



Process Optimization by DMAIC Approach in Algerian Industry

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ABSTRACT

The aim of this paper is to contribute to the improvement of the performance of the functioning of the SCIMAT company. For that purpose, we made a diagnosis of all workshops to identify the possible axes of improvement and to choose the solutions to be implemented.

This diagnosis is made by implementation of DMAIC methodology of Six sigma approach at SCIMAT company in Algeria, DMAIC is the five-step approach that makes up the Six Sigma tool kit, and its sole objective is to drive costly variation from manufacturing and business processes. The five steps in DMAIC are *Define, Measure, Analyze, Improve, and Control*. As the backbone of the Six Sigma methodology, DMAIC delivers sustained defect-free performance and highly competitive quality costs over the long run.

Keywords

Continuous improvement, Six Sigma, Kaizen, DMAIC, variability

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1. INTRODUCTION

Whatever the activity, all companies today are faced with ever-increasing pressures. These pressures have resulted in improvement initiatives such as Six Sigma. A very powerful feature of Six Sigma is the creation of an infrastructure to assure that performance improvement activities have the necessary resources. Creating a successful Six Sigma infrastructure is an ongoing process whose aim is to infuse an awareness of quality into the way all employees approach their everyday work [10].

Six Sigma is a global approach turned particularly to increase profitability, she appeared in Japan and it was formalized by the U.S. company Motorola.

This approach consists among others of a method to problem solving (DMAIC) formalized and structured to achieve the objective.

In the framework of this work, we will focus on the method of problem solving DMAIC Six Sigma. It is divided into five steps: Define, Measure, Analyze, Improve and Control, which aims to improve the quality and profitability by relying on statistical methods and mastery of the voice of customer

2. DÉFINITIONS

Six Sigma was developed in the 1986 by Motorola, and has been used successfully to reduce defects, redundancy, and waste in operational processes.

As a result of implementing a Six Sigma process, companies may realize improvements in quality, customer satisfaction, and operational and financial [1]

It provides increased profitability in the company by reducing quality costs, improving yields. Also, The Six Sigma is a simple concept: it is the elimination of variation and defects, and variation and chance of defects in the process.

3. PROCESS IMPROVEMENT

Process improvement is a series of actions taken by a process owner to identify, analyze and improve existing processes within an organization to meet new goals and objectives [3]. These actions often follow a specific methodology or strategy to create successful results. Process improvement results in costs associated with the purchase of new technology, modification of existing equipment, training employees, hiring new employees and investment in information technology infrastructure. Six Sigma is the process management tool that has yielded the greatest results and Six Sigma is ranked much higher than other Process improvement techniques

Table 1. Rating of process improvement techniques [3]

Process improvement tool	Impact (%)
Six sigma	53,60
Process mapping	35,30
Root cause analysis	33,50
Cause and effect analysis	31,30
Iso 9001	21,00
Statistical process control	20,10
Total quality management	10,30
Malcolm baldrige criteria	9,80
Knowledge management	5,80

4. SIX SIGMA STRATEGIES, TOOLS, AND TECHNIQUES

Kwak (2006) pointed out that six sigma is more comprehensive than prior quality initiatives such as Total Quality Management (TQM) and Continuous Quality Improvement (CQI). The six sigma method includes measured and reported financial results, uses additional, more advanced data analysis tools, focuses on customer concerns, and uses project management tools and methodology. He summarized the six sigma management method as follows [12]:

Six Sigma = TQM + stronger customer focus + additional data analysis tools + financial results + project management

4.1 Principles of the method

In statistics, the Greek letter sigma (σ) denotes the standard deviation, "Six Sigma" therefore means "six times the standard deviation." The standard deviation can be assimilated to the dispersion process. The standard deviation is the square root of the sum of squared differences of each value to the average of the sample considered.

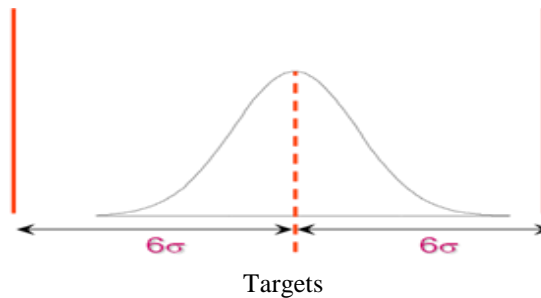


Fig 1: Meaning of Six sigma

The principle of the method is to ensure that all elements from the studied process are within a range of maximum away 6sigma compared to the average of the elements from this process.

