Software For Six Sigma Projects with the Use of the Paraconsistent Logic

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***Abstract*—Companies of products and services, implement the six sigma methodology in several scenarios, however, without taking into account factors (organizational climate, organizational culture) that are fundamental to the success of the implementation in the pre-project phase and even in the selection of its six sigma projects. The purpose of this study is the development of a system that uses the Paraconsistent Decision Method to study the feasibility of its implementation in Six Sigma in a given scenario, making the decision making more precise. The Paraconsistent Decision Method allows the support of paraconsistent logic in the (pre-project) phase of choice in consideration of six sigma projects; we have the quest to enable improvement in success accuracy in scenarios where there are factors (organizational climate, organizational culture) critical of success. This article aims to contribute to the constant search for quality (reduction of defects) and mitigation of costs by companies in low-quality scenarios (defects in products and services).**

Keywords— Six Sigma; Quality; Paraconsistent Annotated Evidential Logic Eτ; Paraconsistent Decision-Making Method.

I. INTRODUCTION

According to Mikel Harry, he recognizes as a six-sigma methodology process improvement that achieves defect levels of 3.4 ppm (parts per million) for critical quality characteristics of customers. Deming in 1990, in his vision of states, reinforces that in every process there is some variation in greater or lesser quantity; the key to improving processes is to attack and reduce the cause of variation systematically. From the tools applied logically and structured in a scenario that has the essential for the operation and proper performance of the system, in this scenario, a scene with an excellent organizational climate and an ethical corporate culture, preventing human factors can affect system performance. [2]

The question is related to the fact that the organizational culture and organizational climate can be considered as unstable and ephemeral since both are mostly human and suffer constant changes which can affect the behavior of the system.

Noticeably, or not, the most significant difficulty in the deployment of Six Sigma is in exercising our knowledge and their tools, where the system depends on both the team collaboration and the environment, as well.

There are fundamentally human interactions, where these interactions may not suffer from the human inconsistencies or attitudes as vitiate the data obtained through the Six Sigma projects. [6].

Problems and inconsistencies occur naturally in the scenario with humans, not impeding the ability of reasoning or human thought, the system can perform its knowledge of the situation, together with the humans correctly when finding themselves in a scenario that meets their needs entirely. [6]

Given this assumption, we have sought to establish the feasibility of implementing the Six Sigma system, considering the critical success factors, the organizational climate, the organizational culture and the scenario. [6]

Considering that the decision-making has always been a painful process for both the machine and the human, the vast amount of data, possibility and possible results made this task a problem that needed something new to resolve; it needed a system capable of accurately calculate and show the possible scenarios, a method to support decision-making. [6].

However, in addition to a support system for the decision, a precise system, capable of calculating all the inconsistencies of the scenario, working with a calculation which includes all the variables and brings.

As a result, the feasibility of the System of choice for pre-Six Sigma projects with the use of Paraconsistent Logic becomes patent, since such logic has the ability to process uncertain, inconsistent and even incomplete data in a non-trivial way.

Hence we have chosen the said logical system as the logic underlying our studies.

II. EASE OF USE

A. Six Sigma

In the mid 80's, Six Sigma was born in the company Motorola. Directly and indirectly, the company, at that time, was spending around 10% and 20% of revenues in low quality. After studying the scenario, the bond between the experience of apparent failure on clients and, also, the knowledge of internal defects in their factories, Motorola started to be aware of the fact that the low quality obtained a significant impact on its profitability of primary line. [2]

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Soon after its deployment at Motorola, Six Sigma has different settings that in short, were linked to efficiency in processes and operations, the improvement of business processes, achieving excellence in our processes. [3]

However, the primary objective of Six Sigma continues to lead the continuous improvement of the process of troubleshooting methodology, being documented and verifiable repetition. [3]

Another definition that can be attributed to this system, which is the definition of a management philosophy, which seeks to achieve challenging objectives considered, reduction of defects in products, using processes and services, through a careful analysis of the results obtained and data collection. [1]

The level of the Six Sigma identification is taken into account as main inputs: total opportunities (number of units tested * possible quantities of opportunities) along with the number of defects found. In a given hypothesis (errors found in production) as shown in table 1, we considered the total of opportunities = 1; then we had the perception of how impotent means the search for the 6sigma level, which represents the almost total extinction of defects, and consequently to the almost 100% success.

