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**Processes Engineering and Theory of Constraints Thinking Process Model
for Service Processes Analysis**

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Abstract:

This work presents an application of the use of the concepts of the Process Engineering and the Theory of Constraints Thinking Process for a systematic and systemic analysis of the processes modeled. Process Engineering contributes as an instrument of action in the organizations throughout the identification and representation of the existing processes. Process modeling qualifies the construction of an integrated vision and makes possible a quarrel and systematic analysis of the organizational processes. On the other hand, the Theory of Constraints Thinking Process is used in the critical analysis of each one of the selected processes. This analysis contributes for the understanding and identification of the causes that support the existing problems in the studied processes, providing a systemic vision of the them throughout the processes. In the research processes of an Institution of Superior Education have been modeled. Each one of the processes was analyzed from the construction of the Current Reality Tree. After that technique of the Evaporating of Clouds was applied to breach the assumptions that keep the problems in the process. On the basis of the Current Reality Tree and the Evaporating of Clouds the processes had been redesigned. The gotten results of the used boarding had been promising.

Key-Words:

Theory of Constraints Thinking Process, Engineering of Process, Systemic Analysis

1. Introduction

The thinking process of Theory of Constraints is a set of tools which enable identifying, analyzing and proposing solutions for the organizational problems (ANTUNES et al., 2004). Noreen et al (1996) present several study cases of the application of the Thinking Process for solving specific problems in the organizations. However there is no systematic approach for using this tool in the overall organizations. Although it is a systemic approach for problem resolutions, the Theory of Constraints does not systematize its utilization for areas or organizational processes. Realizing an analysis of the undesirable effects and its causes in terms of processes can contribute for the processes understanding and for the understanding of their relationships with other organizational processes.

In this context, the Process Engineering can cooperate effectively as an element to conduct the organizational analysis in a process level, contributing for the Thinking Process

of Theory of Constraints. The process view privileges the analysis of the horizontal activities of the organization, enabling an overall understanding and improvement of the organization.

The main purpose of this work is therefore presenting a case of integration between Process Engineering and Thinking Process of the Theory of Constraints, pointing out the complementary of the two theories and their benefits for the organization. The advantages that can be described for using both theories are: i) a better processes comprehension; ii) a systemic view of the problems that are found in the processes and consequently; iii) a better process redesign. For this, it was realized a study case in an Education Institution, in where processes were modeled and the concepts of the two theories were applied. In this way, it was possible to have an integrated view of the processes and of the undesirable effects that they cause in the researched organization. Consequently, the process were redesigned in it lives her consistent way, seeking to act in points in which the actions will have a great impact in the overall system.

2. Theoretical references

The two theories are presented: i) The Thinking Process of the Theory of Constraint; and ii) concepts referred to Process Engineering.

2.1 The Thinking Process of Theory of Constraints

According to Antunes Jr. et al (2004), the Thinking Process of the Theory of Constraints can be considered as a method of identification, analysis and problem solution. The Thinking Process is a method that seeks to facilitate the liberation, focus and intuition criticism, which is, a set of tools through which it's possible to facilitate the good sense. (GOLDRAT, 1990; GOLDRATT, 1991, GOLDRATT, 2004). According to Cox & Spencer (2002), the Thinking Process is a set of tools that can be utilized individually or that can be

linked logically, enabling the identification of main problems, the determination of solution win-win and in the determination and overcome of the possible obstacles for implementing the solution.

The Thinking Process is based in the scientific method and seeks to answer three questions: What to change?; Change for what?; and How to provoke the change?. The Thinking Process logic is based on effect causes relations and in a critical view of the reality, where it looks for knowing why things happen and not how they happen (ALVAREZ, 1995).

As Cox & Spencer (2002), the Theory of Constraints has five tools that to answer those three main questions, which are represented in Figure 1. The tools are sustained by two main points: the critical view of the reality and the effect causes analysis (ALVAREZ, 1995). For this work, the Current Reality Tree and the Evaporating clouds are presented.

Figure 1 – Thinking Process five tools

Main question	Tool
What to change?	Current Reality Tree – CRT
To what to change?	Evaporating Clouds – EC
	Future Reality Tree – FRT
How to cause the change ?	Prerequisite Tree – PRT
	Transition Tree – TT

Font: The authors. Adapted from (COX & SPENCER, 2002).

2.1.1 Current Reality Tree

The Current Reality Tree aims to define the main problems that are found in a specific system (ANTINES Jr. et al, 2004). The construction of the Current Reality Tree must be realized in groups that involve different functional areas, providing an effective communication of the main problems of the organization and a common understanding of those problems (KINGMAN, 1996).

Noreen et al (1996) and Cox & Spencer (2002) present a set of steps that help to construct the tree. According to Norren et al (1996) the logical relationships are the

indicatives of sufficiency, which is, to occur a determined undesirable effect is necessary the occurrence of other effect (individually, simultaneously or both).

According to Klein & DeBruine (1995) and Cox & Spencer (2002), the Current Reality Tree once is completely constructed, provide mechanisms for: i) identifying the impacts of politics, procedures and actions in the organization; ii) communicating, clearly and consciously, the causality of those politics, procedures and actions; iii) identifying clearly the main problem in the situation; iv) enabling the creation of a good relationship with the problems, putting all the effort to solve the main problem.

2.1.2 Evaporating Clouds

Since the main problem is identified, the question 'What to change' is answered. The next step is: "To what to Change?". To respond this question, the Evaporating clouds and the Future Reality Tree are utilized. The Evaporating cloud aims to formulate an effective solution to eliminate the main problem (ANTUNES et al, 2004). The Evaporating clouds seek to verbalize the presuppositions that are not verbalized, which causes the main problems. In general those problems are originated in a conflict of positioning (ANTUNES et al, 2004). To solve those main problems (conflicts) compromising solutions are utilized (ALVAREZ, 1995).