The principle is therefore to work on the process to ensure that only products that meet the requirements to be delivered: to produce just right the first time by eliminating rework costs, recycling, disposal and may sell non-conforming product..

So, Six Sigma is based on the concepts of customer processes and measurement, it relies in particular on:

- measurable customer expectations
- reliable measurements measures the performance of the business of the company in relation to these expectations process;
- statistical tools to analyze the causes affecting performance source;

4.2 Goals of Six Sigma

Based on improved customer satisfaction, six sigma methodology is a source of increased profitability for the company by adding the following effects:

- Increase profits following cost reduction and quality improvement.
- Improve customer satisfaction and greater customer loyalty through better quality
- Reduce the number of nonconformity by reducing expenses highly reducing the number of rejects, rework and waste
- Reduce variability
- Organizing skills and responsibilities
- Strategy, Data Analysis, Decision Making

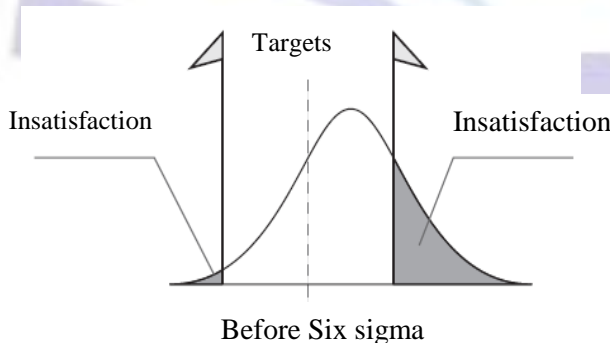


Fig 2: Measurements made before Six Sigma

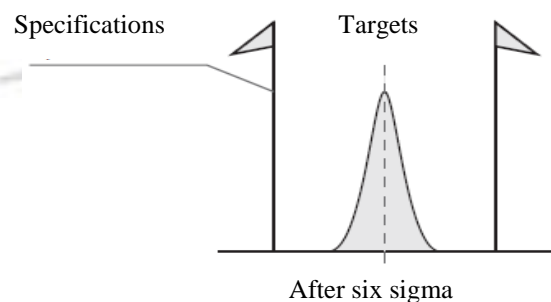


Fig 3: Measurements made after Six Sigma

4.3. Overall sigma level

Six Sigma was a way for Motorola to express its quality goal of 3.4 DPMO (Defect Per Million of Opportunity) where a defect opportunity is a process failure that is critical to the customer [06]



This goal was far beyond normal quality levels and required very aggressive improvement efforts. For example, 3 sigma results in a 66,810 DPMO or 93.3% process yield, while Six Sigma is only 3.4 DPMO and 99.99966% process yield. Fig. 4 shows the relationship between DPMO and Process Sigma assuming the normal distribution

