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Strategic Planning: a model based on Systems Engineering

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Abstract*—This work has the main motivation to propose an approach based on Systems Engineering to expand the scope of Organizational Strategic Planning. The proposed method was idealized considering the approaches of Chiavenato & Sapiro (2003) and Loureiro (1999). It is considered that the proposed method was more adequate than the traditional models previously applied.*

***Keywords*—*Strategic planning, Strategy, Systems engineering*.**

I. INTRODUCTION

Traditional strategic, tactical, and operational planning processes focus on three types of stakeholders: the shareholders, customers, and competitors of the organization. In addition, the metrics derived from this process are hardly deployed to the abilities of the organization's individuals and groups. This work has as main motivation to attack these two opportunities, scope and depth, using a systemic approach to expand the scope of Strategic Planning and at the same time, it proposes to deepen the definition of organizational metrics towards the competence required of people.

In Strategic Planning, all strategies should go in a balanced way to meeting the strategic objectives. Strategic Planning shows a static picture of a future planned for the organization. Lacking Strategic Planning, however, tools to analyze the relationship between objectives and prospect the evolution of these objectives. These types of tools are the essence of Systems Engineering. The goal setting process is complex and dynamic. Organizations do not just pursue a goal, they need to satisfy a huge amount of requirements imposed on it by the environment and the different stakeholders. The objectives, too, are not static, as they are in continuous evolution, modifying the organization's relations with its environment. Thus, it is no exaggeration to say that organizations are rationally planned structures to achieve goals. In general, in Systems Engineering, the first step is to always identify the stakeholders of a particular system and what its needs are, and then draw up a list of specific requirements for the system. These system requirements resemble organizational goals. Thus, in System Engineering, the system functions and all its other physical characteristics are formatted to meet, in a balanced way, the requirements of the stakeholders.

Strategic Planning lacks the tools to shape strategies once the strategic objectives have been defined. In Systems Engineering, on the other hand, after establishing the requirements of the stakeholders, several functional and physical modeling tools are applied, in order to conceptually shape the product or system to be developed, as stated above. As both disciplines have important tools for analyzing and defining actions, the most appropriate ones can be used in each situation, thus making a broader approach to achieve the desired result. In fact, the concern should be with the concept and not with the tools themselves.

According to Stevens et al. (1998), Systems Engineering will define the future of modern business. This is because a good system engineering system represents a real advantage, enabling organizations to satisfy their stakeholders in a competitive way. And according to Chiavenato & Sapiro (2003), undoubtedly conquering new market spaces is the result of superior strategies. The chronicle of business clashes between companies is rich in fascinating examples of daring actions, cunning, strategic and systemic reasoning, and also dedication.

This paper aims to present a Systems Engineering approach for the elaboration of Organizational Strategic Planning. Systems Engineering is a collaborative multidisciplinary approach to derive, develop and verify a balanced solution / system throughout the life cycle to satisfy the expectations of stakeholders (Loureiro, 1999). Systems engineering is generally used for the development of complex products or systems. Strategic Planning is a process of formulating organizational strategies, in which the organization and its mission are sought in the environment in which the organization is operating (Chiavenato & Sapiro, 2003).

In this paper, we start from the premise that organizations are complex systems that can be evolved by Systems

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Engineering. Another premise is that the traditional Organizational Strategic Planning process does not include necessary aspects covered by Systems Engineering, such as the analysis of the needs and expectations of all stakeholders, the mapping of processes, the analysis of risks, the unfolding of objectives and goals , allocating them in the processes that generate them, in order to attend all stakeholders in a balanced way, among others.

II. LITERATURE REVIEW

2.1 STRATEGIC PLANNING

The term strategy, from the Greek word strátegos, was used to define a position (the general in command of an army), over time came to designate "the art of the general", meaning the application of the general's powers in the exercise of its function (military art). 450 BC, by the time of Pericles, the strategy designated managerial skills, leadership, oratory and power. By the time of Alexander the Great (330 BC), it meant the use of forces to defeat the enemy.