Compromising solutions are decisions that are made privileging a positioning conflict in relation to other. They are conciliatory solutions which, in general, should have been implemented in an attempt to solve the problem. In management activities, there are situations of trade-offs, which is, situations in where the manager should realize the choosing an option in detriment of other. In those situations, the Theory of Constraints has always a simple and creative solution that breaks the existing presuppositions related to the main

problem (GOLDRATT, 1991; ALVAREZ, 1995; KLEIN & DEBRUINE, 1995; NOREEN et al, 1996; COX & SPENCER, 2002; GOLDRATT, 2004; ANTUNES et al, 2004).

Figure 2 presents graphically an Evaporating Clouds Diagram. This tool looks for innovative solutions (injections) through the exercise of creativity, seeking elements that enable validating the existing presuppositions. In this way, it's possible to build consistent solutions that do not depend on commitment which in general leads to a lose-lose.

The Interpretation of the Figure 2 illustrates that both sides have the same objective in common, however, there are legitimate presuppositions of both sides that generate conflicts among parts for the problem resolution. Cox & Spencer (2002) illustrate this relation in the following statements: “For accomplishing A, I should accomplish B because of the relationship AB. For accomplishing B, I should accomplish D because of the presupposition BD.” (COX & SPENCER, p. 263, 2002). In the other way: “For accomplish A, I should accomplish C because of the relationship AC. For accomplish C, I should accomplish D because of the presupposition CD (COX & SPENCER, p. 263, 2002).

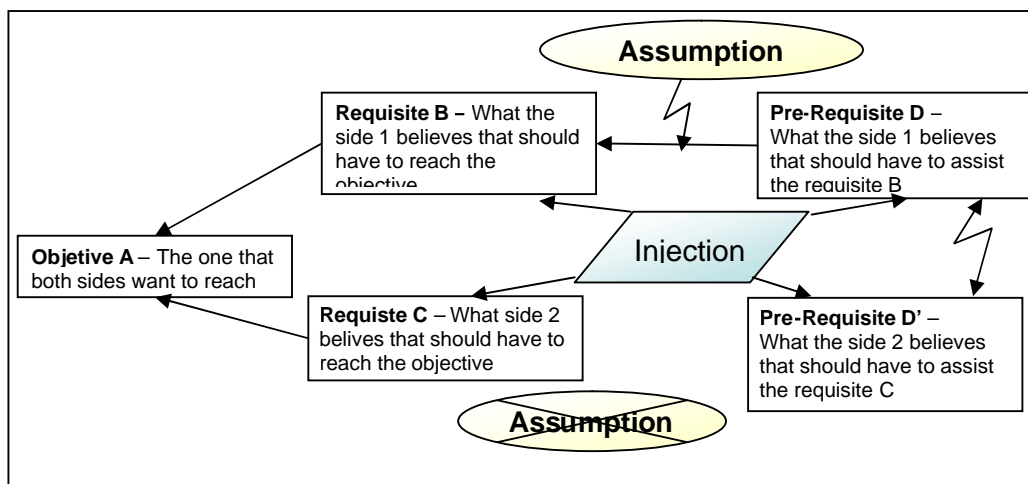


Figure 2 – Generical Representation of an Evaporating Clouds Diagram
 Font: Adapted from (COX & SPENCER, p. 263, 2002)

According to Goldratt (1991) the first step to solve a problem is defining the problem clearly. In this way drawing the clouds contributes for the problem definition and to find the solutions. Once those steps are realized, the injections must be done. For the elaboration of them, there is no sequence or formal technique. The utilization of the brainstorming is suggested, seeking creative solutions (injections). (GOLDRATT, 1991, ALVAREZ, 1995; GOLDRAT, 2004, RODRIGUES, 2004).

2.2 Process Engineering

According to Paim (2002), the Process Engineering should be understood as architecture (framework) for the understanding, analysis and improvement of processes internally or among organizations. Through the horizontal activities and information flows of activities representation in the organizations, it seeks to build a systemic view of how the unities of the organization integrate themselves and to generate the results and aggregate value for the final clients. For achieving that, the processes are utilized as a central element, seeking to understand, interfere and accompany the organization results.

A process is defined as a specific work activity ordination through the time and space, with a beginning, an end and a set of clearly defined inputs and outputs (DAVENPORT, 2000). The processes can be better understood once they are perceived as a logic and temporal structure of actions and resources that aims to generate one or more products or services for the organization clients (SALERNO, 1999; VILLELLA, 2000; PAIM 2002).

The growing application of the Process Engineering in the organizations results from a need of more flexibility, coordination of activities and because of an orientation for integrated results in the organizations. In a certain way, the process approach opposes the

functional way the organizations are usually organized. On one side, the functional organization makes potent the growth of specialized knowledge since it groups people by technical expertise and prioritize the departmental performance indicators. On the other side, there is no guarantee of a global performance of the organization.

Through the identification and representation of the organizational processes, the Process Engineering aims to make a critical analysis of the organizational process, which seeks to enable improving the operations (HAMMER e CHAMPY, 1994; DAVENPORT, 2000). It also propitiates an integrated manner of management in a way which increments the consistent and systematic performance (RUMMLER e BRACHE, 1995; DAVENPORT, 2000). The perception of the activities interdependence enables to make potent the discussion of problems and their undesirable effects through the organization.

The process view prioritizes the analysis of the organization functions from an optics of the activities sequenced logically and temporally (SALERNO, 1999, CAULLIRAUX & CAMEIRA, 2000). In this way, it aims to optimize not only the activities locally but also to contribute to the overall improvements of products and services in the organization. Grover & Kettinger (2000) present as advantages of the Process Engineering applications in the organizations: i) standardization of the understanding of the form of work; ii) a greater integration; iii) a larger facility for analyzing and improving the flow of information; iv) the exposition of process organizational know-how; v) realization of organizational analysis and indicators proposals; vi) realization of simulations that support the decision making and the organizational management, in an integrated way.

