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Use of Quality Tools for Problem Analysis (FMEA and Ishikawa Diagram) in a Small Textile Business

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Abstract

This study is part of a research carried out in a company and is based on the analysis of quality tools for process analysis in a textile factory checking the contribution to the quality. The study focuses on examining practices, use industry resources and methods contributing to the process and also, meeting customers' needs. In this context, process analysis helps finding problems hindering the management of production processes, causing rework and losses. Purpose, therefore, is to analyze, check practices, use tools that assist in the verification of problems. Research developed through case study was based on the organization's reality. Data collected through investigation using tools, such as: interviews, questionnaires and secondary source (books, articles and magazines) were used as information basis and provided the due the necessary clarifications for reasoning.

Keywords: FMEA; Ishikawa diagram; Quality; Methods; Resources

Introduction

This paper focuses on quality tools used for analyzing problems, checking the management, dynamics and parameters to develop production process. Application of the tool follows parameters and concepts linked to these processes, understand its purpose helps uncover the organization's needs. Thinking of obtaining quality, it is deemed important to understand technical applications to make progress in process development.

Several social, environmental and technological changes felt in the last decade led to manifestations in the market. Concern with environmental impacts caused by men is seen worldwide. In this aspect, companies also concerned with possible damages seek to contribute to reduce such an impact with proposals to improve production processes.

Rationale

This research in the product design field emerged from the author's interest in collaborating with the development of management in the textile industry production system. In Brazil, several companies contribute for growth in labor market. The textile industry accounts for 30 thousand companies, and creates an average of 1.5 million jobs, according to Santis (2013).

Objective

- Analyze processes with quality tools making it possible to find solutions or even draft changes;

- Acquire knowledge that can assist in the development of the textile industry production process.

Textile Industry

The last decades stages several global changes. Globalization, technology, information introduced changes in the market and in organizations. Methodologies, techniques and tools that transformed companies in a complex and competitive environment emerged in this context.

Processes management development in the last years have been marked by many changes, technological and management progresses,

and this increasingly intense change required the use of functional and resources management techniques in organizations.

For this reason, a study in small and medium textile companies may contribute to adapt practices and tools used to maintain the quality of products and services.

Companies seek to expand their production following current concepts to become more competitive in the market. Goods and services production techniques necessarily prioritize ways of making the process increasingly agile and contributing to the use of reduced resources, quality and performance of the company. Ballestero-Alvarez [1] declares the process is:

"[…] a structured and predefined sequence of actions transforming actions and inputs obtained in outputs and offers them to the environment, adding value from the moment these inputs are properly handled".

BALLESTERO-ALVAREZ [1] definition shows the transformation of the input occurs by a certain number of actions comprising the process sequentially.

Company Processes

The company which is the subject matter of this research produces knitted fabric, operates in the circular knitting sector, such as: knit for fitness, liners, beach and microfiber. Company ZZ, founded in the 40s, is the subject matter of this research because it has tradition in the Brazilian textile industry and is considered a small business in

the region of Brás. Products are generally made of fabric composed of mixtures of polyamide, cotton and spandex in circular looms.

It's manufacturing process consists of weaving textile yarns, always horizontally (weft). This procedure is made with needles (interlacing)**.** The knitting, whose system to produce circular knitting machines, knitted manufactured seen by a magnifying lens in Figure 1, using industrial process with automatic looms.

The company is structured in three processes, namely: purchase, sales and finance/billing; as per (Figure 2). Other processes, such as Human Resources, accounting and cleaning are outsourced.

Administration has four sub-processes: purchasing, sales, finance and production that perform all movement in modules for accounts payable, receivable, sales, inventory, production and finance.

Quality Tools

FMEA methodology (FAILURE MODE AND EFFECT ANALYSIS) consists in the analysis, monitoring and prevention of failures. Defect in a textile item causes losses that cannot be recovered, for this reason, failures presented must be controlled and reduced. Failures items in processes identifying from the entry of raw materials to its output was measured in order for this to occur. FMEA analysis table adapted from the Good Practices guide of the quality management system [2] (Table 1).