TABLE1. PROJECT SIX SIGMA WITH TOTAL OPPORTUNITIES = 1 AND FORMULA.

Sigma Level	DPMO-Defects per Million Opportunities(DPO x 1.000.000)	% Error - Six Sigma	% No Error - Six Sigma
6	3,4	0,00034%	99,99966%
5	233	0,02330%	99,97670%
4	6210	0,62100%	99,37900%
3	66807	6,68070%	93,31930%
2	308538	30,85380%	69,14620%
1	691492	69,14620%	30,85380%

(Source: Author)

In the Six Sigma system is used the tool DMAIC (Define, Measure, Analyse, Improve and Control)

Defines: an accurate definition of the scope of the project;

Measure: Find the focus of one or more problems in the scenario;

Analyze Definition of the causes of each problem;

Improve: Evaluate, present and calculate possible solutions to questions;

Control: Ensure that the answer will keep for a long-term goal. [6].

The logical way to use the DMAIC tool, follow the steps as shown in figure:

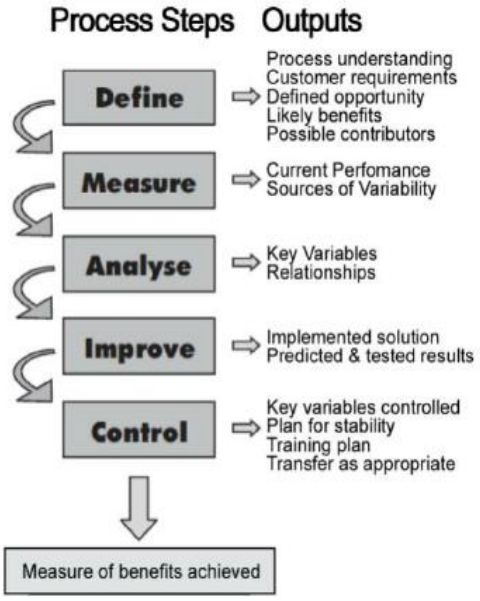

Fig. 1 – *DMAIC – Source:* [10]

B. Success Factors of Six Sigma

It can be identified as factors affecting the system: assigned projects and the environment in which it is being implemented, team preparation and top management, lack of structure and necessary knowledge to work with the system, lack of leadership and team monitoring. Add to that the internal processes of the company. All this leads to the prevention of the achievement of objectives and improvement in the operations and products of the company. [2]

The leadership can be singled out as essential and indispensable for achieving the success of Six Sigma. Monitoring progress and ensuring team commitment is monitored through meetings. Such commitment constitutes one of the fundamental tasks that an active leadership and senior management need to realize. [2]

In addition to the performance of the high administration, customer focus, the use of a structured method and the proper infrastructure are considered the factors of success of Six Sigma. [2]

C. Organizational Climate

The organizational climate can be roughly defined as the work environment, the corporate environment, and psychological atmosphere. Within this environment, it is easier to detect the effects of climate change on people, affecting mainly the performance and teamwork, both significantly essential pillars for the performance of the system Six Sigma, which detect for what reasons the environment is this way.[4]

Even when, understood that the organizational climate is fundamental of inconsistencies and unforeseen changes, makes it essential for the study and the importance of balance in the environment that the system works mainly with human interactions and develops its methodology in the team. [4]

It makes the current mood is the motivation of the members which, as a result, make the environment more productive and satisfying, generating positive effects and animation, collaboration and interest.