According to Paim et al (2003), among the main objectives of the Process Engineering are: the construction of a homogeneous view of the business, the improvement of information flow, the standardization of processes, the improvement of organization

management, a better processes knowledge and the reduction of processes costs and lead times.

2.3.1 Process Modeling

Process modeling is presented as a main tool for conducting the process actions in the organizations. It aims to represent the process providing inputs for analyzing and improving the forms of works between the organization functions (HUNT, 1996, VERNADAT, 1996). According to Paim et al. (2002), the process modeling is actually supported by tools that enable, through a common and integrated referential, the development of different actions based in the process approach.

A model can be understood as explicit and external representation of part of the reality which is viewed by people who desire to use the model for understanding, changing, managing and controlling the part of the reality in some way (PIDD, 1999). The process models seek to represent all the relevant aspects in terms of activities execution of a specific organization. In this way, the process modeling enables the generation of a unique reference for the development of actions based in processes. Among the main objectives of process modeling are (JOHANSSON, 1995; PAIM, 2002): better representation or understanding of how an organization works (or part of it); the use of the acquired knowledge and the experience for future uses; rationalize and assurance of the information flow; project and specifies a part of the organization (functional, behavioral, informational, organizational or structural aspects); analyze some aspects of the organization (economical, organizational, quantitative and qualitative analysis, layout, etc.); simulate the behavior of parts of the organization; accomplish of better decisions about the operations and the organization and control, coordinate and monitor some parts of the organizations (which is, some processes).

The modeling actions can be supported by different methods (PAIM, 2002). Independently of the approach that is utilized, an important point of convergence among the diverse methodologies is the provision of a common and structured language for taking the modeling actions.

In terms of those actions, it should have a standardization of the detailing levels utilized by the representation of process and a standardization of models and nomenclature that are adopted. This definition is directly related to the modeling objectives, as well as the scope of the modeling in the organization. Building this common view is fundamental for generating the standardized process models guaranteeing a clear understanding of the professionals that utilize the process models for understanding the reality and to intervening in it.

In general is not possible to build a priori an overall view of all the processes that exists in the organization. This building occurs in most of the cases through the bottom-up approach, which is, the description of the activities flows of each organizational unit and the identification of the interfaces between those units that, progressively, enable the construction of an integrated view of the all processes that, transversally, occur in the organization. In terms of this work, the process modeling is a way of better understanding the analyzed reality and as an instrument of analysis and the proposition of improvements in a systemic way for the studied organization.

3. Methodological approach

To achieve this work objective of integrating the Thinking Process of the Theory of Constraints and the concepts of the Process Engineering, the approach was qualitative. In this way, the technique of study case was used, in which a Learning Institution serves as an

object of analysis of the integration between the two theories. The study case is an appropriated method for investigating and understanding a determined phenomenon as one of the main characteristics in the qualitative studies. It's important therefore that the object of study should be believable of observation.

Besides that, the study case can be utilized for the construction of the theories. Because it's a technique that develops an explanation and understanding about a phenomenon, it makes possible the emergence of new theories. Einsenhardt (1989) presents a construction of diverse theories starting from study cases. The study case can be used for: (1) explore a subject or problem, understanding the question clearly; (2) explain a phenomenon; (3); describe a phenomenon; and (4) predict characteristics of a determined phenomenon (ELLRAM, 1996; YIN, 2001).

3.1 Technical procedures and work method

Figure 3 presents the general form of the work method utilized for the research development. The first procedure was the accomplishment of the analysis of the theoretical elements that sustains this work. The second step consisted on choosing the organization for doing the study. The choosing of this organization occurred because of accessibility of the data and the interviewees.

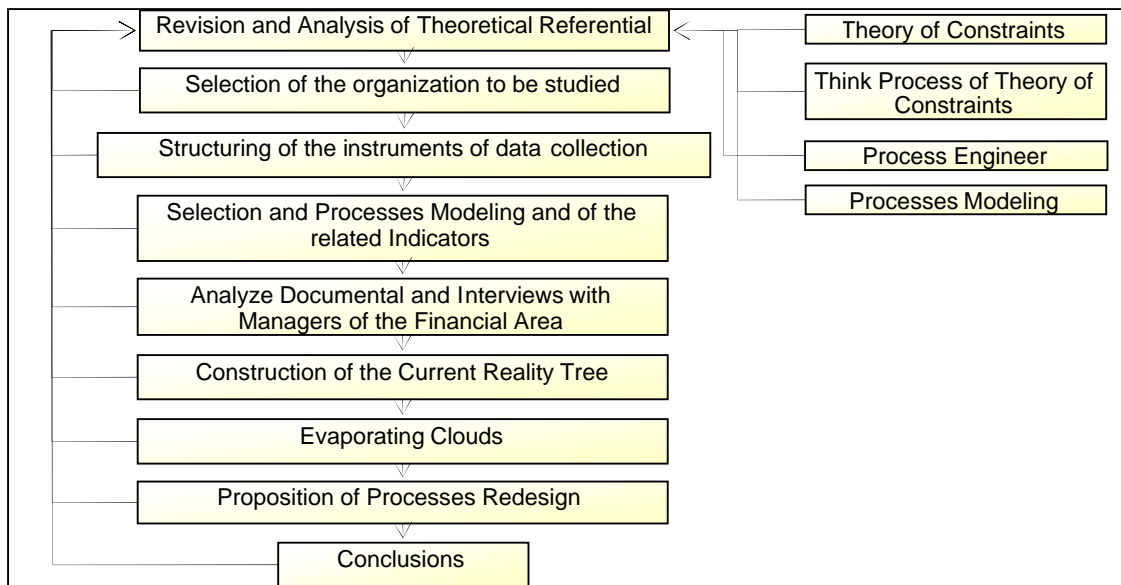


Figure 3 – structure for the research.