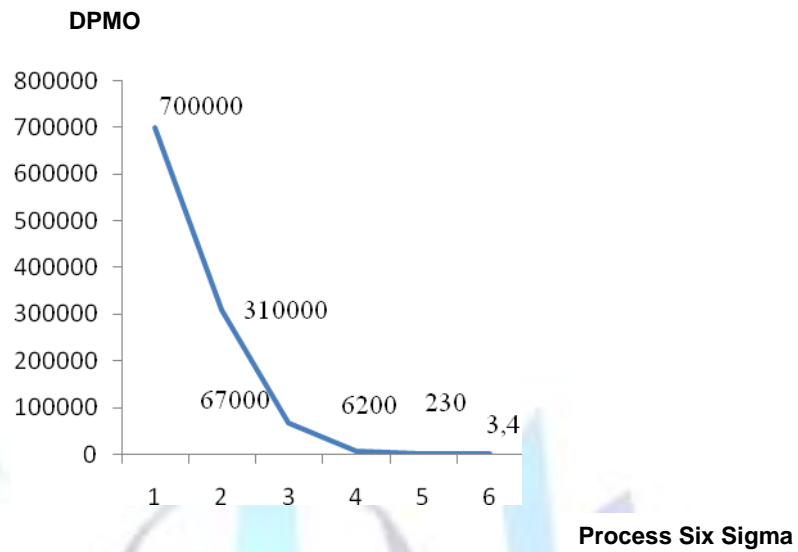


Fig 4: DPMO and Process Six Sigma

In a six sigma quality plan, one of the performance measures of an organization is the **sigma quality level**. An organization can be classified as either “world class” or “industry average” or “noncompetitive” based on the sigma level it achieves at a given point of time as given in table [4], [7]. Not all processes should operate at the Six Sigma level. The appropriate level will depend on the strategic importance of the process and the cost of the improvement relative to the benefit.

Table 2. classification of an organisation using Sigma level [7]

Sigma level	DPMO	category
6	3,4	World class
5	230	Industry Average
4	6200	
3	67000	
2	310000	Noncompetitive
1	700000	

4.4 Operation and running of the method

The Six Sigma approach is a sequence of several steps, depending on the purpose: Process improvement (our goal) Or Implement new processes

The method is thus based on five steps that contract in the acronym:

- **DMAIC:** Define, Measure, Analyze, Improve, Control
Used to improve existing processes.
- **DMADV:** Define, Measure, Analyze, Design, Verify.
Used to develop new processes

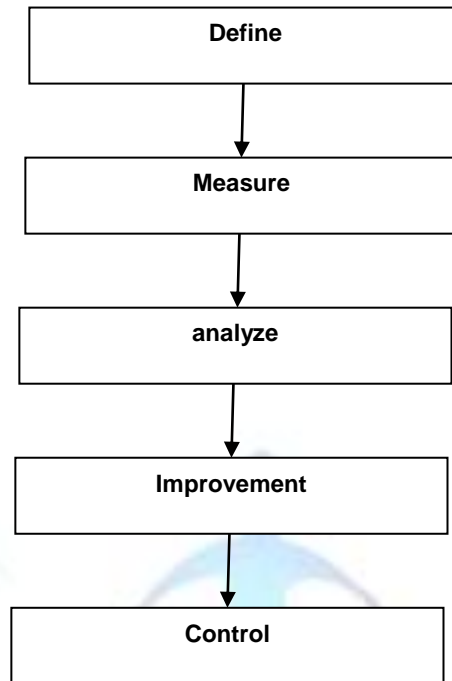


Fig 5: Steps in Six Sigma approach

5. IMPLEMENTATION OF THE SIX SIGMA APPROACH

After a practical internship at the cement factory of Batna (Algeria), we will try to implement the DMAIC approach in the context of a project to improve performance workshops factory of SCIMAT.

5.1 Step 01: define the problem

This phase is devoted to the exploitation of some tools of Six Sigma approach. These have been implemented in raw mill through a commitment to performance improvement.

The project takes place in the mill shop Several problems are identified in this workshop, the most common is **the jam mill**.

- **The context WWWWHW:** What, Who, Where, When, How and Why

Table 3. Présentation of WWWWHW

what	the jam mill
who	Team responsible for the project (production, maintenance, quality).
where	In the workshop production (mill)
When	At Career (2 days).
how	The identification of sources of jam and reduction. study of processes and improvement of their knowledge and control
why	load unbalanced mill. The particle size of the raw material is higher than the standard.

- **L'IPO: Input Process Output:** Once the project limits are set, it is necessary to know the specific objectives and the means made available to achieve

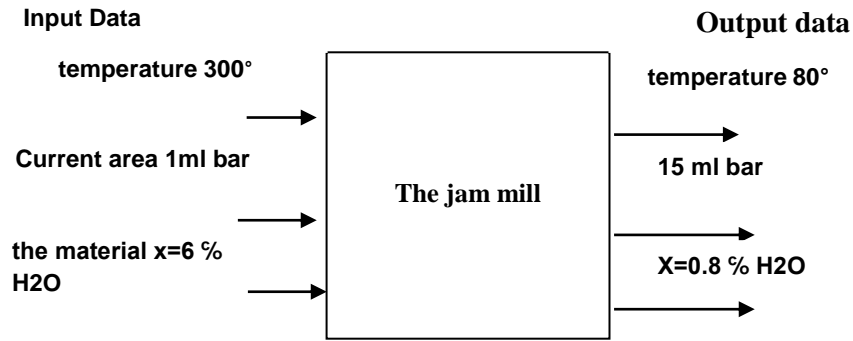


Fig 6 : L'input Process output of the mill.