This methodology includes the analysis of occurrences of failures in processes or products, the analysis is done by managers to monitor the process, as defined in the company. A measurement system by means of events criticality was adopted in this analysis to make it easier for managers to analyze and understand and rates established criteria. Noncompliance should be documented for managers to track it whenever there is discrepancy or inconsistency (failures and defects) (Table 2).

According to Campo [3], understanding failures and effects consists in the understanding of control process and causes presented as a mean to achieve continuous improvement.

Criteria adopted should be included in analysis forms and rates compared weekly for controlling failures and defects, therefore, analyze the main forms of failures and defects presented in the Good Practices guide of the quality management system-Portugal [2] and presented in the company [4-9].

The initiation step defined the main aspect to be addressed for identification of processes and needs, a check list was made and through FMEA a diagnostic analysis was made of the process [9-11].

Results

Results presented in company's diagnosis made by observing and conducting interviews made it possible to identify problems and prepare corrective actions, such as:

- Goods receipt process without control;

- Lack of information to receive raw material causes delays in goods delivery, once it needs authorization to discharge the yarn;

- Raw material received was not inspected or did not receive any type of verification;
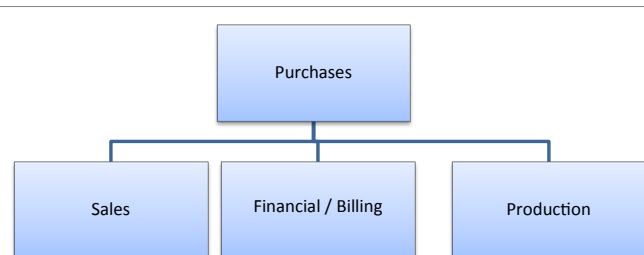
No description of responsibility or defined tasks, activities have no description or documentation, which causes rework and idleness;

- Production processes: not documented;

- Failures or defects of processes are not documented;
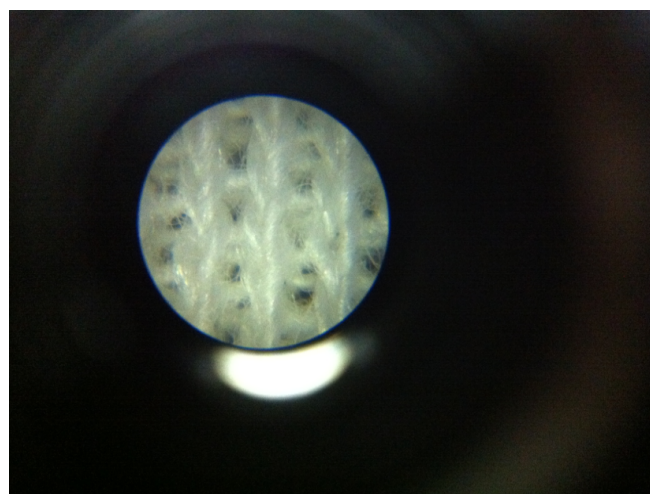
Source: Santis (2013).

Figure 1: Article Mesh.

Source: Author.

Figure 2: Diagram of the processes.

Diagnostic Information	Diagnostic verification information of the main faults and defects. Report the area manager, verify the occurrence, severity and effects, Solve the problems, note the occurrence in history.
Analysis	Detection analysis of causes and effects.
Processes/Article	Verification processes and finished products.
Customer needs	Evaluate the expectations of internal and external customer.
Modes failures.	Types of failure.
Severity	Severity Check considered high severity preventing the continuation of the process, medium gravity fault those who cause damage to articles and low- severity flaws.
Occurrence	Amount of occurrence, how many occurrences were noted.
Effects	Effects on process and product.
Causes	Means for causes all obstacles in order to have continuity in a process or product, as a result of any event that may prevent continuity.

Table 1: FMEA Diagnosis - Good Practice Quality Management System and Pearson Education, Brazil p.87, adapted by author.

- Product defects have no control;

- Lack of information about machine maintenance;

- Production process does not have an equipment programming, leading to idleness or waiting for equipment;

- Inventory process has no control causing lack of raw materials or excessive purchases.

To facilitate visualizing the main problems, a model for monitoring (Table 3) was developed, consisting of the following:

FMEA tool used to support procedures and monitoring faults and defects, providing through the analysis of events determination of root causes and further corrective actions and proposals for improvements.

In each verification of possible failure, a possible effective and one action for control was prepared, corrective measures and improvements were attributed for each risk presented. Thus, FMEA tool supports the implementation of improvements and process monitoring, enabling corrective and preventive actions. Determining level of failures enables finding critical points in processes and articles. Analysis of company's processes and procedures of conducted to continue. During this work, meetings were conducted to show the progress in activities flow, controls and indicators proposed to managers to better elucidate the production process. Tool 5W1H (what to do) was used to define improvement opportunities.

Improvement implemented (WHAT)

Forms to control receipt of raw materials, production scheduling and inventory control.

Expected results (WHY)

Allow condition of control from the entry of raw materials to the completion of the production process through prepared forms.

Responsible (WHO)

Operation technicians, administrative assistants and area supervision.

Place of conduction (WHERE)

Upon receipt of raw material, production and inventory.

Date (WHEN)

Beginning of the entry of raw material to completion of the production process, being a daily and continuous process.

Execution (HOW)

Complete form in each procedure setting next to the area manager

This step enabled the development of the plan established through monitoring the execution of improvement actions planned and the corrective actions.

To identify and document processes, a plan was prepared to monitor procedures being developed and know the purpose of each step. A plan containing steps to check control and indicators was prepared, and this work process is defined as per description below:

- Check existing controls and indicators:

- Assess needs for controls;

- Check the availability of technical instructions for manufacturing orders to be started;

- Check processing sequence of manufacturing orders;

- Collect information to control the proposal of controls and indicators.

Control items are the undesirable effects in the process, they are

Assessment of Occurrence - perception of internal and external customer	Occurrence	Occurrence detection of failures and effects	Severity
Low occurrence	1	Unlikely effect	1
Moderate Occurrence	2	Moderate effect	2
High occurrence	3	Perceived effect	3
High occurrence	4	Serious effect	4

Table 2: Criteria FMEA - Pearson Education, Brazil p.87, adapted by Santis (2013)

Process	Failure mode	It is made	Cause	Corrective Actions
Receipt	Receiving unchecked	Delay in the process	Lack responsible for the task	BPMN-business processing modelling
	Delay in the Receiving	Delay in the process	No description of the process	5W1H
	Line of trucks	Delay in the process	Lack of designation for receiving the task	Organization chart- definition of responsibility
Receipt	Failure to receive information of goods/raw and materials	Delay in the process	Lack of process stream transmission of information	Diagram of flow process (BPMN) receiving
	Incoming raw material does not have inspection	Defective article	Lack of inspection	Visual inspection and evaluation of raw material machine maintenance
Production	Process are not documented employee did not know how to do	Delay in the process	Lack standards and work procedures	Standards of working procedures
	Failures and defect of the process are not documented. Has no controls and records record faults or defects.	Defective article	Lack form for registration of non-compliance	Control forms Control charts Registration information in excel and word system
Production	Weight no standards	Article aspects (the higher the softer the fabric weight)	Lack of tear machine regulation or error in the settings. Wire out pattern.	Verification and machine maintenance. Product specification data sheet.

Table 3: FMEA Model.

results, and for this reason Ishikawa diagram was used to monitor the effects and causes.

In this step, the diagram consists in maintaining control of the system through relation of cause and effect of problems. Processes, products were defined as control items, the analysis of possible causes for problems in the system.

Instruments and forms implemented in this phase support the system monitoring and control, and follow-up meetings support this process.

Within this argument, aspects analyzed to prepare the diagram call attention to the items relating them to the causes of problems. Items operated as a form to check and control the main cases of the problem supporting the system to improve performance.

Effect of delay or error in assessment process by 6Ms

Items related through 6Ms techniques checked causes of problems related to the process whose effect was delay or causes error.

1. Measurement is a way to evaluate the process in all its phases, thus a failure or mistake can have severe consequences. Main causes are:

- Lack of measurement: due to lack of knowledge of the measurement process.

- Measurement error: insufficient measurement, sample taken without following the norms or standards.

- Unrepresentative sample: insufficient quantity for evaluation.

2. Materials-faults in the raw material hindering or preventing the follow-up of process related to the raw material.

- Late delivery - machine keeps waiting for the yarn delivery to start or continue the process;

- Out of standard - non-inspected yarn with error; unreliable supplier; delivery of low quality or irregularity in yarn (mixed raw material).

3. Workforce - problems related to the person in charge for performing activities or tasks.

- Lack of workforce for due operation;

- Workforce with lack of training - people with little or insufficient training; lack of action or proceeding-related knowledge.

- Inefficient training; no understanding of the training;

- Lack of training-no training for operation.

4. Machine-problems related to equipment.

- Lack maintenance on loom or parts without proper maintenance or long time without proper maintenance;

- Loom wear - worn parts or equipment with expired service life (old loom);

- Little loom capacity-improper capacity to produce the product quantity; old equipment with a capacity below production need causing loom stops;

- Lack of loom regulation before the process or lack of regulation on maintenance.

5. Method - problems related to how conducting the process or procedure.

- Procedure unfollowed - there is procedures definition; there is resistance to the methods prepared;

- Inadequate procedure-there is procedures definition, but in practice, they are wrong or do not provide the necessary support for the activity;

- Inexistent procedure-there is no definition on the way of performing the task or activity.

6. Environment-storage of raw material and transportation.

- Improper storage-place without support for inventory of raw material (small for the quantity of material);

- Place out of standard - irregular storage; no stacking conditions; stacking amount stipulated out of standard;

- Non-inspected place - lack of due care with materials; boxes stacked improperly.

Problems are discussed with people in charge and solutions are presented. All items assessed require a corrective action providing the solution, in this sense, implementing corrective actions to problems or new assessments according to the diagnosis presented (Figure 3).

Effect of defect in assessment article by 6Ms

Items inventoried through 6Ms technique checked causes of problems related to the article whose effect was defect. Methodology consists in checking and measuring the article (process final product), so as to diagnose a failure or error with severe consequences. Causes raised are:

1. Measurement - Assessment of article standards as per norms requirements.

- Unrepresentative samples when samples taken from the article does not meet specifications or is insufficient to serve as parameter used to confirm integrity.

- Lack of tests - procedure is not performed;

- Measurement instrument - measurement instruments (scale or sample) have insufficient quantity for assessment; with deviation of parameters or incorrect data.

2. Materials - problems or difficulties with raw material.

- Irregularity in the yarn - mixing of batches in article composition; supplier with yarn testing and quality certification;

- Low quality yarn - 2nd-line supplier; supplier without certification;

- Lack of inspection in yarn - no verification of conical or yarn conditions;

- Lack of verification in choosing the supplier - supplier without verification or history; lack of yarn certification;

- Delayed delivery - supplier does not meet the established deadline.

3. Workforce - problems related to the person in charge for performing activities or tasks.

- Lack of workforce for due operation;

- Workforce with little qualification - people without due knowledge of the procedure;
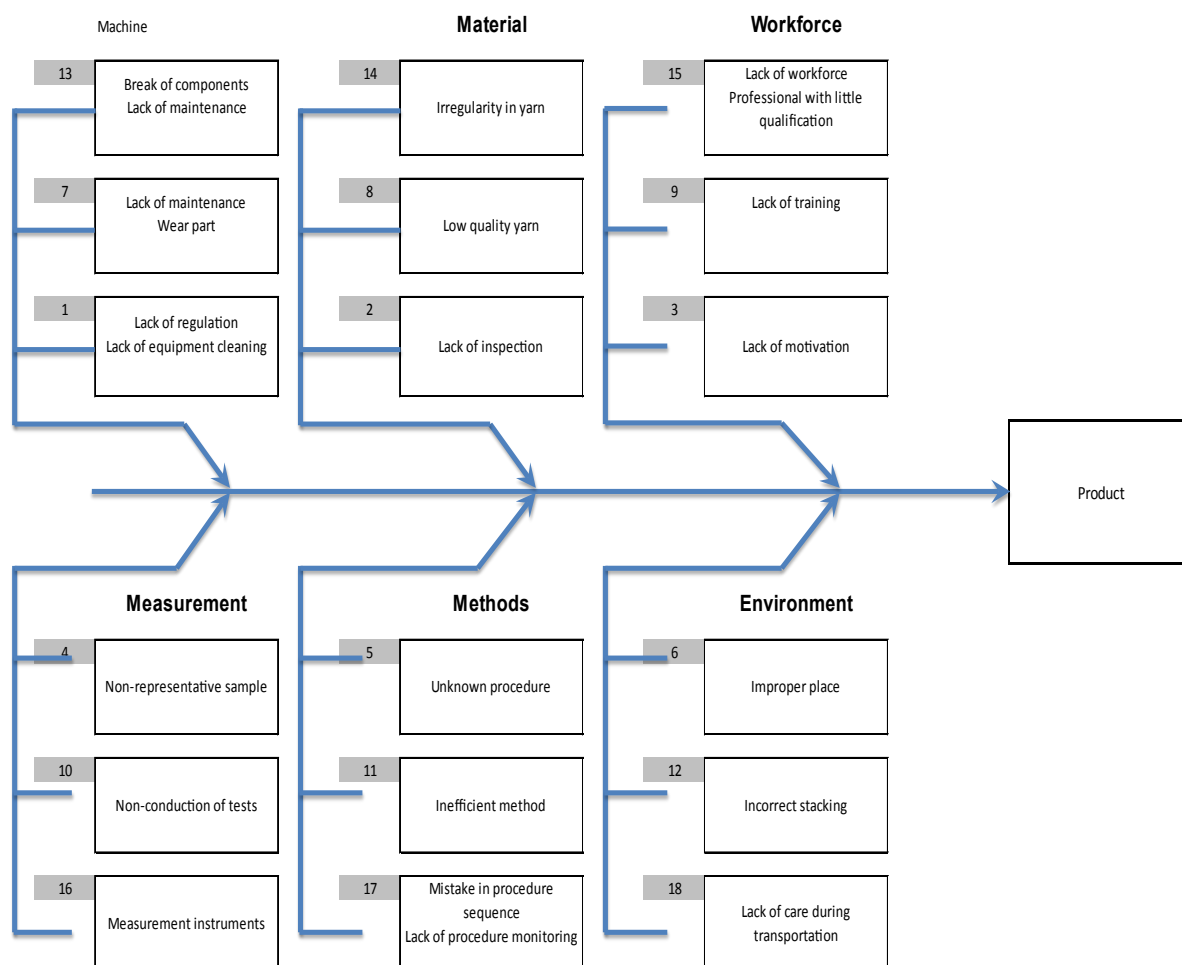
Figure 3: Cause and Effect Diagram (Campos, 1992) adapted by the author.

- Lack of training - lack of training for the operator;

- Lack of motivation - employee makes mistakes for not being satisfied with the work (resistance);

4. Machine-problems related to equipment.

- Break of components- break of parts in the loom machine;

- Lack of maintenance - equipment maintenance not conducted;

- Wear parts- wear parts or components;

- Lack of loom regulation before the process or lack of regulation on replacement.

5. Method - failures related to how conducting the process or procedure.

- Unknown procedure - does not know the process or procedure;

- Inadequate procedure-there is procedures definition, but in practice, they are wrong or hard to understand;

- Error in sequence - error in procedure sequence;

- Lack of procedure monitoring - procedure is not being followed by the operator;

6. Environment - article and transportation inventory.

- Improper place - place without support for inventory of article;

- Incorrect stacking - irregular storage; no stacking conditions; stacking amount stipulated out of standard;

- Lack of care during transportation - lack of due care with articles.

After these actions it was decided to begin work procedures. The company needs quality controls. Thus, to meet these needs, it was identified the critical points to develop controls and indicators to help the company.

Final Considerations

The company needs support in its processes, and problems identified may lead to loss of productivity and affect performance.

Actions conducted, however, demonstrate quality tools are efficient to analyze the process, and also showed the company needs to establish controls.

Both FMEA tools and Ishikawa Diagram helped detail the problems in the production process and this is very important. Problems could be noted in the situation presented and solution for improvement could be pointed out.

FMEA identified effects and corrective actions to solve the problem, Ishikawa diagram demonstrated possible causes for defect and this helped formulate actions. Thus, both tools used helped formulating actions to solve the problem.

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