Font: the authors

Soon after, the instruments for data collection that consist on questionnaires semi-structured and report analysis and management information were defined. The next step consisted on the selection of the processes, subprocesses and related indicators that were modeled and analyzed. Once the subprocesses were selected and also the related indicators, the people to be interviewed were identified and the set of documents that would be used to validate the attests was identified. Inserting the indicators in the mapping processes had the objective to provide a larger set of the elements for constructing the Current Reality Tree and consequently contributes to the problem definition through the evaporating clouds. Based on the transcriptions of the interviews the undesirable effects were identified.

Knowing the figure of the undesirable effects identified in the subprocesses and the indicators, the Current Reality Tree were built for each one of the subprocesses. After the construction of the individualized trees, the trees were integrated and other undesirable effects were identified through the revision of the individual trees and of the integrated Current Reality Tree. After that a question of the cause that can propel the improvements of

the system was built through the evaporating clouds. As a result of the evaporating clouds the processes and the related indicators were associated.

4. The Case

The organization that was object of this research was a learning Institution of the south of Brazil. This organization provides service of undergraduate education and graduation. Besides that, it also develops researches in terms of graduate programs. This data collection was begun in June, 2000 and there were identified 11 macroprocesses, 80 main processes, 441 subprocesses and 1900 activities (business transactions). The process modeling counted with a 150 team from different areas in the institution and the ARIS modeling methodology was used (SCHEER, 1999)

The high quantity of macroprocesses turns unviable the study of all of them. Because of that, it was realized an initial cut selecting the processes that are involved in a specific area in the organization. The financial-administrative area was chosen because it is a critical area inside any organization. A lot of subprocesses were analyzed, but to make possible the accomplishment of this work, only a subprocess and the related indicators were selected among all the mapped processes: the subprocess of Budget Elaboration.

4.1. What to change?

In this section it's presented the current subprocess, the indicators linked to the process and the systemic impacts observed in the Current Reality Tree.

4.1.1 The AS-IS process

The subprocess of budget elaboration aims to calculate and consolidate the set o of monetary needs of the institution, in a determined period, discussed and approved in the appropriated instances. The graphical representation is expressed in Figure 4.

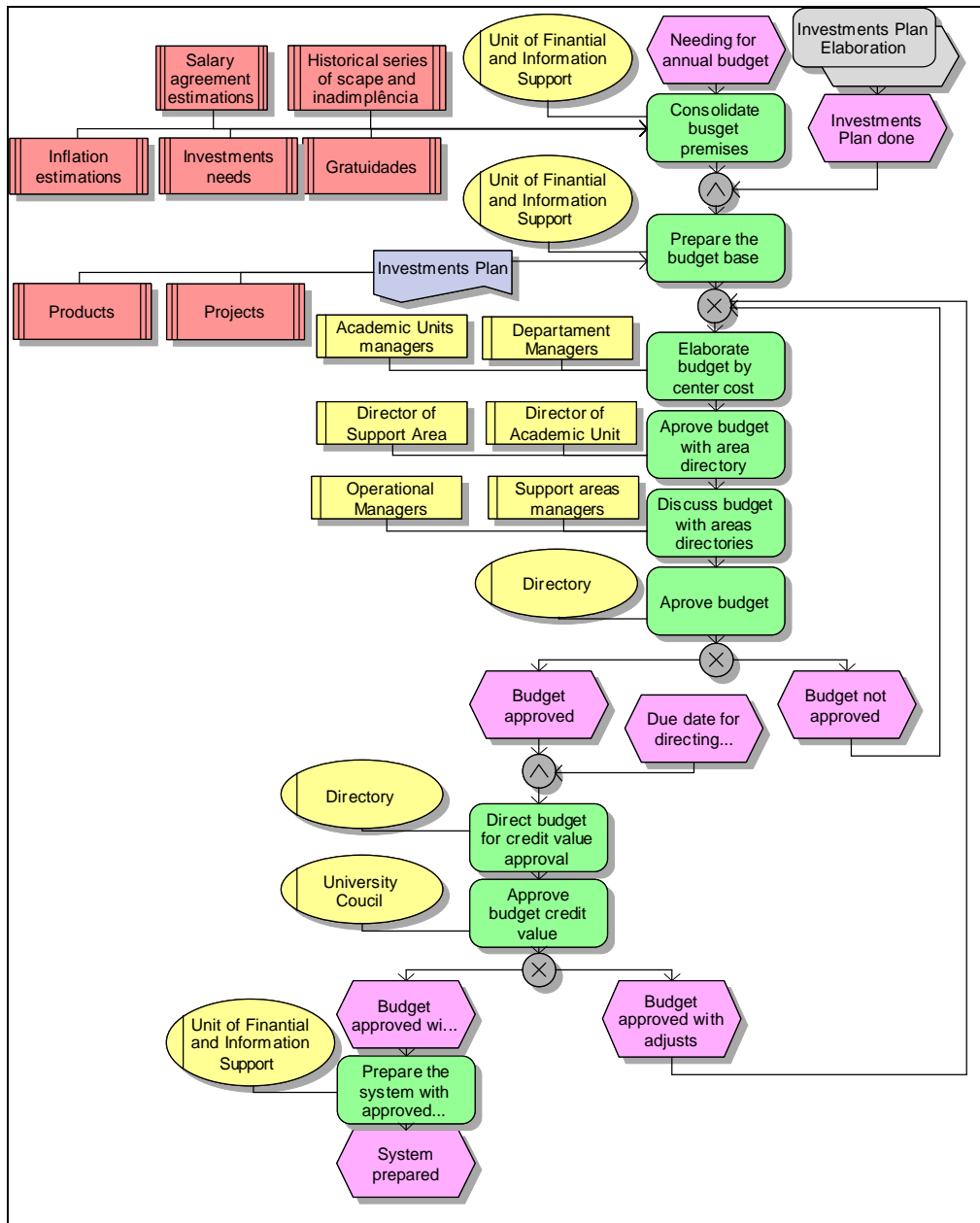


Figure 4 – Budget Subprocess. Font: The authors

It consolidates the budget premises through the estimation of the enrolled credits, inflation indexes and salary agreements, needs of investments and free payments and the historical series of escape and not paying. Realizing the consolidation, the basis of the budget is prepared with adjusts or amplification of the accounts, considering the investments plan and their respective projects or products.

