THE BALANCED SCORECARD AS THE GUIDELINE FOR THE MANAGEMENT OF MECHANICAL ENGINEERING COURSES

Júlio Miranda Pureza
Universidade do Estado de Santa Catarina (UDESC), Joinville (SC), CEP 89223-100, CP 631.
pureza@joinville.udesc.br

Luiz Veriano O. Dalla Valentina
Universidade do Estado de Santa Catarina (UDESC), Joinville (SC), CEP 89223-100, CP 631.
dalla@joinville.udesc.br

Abstract. *Due to the dynamism of the current economic environment, management systems are being demanded to anticipate changes and identify alternative strategic actions. In this sense, the Balanced Scorecard model is very successful, providing a complete set of relations among the critical factors, that conduct to a logical and structured basis for the strategy of a firm.*
This situation also affects the engineering courses that need to respond to the demands of the community at the same rate of the changes in the environment. The Brazilian educational legislation has been already considered this aspect in the definition of the profile of the professional, as being capable to evolve and adapt himself to the environment, being creative and dominating new technologies and processes.
In order to satisfy these demands, there must be a change in the way the courses and the departments have been managed. Aspects like strategic planning, evaluation and the continuum improvement of the processes must be usual proceedings in these institutions. In this work, we present a model based in the Balanced Scorecard and we use it in the management of a mechanical engineering department at a public university, with graduation and post-graduation courses. It was possible to obtain the diagnostic and the strategic map of the department, which will be the guidelines of the strategy.

Keywords*: superior education, strategic planning, balanced scorecard*

1. Introduction

During the last decades, important changes have been observed in economy demanding a strategic vision of the business from the firms which anticipates any changes in order to avoid menaces and to make the most of opportunities. This situation affects the superior education system in the sense that it must form professionals able to respond to the demands of the society. On the other hand, it may be necessary for the university and the industry to be partners in research and extension programs. This partnership may help the maintenance of the educational system and the basic research, at the same time that the private partners become more competitive.

All this discussion reports to the necessity the university has to plan the actions, to evaluate its positions in terms of the environmental transformations and to control the interaction with the private organizations and the society. The departments and courses must develop a strategic culture and use modern administration tools in order to be updated with the new age demands.

Nowadays, small and large firms in any sector of the economy are conducting strategic planning systems that follow various models with different procedures, measures and decision criteria. We suggest a model, based in the Kaplan and Norton's balanced scorecard (2001), which may be applied to non-profitable or public organizations in the formulation of new strategies and that includes aspects like the social responsibility actions, production and supply chains and the point of view of the employees.

This model is used in the management of the mechanical engineering department of the Santa Catarina State University – UDESC. This department is responsible for the mechanical engineering graduation course, for the materials science and engineering master's degree program and for many research and extension projects. There are not many references about the strategic planning in public organizations, most models are dedicated to private industrial organizations and the adaptations seem unnatural. On the other hand, the structure of the model we use here is flexible, being applicable to profitable firms and public institutions, large and small organizations, with little adaptation in the way it is performed. It was possible to build the strategic diagnostic for the department and the strategic map that will be the guideline for the strategy.

The work is divided in three sections. The model is shortly presented in section two in order to base its application, in section three and in section four some final considerations are presented.

2. The modified balanced scorecard model

One of the main difficulties of the strategic planning is the absence of reliable information about the organization and its environment. For this reason, one of the basic elements of our model is the existence of three specific teams to be responsible for different aspects and stages of the cyclic process shown in figure 1.