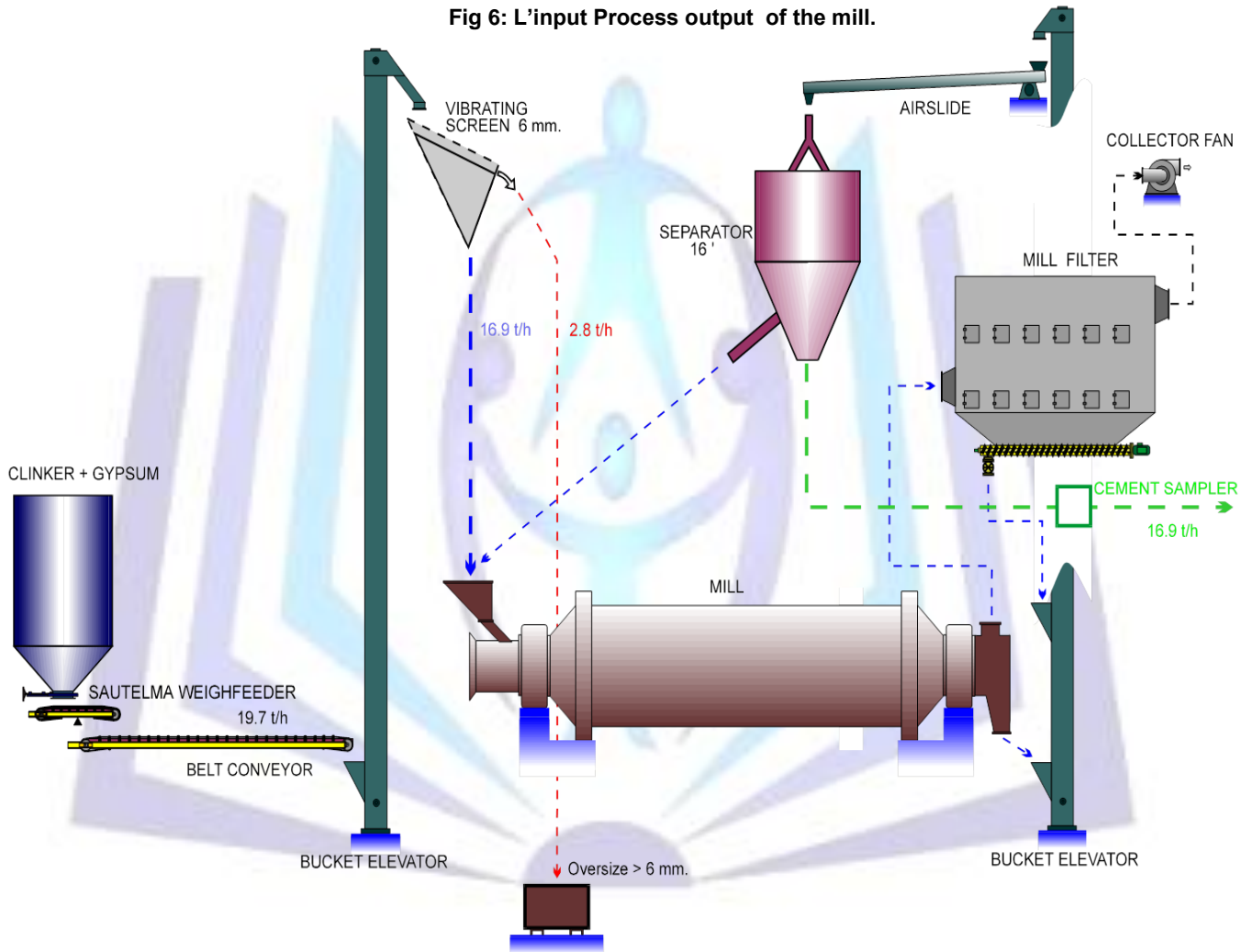


Fig 7 : Presentation of the JAM MIL

5.2 Step 2 : measure

Once the stage define made, we move to the second stage which aims to audit the manufacturing process. in this case we use the Pareto chart

- **The Pareto tool: Method 20/80**

After an on-site verification, we chose the workshop production as a source of disturbance and stopping of the manufacturing process

- **Interpretation of the curve**



Area A: 33.33% frequency have 70% of all faults.