Changes happen all the time, preventing the balance still and stable. However, control the variation and seek that doesn't happen an extreme contrast, making the climate with foci of disinterest, depression, dissatisfaction, in more severe cases, which may lead to strikes, nonconformism, unrest among the members of the scenario that consequently also become dissatisfied with the company. [8]

The organizational climate must be studied and thoroughly analyzed by the administrator, then, toil to encourage their decisions, and then find it necessary, interfering in the environment to generating positive changes and gradual climate and organizational culture. [9]

D. Organizational culture

Speak of regulatory climate makes consequent need to speak of corporate culture since one refers to the other. [5]

Organizational culture is what influences and defines the regulatory environment. Would the reasons by which, the atmosphere is the climate in which is, he is a particular climate or not, the study of the culture, is the study of attitudes, habits, gestures, speech, among many others, that establish the environment and team collaboration among themselves. [5]

After setting a set of norms, values, and beliefs that guide and normalize the behavior of particular team, becomes noticeable that culture is broader than the organizational climate. The importance of organizational culture is the significant influence that it has on the environment and people. [9]

If the environment is detrimental to the team and the processes, changes must also come from the culture, essential points for a motivational change are communication, competence, commitment, continuity, and understanding. [9].

E.. Paraconsistent Method of Decision

The Paraconsistent Method of Decision (MPD) was developed by Carvalho (2006) through their studies. To recognize the factors that influence in the enterprise, causing the success or failure, in other words, what can influence the decision of continuity of particular project or not. [7]

It was possible to recognize that specific factors may present different results, as favorable conditions, in other cases, unfavorable terms, or else, can still submit circumstances indifferent to the project. [7]

TABLE II
EXTREME AND NON-EXTREME STATES

Extreme States	**Symbol**
True	V
False	F
Inconsistent	T
Paracomplete	⊥
Non-extreme states	**Symbol**
Quasi-true tending to Inconsistent	QV→T
Quasi-true tending to Paracomplete	QV→⊥
Quasi-false tending to Inconsistent	QF→T
Quasi-false tending to Paracomplete	QF→⊥
Quasi-inconsistent tending to True	QT→V
Quasi-inconsistent tending to False	QT→F
Quasi-paracomplete tending to True	Q⊥→V
Quasi-paracomplete tending to False	Q⊥→F

The MPD receives data from the members of the decision-making process, as the experience, uses the so-called "experts" for evaluation, making them essential tools in the assessment of a specific issue. Moreover, through the information obtained, performs the calculation considering all the possibilities, not only of the members, as well as the scenario and the company. [7]

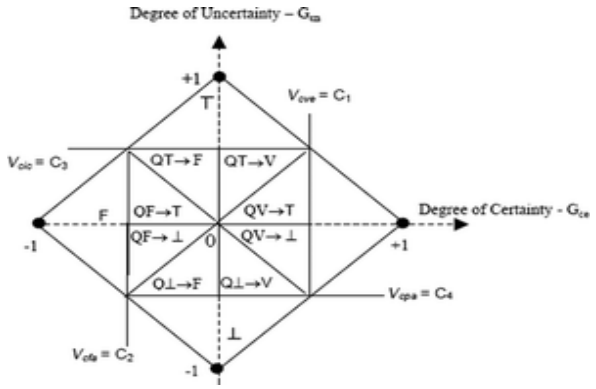

Fig.3.Extreme and non-extreme States. Source[13]

III. THE PROJECT

This study proposes the development of software that can calculate the feasibility of pre-projects of Six Sigma system through the use of the Paraconsistent Method of Decision, aiding in the decision-making process. By using the Paraconsistent Method of Decision, a questionnaire is considered to collect the necessary data on the project.

The user will define the experts who will provide the information on the project and the importance (weights) of each expert, making the report of a particular expert more relevant, in comparison with the other information from other experts. Once completed the questionnaire, it will be done the calculations with the evidence degrees, and it will be delivered the result of viability to the user.

Whereas it is necessary to calculate many variables, the software will be responsible for providing more accurate information essential for the decision-making process. Obviously precision and accuracy of the results are paramount in this process, and of utmost importance for the scenario.

To reflect the joint influence of all factors with weight in each decision, one must take into account the Global Analysis and are collected by the favorable and contrary evidence degree.