This shows that the concept of strategy has been applied in a scenario of war. The generals began to plan military actions before taking action. About 500 BC a book on the art of war was written by Sun Tzu, a Chinese general. In this book is portrayed the preparation of war plans, the variation of tactics, the army in march, the terrain, the strengths and weaknesses of the enemy, the organization of the army, among other important points.

According to McCraw (1998), the adaptation of the term military strategy to the business area began after the Industrial Revolution in the nineteenth century, when organizations began to use military concepts of strategy in their business operations.

There are many concepts of strategy, by different authors, let's look at some of them:

- Business Strategy means a pattern of objectives and key policies to achieve them, expressed in a way to define in what business the company is, or should be, and the type of company that it is or should be (Andrews, 1980).
- Business Strategy can be defined as the determination of a company's long-term goals and objectives and the adoption of courses of action and allocation of the resources needed to achieve those goals (Chandler, 1976).
- Business strategy means competitive advantage. The only goal of Strategic Planning is to enable the company to gain, in the most efficient way possible, a sustainable margin over its competitors. Corporate strategy means trying to change the power of a company over its competitors in the most effective way (Ohmae, 1982).
- Competitive strategy is, in essence, the development of a broad formula for how a company will compete, what its goals should be, and what policies are needed to achieve those goals (Porter, 1986).
- Business strategy is a comprehensive master plan that establishes how the organization will achieve its mission and objectives (Wheelen& Hunger, 1989 apud Chiavenato & Sapiro, 2003).
- Business strategy is the standard, or plan, that integrates the main goals, policies, and sequences of actions of an organization into a coherent whole (Quinn, 1992).
- Strategy is the means employed, the way forward, that the company chooses to achieve a goal, a goal (Valadares, 2002).

As for Strategic Planning, it can be defined as the continuous process of, systematically and with the greatest possible knowledge of the contained future, to make current decisions that involve risks; to systematically organize the activities necessary to implement these decisions and, through organized and systematic feedback, to measure the outcome of these decisions against the expectations fed (Drucker, 1984).

And yet, Strategic Planning is the managerial process of developing and maintaining a workable fit between an organization's goals, capabilities and resources, and the opportunities of a constantly changing market. The goal of Strategic Planning is to shape the business and products of a company so that they enable the desired profits and growth (Kotler, 2000).

Also, according to Chiavenato&Sapiro (2003), Strategic Planning is a process of formulating organizational strategies in which the organization seeks to insert its mission in the environment in which it is working. Strategic Planning is related to medium- and long-term strategic objectives that affect the direction or visibility of the organization. But, applied in isolation, it is insufficient, because we do not only work with immediate and operational actions: in the Strategic Planning process, all the strategic, tactical and operational plans of the organization must be elaborated in an integrated and articulated way. Planning should maximize results and minimize deficiencies, using principles of greater efficiency, effectiveness, and effectiveness. They are the main criteria of management. In short, strategy points the way. Strategic Planning tells you how to walk in it.

2.2 SYSTEMS ENGINEERING

A system is a set of interrelated components, which interact with one another, in an organized way, toward a common purpose. The components of a system can present themselves in various ways, being people, organizations, procedures, software, equipment, etc.

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Every system exists in a larger supersystem context (a collection of other systems, thus forming a supersystem). Managers of a super system define policies, set goals, determine constraints, and define the costs that are relevant. (NASA, 1995)

Similar to strategy, Systems Engineering also originated in a war scenario. According to Brill (1998), the origin of the discipline of Systems Engineering occurred in the late 1940s and early 1950s, with the junction between the theoretical foundations of systems science and the experience of World War II.

In the case of Systems Engineering, this is mainly used for the development of complex products, since its first use was for the development of missiles in the late 1950s.

It is also used in several sectors of the economy, but its great applicability in the aerospace and aeronautics industry is observed, as can be seen in the case of projects, integration and testing of satellites, aircraft projects, aerospace missions, among other applications.