Area B: 33.33% frequency have 25% of all faults.

Area C: 33.33% frequency r have 5% of all faults.

Table 4. Failure frequency

Réf	Failure	Time stop	frequency
A	Jam	128 h 20	41
B	a programmed stop to change gear symmetry CMD + Control System	520 h 00 '	27
C	Rush hour	4 h 00 '	31
D	oven stop	69 h 38 '	23
E	lock hopper Drain and mix	7 h 10 '	1
F	lock hopper mix	11 h 33 '	11
G	Jam R1 (Air lift)	42 h 54 '	8
H	Oven stop	104 h 38 '	19
I	recorded mechanical R1 (Change of the elevator band R1)	120 h 00 '	6
L	Deficit mixture weight	17 h 07 '	3

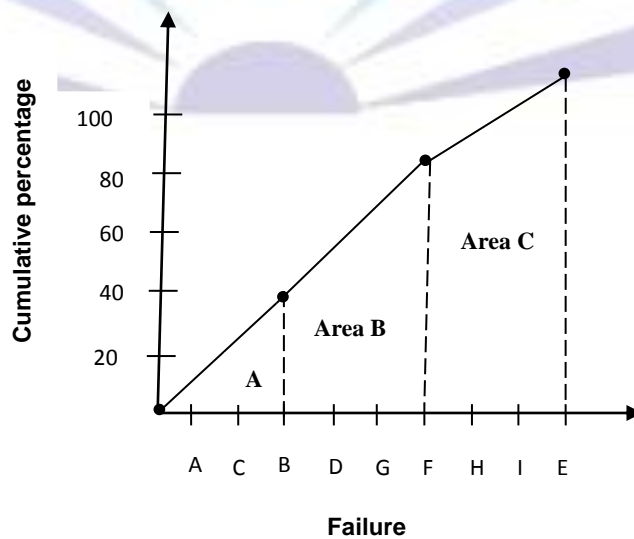


Fig.8 ABCcurve

➤ **Axis of investigation**

A collection of different failures, operated by Pareto, allowed us to determine the percentages of defects we see that the equipment that generates the most stops are jamming the mill.

➤ **Data collection and distribution of stops motifs**

A data collection has been implemented in order to know the reasons for stops. The Pareto distribution shows the jam mill. At this level of thinking, a multidisciplinary meeting proved necessary to identify the root causes of these stops and take action decision

