LUIZ HENRIQUE RIBEIRO PICCINI

PROPOSAL OF STRATEGIC ACTIONS FOR AN UNDERGRADUATE PRODUCTION
ENGINEERING COURSE

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FICHA CATALOGRÁFICA

Para minha avó, que sempre me apoiou em tudo que fiz

ACKNOWLEDGEMENTS

Education is the mother of leadership

(Wendell Willkie)

ABSTRACT

This work analyzes the situation of the undergraduate production engineering course of *Escola Politécnica*, the Polytechnic School of São Paulo, and presents a set of strategic actions to improve it, addressing the issues detected and aiding the Production Engineering Department in achieving its objectives in an efficient and socially desirable way. Various examples of strategic planning in higher education institutions and many authors who specialize in the subject are studied, providing the basis for the course situation to be analyzed through Stakeholder Analysis and the analysis of Key Performance Indicators. Targets are created for these indicators, to guide the development of the strategic actions. Finally, a set of strategic actions is proposed, based on the needs of the course and the examples of other universities around the globe, along with implementation tactics and a timetable suggestion for each strategic action, as well as a prioritization analysis for them.

Keywords: Higher Education; Production Engineering; Engineering Teaching; Strategy; Strategic Planning.

RESUMO

Esse trabalho analisa a situação do curso de graduação em engenharia de produção da Escola Politécnica da Universidade de São Paulo e apresenta um conjunto de ações estratégicas para aprimorá-lo, abordando as dificuldades detectadas e auxiliando o Departamento de Engenharia de Produção a alcançar seus objetivos de uma forma eficiente e socialmente desejável. Vários exemplos de planejamento estratégico em instituições de ensino superior e diversos autores especializados no assunto são estudados, provendo a base para a situação do curso ser analisada através da análise de *stakeholders* e da análise de *Key Performance Indicators*. Metas são criadas para estes indicadores, para guiar o desenvolvimento das ações estratégicas. Finalmente, um conjunto de ações estratégicas é proposto, baseado nas necessidades do curso e nos exemplos de outras universidades ao redor do mundo, juntamente com táticas de implementação e uma sugestão de cronograma para cada ação estratégica, assim como uma análise de priorização para essas ações.

Palavras-Chave: Ensino Superior; Engenharia de Produção; Ensino de Engenharia; Estratégia; Planejamento Estratégico.

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LIST OF ABBREVIATIONS AND ACRONYMS

CAEP   Poli's Production Engineering Students' Union

Enade   National Evaluation of University Students Performance

HEI   Higher Education Institution

KPI   Key Performance Indicator

PEC   Poli's Production Engineering Course

Poli   *Escola Politécnica*, the Polytechnic School of São Paulo

Polito   *Politecnico di Torino*, the Polytechnic School of Turin

PRO   Poli's Department of Production Engineering

RUF   *Ranking Universitário Folha*

STEM   Science, Technology, Engineering and Mathematics

SWOT   Strengths, Weakness, Opportunities and Threats

UFRJ   Federal University of Rio de Janeiro

UFSC   Federal University of Santa Catarina

USP   *Universidade de São Paulo*, the University of São Paulo

SUMMARY

1 INTRODUCTION

The present work aims to analyze the strategic position of the Production Engineering undergraduate course of the Polytechnic School of the University of São Paulo, using Key Performance Indicators to evaluate its current situation and then proposes a set of strategic actions to improve it.

This introductory chapter will contextualize and explain the problem, outline the objectives for this work and briefly visit the structure of the next chapters.

1.1 Context and relevance

Brazilian public universities face a multitude of new challenges. First, the demand for Higher Education has been growing fast. This growth is fueled by the change of demographics in Brazil after the high birth rates in the decade of 1980, the rise in demand for highly skilled labor, the large number of people that ascended to the middle classes, the higher percentage of high school graduates and the federal government programs which facilitate the obtaining of scholarships and student loans (LERNER, 1999; TANEGUTI, 2013).

This rise in demand pushed for the opening of more courses and the acceptance of more students in the existing ones, but this was not accompanied by a corresponding rise in budget for the universities. In fact, many universities suffered budgets cuts. This, associated with rising labor costs and years of inapt management, led to financial crisis in many of them, including some of the biggest and most prestigious ones (DURHAM, 2014; PEREZ, 2014; TAKAHASHI; TUROLLO JR., 2015).

Another big challenge comes from a growing global competition. With more and more possibilities for studying abroad, many offered by the Brazilian government, associated with the facilities of travel and communication in the globalized world, the number of high achieving students trading Brazilian universities by foreign ones is increasing. Although it is still early to say if this "brain drain" will hurt the Brazilian economy, its effect on universities is already visible (DA SILVA, 2007; SANTOS JR., 2014; VALERY, 2009)

In this context, public universities are being required to justify their purpose for society, and to search efficient ways of achieving this purpose. The University of São Paulo (USP) is no exception to this.

1.2 Research motivation

USP is the biggest and most prestigious university of Brazil, having more than ninety-thousand students and accounting for a quarter of all Brazilian scientific production (CASTRO, 2005; "USP em números", 2013). The main focus of this work is the undergraduate course of Production Engineering of its Polytechnic School, or *Escola Politécnica* (Poli), which is the course attended by the author.

Although the Department of Production Engineering (PRO) has a high reputation and is acknowledged as a pioneer in production engineering education, having impactful results for the Brazilian society for more than fifty years, it is under the same kind of pressures as the University to improve its operations. As we will describe in the next chapters, it may take advantage of new tools and initiatives adapted to be applied on the context of a university department.

To deal with this matter, a performance measurement system was needed to understand its current condition. After that, actions to improve this condition could be proposed and implemented. The vice-president of the Undergraduate Course Coordinating Committee, Professor Eduardo de Senzi Zancul, suggested that students connected to a student´s research group called InovaLab@POLI developed their Thesis on the subject.

As such, André Bain proposed a set of Key Performance Indicators (KPIs) to evaluate the course (BAIN, 2015) and, in parallel, the author of this work analyzed these KPIs and proposed a set of strategic actions to improve the course, which was presented as a master thesis to the Politecnico di Torino in July 2015 (PICCINI, 2015). The present work is the continuation of that one, with further development and validation of the strategic actions to improve the course.

1.3 Objectives

The main objective of this work is to analyze the situation of the Production Engineering Course of the Polytechnic School of São Paulo and propose a set of strategic actions to address any issues detected, aiding the Production Engineering Department in achieving its objectives in an efficient and socially desirable way. To do that, the following steps must be taken:

i)   Analyze the current situation of the graduate course of Production Engineering of the Polytechnic School, using Strategic Management tools and Key Performance Indicators;

ii)   Define target values for the KPIs;

iii)   Define Strategic Actions to achieve these targets and improve the course's condition;

iv)   Present implementation strategies for these actions and the expected result;

v)   Submit this Strategic Actions to the Course Coordinating Committee;

vi)   Make the necessary adjustments to validate the actions and obtain the support of the Committee;

vii)   Propose a final set of actions and an implementation plan.

1.4 Chapter structure

This work is divided in six chapters, plus references and annex.

This first chapter, Introduction, contextualized and explained the problem, outlined the objectives for this work and explained the methodology employed.

The next chapter, Review of the literature, will look into key concepts of strategy, management and performance indicators and expose the theoretical basis of this work, by comparing different authors and studies. In addition, it will study the use of strategic management in public institutions and higher education institutions in general, while also presenting examples of strategic actions taken by other universities or proposed by the studied authors.

The third chapter, Methodology, will present the methodology employed to develop this work.

After that, the chapter Situational Analysis will use the tools introduced in the second chapter to evaluate the current situation of POLI's Production Engineering course, comparing it to other courses of POLI, to other Production Engineering courses in Brazil and to other selected universities in the world. Also, we will look at historical data to elicit trends and to better understand the factors underlining the situation.

This analysis will then be used in the next chapter, Strategic actions, to propose specific actions to be implemented in order to improve the course condition.

Finally, Conclusion and next steps will examine the findings of the work and its implications, and propose next steps to be taken towards the implementation of the Strategic Actions.

2   REVIEW OF THE LITERATURE

This chapter will look into key concepts of strategy, management and performance indicators and expose the theoretical basis of this work, by comparing different authors and studies. In addition, it will present examples of strategic actions taken by other universities or as suggested in the literature.

2.1 Key Performance Indicators

Peter Drucker is famously quoted as saying that *"If you can't measure it, you can't manage it."* (PATRINOS, 2014). Although there is some controversy around the actual author of this quote, it does summarize well the need for measurements in management science. Only by having relevant and correct performance measurements we can access what must be done and do it (WEBER; THOMAS, 2005).