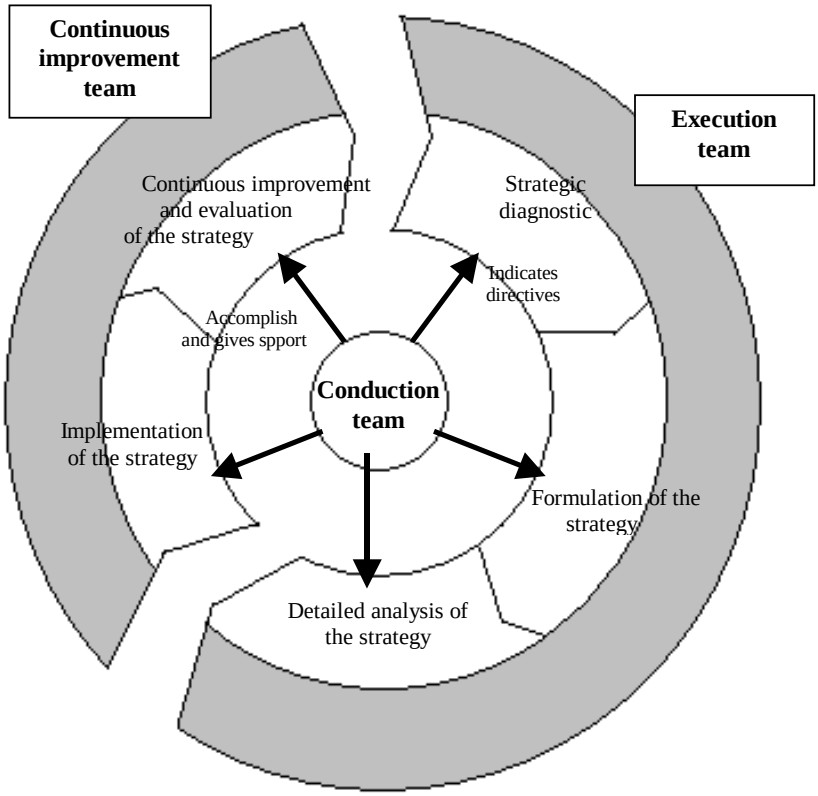

Figure 1 – The structure of the model in terms of the three teams that conduct the process

The first team comprises people from all sectors of the firm and is responsible for the management and continuous improvement of the processes. Its work reduces the possibility of conflicts and is a source of information at the formulation of the strategy. Moreover, a systematic process of substitution of its members favors the participation, commitment and empowerment of all employees.

Some high rank employees form the conduction team and represent the direction of the firm. This group defines the general lines of the plan and is responsible for the decisions to be made. The execution team does all operational work and is formed by some members of the management and continuous improvement team. They collect information about the internal and external environments, make any necessary analysis and detail the actions to be performed.

The constitution of the teams is a fundamental aspect for the identification and for the solution of the strategic dilemmas: the conduction team guarantees the necessary commitment of the board of directors with the strategy. The other two groups represent the technical support to the project. It is important to involve the other employees, by realizing area meetings and presentations, when their participation will be stimulated by identifying present and potential problems and helping the execution team in the operational work.

Likewise the original Balanced Scorecard (Kaplan and Norton, 2001 and 2004), our model identifies a set of four perspectives as the guideline for the strategic decisions. These perspectives are related in such a way that a chain of cause and effect relationships links them and builds the strategy, as shown in figure 2.

The first perspective represents the point of view of the group that will be the ultimate responsible for any strategic decision, from now on denominated powerholders, no matter it is a private enterprise, a non-profitable or a public organization. The second perspective, the customers' point of view, represents their expectations and the tendencies of the market. The third perspective considers all processes that aggregate value to the products and services, inside or outside the firm. This approach assures the inclusion of the production and supply chains and the social responsibility actions. At last, the resources' perspective considers both tangible and intangible assets and measures the capacity to

develop a given strategy. It includes the financial resources, the organizational culture, the information system, the employees' capabilities and the image of the firm.