5.3 Step 3 : Analyze

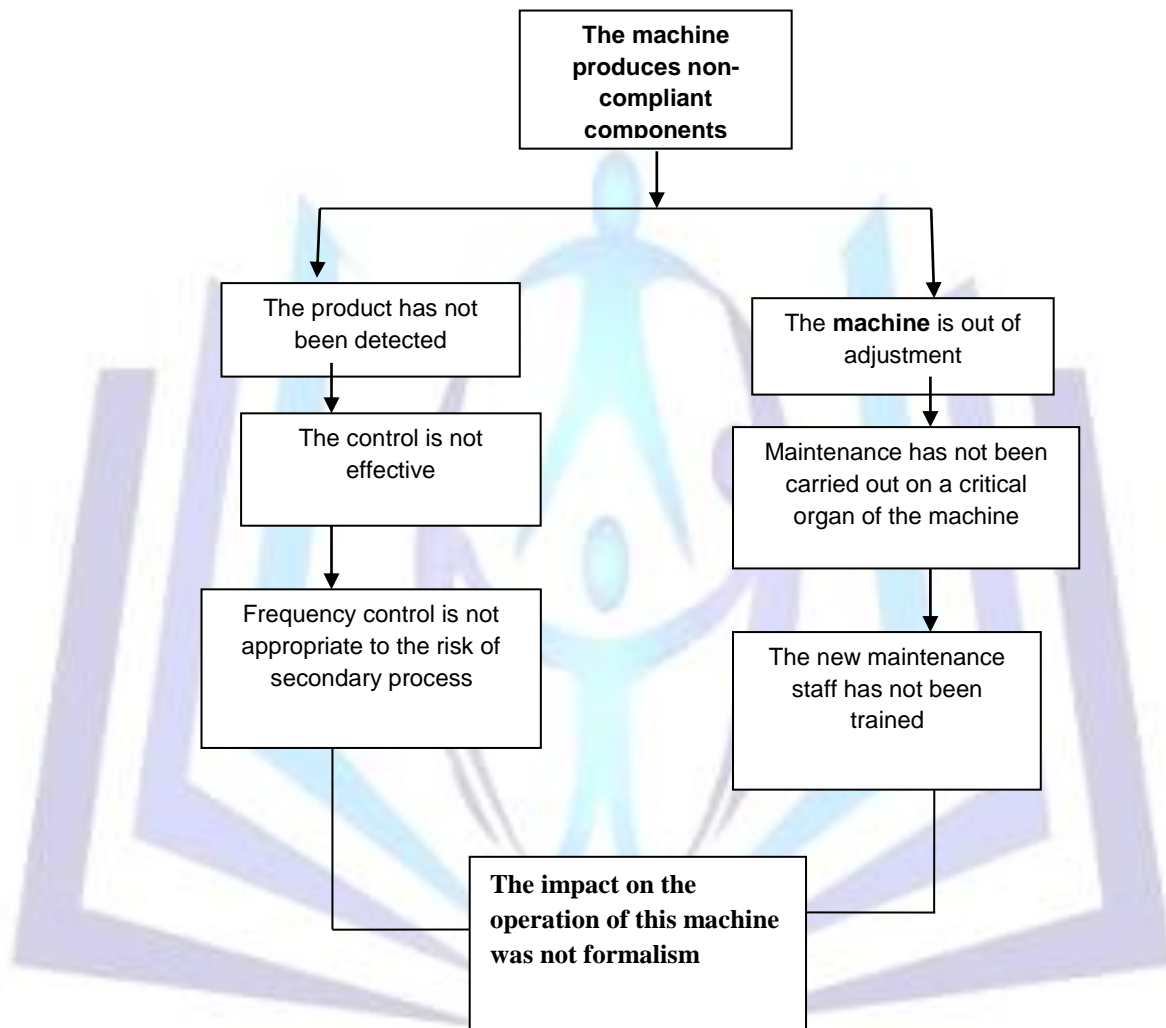


Fig.9 Five Why

To get a clearer view of the different sources of proposed correction and help us determine which will be the subject of further investigation. These notes are classified with Ishikawa diagram

➤ **Interpretation:**

This diagram gives a clear and readable approach to different sources of jam and it serves basic choice of direction to take in the investigation.

5.4. Step 4 : improve

In order to be as efficient as possible and get gains quickly, we decided to practical action to reduce the number of defects by the kaizen principle (improvement)

Once the root causes stops are detected, We go to the next step of the DMAIC approach consists in implementing improvements to act on the root causes and reduce the undesirable effects observed and measured: stopping mill.

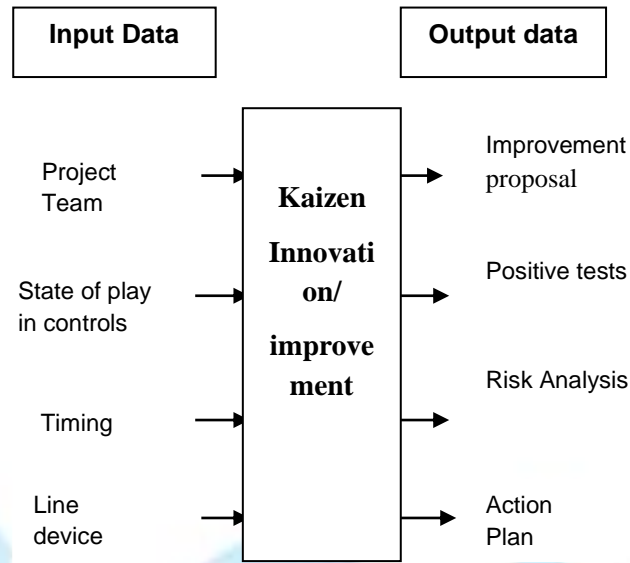


Fig.10 Kaizen principles

5.5 Step 5: Control and standardize

The final stage of the DMAIC process is the control and monitoring.