Systems Engineering consists of two important disciplines: the domain of technical knowledge in which the engineering system operates and the management of Systems Engineering. In this case, the focus is the management of the engineering system.

In the case of Systems Engineering, it can be said that it is a robust system, designed to design, create and operate systems. In simple terms, it consists of identifying and quantifying system goals, creating alternative systems concepts, changing solution performance, selecting and implementing best solutions, verifying that the solution is properly built and integrated, and by post-implementation, ensuring how well the system achieves its goals. An engineering system is performed in line with a management system. The main role of an engineering system is to provide information that the management system needs to use to make the right decisions (NASA, 1995).

Three definitions are commonly used for Systems Engineering:

- A logical sequence of activities and decisions that transform operational needs into descriptions of system performance parameters and the preferred system configuration. (MIL-STD-499A, 1974)
- An interdisciplinary approach encompassing the technical effort to evolve and verify an integrated and balanced lifecycle solution in a people, product, and process-based system that meets customer needs. (EIA Standard / IS-632, 1994)
- A collaborative interdisciplinary approach that stems, evolves and verifies a balanced solution to the life cycle, in which it satisfies customer expectations and meets the public's acceptability. (IEEE P1220, 1994)

In short, Systems Engineering is a collaborative interdisciplinary and multidisciplinary approach to derive, evolve and verify a balanced solution / system, along the life cycle, that satisfies the expectations of stakeholders (Loureiro, 1999).

One of the goals of Systems Engineering is to show that the system is designed, built and operational, and that this system fulfills its purpose of cost effectiveness, in the best possible way, considering performance, cost, time and risk. The cost effectiveness of a system combines cost and effectiveness concepts in the context of its objectives. System engineering has some dilemmas (NASA, 1995):

- Reduce costs x keep risks: performance should be reduced.
- Reduce risks x keep costs: performance should be reduced.
- Reduce costs x maintain performance: greater risks should be accepted.
- Reduce risks x maintain performance: Greater costs must be accepted.

The process of Systems Engineering is the heart of the management of Systems Engineering. Its purpose is to provide a framework, with a flexible process, that transforms requirements into specifications, architectures and basic configurations. The discipline in this process provides control and traceability to develop solutions that meet customer needs (DSMC, 1983 apud Loureiro, 1999). The Systems Engineering process is a top-down, comprehensive, interactive, and recursive process of problem solving, applied sequentially through all stages of development, which is used for (DSMC, 1983 apud Loureiro, 1999):

- Transform needs and requirements into a set of product and process specifications (add value and more details at each level of development).
- Generate information for decision makers.
- Provide inputs to the next level of development.

The core of the Systems Engineering process consists of requirements analysis, functional analysis and development synthesis. All these activities are balanced by techniques and collective tools, called system analysis and control. Systems Engineering controls are used to track decisions and requirements, maintain technical bases, manage interfaces, manage risks, track costs and schedules/schedules, track technical performance, verify requirements are met, and review / audit progress (SMC , 2001 apud Loureiro, 1999).

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III. PROPOSED APPROACH TO STRATEGIC PLANNING

The scope of the proposed method for Organizational Strategic Planning presented here is based on the model of Loureiro (1999), representing the systems engineering tools, and the Chiavenato&Sapiro (2003) model, representing strategic planning activities.

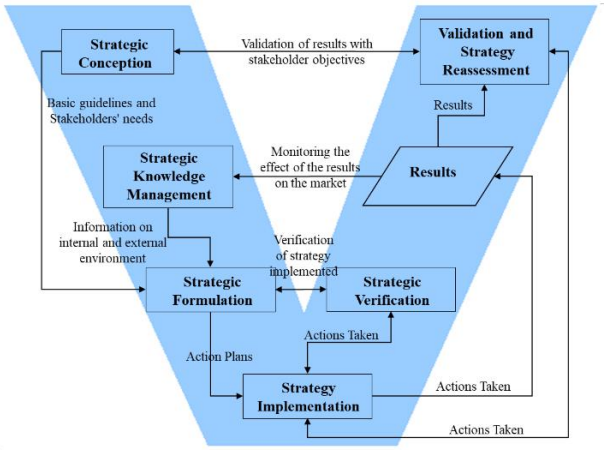

Fig.1: Generic model of the systems engineering approach for the organizational strategic planning

The left side of the "V" has as main product the definition of the strategy of the organization. On this side, the items of strategic design, strategic knowledge management and strategic formulation are allocated. Alluding to the PDCA Cycle, it is observed that this side is associated with the planning stage, which represents the idealization of the necessary actions, to make the company competitive. Alluding to the "V" of Systems Engineering, this is the side of systems architecture.

At the base of the "V" is the implementation of the strategy, which represents the execution and integration of the actions defined in the strategic formulation. The basis of the "V" represents the stage of execution of the PDCA cycle, in which the actions take place, properly speaking. The basis of the "V" is the construction of the system, in Systems Engineering.

On the right side of the "V" is the verification and validation of the strategy, which will evaluate if the planned actions are being executed and if they are producing the expected result. Also, it is at this stage that the actions of improvement are taken, in order to make feasible the defined actions or adequacy of the strategy, in face of the reality of the market. This side represents simultaneously the verification and improvement steps of the PDCA cycle. This side of the "V" represents the side of verification and testing in Systems Engineering.

The method aims to build a sustainable organization and consists of the steps in the flowchart shown in Table 1, according to Andrade (2008) and Andrade &Loureiro (2017).

Table.1: Summary Flowchart of Organizational Strategic Planning Steps

A SYSTEMS ENGINEERING APPROACH FOR STRATEGIC BUSINESS PLANNING, INTEGRATING PRODUCT, BUSINESS PROCESS AND ORGANIZATION	
Description	**Objective**
Identification of Stakeholder Needs and Expectations	Know the factors that contribute to add value to stakeholders
Strategic Design	Determine business, declare mission, design vision, identify values, define management policies and identify and map business processes.
Strategic Knowledge Management	Carry out external and internal diagnostics, construct and analyze scenarios and analyze risks from the above analyzes.
Establishment of Strategic Objectives	Analyze the results of steps 1, 2 and 3 and consolidate the strategic objectives, critical success factors and effect their unfolding.
Strategic Formulation	Based on item 4, elaborate strategies and strategic actions, through Brainstorming, 5W2H Action Plan and Skills Development Plan.
Strategy Implementation	Implement the strategic actions defined in the 5W2H Action Plan and Skills Development Plan.
Strategic Verification and Validation	To monitor the implementation of the strategic actions contained in the action plans, the progress of the strategies in relation to the objectives and their results. If you have not fulfilled the actions of the plan or the results diverge, propose actions to correct course using the DCA.

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Strategic reassessment	Evaluate the adherence of the implemented actions and their results and propose actions to correct the strategy or review the strategy, in face of the new needs of the external or internal environment.

It is worth remembering that people are often encountered when trying to formulate, implement or evaluate a strategy. People can be the competitive advantage, but they can also be the obstacle to their effective realization. This is because, when it comes to a strategy, its evaluation must cover from the stage of strategic intention, external and internal strategic knowledge management, strategic formulation to implementation of the strategy in terms of performance and execution as it is being placed in practice; but the final step almost always refers to the results that it can achieve. All this is done through people. You do not formulate or implement a strategy without people. They are the essential stakeholders in this task (Chiavenato & Sapiro, 2003).

IV. FINAL CONSIDERATIONS

In this work, a method was developed for Organizational Strategic Planning, based on a Systems Engineering approach, using reference models from both disciplines, as previously mentioned.

The method was applied in 3 organizations, being a steel industry, a business management consulting firm and a public organization with research in the aerospace sector. In these situations, the method was more adequate than the traditional models previously applied.

It is suggested for future work the development of decision support systems to assist in the management of strategic knowledge, especially regarding external diagnosis and scenario construction.

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