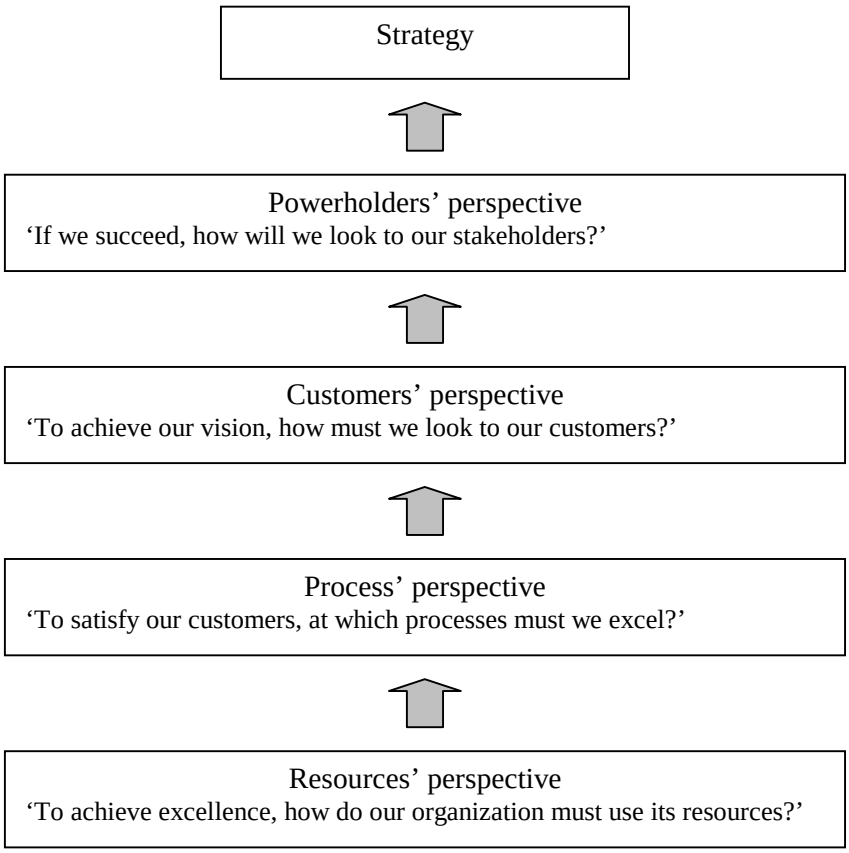

Figure 2 – The four perspectives of the model

Thus, the powerholders' and customers' perspectives represent the expectations that will conduct the definition of the strategy. By analyzing the first perspective, one can identify the interference of the society and the employees, since the improvement of the external and internal images of the firm is an important objective for any modern administration.

The choice of a strategy depends on the present business structure and on the changes that must be made. Thus, the processes' perspective indicates the path to be followed in order to satisfy the clients and powerholders' expectations. Finally, the fourth perspective identifies the dependence between these changes and the resources that are available and will be necessary further on.

Our model allows the construction of a strategic map that identifies the connections between representative elements and the set of performance indicators. Moreover, it naturally includes aspects like the social responsibility actions, production and supply chains, non-profitable or public organizations and the point of view of the employees. It is done without increasing the number of perspectives or complexity, but maintaining the consistency of the relationship of causes and effects that associate its perspectives.

As shown in figure 1, the strategic planning is a cyclic and continuous improvement process with the following steps:

- Definition of the teams that will formulate the strategy;
- Construction of the strategic diagnostic;
- Formulation of the strategy;
- Detailed analysis of the strategy;
- Implementation of the plan;
- Evaluation of the results and corrective actions.

The strategic diagnostic corresponds to a discussion about the firm in terms of the expectations of the future. It is considered how the powerholders see the business and what their vision of the future is. However, the achievement of the mission and vision of the firm depends on an adjustment of the processes on the demands of the markets, satisfying

the constraints imposed by the resources and the culture of the organization. This adjustment brings the other three perspectives of the model to the analysis, as shown in figure 3.

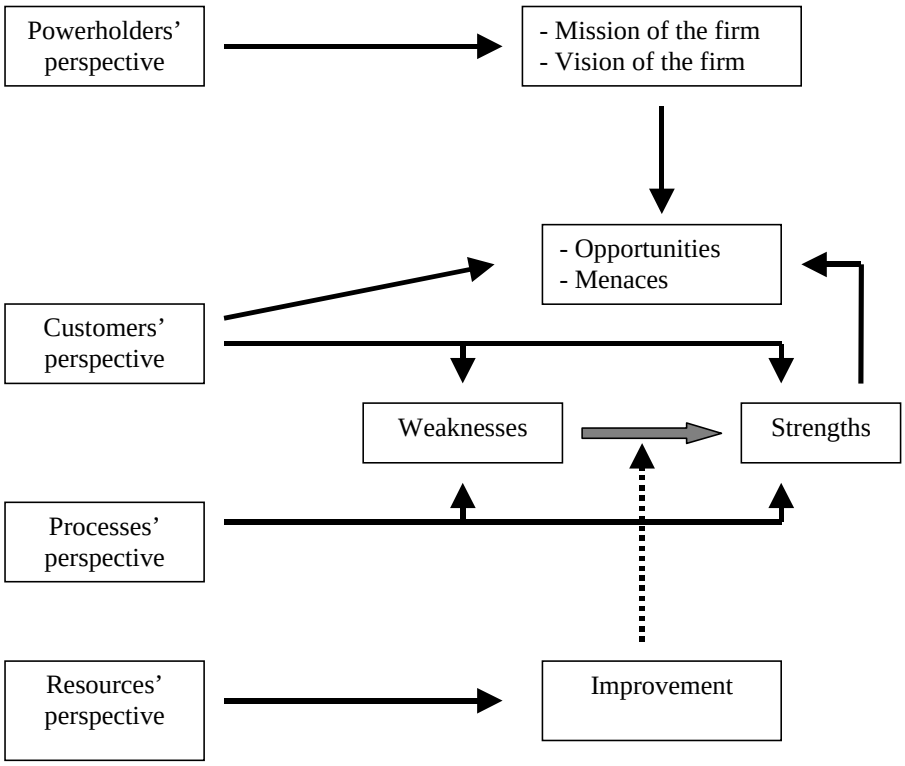

Figure 3 – The strategic diagnostic and the perspectives of the model

This stage begins with an appreciation of the external environment and the organization. It is based on the work that was done by the continuous improvement team and on any other information given by the conduction team. All this material is analyzed according to various criteria, such as alternative scenarios, competitive environment analysis, growth-share matrix, functional analysis or value-chain approach (Ansoff, 1977, BCG, 1980 and Porter, 1986). It allows the identification of the opportunities, menaces, strengths and weaknesses, completing the strategic panorama in figure 3.

This work is done through a series of meetings of the execution team through the application of the Delphi method (Linstone and Turoff, 1975). It is requested to each member of the group to enumerate the principal aspects of the strategic panorama, filling the table in figure 4, that resembles the SWOT matrix (Mintzberg, Ahlstrand and Lampel, 1998). The general result is presented and analyzed by the group and the scoreboard is filled again. The process continues until the opinions of the members converge. The conclusions are then presented to the conduction group so that they make contributions to the work.

At this point, the strategic panorama allows the identification of alternative strategies to be taken. The execution team identifies these possibilities and eventually details them. Then, the conduction team performs the choice of a strategy among all possibilities, while the execution team obtains any necessary information and evaluates the results of the decisions at the tactic and operational levels. In the same way, the Delphi method (Linstone and Turoff, 1975) can be used, when each member of the team independently chooses and defends the actions to be included in the plan. According to Ansoff (1977), this analysis may consider:

- Attractiveness versus competition in target markets;
- Short term versus long term results;
- Risk analysis;
- Competences versus human and physical resources;
- Synergy with the present situation.

At the next stage, the execution team details the strategy. It begins with a rigorous evaluation of the demands, not only physical, but in terms of the capabilities to be dominated by the employees, the functional structure and the management of information. All these needs will demand amounts of investment from the firm along the years to come. With all this information, the conduction group establishes a priority criterion that will determine the schedule for the actions to be realized and the corresponding strategic map (Kaplan and Norton, 2004). Moreover, any performance indicator may be associated with a link in the strategic map and identifies a cause and effect relationship between two

elements of the strategy (Kaplan and Norton, 2004). In these terms, the execution team defines a convenient set of performance indicators to be used in the evaluation of the plan. It can be done by the use of affinity groups and causal loops evolving the elements of the strategic map (Haraldsson, 2004).