The calculation of the Global Analysis can be extracted by the weighted average of the evidence of conviction and uncertainties resulting from all the factors. When the weights in each decision are equal, the Global Analysis should be calculated by the arithmetic mean of the evidence of belief and uncertainty, becoming the geometric center.

At this point, the study advances and reinforces the importance of data collection by forms filled by experts to the implementation of algorithms represented in flowcharts in a way to implement in any computational technology and that support the decision support by the proposed system. The decision-making process consists of choosing one of several alternatives. The unified process of annotated paraconsistent logic is proposed as an aid in the decision-making of recounting, as follows:

TABLE III. UNIFIED MACRO PROCESS PARACONSISTENT ANNOTATED LOGIC

Item	Process	SubProcess
A	Definition	Define Proposition; Define Factors; Define Section; Define Database;
B	Transformation	Generate Normalization; Use Evidence (favorable and unfavorable);
C	Calculation	Calculate Maximization; Calculate Minimization; Calculate Evidence (Resultant Min, Resultant Max); Calculate Degree (Gce: Certainty, Gco: Contradiction); Calculate Globals Analysis (Gce: Certainty, Gco: Contradiction);
D	Parameterization	Parametrize Limitvalues;
E	Processing	Process Para-Analyzeralgorithm;
F	Decision-making Support	Assists decision-making;

The use of Paraconsistent Logic Annotated as support in decision-making in implementing six sigma projects should fill a significant gap in the demands for products and services that are based on the six sigma methodology. In this new proposed form, factors of climate and/or culture should be taken into account in the implementation of the six sigma by managers who decide success.

IV. DISCUSSION OF RESULTS

The study for the development of software capable of bringing the Paraconsistent Method of Decision to calculate the inconsistencies of the scenario and the people who are part, brought more reliability and accuracy to the decision-making process, giving due importance to the calculations and the results obtained.

The study necessary for the development was about the whole process from the pre-project the decision of deployment of the system Six Sigma. The approach by the proposed system must be based on the form that meets propositions able to foment data in the possibility to allow the use of paraconsistent logic and to obtain results that will aid in the whole of decision making by six sigma projects.

Other ways of representing the paraconsistent logic with possible implementation in a particular programming language are to launch the use of the flowchart, where we have:

In this stage of the flowchart, there is an excellent possibility of being quasi-true tending to the inconsistent, or inconsistent tending to the True,

because the Gce and Gco conditions result in some response and when there is no possibility to answer, it follows in the "Y" flow to explore the possible answers offered by the paraconsistent logic

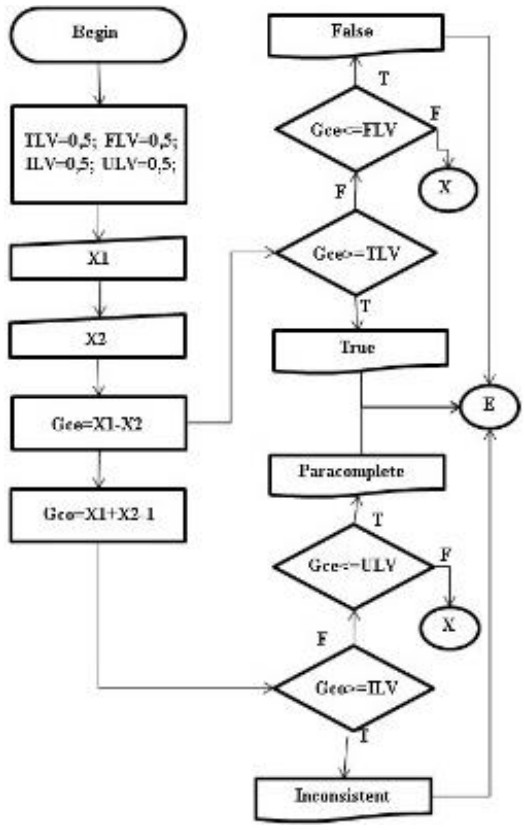

Fig. 4. Paraconsistent logical flowchart: True, False, Inconsistent, Paracomplete. (Source: Luiz A. de Lima).