The budget is elaborated based on center costs, areas of responsibilities, academic and support areas. After that, resources adjusts are done, because of the evaluation of the managers from the academic and support areas. This interaction occurs until the equalization of the differences or until the due date for sending the budget to the superior instances is met.

The budget is therefore sent to the University Council approval that approves or reproves (initializing again the subprocess). Once is approved, the necessary adjusts are done (if it's the case) and the system is prepared according to the budget model.

4.1.2 Current process indicators – (AS-IS)

The current indicators for the university products managers are measured locally in relation to the product that are above their management without having a view of the impact of the actions in the university. In this way, the current indicators linked to the subprocess are the ones described above:

a) Productivity Index: This indicator aims to verify the level of productivity of a specific university product, through the return of each monetary unit related to the expenses of the university product or area that is analyzed. There is an expectation of this index growth, which is, it hopes that for each dollar in expense there is a superior quantity of revenues.

$$\text{Productivity Index} = \frac{\text{Reveues}_i}{\text{Operational Expenses}_i + \text{Financial Expenses}_i}$$

Equation 1 – productivity Index. Font: the authors

b) Difference between estimated and realized: This indicator demonstrates the differences between the contracted results of each one of the university products and the results effectively accomplished. It hopes that this indicator is near to 1 (one), making that the forecast is materialized or is superior of 1 (um), so that the expectations are overcame. Since

the objective is the equilibration, the ideal is that the index demonstrates that the forecasts are precise.

$$\text{Difference between estimated and realized} = \frac{\text{Operational Results Realized}_i}{\text{Operational Results Estimated}_i}$$

Equation 2 – Difference between Budgeted and Realized. Font: the authors

c) **Level of accomplished revenues:** the level of executed revenues aims to demonstrate the differences between the forecasted and the realized revenues of a determined university product or area of management "i". Complementarily of this indicator, there exists an index of the revenue evolution in nominal and real terms, which also concerns to a determined area or university product, where "i" is one determined product or area and "k" is a determined period of analysis. It hopes that those indicators increase along the time.

$$\text{Level of accomplished revenues} = \frac{\text{Revenues Realized}_i}{\text{Revenues Estimated}_i}$$

Equation 3 – Level of accomplished revenues of product/area. Font: the authors

$$\text{Real/Nominal Evolution of Revenues} = \frac{(\text{Revenues Realized}_{ik} - \text{Revenues Realized}_{ik-1})}{\text{Revenues Estimated}_{ik-1}}$$

Equation 4 – Real / Nominal Evolution of the revenues of a product or area. Font: The Authors

The Budget Elaboration subprocess, in an integrated way to the set of the indicators, presents a lot of undesirable effects that are sustained for a determined number of causes that are inter-related. Those relations are described as following:

4.1.2 Current Reality Tree of the Budget Process (AS-IS)

The Current Reality Tree is diagramed in Figure 5 identifying the main undesirable effects and the possible causes of the Budget Elaboration subprocess. In the picture it can be verified the main undesirable effect: the budget does not represent the strategy of the institution.

Because of the Budget Elaboration subprocess is realized individually and, after that, a budget negotiation among the areas, it's verified the need of an insertion of security financial margins in the various levels in the organization. This generates a super estimated value of necessary resources for each area individually. After that, the social and behavioral components of the negotiation process come like the cut resources among others. The areas planning are not realized in a unified way. Each area plans its activities individually and the actions that should be realized in an integrated way occur only eventually, because it depends on the good sense and the relationship of managers from areas or departments.

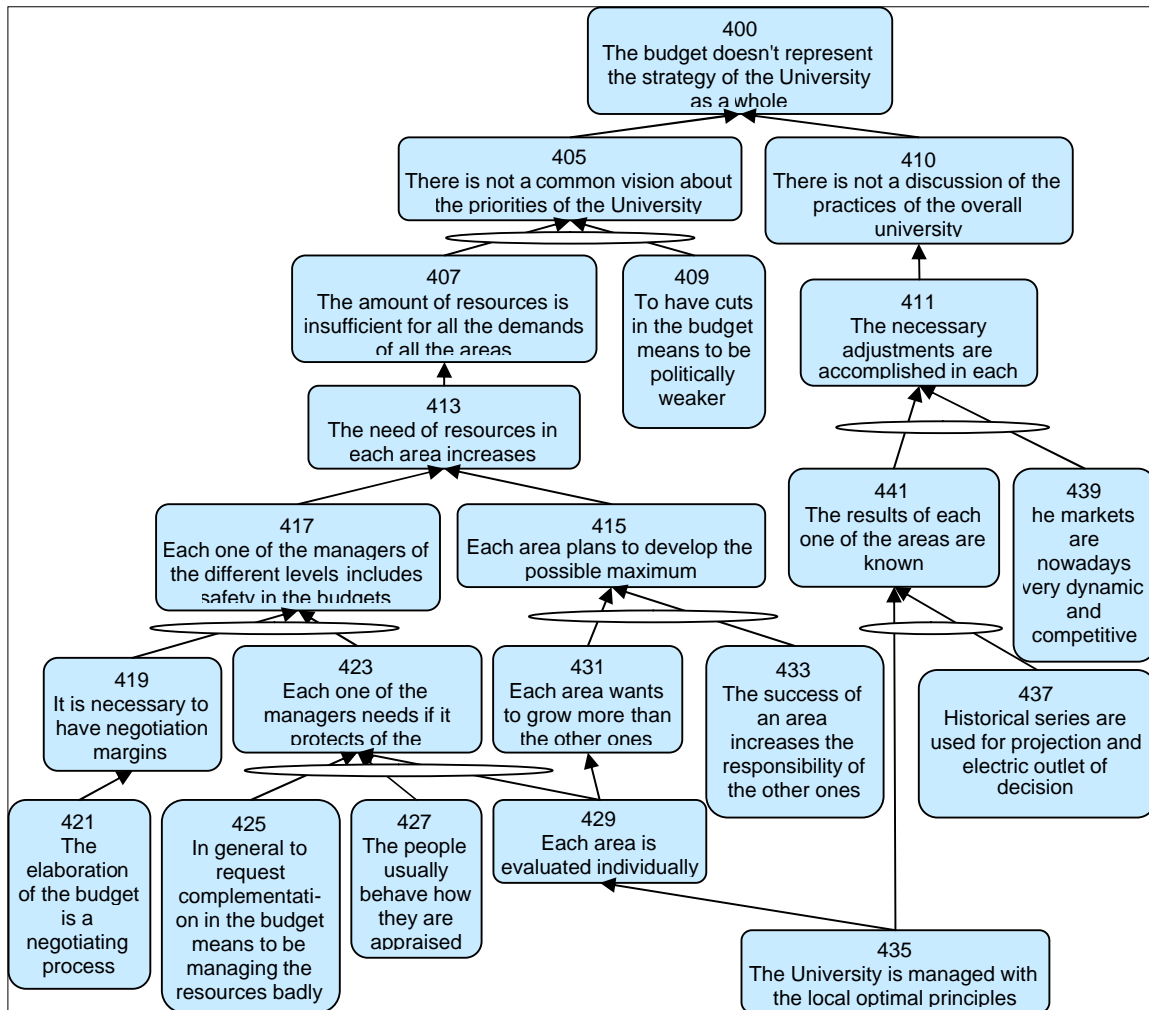


Figure 5 – Budget Elaboration Process (AS-IS).

Font: The authors

One relevant aspect to be considered is that budget is extrapolative starting from the previous series. Although corrections in the previous data are made based on the new market, an important process does not occur: the discussion of the institution and its practices in the past and in the future. The lack of this discussion leads to an environment of fragmented view of the business that stimulates the internal competition between the areas and management.

4.2 Clouds evaporation

Through the Current Reality Tree it was identified that the main problem was that the budget does not represent the strategy of the institution. In an investigation process with managers that seeks to identify the reasons why the budget does not reflect the strategy of the institution, it was verified that the institution is managed with the local improvements principles. Each department seeks the best result for itself, independently of the systemic effects for all the organizations. In this way the evaporating clouds diagram it was utilized (Figure 6) for identifying the presuppositions to sustain the main cause, seeking to bring one or more injections that can break mental blockades for a better solution. The objective was to find a solution that has no commitment, where each one of the parts gives up a little to find a consensus.

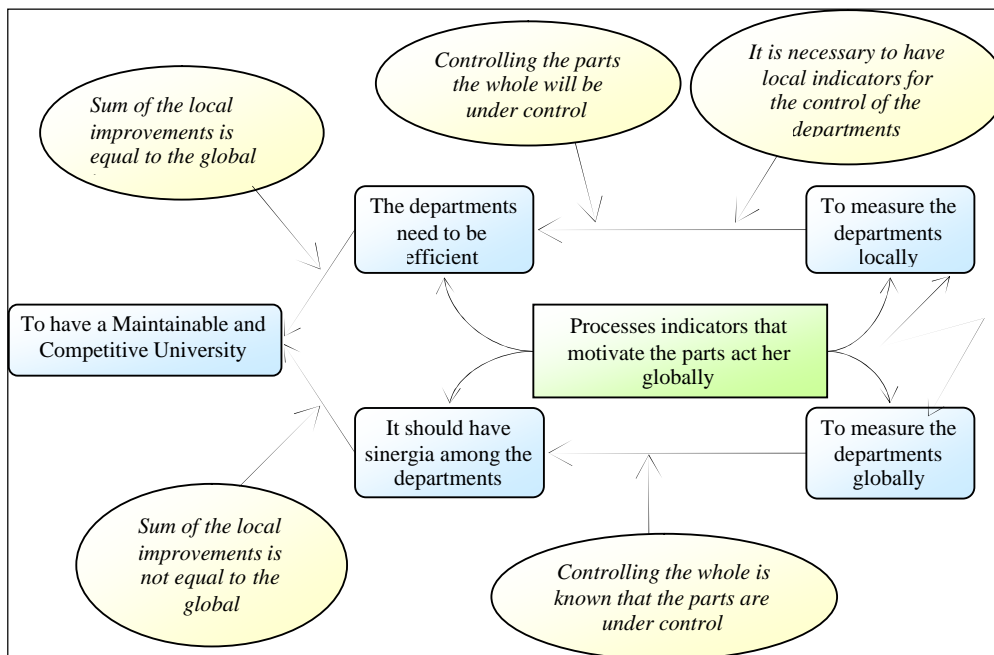


Figure 6 – Clouds evaporating diagram– Basic cause of the tree. Font: the authors

For occurring this it's necessary to establish the objective in common between two managerial views. In this way, the common objective is established: "Having a sustainable and competitive university". However, for obtaining this common objective there are two

ways: a) the departments need to be efficient; and b) it should have synergy between the departments. This antagonistic positioning is sustained for the presuppositions pointed out in the circles of the Figure 6. In one way, for attending the presuppositions of one way it's necessary to measure the departments in a local way, because controlling each one of the department and for each one to get a better level, the overall is going to the same direction and the ones that are not contributing can be suffering the corrective actions. For the other way, for achieving a better result, it's necessary to measure the overall in relation to the parts. According to this view the general results have more importance than the local performance.

For dealing with this problem, the injection for creating indicators related to processes that motivates the parts to act globally was presented, in a way that all the departments works for the overall. In this sense, there is collaboration for the results that are best for all, because of the sustainability of the overall and the survival of the parts. Seeking to contribute for the systemic improvement of the organization, the processes are redesigned and the indicators are aligned to the injection. The propositions are presented in the sequence of the work.

4.3. The Proposition of the Budget Process Redesigned (TO-BE)

A redesigned process proposition is presented as following. This proposition is aligned with the injection mentioned.

4.3.1 Budget Elaboration Process Redesigned - (TO-BE)

The Budget Elaboration is a result of a projection and a financial and economic analysis of the university. In this sense it seeks to express in numbers the strategic options for the university as a whole and for the set of products. In this way, the subprocess begins with the analysis of the set of products and the demand estimations, at the same time that

consolidates the revenues of the different university programs and consolidates the variable costs that refers directly to those products. In this way the Total Gain of the University is obtained.

Having this information from the information system, it totalizes the operational expenses and realizes the behavior of those expenses as the improvements propositions for maximizing the benefits with the expenses of those resources. From the subprocess of the Investments Plans the investments it gets the budget of the university for the next period. Since that it should be realized the consolidation of the overall result of the university considering revenues, gains, operational expenses and investments. In this moment that the budget is almost finalized the administration of the university must realize an analysis of the alignment between the budget and the strategy.

Once the budget expresses the university strategies, the goals of gains, operational expenses and returns of the investments are finalized. The budget is approved in the university council and the data is put in the system to control the budgeted versus the realized and to check if the goals are met. In the opposite case three actions should be done: i) repositioning the operational expenses to sustain the strategy; ii) realigning the investment plans to the strategies; and iii) repositioning the products for sustaining the strategies. Figure 7 presents graphically this subprocess.

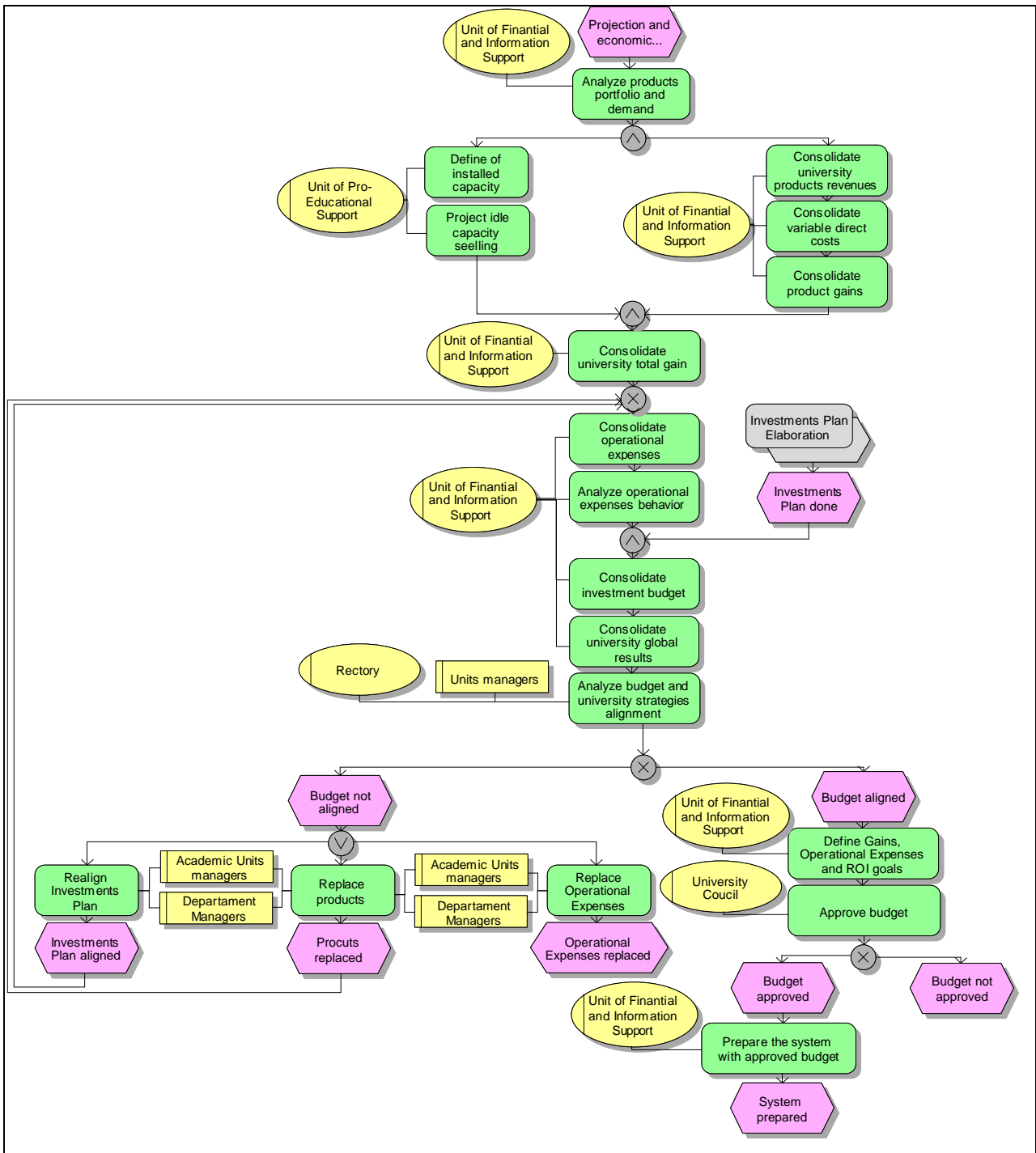


Figure 7 – Redesigned Budget Process (TO-BE). Font: The authors

4.3.2 Indicators – (TO-BE)

Seeking to provide an alternative not only in terms of processes but also in terms of indicators, the indicators proposed are described and since they are aligned to the redesigned process they enable a more general view, seeking for a global improvement for the organization.

a) Index of General Operational Expense Approximation: Through this index it's verified if the total operational expenses that was foreseen was effectively realized, and better, if it's reduced. In a systemic way, this indicator should be achieved to punish or award the parts. This indicator can be optimized for achieving the other two indicators of the subprocess Analysis and Financial Projection (Return of the Investments and General Liquid Profit). The estimated behavior is the minimum difference between the foreseen and the realized or, if it's the case, the reduction of the effective operational expense in relation to the one that was projected.

$$\text{Index of General Operational Expense Approximation} = \frac{\text{Operational Expenses Realized}}{\text{Operational Expenses Estimated}}$$

Equation 5 – Índice de Efetivação da Despesa Operacional. Font: the authors

b) Index of University Total Gain Approximation:

This indicator aims to make diverse areas interacting in the university to achieve the gain goal of the university. This occurs through the comparison between the university gain that was established for the period and the one that effectively occurred. Since some one is accompanying the global level of this indicator, the interaction among the parts are practically obligated.

In what refers to Marketing, there will be a pressure for the forecasts to be the as accurate as possible. In what refers to managers it should have an interaction for a grater selling and

consequently the generation of more gains to the overall. Another way is that parts can look for improving the variable costs in a way that the total gain of the university goal is achieved. It hopes that this indicator is as close as possible to the planned one or it's superior of the foreseen indicator.

$$\text{Index of University Total Gain Approximation} = \frac{\sum_{i=1}^n \text{Price}_i - \text{Variable Costs}_i}{\text{Throughput University Projected}}$$

Equation 6 – Index of University Total Gain Approximation. Font: the authors

c) Index of University Total Net Profit Approximation:

The same way as the previous indicator, this indicator aims to award or punish the university managers in what refers to the achievement of the total net profit that is necessary to the survival of the university. It hopes that this indicator is as close as possible to the planned one or it's superior of the foreseen indicator.

$$\text{Index of University Total Net Profit Approximation} = \frac{(\sum_{i=1}^n \text{Throughput Product}_i) - \text{Operational Expenses University}}{\text{Total Net Profit Estimated}}$$

Equation 7 - Index of University Total Liquid Profit Approximation.

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d) Index of General Return of investments Approximation

This indicator verifies the expected return on the realized investments. In this way, the effective returns are checked in financial terms, in an aligned way to the other indicators. The managers will be evaluated according to the achievement of the overall index. It hopes that this indicator is as close as possible to the planned one or it's superior of the foreseen indicator.

$\text{Index of General Return of Investments Approximation} = \frac{(\sum_{i=1}^n \text{Throughput Product}_i) - \text{Operational Expenses University}}{\text{Total Investments} / \text{Total Return of Investment Estimated}}$
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Equation 8 – Index of General Return of investments Approximation. Font: the authors

5. Conclusions

This work demonstrates a practical case of how the Process Engineering can be utilized for contributing to the Thinking Process of the Theory of Constraints. Using the concepts and techniques of the Process Engineering it was possible to systematize the Theory of Constraints approach for several areas and processes in the organization. By limitations of the space in this paper, there were presented only the results achieved by the analysis and redesigned of one subprocess of the institution.

The Process Engineering enables through the proposed approach the discussion through the diagnosis of the organizational problematic starting from the modeled processes. During the modeling processes phase, besides the description of the activities itself, it was verified a set of perceptions that make richer the construction of the Current Reality Tree.

Another relevant factor of the contribution of Process Engineering is that it enables the starting point for the construction of the trees. In the theoretical concepts of the Theory of the Constraints there is no indicative of how to start in order to build the Current Reality Tree. In this way, the process modeling made it possible through a bottom-up construction, starting from the undesirable effects of the day by day activities until the consolidation in an organization level, in an integrated way, through the processes.

In this specific case this enables the development of a systemic diagnosis of the processes in the economic-financial area through the Current Reality Tree, demonstrating the existing of a reduced number of the main causes that are responsible for the most quantity of the undesirable effects in the organization studied.

The management for the local improvements, motivated by the parts (units, departments, programs, etc.), that seeks for the individual maximizing gives undesirable consequences in a series of local actions, which can prejudice the global performance in the organization. Another relevant question is that the processes design and the current indicators can sustain a set of undesirable effects and since they are analyzed systematically they can be redesigned altering the effects in the organization. In this way, this work seeks to contribute for the construction of a link between the Process Engineering Approach and the Thinking Process of Theory of Constraints through the utilization of a set of procedures that came from those theories.

6. References

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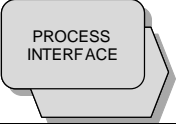




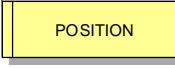
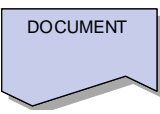
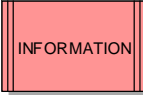
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7. Annexes

	Process Activity		Activities shooting or results of activities
	Process interface		"and": all the outputs are followed or all of the inputs are necessary
	"or": one or more ways can be followed		"or exclusively ": starting from this point, just one way is followed
	Organizational unit		Organizational Position
	Physical media that contains information		Any information in a system or a document

Font: adapted of (SCHEER, 1999).