Key Performance Indicators (KPIs) are a way of achieving this, using metrics to have a broad vision of every aspect of the company, in opposition to measuring only the financial performance. This is particularly useful to public institutions, as their main objective is not to seek profit, but to work towards the public good (BRIGNALL; MODELL, 2000; FRANCESCHINI; GALETTO; MAISANO, 2007; FRANCESCHINI; TURINA, 2013). However, the use of irrelevant or inaccurate KPIs could actually send the institution in the wrong direction. Thus, any set of KPIs should meet some requirements. Borges and Carvalho argue that the very name "Key Performance Indicators" already indicates the requirements of a good KPI (BAIN, 2015; BORGES; CARVALHO, 2011), as such:

- Key (K) – Main factors to determine the success or failure. Irrelevant or redundant indicators must not be taken into account, as the KPI objective is to help the managerial decision making, so the set must be simple and concise.
- Performance (P) – Indicators must be measurable, quantifiable and controllable. The metrics should be represented numerically, to compare them with past performance, other companies and with the company goals. Also, the company must have a way of influencing this metric in its favor, otherwise there is little benefit in measuring it.
- Indicator (I) – Elements should efficiently indicate the company's past and present status, showing its strengths and weaknesses and its evolution over time.

2.2 Balanced Scorecard

The balanced scorecard is a strategic measurement system introduced by professors Robert Kaplan and David Norton. These professors thought that most companies measured performance in a narrow way, only seeing it by the financial perspective. Hence, they proposed this system to offer a more balanced view of the company, by introducing three new perspectives – Customers, Internal business process and Learning and growth, as we can see on figure 2.1 below (KAPLAN; NORTON, 2007).

Figure 2.1 - Translating Vision and Strategy: Four Perspectives.
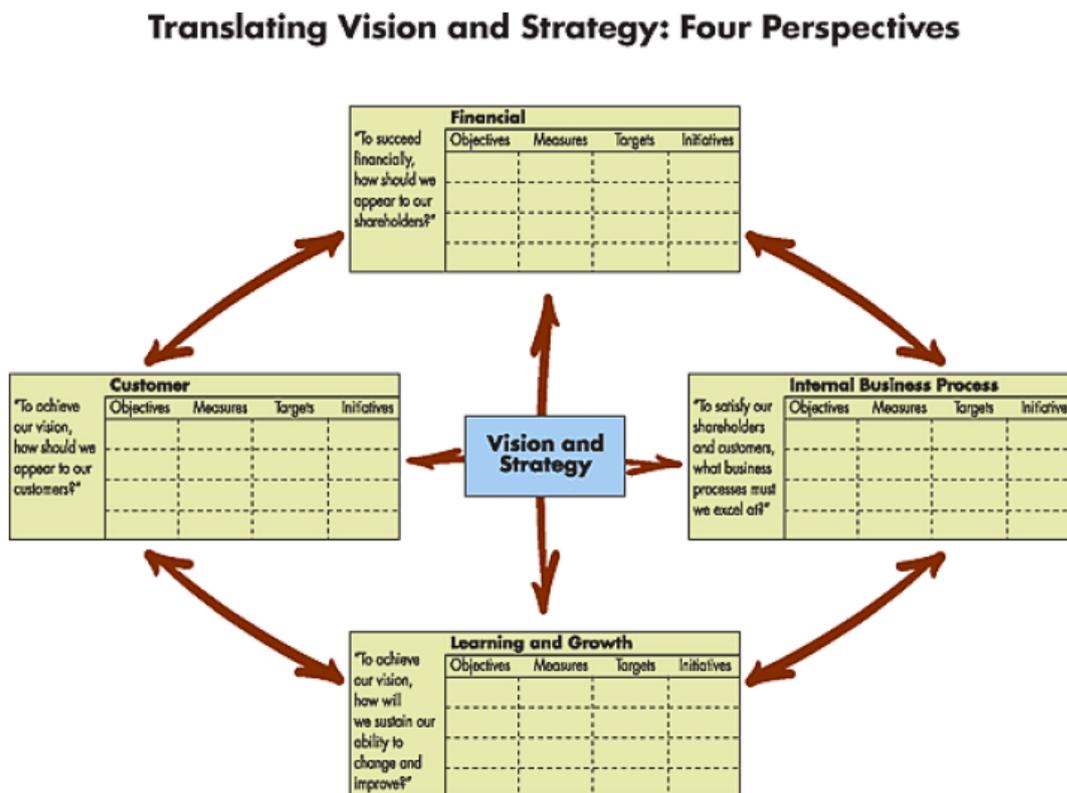
Source: (KAPLAN; NORTON, 2007)

- **Financial Perspective** is the traditional perspective by which companies evaluate performance, with indicators related to earnings, costs, return on investment, etc. It is important to notice that the authors criticize the use of this kind of indicators

when they are the only kind used, because they tell only a part of the history of the company.

- **Customer Perspective** encompasses indicators related to the customers and to how they see the company, its products and its services. KPIs in this perspective could include market share, customer satisfaction, customer loyalty, customer retention, average sale per client, etc.

- **Internal Business Process Perspective** looks at what processes are critical to the creation of value within the company and provide information to streamline production and maximize the value brought to the clients. Common indicators in this perspective are machine productivity, lead-time, employee downtime and percentage of defects.

- **Learning and Growth Perspective** measures what sustain the company in the long-term. Examples of indicators are capacitation of employees, infrastructure investments, research and development, employee turnover, employee satisfaction, etc. If the other perspectives tell how the company is acting today, this one is important to ensure the company has the capability to keep doing its activities in the future.

The image also shows the four dimensions of each perspective:

- **Objectives:** main objectives derived from the Vision and Strategy
- **Measures:** what will be measured to track this objective – the KPIs
- **Targets:** the desired value for the KPI
- **Initiatives:** what is to be done to achieve the targets and objectives

The system that will be used in this work was created by André Bain based on the Balanced Scorecard but with two adjustments. First, the Customer Perspective was changed to Stakeholder Perspective. As will be shown ahead, it is not always clear who is the customer in a Higher Education Institution, as many groups benefit from it, so the stakeholder approach should yield better results. He also added one perspective, the Social Responsibility

Perspective, as the São Paulo University is a public university and has a duty to contribute to society as a whole (BAIN, 2015).

2.3 Stakeholder Theory

Another important concept to be reviewed is that of a "Stakeholder". This concept appears for the first time in the 80s, in the book "Strategic Management: A Stakeholder Approach" (FREEMAN, 1984), and in a few years many managers and academics accept it and start to use it, to the point that by the middle of the 90s stakeholder theory was already a standard element in any management course (DONALDSON; PRESTON, 1995).

Stakeholder is a wordplay with "stockholder". Those who defend the Stakeholder approach claim that the traditional management techniques tend to focus too much on the stockholders, whose main concern is with profits, and often with short-term results, which may be harmful for the company in the long run (DONALDSON; PRESTON, 1995; MAINARDES; ALVES; RAPOSO, 2010). To avoid this, companies should broaden their perspective and pay attention to a greater number of interests when developing its strategy. A stakeholder may be "any group or individual who can affect or is affected by the achievement of the organization's objectives" (FREEMAN, 1984). The exact stakeholders and their level of importance for the organization varies between and inside industries, but common stakeholders are (CERTO; CERTO, 2005):

- Employees
- Customers
- Suppliers
- Community
- Creditors
- Government
- Stockholders (or owners)

For any decision to be successful, the right stakeholders must be considered and involved. This is increasingly important as the globalized world becomes more complex and

interests become more interconnected. This is particularly important for public organizations, as their stakeholders are more numerous (arguably the whole society). (BRYSON, 2004; NUTT, 2003). There are various methods to decide which groups or individuals should or should not be included in the analysis, and what are their degree of importance.

In summary, the procedure is to:

- come up with a list of stakeholders (through brainstorming, interviews or literature review);
- evaluate their power to influence the objectives of the institution and their interest in the achievement of these objectives;
- and elaborate a plan on how to deal with the shareholders, according to their importance (BJORKQUIST, 2009; BRYSON, 1988, 2004; MAINARDES; ALVES; RAPOSO, 2013, 2010).

2.3.1 Stakeholders in Higher Education Institutions

Stakeholder Theory can be particularly useful to Higher Education Institutions (HEI), as it is sometimes difficult to pinpoint the exact group benefiting from the education. Students are, of course, in the center of any analysis, although the exact treatment given to them varies. Depending on the HEI vison, students can be seen as customers; participants in the knowledge creation; or even recipients or "products", that will benefit companies and the society (BJORKQUIST, 2009).

Going back to the definition of stakeholder, "any group or individual who can affect or is affected by the achievement of the organization's objectives" (FREEMAN, 1984), we could fit a myriad of possible groups as stakeholder in an university. As we can see in table 2.1, different authors have suggested many different stakeholders.

Table 2.1 - Studies Defining Higher Education Institutional Stakeholders.