The flowchart (Fig. 4) shows that there is a possibility of being quasi-true tending to the inconsistent, or quasi-inconsistent tending to the True because the Gce and Gco degrees conditions result in some response. When there is no possibility to answer, it follows in the "Y" flow to explore the

possible answers offered by the structure of paraconsistent logic.

The flowchart (Fig. 5) shows that there is a possibility of being quasi-true tending to the inconsistent, or inconsistent tending to the True because the Gce and Gco conditions result in some response. When there is no possibility to answer, it follows in the "Y" flow to explore the possible answers offered by the paraconsistent logic.

The next flowchart (Fig. 6), there is a possibility of being quasi-true tending to the Paracompleteness or Paracompleteness tending to the True, since the Gce and Gco conditions result in some response. Moreover, when there is no possibility to answer, it follows in the stream "Z" to explore the possible answers offered by the paraconsistent logic.

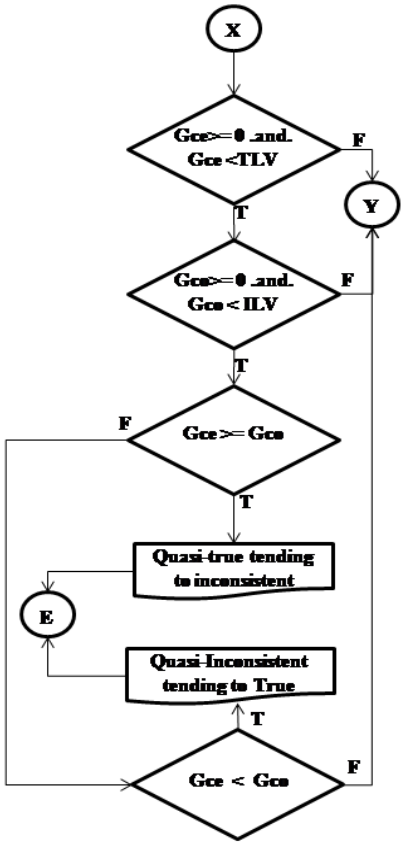

Fig. 5. Paraconsistent logical flowchart: Quasi True tending to the Inconsistent, Inconsistent tending to True. (Source: Luiz A. de Lima).

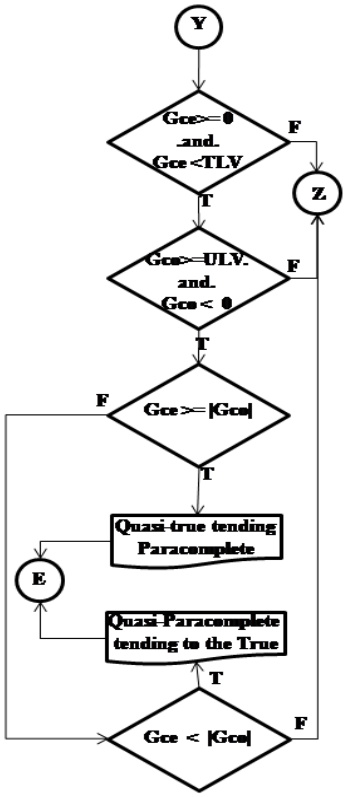

Fig. 6. Paraconsistent logical flowchart: Quasi True tending to Paracompletenessn, Paracompletenessn tending to the True . (Source: Luiz A. de Lima).

V. FINAL CONSIDERATIONS

Inconsistencies and human errors continue making the decision-making processes involved, as well as affect the production within an organization. Calculate is not enough, it is necessary to make these calculations automated, easy access to the user. Make the decision-making process more accurate, reliable and fast. The production and operations grew to become the most common errors within the activities, the search for the improvement of operations and the quality of the same, brought the study and development of Six Sigma, which proved to be a useful tool and produced results that demonstrate the improvement in processes and production. In addition to this study, in order to support managers for the implementation of the six sigma methodology, we seek artificial intelligence techniques and, in particular, parachutist logic, aid in decision making with more accuracy and even allowing the refuse in the implementation of six sigma projects, when considering factors such as climate and / or organizational culture.

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