➤ **Monitoring of performance indicators**

To enable monitoring of the effects of improved implementation and determine if the actions carried responded well to their goals, It is necessary to choose indicators for monitoring

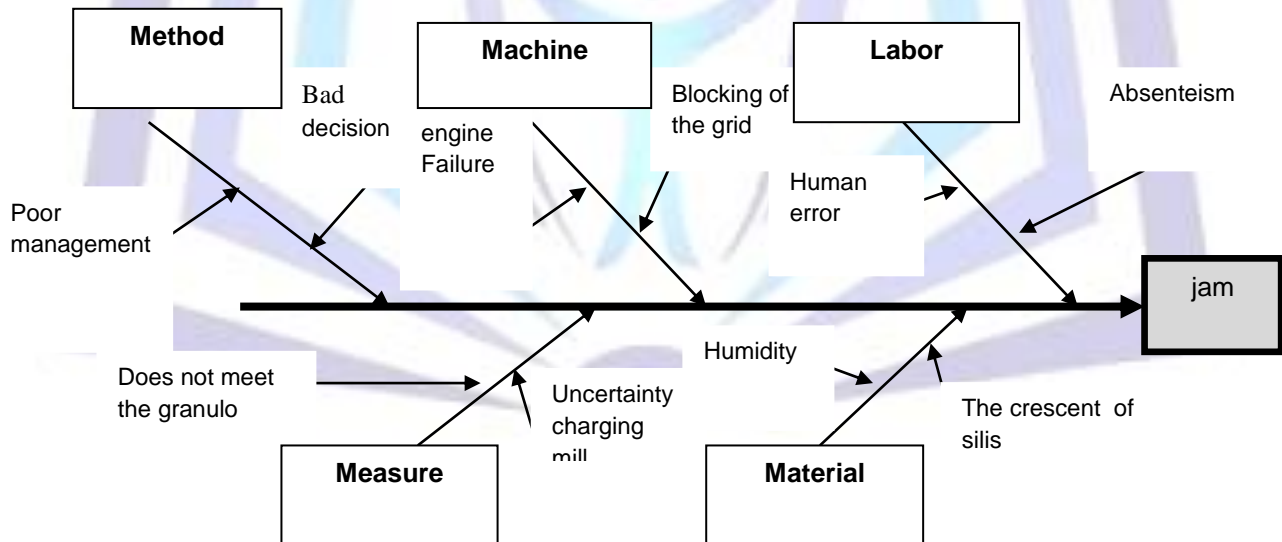


Fig.11 Ishikawa diagramm

The percentage evolution of the number of stopped mill must be followed before, during and after the introduction of improvements

➤ **Review of "standard operating procedures"**

Any system of quality requires sustainability of each improvement implementation.

To do so, each change of process requires being a modification and a validation standard operating procedures SOP.

New versions should be known to all and applied by all, they become references in terms of procedures.



These modifications is the subject for training in both theoretical and practical to Make sure, that each actor of the lines of milling took note of the new SOP

Finally, once they are trained, they need to ensure the proper application of these new procedures.

6. CONCLUSION

In this study, we find that the deployment of Six Sigma method in the framework of a project to improve productivity in SCIMAT reveals appropriate and effective.

The success of the approach requires ongoing monitoring of all frames, and for a better implementation, it is necessary to complete the method by lean manufacturing method.

With this method, we identify the core production processes, evaluate the performance, analyze the problems, propose and implement the improved measures to make the quality level of this processes improved consistently.

Finally, training is essential to promote cultural changes that involves. The time and cost of training are the first obstacles of implementing Six Sigma project in firms

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