Research	Higher Education Institutional Stakeholders
Weaver (1976)	Government, institutional managers, teaching staff, consumers (students, their families, employers and society in general).
Smith and Cavusgil (1984)	Providers of financing and/or products and/or services, regulatory agencies, actors (such as the media and professional bodies that convey messages as to the university to both students and employers), student parents.
Conway, Mackay and Yorke (1994)	Primary – students, Secondary – paying entities, educational authorities, Tertiary – accreditation entities, former students, employees, parents.
Kotler and Fox (1995)	Foundations, former students, local community, the public in general, the mass media, potential students, registered students, supervisory bodies, student parents, managers and technical staff, teaching staff, university bodies, competitors, suppliers, business community and government entities.
Taylor and Reed (1995)	Teaching staff, education boards, university boards, competitors, suppliers, the business community, government agencies, foundations, former institutional members, the local community, the public in general, means of communication, potential students, current students, accreditation and supervisory institutions, student parents, managers and employees.
Sandison (1996)	Students or pupils, teaching staff, administrative personnel, service personnel, suppliers, parents, government, trade and industry and other teaching systems.
Rowley (1997a)	Students, parents and family, the local community, society, government, senior institutional management, local authorities, current and future employers.

Continues in the next page

Table 2.1 continued

Research	Higher Education Institutional Stakeholders
Reavill (1998)	Students and their families, employees and lecturers, suppliers of goods and services to the university, the secondary school sector, other universities, trade and industry, nation, government, local and national tax payers, the professional orders.
Macfarlane and Lomas (1999)	Students, employers, professional associations, the government, the academic community and society in general.
Duderstadt (2000)	Internal: students, teaching staff, employees, management bodies, External: government, local communities, the public in general, the media, politicians.
Rosenberg (2000)	Students, former students, student parents, employers, governmental bodies, professors, employees, the local community.
Costin (2001)	Graduate and post-graduate students, former students, recruiters, executives, accreditation agencies, university management bodies.
Tam (2001)	Students, employees, teaching and other staff, government and their financing agencies, accreditation providers, auditors and evaluators (including professional organisms).
Amaral and Magalhães (2002)	Students, parents, employers, state, society, higher education institutions themselves (in relation to the system).
Baldwin (2002)	Current and potential students, management and academic staff, employers, government, families, accreditation agencies, foundations, professional companies, the local community, society in general.
Watty (2003)	Government, quality agencies, individual academics, students, employers, the country and society in general.

Table 2.1 continued

Research	Higher Education Institutional Stakeholders
Zait (2006)	Middle school students (future university candidates), current university students, former students, university professors, employers and public opinion in general.
Giesecke (2007)	Ministry of education and accreditation authorities, main political parties, large nongovernmental organizations.
Pachuashvili (2007)	Students and their parents, colleagues, international institutions, donor organizations, academic oligarchy, religious groups, the business community, accreditation organisms, political parties and other interest groups.
Slantcheva (2007)	State authorities (accreditation agencies, government, legislators), professional and business groupings (trade unions and provincial councils, religious institutions), students (parents, role models), rival institutions, donors and foundations, international organizations and associations, the cultural framework (potential students, secondary school career guidance providers, students, parents, the media, neighbors, community).
Suspitsin (2007)	Students, employers, corporate sponsors, industrial and privately owned organizations, other educational organizations.
Blazey, Ashiabor and Janu (2008)	Students, teaching staff, employers, professional associations, former students.
Jongbloed, Enders and Salerno (2008)	Internally: students, employees, the research community and the management, Externally: the research community, former students, companies, social movements, consumer organizations, governments and professional associations.
Matlay (2009)	Internal stakeholders: students, teaching and research staff, administrators and the management, External stakeholders: parents, students and business persons as well as various representatives of companies, trade, professional entities, government and community.

Table 2.1 continued

Research	Higher Education Institutional Stakeholders
Nishimura and Okamuro (2009)	Companies, other universities, research institutes, incubators, financial institutions.

Source: adapted from (MAINARDES; ALVES; RAPOSO, 2013)

As we can see, there is a vast literature on the subject. Almost all authors in this list agree that students are stakeholders; only two of the twenty-five works exclude students. Eight works include former students, and five include even potential students as stakeholders. This was expected as "without students, there is no university" (MAINARDES; ALVES; RAPOSO, 2010). In addition, as expected, the students' families are also included, being mentioned in fourteen works.

The second most mentioned group is the government and its agencies, considered stakeholders by twenty authors. This can be explained by the large influence that the government has on the universities, by regulating the market and establishing guidelines to the courses (BJORKQUIST, 2009).

"Companies", "businesses" or "employers" appear in seventeen works, as they benefit from the human capital created in the university, and can influence it through donations and indirectly through the students. Thirteen works mention "society", "community" or "taxpayers", who both influence the universities by pressuring them (through the government and the media) and benefit from the higher level of education in the country or region. Finally, "Teaching staff", "academic staff" or "professors" are mentioned in twelve works, acknowledging the influence of professors in the university. Figure 2.2 summarizes the number of appearances of each stakeholder group in table 2.1.

Figure 2.2 - Number of appearances in the compilation of MAINARDES, ALVES and RAPOSO.

Number of appearences in the compilation of MAINARDES, ALVES and RAPOSO
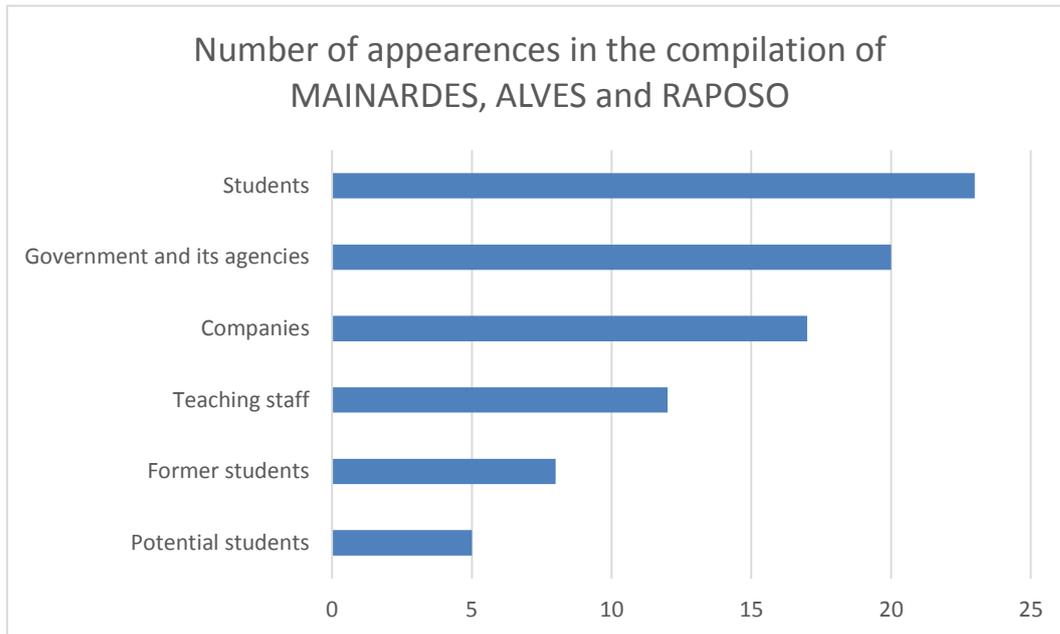
Source: author

2.4 Strategy

2.4.1 *Definition of Strategy*

"Strategy" is a concept that has been around for millennia, deeply identified with the military, where it means to maneuver troops and utilize resources in order to gain an advantage over the enemy. In fact, the word comes from the Greek "*strategos*", meaning "military commander or general"(LERNER, 1999). Today "strategy" is commonly used in the business world, where its exact definition is often a source of disagreement between authors. According to Mintzberg, people use strategy in several different ways (NICKOLS, 2012):

i) Strategy as a **plan**, a guideline explaining how to go from here to there.

ii) Strategy is a **pattern** in actions over time; that is, a consistent behavior in decision making, whether or not it is intentional

iii) Strategy is **position**; that is, means to locate an organization in an environment, by offering particular products or services in particular markets or in a particular way.

iv) Strategy is **perspective**, that is, vision and direction that is shared by members of an organization and guide their decisions.

Another useful definition is that "Business Strategy is the plans, choices and decisions used to guide a company to greater profitability and success" (KOURDI, 2015), which is a broad but concise definition, clarifying the objective of business strategy, but limiting it to profit.

The definition which will be used in most of this work, though, is that given by Michael Porter: "Strategy is the creation of a unique and valuable position, involving a different set of activities" (PORTER, 1996). This definition embraces all of Mintzberg's definitions by synthesizing them in the process of "creation". In addition, this definition is applicable to both profit and non-profit orientated organizations, by emphasizing **value**, which is a concept important to all organizations, even (perhaps mostly) public ones. All that without failing to be clear and concise.

2.4.2 Brief History of Strategic Management

It is useful to look at the development of the science of management to understand how the ideas that dominate the field today came to be. Strategy emerges among industrial firms during the Second Industrial Revolution (roughly between the decades of 1850 and 1870), as a way to control market forces and to shape the competitive environment. Historian Alfred D. Chandler Jr. has stated that during this time the "invisible hand" of Adam Smith's free market was tamed by what he called the "visible hand" of professional managers, who at that time had started designing more complex hierarchical structures and coordinating investments in manufacturing and marketing. (GHEMAWAT, 2002).

During the final decades of the 19th century and the first ones of the 20th, many firms started trying to implement management strategies to improve production effectiveness. The most famous example is Henry Ford, with the mass production in his company of the Model T car. However, it was only after the World War II that systematic and academic approaches to management appeared. During the 1950s, Peter Drucker, Philip Selznick, Alfred Chandler, Igor Ansoff, and Bruce Henderson, among other professors, economists and managers, defended the need to establish goals and objectives in order to point the organizations in the desired direction. In the subsequent decades, ever new ideas shared the attention of companies and academics, most notably the SWOT analysis in the 60s, and the Porter Five Forces in the 80s

(GHEMAWAT, 2002; LERNER, 1999). In order to better understand these fundamental ideas, it is important to briefly revisit them.

2.5 Strategic Management tools

2.5.1 *SWOT analysis*

SWOT stands for Strengths, Weaknesses, Opportunities and Threats. It is a structured method to evaluate the situation of a business or a specific project. Sometimes its elements are shown in a 2x2 matrix, as shown in figure 2.3.

Figure 2.3 - SWOT Analysis matrix.
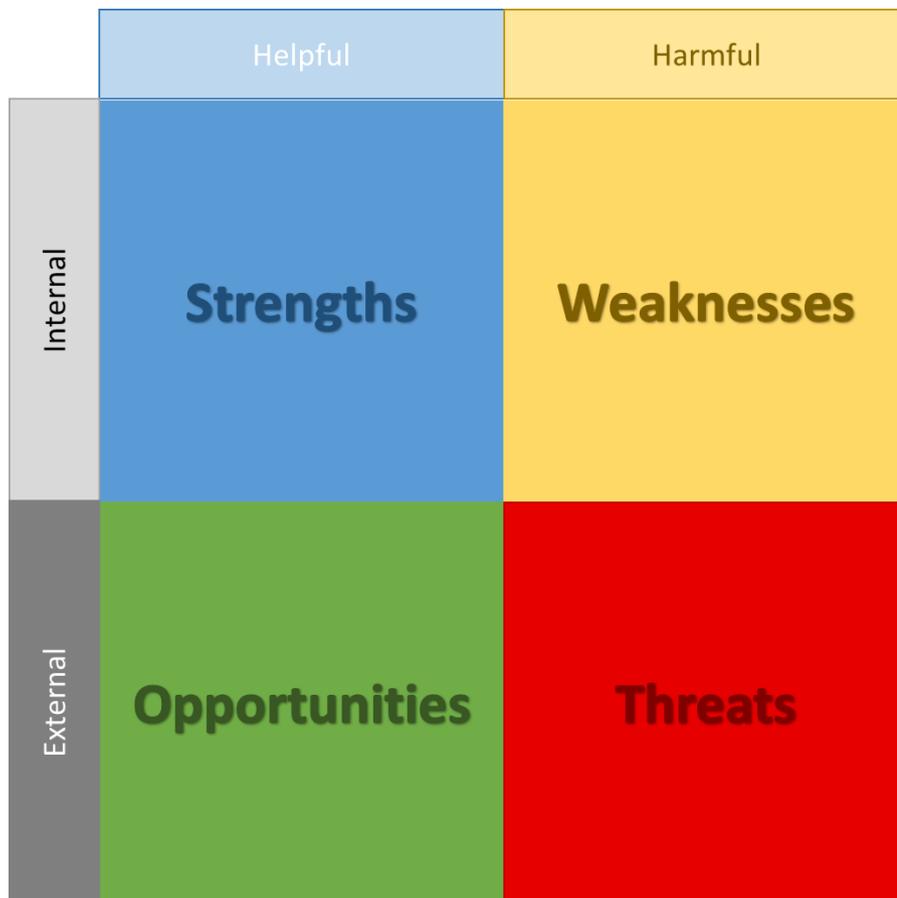
Source: author

This matrix is useful in understanding what the four elements of the analysis consists of:

- **Strengths** are internal characteristics of the business that are helpful (advantageous) for achieving its objectives, for example a university having good teachers and staff;
- **Weakness** are internal characteristics of the business that are harmful for achieving its objectives, for example a lack of financial resources;
- **Opportunities** are external factors that may favor the business, such as a government decision to give subsidies or an expected growth in the market;
- **Threats** are external factors that may hurt the business, such as increased regulation or the rise of new competitors.

The analysis of these factors will help build the strategy for the company by confronting Strengths/Weaknesses with Opportunities/Threats. Simply put, strategies may fall in four categories (BRADFORD; DUNCAN; TARCY, 2000):

- **Offensive S-O strategies**, when there are opportunities that may be seized using the company's strengths;
- **Defensive W-O strategies**, when weakness must be overcome in order to pursue opportunities;
- **Adjustment S-T strategies**, when external threats can be dealt with using the firm's strengths;
- **Survival W-T strategies**, when external factors threat the firm's weaknesses, and it may have to reevaluate its position.

2.5.2 *Porter five forces*

Porter five forces analysis is a framework to analyze the environment in which a firm is inserted and its attractiveness, by accessing how five forces act to drive the overall profitability up or down. The stronger this forces as defined here, the smaller the profitability. We represent the five forces as defined by Michael Porter (PORTER, 2008) in figure 2.4:

Figure 2.4 - The five forces that shape industry competition.
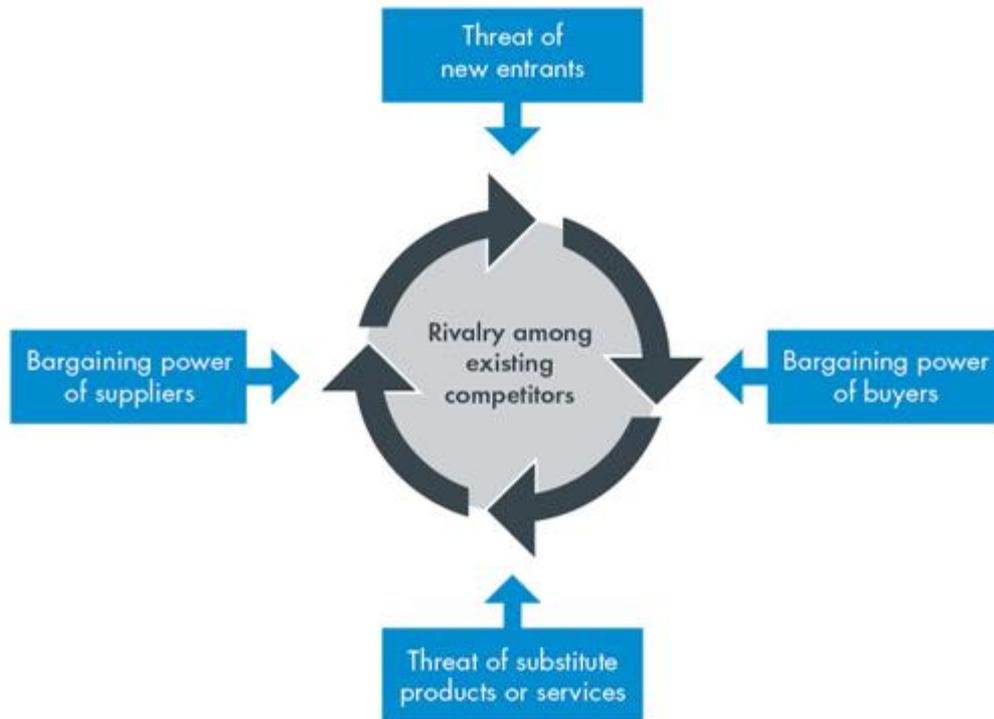
Source: adapted from Porter (2008)

- **Threat of new entrants** refers to the probability that new competitors might entry the industry, driving profitability low. High profitability will always attract new entrants, unless the incumbents or the very industry structure blocks this entrance. Usual barriers to entry include intellectual property rights (patents, copyrights, etc.), government policy, high capital requirements, economies of scale, switching costs and customer loyalty.

- **Threat of substitute products or services** relates to the existence of products or services that are not direct competitors to the ones offered by the firm, but may be perceived as a substitute by its consumers. For example, video conference as a substitute for travelling, movie downloads as a substitute for going to a movie theater, delivery food as a substitute for restaurants, etc. Potential factors for this force include perceived level of product differentiation, ease of substitution, switching costs, customers' price sensitivity and propensity to substitute.

- **Bargaining power of buyers** indicates how powerful customers can capture more value from the industry participants by demanding lower prices, better quality,

better conditions, etc. Factors for this force include buyer concentration, switching costs, price sensitivity, availability of substitutes, type of buyer (industrial or people, final buyer or intermediate) and availability of information.

- **Bargaining power of suppliers** relates to the other side of the coin, indicating how the suppliers may capture more value and drive down profitability by charging higher prices, limiting quality, passing on costs or offering worse conditions overall. Potential factors for this force include concentration of suppliers, price sensitivity for the industry participants, degree of differentiation of inputs, availability of inputs substitutes, competition for inputs with other industries (if various industries use steel, for instance, the supplier of steel might serve only the more profitable ones) and switching costs.

- **Rivalry among existing competitors**, the final force, relates to the many forms of competition in any industry, such as price competition, introduction of new products, advertising campaigns, suppliers or buyers exclusivity contracts, power over distribution channels, etc. Factors that determine rivalry include industry growth, number of participants in the industry, ratio between fixed and variable costs, existence of exit barriers, benefits for being the industry leader, degree of differentiation of the product and innovation rate in the industry.

The study of these forces will help the understanding of the industry structure, which can explain the current state of the industry and give basis to forecast its future. This information is crucial in developing a strategy, as it aids in positioning the company in the market, exploiting industry change and building an organizational structure suitable to maximize profitability in that industry.

2.6 The need for strategic planning in universities

Strategic Planning emerged in Higher Education Institutions (HEIs) during the turbulent times these organizations faced in the United States in the 1980s, when they faced financial, demographical, technical and social changes. At the same time, Strategic Planning was being used successfully in private and public organizations, and many HEIs decided to implement it,

to the point that 88% of American postsecondary institutions declared to be using some form of strategic planning in 1985 (GUANGKUAN, 2013; HINTON, 2012; KELLER, 1983).

In the three subsequent decades, the successful examples in the United States inspired institutions around the globe to develop strategic plans, and its benefits started to become clear. Alexandra Lerner summarizes well these benefits to universities (LERNER, 1999, p.4):

> *Strategic planning:*
> - *Creates a framework for determining the direction a university should take to achieve its desired future,*
> - *Provides a framework for achieving competitive advantage,*
> - *Allows all university constituencies to participate and work together towards accomplishing goals,*
> - *"Raises the vision of all key participants, encouraging them to reflect creatively on the strategic direction" of the university (Hax & Majluf, 1996, p. 32),*
> - *Allows the dialogue between the participants improving understanding of the organization's vision, and fostering a sense of ownership of the strategic plan, and belonging to the organization,*
> - *Aims to align the university with its environment,*
> - *Allows the university to set priorities.*

All these benefits can be reaped both by private and public institutions. And while private institutions may have more pressure to implement strategic planning as a mean to raise its profits, popular opinion and governmental directives can also exert pressure on public institutions (ESTRADA, 2001). However, as noted by John Bryson, public organizations can benefit immensely from strategic planning. He lists the following benefits of Strategic Planning (BRYSON, 1988, p. 78):

> *Government and non-profit organizations in the United States are finding that strategic planning can help them:*

- *Think strategically;*
- *Clarify future direction;*
- *Make today's decisions in light of their future consequences;*
- *Develop a coherent and defensible basis for decision making;*
- *Exercise maximum discretion in the areas under organizational control;*
- *Solve major organizational problems;*
- *Deal effectively with rapidly changing circumstances;*
- *Build teamwork and expertise.*

2.7 Developing a Strategic Plan for a HEI

Many authors have dedicated themselves to establishing a framework or guide to developing a strategic plan for a Higher Education Institutions. These frameworks are mostly based on already established business frameworks, with adaptations to better suit HEIs, needed by many reasons. First, universities are usually more resistant to change than the usual business, and even after accepting the change, are slower to implement it, as their structures are rigid and their activity takes time – a student takes years to graduate, so any change implemented on his first year may only become apparent years later. This is why the timeframe for the plan must be longer than it would be in other businesses (LERNER, 1999).

Moreover, universities – especially public ones – are less "top-down" than the usual business, as teaching faculty can hardly be "commanded" into accepting changes against their will, which means that the plan must have a larger support to be successful. This is even more important in public universities, where normally teachers have a safe and stable position, while the administration changes from time to time (LERNER, 1999).

Other differences between HEIs and the average business include stricter government regulation, a different value system, a more fluid concept of customers (as seen in the section about stakeholders), higher switching costs for students and employees, and higher barriers to entry and to exit (ESTRADA, 2001; GUANGKUAN, 2013; LERNER, 1999). With all that in mind, it is possible to list some of the most appropriate frameworks for strategic planning in HEIs.

Alexandra Lerner (LERNER, 1999) presents a structured model for strategic planning, reproduced in figure 2.5 below, which begins by identifying the HEI mission and vision. After that, a series of analyses are made in order to provide a context for developing the strategic issues. These analyses include an environmental scan (which may use the Five Forces of Porter and SWOT frameworks), a gap analysis and benchmarking. The next step is to determine the strategic issues that the organization has to address to achieve its mission and move towards its desired future, and create strategies to accomplish that. The author leaves room for "emergent strategies" to be developed as the organization gathers new knowledge or is faced with unforeseen events. These strategies should consist of strategic goals, action plans and tactics. Finally, the whole process must introduce strategic learning and thinking throughout the organization, and the plan must be reassessed on a regular basis to ensure it is still efficient in directing the organization.

Figure 2.5 - Strategic Planning Process Model according to Lerner.
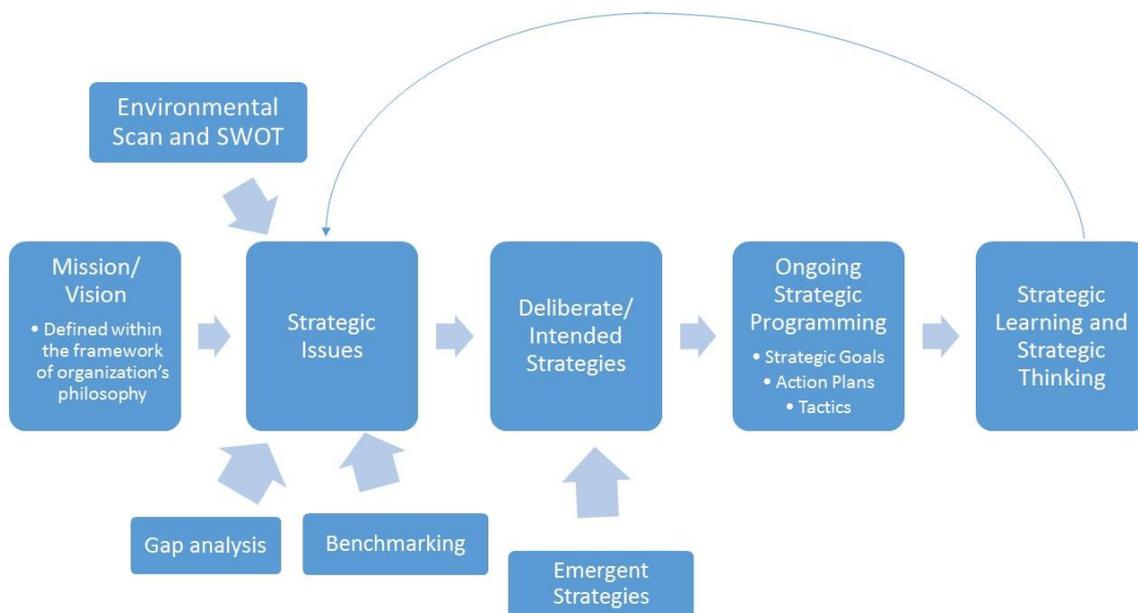
Source: adapted from (LERNER, 1999)

In "A Practical Guide to Strategic Planning in Higher Education" (HINTON, 2012), Karen Hinton explains thoroughly how to design and implement a strategic plan for a university. For this author, the components of a strategic plan can be divided in three groups: Foundation, Supporting Components and the actual Strategic Plan.

Foundation consists of the institutional mission statement, which should concisely delineate why the institution exists and what it intends to achieve.

Supporting Components are values, institutional goals and vision. The values are what the institution stands for and how they believe their activities should be conducted. Institutional goals are an optional component, which can further develop the mission statement, if the institution must accomplish a great number of things, this way the mission statement can stay concise without the information being left out of the plan. Finally, the vision statement should describe what the organization intends to become.

The actual Strategic Plan, for Hinton, consists of two things: Goals and Objectives, and the Implementation Plan. Goals and Objectives should present specific targets or milestones for the Strategic Plan. The author says that both words can be used almost interchangeably, as long as everyone involved in the plan knows which word is indicating what, but that usually "goal" denotes a target that can be reached and "checked off", while objective has a more general connotation. The Implementation Plan is what turns goals and objectives into a working plan, stablishing actions and tactics, and preferably identifying resources and time needed for each step towards the goals. These components are organized in figure 2.6 below.

Figure 2.6 - Components of a Strategic Plan according to Hinton.
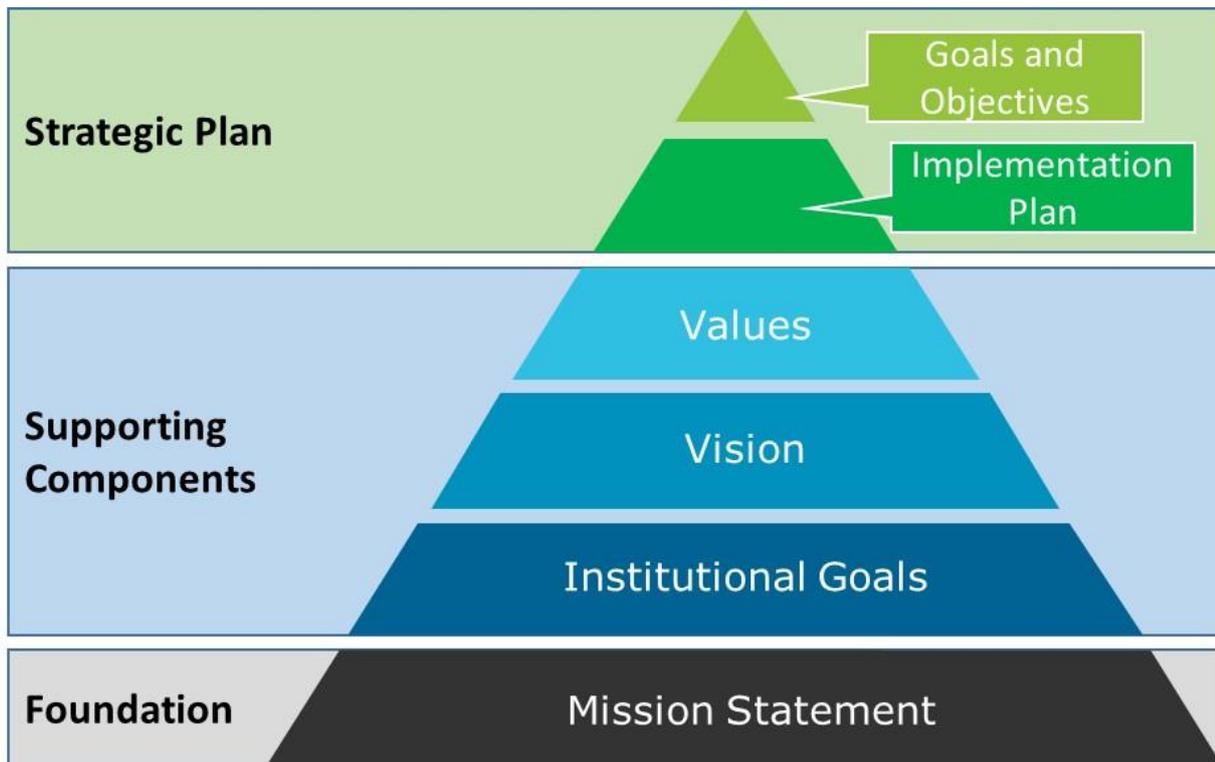
Source: adapted from (HINTON, 2012)

In the work "Strategic Planning in the University" (PARIS, 2003), Kathleen Paris presents a simple and easy-to-follow Strategic Planning Model. For her, the strategic planning process is recurrent, that is, it should be done on a yearly basis, with weekly, monthly or quarterly checks to identify deviations from the plan or opportunities to improve it. The Model starts with definition of the mission, operating principles and vision of the organization. These, together with a Situation Analysis, will provide the ground to name the Strategic Priorities of the institution. After that, the HEI can develop a One Year Action, Planning, Budgeting and Process Improvement, which will be Periodically Checked. At the end of the year, the whole process should be reexamined, and necessary changes can be done. The model is reproduced in figure 2.7 below.

Figure 2.7 - Strategic Planning Model according to Paris.
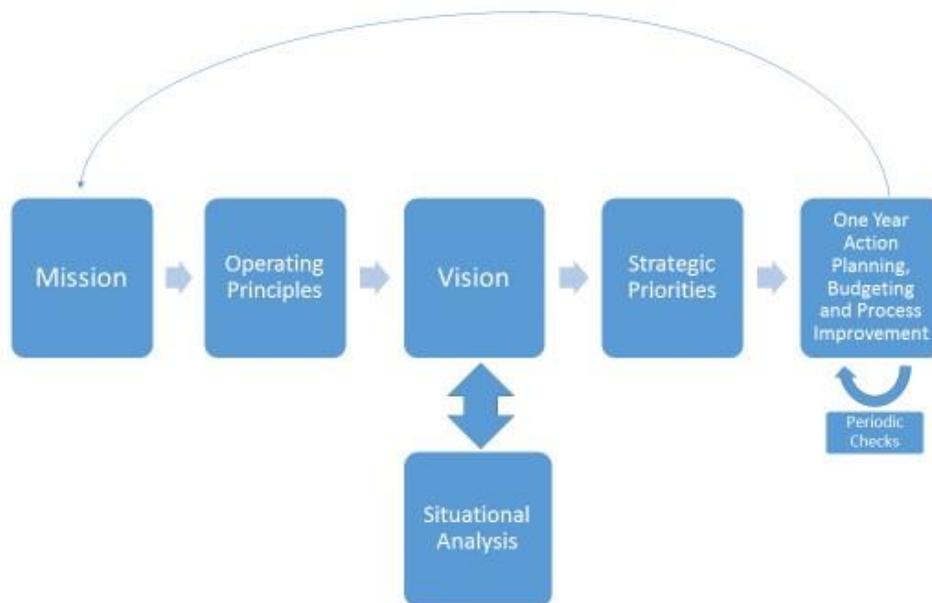
Source: adapted from (PARIS, 2003)

2.8 Elements of the Strategic Plan

This section will go over the literature concerning the elements of the strategic plan, which are the Mission, Values, Vision and Objectives.

2.8.1 *Mission*

The Mission Statement is the basis for any Strategic Plan. It must be a clear and concise definition of the purpose of the institution (HINTON, 2012). A study on 120 mission statements of HEIs in Brazil (BRAGA; MONTEIRO, 2005) listed some commonly found elements in those missions:

- Creation of knowledge
- Education of citizens
- Training of professionals
- Contribution to the improvement of life quality

- Commitment to democracy and citizenship
- Offering of community services
- Education of people able to transform society

The same study also compares mission statements across the world, with some interesting findings. For example, in the USA and in Europe most universities mention culture in their statements, while in Brazil this is rather uncommon. North-American and European mission statements are also said to be more detailed.

The authors go on to give good and bad examples of missions. They emphasize the importance of connecting the mission statement to the daily practices of the institution, giving examples of HEIs that have statements that do not reflect the way they conduce their activities.

2.8.2 *Values*

The values are the definition of what the institution stands for, and how it believes its activities should be conducted. It is important to transmit this values to students and professors, creating a culture based on them (HINTON, 2012). They do not need to have external justification, as they should have an intrinsic value, shared by all people in the organization. For example, ethics and citizenship are values that most HEIs considered worthy to be fostered by their intrinsic value, not for strategic reasons, even though they might fit the institution's strategy (COLLINS, 1996).

2.8.3 *Vision*

The Vision Statement is a clear definition of what the institution aspires to be. It shows what the "ideal" scenario of the organization is, what it wants to become (LERNER, 1999; PARIS, 2003). This is important to ensure that everyone in the organization is shares the same vision of the future and agrees to go in the same direction, aligning efforts and avoiding dissatisfaction and wasted effort (HINTON, 2012).

2.8.4 Objectives

Karen Hinton says that the words goals and objectives are many times used interchangeably. She notes, however, that the world "goal" has a more specific connotation, meaning an achievement that can be "checked off", while an objective gives a more general direction (HINTON, 2012). For the strategic planning model that will be developed in the "Methodology" chapter, the word "Objectives" was preferred, setting the general lines of what the course must aim to achieve. The quantitative side of goal setting was left to the specific KPI targets, which will be presented in the Situation Analysis chapter.

2.9 Elements of the Strategic Plan and Strategic Actions

This section will look at the literature used to understand some objectives of strategic planning in HEIs, as well as the development of strategic actions. Other universities in Brazil and abroad were studied to provide insights on the elements of the strategic actions. Among the various institutions studied, the ones that must be highlighted are the University of Ulster, University of Sheffield, University of Edinburgh, Cornell University, University of Oxford, Washington State University, State University of New Jersey and University of Michigan.

There were many ideas drawn from observing the strategy of these institutions and studying the literature on them. Four topics deserve a deeper review: Internationalization of the course, Academic Mentoring, Focus on Leadership and Gender Equality.

2.9.1 Internationalization of the course

In today's globalized world, many universities feel the need to attract students from other countries, and to proportionate to their students the experience of studying abroad. Jane Knight and Hans de Wit (KNIGHT; WIT, 1995) provide us with a spectacular description of the history of internationalization in universities, as well as the reasons to foster international exchange and how to do so. They split the reasons for internationalization in two groups: "Economic and Political Rationales" and "Cultural and Educational Rationales".

The first presented argument of the "Economic and Political Rationales" is that it has a positive effect on economic growth and it is an investment in the future economy. Student exchange brings foreign knowledge and technology to the country. In addition, foreign students that are educated in a country will become decision makers in their homelands in the future, and might be more prone to invest in a country that was receptive and friendly towards them in the past.

Another argument in this group is the labor market one. Foreign students can decide to stay in the country, adding highly skilled workers to the workforce. In addition, creating an international environment and sending your students abroad will help those getting used to intercultural situations, as well as learning other languages, both skills favored in the labor market.

The internationalization can also be part of the country's foreign policy, strengthening bonds with friendly nations and improving the country's image. This has been seen in the European Union's exchange programs, which helped the building of a unity sense among young people who went to study in other European countries. Finally, internationalization might be a solution for the country's higher education demand, if the country does not have the resources or the will to create this supply internally.

Moving on to the "Cultural and Educational Rationales", many universities believe that it is part of their mission to stimulate cultural development. To live with people of other nationalities is one of the best experiences in this sense. In addition, some countries have used exchange programs as a mean to propagate its nation's cultural and moral values. This is especially true for the United States and for France.

The second argument of this group is that of development of the individual. To know people of other backgrounds, to travel the world, to get in contact with different languages, ethnicities and cultures, all help this development, and promote values of tolerance.

Internationalization is also beneficial in the sense that it provides an international dimension to research and teaching, expanding the influence of the institution beyond its original borders.

This expansion is closely related to the next two arguments. Internationalization is important in "Institution-building", that is, schools that are known abroad enjoy more reputation

that the ones restricted to their region. This will also benefit their teachers and researchers, who will have better chances to expose their work to the world. Finally, international students will help the development of the school, bringing new ideas and challenges, and setting the bar higher for the quality of research and teaching.

2.9.2 Academic Mentoring

One action employed by many successful universities was the establishment of mentoring programs to improve student satisfaction and performance. Academic mentoring has been shown to improve both while also facilitating psychological adjustment to the university, creating a professional identity and promoting career success (EBY et al., 2008).

Katrina Macintosh lists the benefits of peer mentoring, that is, students mentoring other students, for both the mentor and the mentee (MACINTOSH et al., 2006, p. 8–9):

Benefits to the mentee include:
- *Facilitated transition into Higher Education;*
- *Enhanced relationships and student networking;*
- *Increased motivation due to a sense of belonging;*
- *Friendly support and encouragement;*
- *Academic study advice;*
- *Social integration; and*
- *Improved self-confidence.*

Benefits to the mentor include:
- *Development of leadership, management and support skills;*
- *CV enhancement;*
- *Increased employability;*
- *Personal satisfaction;*
- *Input into the university;*
- *Learning experience; and*
- *Dissemination of personal knowledge and skills.*

The same work presents examples of successful mentoring programs. The program proposed for the Production Engineering course of *Escola Politécnica* will be based mainly on the "Centrally Organized Student Mentoring" program of the University of Sheffield described there (MACINTOSH et al., 2006, p. 35–43), with some elements drawn from the University of Michigan program (UNIVERSITY OF MICHIGAN, 2015).

The University of Sheffield's program consists of training students of the second and third years who volunteer to be mentors. These students will be assigned a small group of two to four students of the first year, to help them with academic and social life problems, in order to help the transition to the university life. The program is reported as successful, with many mentees going on to become mentors in the following years and reporting good experiences in both roles. The main appointed benefit for the mentee is the easier transition into the university life, which in turn helps improving student retention. The mentors on the other had praise the program for helping them develop various social and professional skills.

The University of Michigan's program is also a centralized mentoring program, in which the mentee receives support from both a student and a faculty mentor. The student mentor assumes a role similar to that of the University of Sheffield's mentors, supporting the new students and welcoming them to the campus. The faculty mentor is a professor who oversees the mentorship relationship, helping the student mentor while also being a first contact of the mentee with the university staff. Therefore, the main difference in relation to Sheffield's program is that instead of receiving an intensive training before they start mentoring, the students are accompanied throughout the entire mentoring relationship, which lasts at least one semester and can be extended if the mentee and the mentor agree to do so.

2.9.3 Teaching leadership

As David Day notes, interest in leadership development has been growing fast in the last decades. Companies see leadership skills as a competitive advantage, and try to develop it in their employees, as well as look for it in candidates. As such, there is a pressure on universities to teach this kind of skill. (DAY, 2001)

And recent research concludes that leadership can be taught (WALCK, 1990). Of course, some people are born with a natural talent to be leaders, but those who are not can learn it and become even better leaders than those who have the talent but lack the training.

A multi-institutional study in the United States (DUGAN; KOMIVES, 2007) identified four main trends in the teaching of leadership: expansion of curricular and co-curricular leadership programs, focused theoretical and conceptual leadership models, professionalization in leadership education and leadership research. According to these authors, these four trends provided the justification for the necessity of leadership education programs, as well as a loose structure from which to evolve. The authors also make ten recommendations to enrich campus leadership programs (DUGAN; KOMIVES, 2007, p. 19–21):

- *Discuss socio-cultural issues everywhere*
- *Get students involved in at least one organization*
- *Get students to at least one leadership program*
- *Diffuse leadership programs across the institution*
- *Focus on members, not just positional leaders*
- *Discourage too much breadth in involvement*
- *Develop mentoring relationships*
- *Design distinct programs for specific groups*
- *Align students' self-perceptions of leadership, competence and confidence*
- *Build Bridges with K-12 educators*

All of these recommendations can be beneficial to Poli's Production Engineering Course, and how each of them can be applied will be described in detail in chapter five, Strategic Actions.

2.9.4 Gender Balance

All around the world, women are underrepresented in STEM courses (Science, Technology, Engineering and Mathematics). This, of course, results in a smaller representation

of women in STEM jobs. The literature shows that this is prejudicial both to the society and to the universities (BEEDE; JULIAN; LANGDON, 2011; CARD; PAYNE; SECHEL, 2011; MILISZEWSKA; VENABLES; TAN, 2006).

There are many ways that women education benefit society. Many authors demonstrate the correlation between women education and economic growth, lower birth rates and better human development indicators overall (FITZGERALD, 2011; THE WORLD BANK GROUP, 2014).

However, gender balance in the university does not only benefit the society (which may already be enough reason to pursue it), but also the university itself. Gender-mixed groups have been shown to be better at creative work than male or female groups, and more efficient in solving complex tasks (RICE, 2011).

Another point is that good potential female candidates are being left out of the course due to this unbalance. Whether this is caused by some bias or discrimination in the admission exams, or by the female students being intimidated by the male stereotype of the course, the fact is that if good female students are not getting in the course, talent is being wasted (MILISZEWSKA; VENABLES; TAN, 2006).

All these authors emphasized the importance of female role models to younger women. Penelope Lockwood demonstrates that female students depend more on the gender of mentors and role models in order to identify with them, and that female role models play a key role in the attraction of female students and workers (LOCKWOOD, 2006).

3 METHODOLOGY

This chapter will explain the methodology used for this work. Figure 3.1 summarizes the methodology, and the following sections explain each of the steps.

Figure 3.1 – Methodology of the work
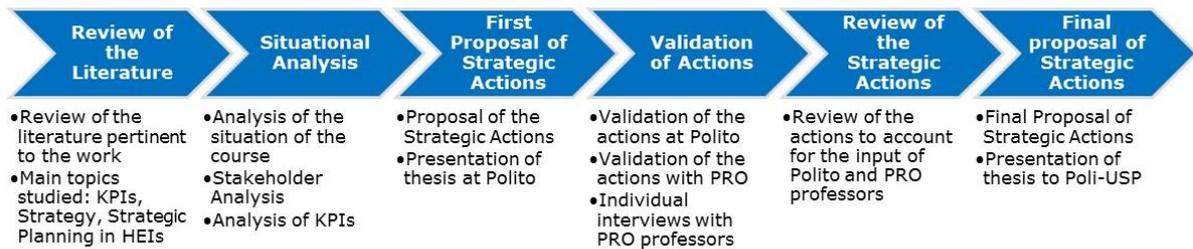
Source: author

3.1 Review of the Literature

The first part of the work was to review the literature pertinent to its realization. The main topics of study to be reviewed were Key Performance Indicators and strategy, in special regarding Higher Education Institutions (HEIs). Many works on these topics were studied to build a better understanding on them.

The review of the literature on KPIs was important, as the strategy would be based on KPIs developed by André Bain (BAIN, 2015). For the same reason, the next topic to be reviewed was the balanced scorecard, in which the authors who originally proposed the system, Professors Robert Kaplan and David Norton, were studied.

Following that, it was noted that the concept of stakeholders would be useful for the work, and as such, it was reviewed both to better grasp the concept and to understand how to choose the relevant stakeholders. A special section was dedicated to stakeholders in HEIs, in which a compilation of former studies on the subject (MAINARDES; ALVES; RAPOSO, 2010) was used to see which groups are usually considered stakeholders in HEIs.

Next, the main topic of the work, strategy, was reviewed, paying special attention to the definition of strategy and to the presentation of two of the main strategic management tools, the

SWOT analysis and the Porter five forces. The need for strategic planning in HEIs was also explored, showing its benefits and the risks of neglecting it.

Then, many authors who showed how to develop and implement a strategic plan in HEIs were studied. The main ones were Alexandra Lerner, Karen Hinton and Kathleen Paris. Works from these authors and others were also used in the review of the elements of the strategic plan.

Finally, specific elements of the objectives and the strategic actions were studied to allow a better proposal of actions. The studied elements were internationalization of the course, academic mentoring, gender balance and leadership. The bibliography reviewed consisted mostly of examples from other universities who faced similar problems or took similar actions.

3.2 Situational Analysis

The situational analysis consisted in analyzing the stakeholders of the course and them analyzing the Key Performance Indicators proposed by André Bain (BAIN, 2015). The KPI analysis also included the setting of targets for the KPIs. The targets were set according to the trends of the KPIs and the current level of the indicator.

3.3 First Proposal of Strategic Actions

The proposal of each of the strategic actions consisted in a small explanation about the action, a plan for its implementation, an analysis of its expected effect on the Key Performance Indicators, and an analysis on how it will contribute to the achievement of the objectives of the plan.

To propose the actions, examples were drawn from other universities and even from organizations out of the educational sector, as detailed in the review of the literature. At this point, the actions were presented to the Politecnico di Torino, in a master thesis for that university (PICCINI, 2015), initiating the next step, the validation of actions.

3.4 Validation of Actions

The validation of actions started at the Politecnico di Torino, with the presentation of the master thesis, where they were judged and commented on by the professors of Polito's production engineering department (*Dipartimento di Ingegneria Gestionale e della Produzione*). The same actions were then presented to the PRO Course Coordinating Committee (COC), when the committee members gave valuable input to improve both the actions and the methodology used to develop them. This input was used to start the next step, the review of the strategic actions.

3.5 Review of the Strategic Actions

The comments and opinions of the professors were used to review and improve the strategic actions, making them more effective and more likely to be implemented. During this phase of the work, individual interviews were conducted with all members of the PRO Course Coordinating Committee, to ensure that the changes were headed in the intended way and to further validate the actions.

3.6 Final Proposal of Strategic Actions

The final step of the work was the presentation of the thesis containing the strategic actions to the Production Engineering Department, as the approval of the department is mandatory for the actions to start being implemented.

4 SITUATIONAL ANALYSIS

This chapter will show the chosen KPIs and use them, together with the tools introduced in the second chapter, to evaluate the current situation of POLI's Production Engineering course, comparing it to other courses of POLI, to other Production Engineering courses in Brazil and to other selected universities in the world. In addition, we will look at historical data to elicit trends and to better understand the factors underlining the situation.

4.1 Stakeholder analysis

As seen in the Review of the Literature chapter, the first step to do the stakeholder analysis is to come up with a list of stakeholders (through brainstorming, interviews or literature review). Then you should evaluate their power to influence the objectives of the institution and their interest in the achievement of these objectives; and elaborate a plan on how to deal with the stakeholders, according to their importance (BJORKQUIST, 2009; BRYSON, 1988, 2004; MAINARDES; ALVES; RAPOSO, 2013, 2010).

So we start by coming up with a list of stakeholders. Through brainstorming, interviews with students and literature review, it was possible to come up with the following list of stakeholders:

- Production Engineering students (PRO Students)
- PRO candidate students
- PRO former students
- Students of other courses that take classes of Production Engineering
- Families of the above groups of students
- Professors
- Non-teaching staff (security, cleaning, administration, library, etc.)
- Vanzolini Foundation
- The Polytechnic School
- The University of São Paulo
- The government
- São Paulo society

- Companies interested in recruiting students
- Companies already employing students

After some prioritization and regrouping, it is possible to define the main stakeholders for the Production Engineering Course. They will be presented in detail below.

4.1.1 Students

The first stakeholder to look into in any educational institution is the student. They are the reason for the courses to exist and can be thought as the direct "customer" for the university services. We have listed four different groups of students, with similar but not identical expectations:

- PRO students, the actual course students;
- PRO candidate students, who want to apply for the course in the near future
- PRO former students, students that have already graduated and are now working or looking for a job,
- Students of other courses that take classes of Production Engineering, usually this students come from other engineering courses

Besides these four groups, it is also possible to add the families of all these students, whose expectations are similar to those of the students. These expectations are mostly related to finding a better positioning in the job market after graduating. To achieve that, these groups expect quality education, a strong university reputation, development of practical skills and actions promoting job placement and networking.

4.1.2 Professors

The professors are the core of the university, being the main agent behind its activities, and have a huge interest in its performance, thus they are one of the main stakeholders. They have the power to create and to disrupt initiatives and their support is essential for any plan to succeed.

Their expectations include professional development and career progression, stability, quality and well spread research, the observation of labor rights and a strong university reputation.

4.1.3   The University of São Paulo and the Polytechnic School

Both the university and the Polytechnic School benefit of the success of the Production Engineering course, and have great power to influence it, especially by controlling the budget for the course. Both institutions are interested in the reputation of the course and in its capability to attract and educate top students.

4.1.4   Government and society

The University of São Paulo is financed by a state tax on commerce, so every citizen who buys any good or service in the state of São Paulo in indirectly giving money to the university. The government, and thus the society, expect that this money be put to good use to improve the quality of life not only for those directly involved in the university, but also for everyone outside of its walls.

Their expectations are transparency, efficiency, education of students to help the society, open collaboration with other sectors of government and society, creation of businesses and jobs, quality and useful research, social responsibility and overall ethical behavior.

4.1.5   Companies

The Production Engineering course of the Polytechnic School is seen as a top recruiting pool for a large number of companies in Brazil, in particular by finance and consulting firms. All students are expected to do an internship in the last year, and many choose to do so even in earlier years. The companies benefit deeply of employing the students, but no single company holds big influence over the course, as there is currently an intense competition between then for the talent generated there.

Companies that employ current and former students expect that the course provide them strong professional skills, which include a sense of working ethics, leadership skills, analytical skills, interpersonal and relationship skills, language knowledge (not built in class, but in experiences like exchange programs), programming skills, etc.

4.2 Presentation of the chosen KPIs

The performance measurement system to be used was introduced by André Bain in his graduation thesis (BAIN, 2015). As stated in the chapter two, review of the literature, he based this system on the Balanced Scorecard. He has made two adjustments, first he changed the customer perspective to Stakeholder Perspective, which was the most important one in his work and will also be the most important one in this work. This change is important because in a public university there is not one single customer but several interested groups (CHEN ; YANG ; SHIAU , 2006). The other adjustment was the introduction of a fifth perspective, the Social Responsibility Perspective, which is of great importance for any public institution, even more for public universities (BEARD, 2009). His design for the performance measurement system is reproduced in figure 4.1.

Figure 4.1 - Perspectives of the Performance Measurement System.

Source: adapted from (BAIN, 2015)

Since the Stakeholders' is the most emphasized perspective, he decided to split the objectives inside this perspective in three areas: attraction, formation and professional performance of students. In this work, we will use the same three areas. The indicators proposed for the Stakeholders Perspective are reproduced in four tables available in Annex A. These four tables present all 46 indicators proposed by André Bain in his work, but only 15 have been developed so far, as not all data is readily available. Hence, this work will focus on analyzing these 15, presented on table 4.1.

Table 4.1 – KPIs to be analyzed.

Stakeholders Perspective		
Attraction	**Formation**	**Professional performance**
1.1. Candidates / opening	2.1. Outgoing students in double degree programs	3.1. Evaluation in the "Guia do Estudante Abril"
1.2. Percentage of approved candidates actually enrolled	2.2. Outgoing students in credits exchange programs	3.2. Ranking in the "Ranking Folha de Universidades"
1.3. