysis, what would be the risks for the next process or for the customer if the we send overweight.Or less material. 6-the cause of the 2nd component “content” is not correctly analyzed, we should go deeper : what is the root cause of “Non-compliance with the technical specifications in the control (interface)”. 7-the 1st RPN for “Time” is wrong.)

Table 1: Failure Mode Effects Analysis for the Reliability of Shipments Control

Components	Failure mode	Causes	Effects	o	S	D	RNP
Weight	Overweight	Maladjustment of the Balance	Weight not in accordance with the needs	1	4	1	4
		Maladjustment of the automatic filling machine	Weight not in accordance with the needs	2	4	2	20
		Inattention of the operator	Weight not in accordance with the needs	1	4	1	4
	insufficiency	Maladjustment of the Balance.	Weight not in accordance with the needs	1	4	1	4
		Inattention of the operator	Weight not in accordance with the needs	1	4	1	4
		Maladjustment of the automatic filling machine	Weight not in accordance with the needs	2	4	2	16
contents	Non-compliance with the customer requirements	Non-compliance with the technical specifications in the control (interface).	Product not in conformity with the needs.	1	4	1	4
Documents	Lack of document.	Late arrival of the documents to the logistics service	Delay sending of the expedition	3	3	2	18
		Too much Time of writing and signature	Delay sending of the expedition	1	2	2	4
	Non-compliant document	Writing mistakes	Delay sending of the expedition	3	4	1	12
Reference	Reference products not in conformity with the expedition	Errors when referencing	Non-compliant documents	3	4	1	12
		Error in sorting of the lots	Product poorly adapted to the expedition.	1	4	1	4
		Input error	Non compliant documents	3	4	1	12
Time	Delay in receiving the finished product	Error of planning	Delay of the shipment	1	3	2	12
	Delay sending the container	Planning in the DMC	Increase of the waiting time of the container”	2	2	2	8
		Delay in the preparation in place	Increase the rate of stay of the container	1	2	2	4
Packaging and conditioning	Damaged packaging	Packaging damaged in production area	Quality of poor packaging	2	3	1	6
		Receipt of the damaged packaging.	Quality of poor packaging	2	3	1	6
		Poorly adapted storage area	Quality of poor packaging	3	3	1	6

4. ANALYSES AND RESULTS

4.1 Weight

The criticality of this factor is one of the highest because the frequency and severity of this type of failure is one of the most important. Analysis of data on the weight control shows that the 20/80 rule (The Pareto Principle) applies perfectly on the products of the company and then to classify gaps detected in the control, we found that:

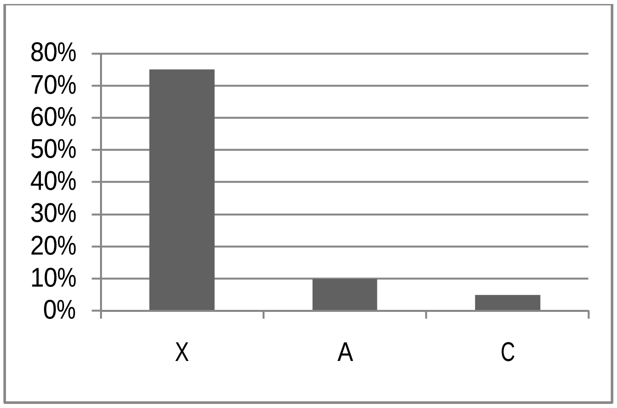

Figure 1: The contribution of each product of the company in the finding of a gap

This diagram (Figure 1) represents the contribution of each product of the company in the finding of a gap. We remark that the problem is present for the Product X, to determine the direct causes of this problem; we have to analyze the weight index data for this product.

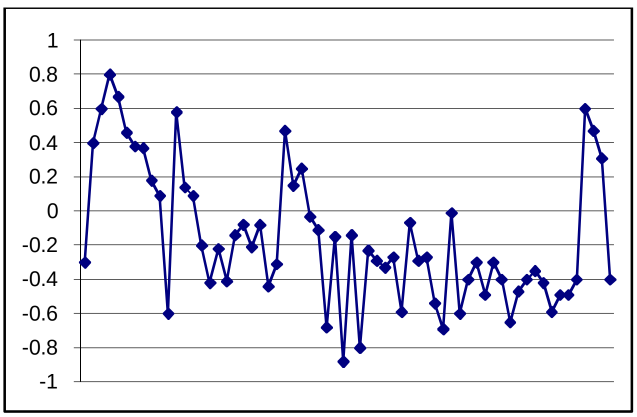

Figure 2: Monitoring of weight control index for product X

We have to indicate that all the products of the company are valuable in two forms of packing: normal bags with open beak or big bags. (It is noted that packing system is completely automatic).The analysis of the control card of weight (Figure2) indicates that 90% of the points which are near the upper limit of control represent Big bag and almost 60% of the points that are near the lower limit are normal bag.

Using the Ishikawa diagram to identify the possible causes of a fairly comprehensive failure revealed two main causes represented below:

Effectively, the real reason of the problem of weight for bags is the quality of packing; a lot of product is lost because the bags are not totally closed.

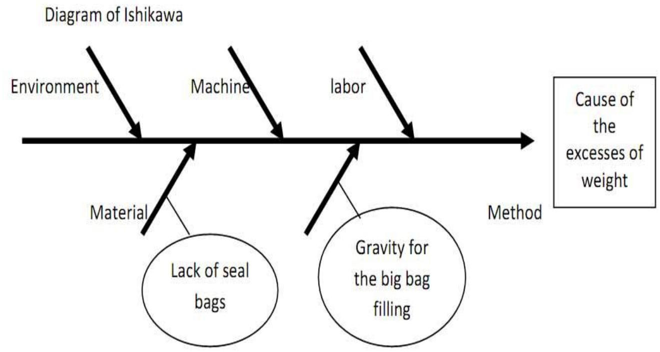

Figure 3: Diagram of Ishikawa

4.2 Benchmarking solutions

4.2.1 The X product bags

From the competition side: it was found that a major part of the competitors proposed plastic packaging for product X bags. And all those who propose paper packaging, the bags are with mouth that can opened and closed after filling the bags. It should also be noted that the new generation of the packaging machines can ensure and the new technique of vacuum bagging as a solution for densification of powder in vacuum sealed bags.

In the filling lines, we must insist for the hygiene and the closure for of sensitive. The risks of contamination are thus diminished, suppression of porous Canes in contact with the product, less effective vibrators... Since a circuit of bagging already exists it would be better to use on the same circuit a case bag sealer. It was therefore proposed a bag sealer that closes the interior valve with a paper and the hot melt and closes completely the valve to prevent loss of product. This machine works at a speed of 1000 bags per hour and can easily be placed in an existing line.

4.2.3 The "big - bag" of the X product

We noticed overweight when filling in Big bags. They are manually hung on a framework over a palette. Then the cycle of filling and dropping out is automatic, the feeding principle is free with a valve so it is the quantity of zinc oxide that falls before the total closure of the valve which causes this overweight. There Must be a machine to powdered products, The principle of powder is gravity with a helmet with 2 valve positions. The solution is the use of valve that is open widely then it closes automatically with the approach of the target weight and finally closes automatically once the weight is reached. The annular cylinder of seal then deflates, the Big bag is deposited on the below pending palette.

4.3 Documents

The most critical failure for this factor is the delay of documents, which is mainly due to the delay of the arrival of the BCI which is established by the commercial management (in direct contact with customers). BCI or the internal order form includes firm orders from customers and represents green light for the launch of the expedition and any delay therefore risks delaying the expedition.

Calculation of the indicator rate = BCI in time / Total of BCI. This indicator can be calculated from the table 2 for the month of May.

The indicator is equal to 60% for the month of May and is therefore an indicator to improve. It is also to report that the BCI sometimes arrives without the minimum amount of information that they should normally contain.

Table 2: The report of the BCI date for 1 month

N° BCI	Date to send the expedition	Date of arrive of the documents	Sign of the observation
706	05/05/05	09/05/05	+
707	05/05/05	10/05/05	+
708	05/05/05	06/05/05	+
710	10/05/05	11/05/05	-
711	16/05/05	23/05/05	+
713	17/05/05	25/05/05	+
715	24/05/05	28/05/05	+
717	25/05/05	25/05/05	-
718	25/05/05	25/05/05	-
1070	06/05/05	06/05/05	-
1072	18/05/05	21/05/05	+
1086	04/05/05	13/05/05	+
1087	04/05/05	17/05/05	+

4.4 The reference

The failures related to this component is mainly due to errors in referencing primarily upon delivery of the product by the production logistics department because the premises or space conditionings do not meet the requirements of a good interface management logistics production in addition to manual traceability. Since the typing by keyboards presents a number of disadvantages: the error rate is relatively high, of the order of 2 to 3 percent of the strikes, the speed is much lower because the data typing on a production site is not made by experiment operators in the typing, but by people for which the data typing is an additional task on their usual work.

All this leads to the fact that data typing input is often postponed, as well as complete on the site of production of vouchers, which are themselves typed later by specialized operators; or even that the typing of the information is purely and simply considered too expensive or too heavy to be carried out. Automatic identification techniques applied to the management of the enterprises are designed to automate this data collection. In this way, the speed and security of the typing allow either considerable gain compared to the existing manual entry solution, or to implement an information system that would not otherwise be possible.

It is also important to note that, to control this kind of anomaly, the company deploys efforts that can be saved and be more efficient through the adoption of a system of electronic traceability. This study has revealed practical recommendations for the company and all hypotheses were verified.

5. CONCLUSION

The application of FMECA, which is conducted on high performing method for ratability H1: The Middle FMECA tools can be applied to the input of the process and considered as equipment.

The most striking result that emerged from the data is that we start work from operation by analyzing the result with another quality tools like the Ishikawa diagram and control chart …to improve firm performance. So, H2 (The combination of several methods of quality management allows for further analysis) and H3 (*Processes upstream of the shipment control process is determinant in the measure of reliability*.) are fully supported.

The application of the FMECA and other tools of resolution of problems in logistics in this industrial case has shown that systems logistics as all the other functions of the company are normally a field of continuous improvement and that the delivery of the company or even its competitiveness is very closely linked to research and improvements made in logistics and operations management.

REFERENCES

[1] D.Mangal .**Supply Chain Management-A Quality Improving Tool in Process Industries**, *International Journal of Application or Innovation in Engineering & Management (IJAIEM)* 2 (1), 149-154. (2013)

[2] D.Mangal , P. Chandna. **Lateral transshipment for controlling inventory-A case study**, *International Journal of Engineering and Technology*, 1 (3), 206-217. (2011)

[3] D.H. Besterfield , C.B.Michna and G.Besterfield. ***Total Quality Management*** , (3rd Edition octobre 2002)

[4] H.Garin.***Maîtrise statistique des procédés***, Editeur AFNOR

[5] L.Jun, X.Huibin Reliability**.Analysis of Aircraft Equipment Based on FMECA Method Physics Procedia,** *International Conference on Solid State Devices and Materials Science*, Volume 25, 2012, Pages 1816–1822 .Macao.April 1-2, 2012.

[6] M.Pillet.***Appliquer la maîtrise statistique des processus (MSP/SPC)***, Editions d'Organisation Paris , 4th édition. 511-522 pp. (2005).

[7] Raymond Biteau et Stéphanie Biteau. ***La maîtrise des flux industriels***, Editions Organisation Paris,vol 1 (X-321pp.).2003

[8] P.Lyonnet. **La qualité outils et méthodes**, *Tech. & Doc*, 300 p.1997 ·

[9] J.M.Juran. ***Gestion de la qualité***. *AFNOR coll. normes et techniques*. Paris,517 p,1983.

[10] M.Perigord. ***Réussir la qualité totale***, Les éditions d'organisation. Paris, 368 p, 1987.

[11] L.Jaupi.***Contrôle de la qualité MSP, analyse des performances et contrôle de réception***, Techniques et Ingenierie, Série Gestion Industrielle,282 pages, 2002.

[12] J.M Juran. ***Planifier la qualité***. AFNOR Gestion, 314 pp, 1989.

[13] M.Ridoux . ***Traité L'entreprise industrielle***, AMDEC-Moyen. AG 4 220, 7- 1999.