<table>
<tr><td colspan="2">Mission of the firm:</td><td>Vision of the firm:</td></tr>
<tr><td>Opportunities:</td><td rowspan="2">Relations among the six elements of the strategy.</td><td>Strengths:</td></tr>
<tr><td>Menaces:</td><td>Weaknesses:</td></tr>
</table>

Figure 4 – The strategic panorama

The continuous improvement team is responsible for next two stages that can be seen as a direct consequence of the work already performed. In fact, the success of these stages is closely related to the commitment of the employees and executives to the plan, and the structure of the teams that elaborate the strategy may help it.

The implementation of the plan starts by a series of meetings in all areas of the firm, when the plan and its objectives are presented. Then, a schedule is defined for each sector, with specific actions and quantitative targets to be performed.

After implementing the strategy, it comes the evaluation of the results and the corrective actions. It is a cyclic and continuous work that may identify the necessity of change in the way the strategic plan is performed. The performance indicators have an important role at this stage, identifying problems in the formulation of the strategy and non-predicted changes in the environment. Moreover, the periodic substitution of the members of the team is very important, in the sense that the evaluation process might be more reliable.

3. The model applied to a mechanical engineering department

In 2003, the Santa Catarina State University performed discussions in which the concepts of mission and vision of the institution were defined. However, this effort was not able to produce a strategic plan for the university that would guide the departments and courses. As a consequence, the Mechanical Engineering department indicated a commission to elaborate its individual strategic planning.

In terms of the model, this commission plays the role of the execution team while the conduction team is the department itself, in the sense that its faculties are responsible for the decisions to be made. On the other hand, the implementation and evaluation of the strategy will be responsibilities of the same commission that will assume the position of the continuous improvement team.

In terms of the perspectives of the model, the state government and the administration of the university represent the powerholders. In fact, all strategic decisions depend, in a certain amount, to their approval and support. The community plays the role of the customers, in the sense that the department and its courses must serve the community that supports it. Then, the scoreboard is completed by the inclusion of the processes' perspective and the resources' perspective. The last one includes tangible assets like equipments, laboratories and buildings, and non-tangible assets, which comprises competences, information and procedures, mainly identified with the faculties.

The work is divided in five stages:

- The first part comprises the definition of the methodology, the strategic diagnostic and the formulation of the strategy, performed by the execution team;
- At the second part, the execution team presents the results of the first part to the faculties. Then, all the work is analyzed in order to adjust it to the objectives of the group;
- The third part comprises a detailed analysis of the plan, to be performed by the execution team;
- At the fourth part, the execution team presents the work to the faculties for the analysis and adjustment;

- The fifth part comprises the implementation and the continuous evaluation stages.

At this moment, the execution team is initiating the third stage of the process. The strategic diagnostic considered an extended analysis in terms of alternative scenarios, competitive environment analysis, growth-share matrix and functional analysis. As a consequence, it was possible do construct the strategic panorama shown in figure 5.

<table>
<tr><td colspan="2">Mission:
To provide the resources for the formation of professionals capable to adapt themselves to the evolution of the environment and to interact with the society in research and extension.</td><td colspan="2">Vision:
The Mechanical Engineering Department will be a high level unit, integrated to the society with adequate human and physical resources.</td></tr>
<tr><td>Opportunities:
- Joinville's industrial park;
- Official programs that provide resources for research and education;
- Many department alumni working in Joinville.</td><td rowspan="2">Actions to perform:
- To Increase the physical space;
- To stimulate the research groups;
- To invest in critical laboratories;
- To implement the Mechanical Engineering master's degree program;
- To stimulate extension programs that may use the laboratories;
- To identify alternatives for the lack of technical staff;
- To implement a marketing and divulgation project;
- To increase the contact with the industries, in order to develop partnership projects.</td><td colspan="2">Strengths:
- Materials sciences and dimensional metrology laboratories;
- Natural gas project with SCgás and Petrobrás;
- Faculties qualification;
- Materials science and engineering master's degree program;
- Graduation course well evaluated by the government.
- Gratuity of the courses.</td></tr>
<tr><td>Menaces:
- Other superior education institutions, especially the Federal University of Santa Catarina;
- The expansion of the number of courses on UDESC reduces the resources invested in the traditional ones;
- Government salary policy.</td><td colspan="2">Weaknesses:
- Energy, projects and processes laboratories;
- Insufficient physical space;
- Library and computer environment;
- Deficiency on audiovisual facilities;
- Insufficient scientific production;
- Deficiency on didactical material and practices;
- Insufficient technical staff;
- Absence of a plan for the marketing of the department.</td></tr>
</table>

Figure 5 – Strategic diagnostic of the Mechanical Engineering department

The formulation of the strategy is the consequence of this panorama, in the sense that the suggestions at the center of the table indicate several objectives to pursue. Further discussions among the members of the execution team indicate two groups of objectives, shown in figures 6 and 7. The first one corresponds to a series of investments to be performed in order to eliminate physical deficiencies, while the second group identifies administrative actions and changes in the culture of the organization.

Objectives	Modernize the department administration	Reform and expand the physical space	Adequate the laboratories
Tasks	-Change the image of the department; -Implement an agile and participative administration.	- Obtain the resources.	- Obtain the resources.
Sub objectives	-Elaborate a visual identity for the department that associates it with the concepts of modernity, agility and competence; - Define a communication policy for the department to divulgate its activities and the image we pretend to develop; -Implement an administrative structure that stimulates the didactical, research and extension work.	- Elaborate a project for the physical space of the department that fits its future needs.	- Formulate a reliable and detailed diagnostic of the laboratories, in terms of the didactical, research and extension activities; - Formulate a project for the recuperation of the critical laboratories; - Identify opportunities for the use of the laboratories in partnership with the industries.

Figure 6 – The first group of objectives

Objectives	Increase the scientific production	Structure the didactical practices	Implement a Mechanical Engineering master's degree program
Tasks	-Structure and support the research groups; -Increase the number of articles in indexed publications; -Increase the amount of resources for research projects.	- Stimulate the didactical activities; - Increase the amount of activities in laboratories; - Increase the publication of didactical books;	- Evolve the faculties and the research groups in this project.
Sub objectives	-Implement a policy that stimulates the research groups; -Implement a policy that stimulates the indexed publication; -Actuate on the general administration to implement an adequate policy for the library and the computer environment.	- Implement a policy that stimulates the didactical activities.	- Identify the knowledge areas to form the basis of the course; - Formulate an adequate project for the course.

Figure 7 – The second group of objectives

At this moment, the plan is being detailed by the execution team with the definition of the strategic map, shown in figure 8. It is a graphic representation of the plan in terms of the perspectives, identifying relevant cause and effect relationships that will help in the definition of the performance indicators.

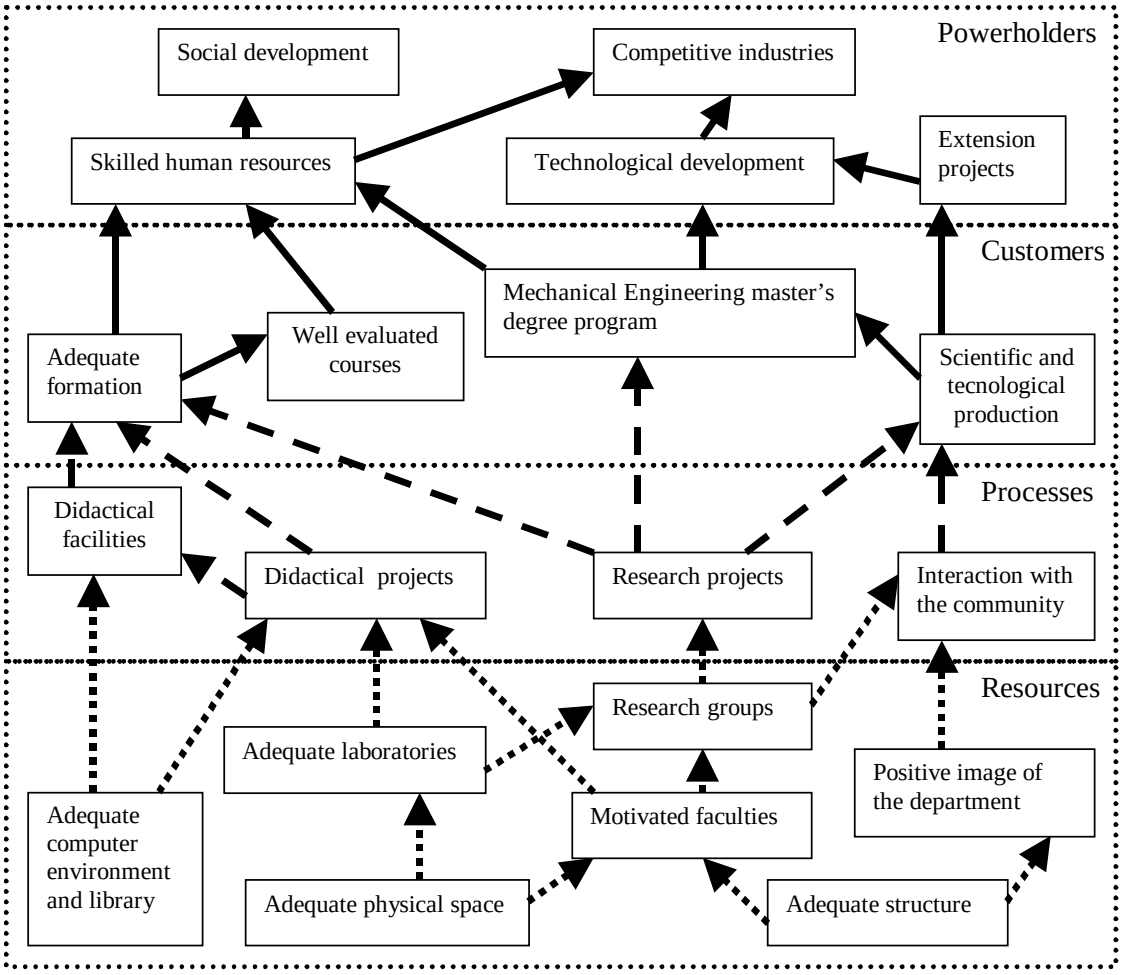

Figure 8 – The strategic plan

4. Final comments

The model presented here is based in the assumption that a set of perspectives is the guideline for any business and the knowledge of the connections among them is the basis for any victorious strategy. It innovates the literature in the sense that the set of perspectives suits different kinds of organizations. Also, it naturally includes aspects like the responsibility actions and its implementation favors the commitment of the employees and executives.

All these aspects facilitate the application of the model in an educational institution with little adjustment. As a result, the strategic plan of the department is being performed without external assistance. At this moment, the execution team is discussing the strategic map and the two groups of objectives in order to identify a set of performance indicators. Then, the results of the work will be presented to the department for the analysis. At the end, the department will indicate another commission to conduct the implementation of the plan.

5. References

Ansoff, H. I., "Strategic management", Macmillan Press, London, 1977.

BCG – Boston Consulting Group, "Les mécanismes fundamentaux de la competitivité", Hommes et Tecniques, 1980.

Haraldsson H. V., "Introduction to systems thinking and causal loop diagrams", Reports in Ecology and Environmental Engineering, Lund University, 2004.

Kaplan R. S. e Norton D. P., "The strategy-focused organization: How balanced scorecard companies thrive in the new business environment", Harvard business school press, 2001.

Kaplan R. S. e Norton D. P., "Strategy maps: Converting intangible assets into tangible outcomes", Harvard business school press, 2004.

Linstone, H. and Turoff M., "The Delphi method – techniques and applications", Addison Wesley, Reading, 1975.

Mintzberg H., Ahlstrand B. and Lampel J., "Strategy safari", Prentice Hall, London, 1998.

Porter, M. E., "Competitive strategy", Macmillan Press, London, 1986.

6. Responsibility notice

The authors, Júlio Miranda Pureza and Luiz Veriano O. Dalla Valentina are the only responsible for the printed material included in this paper.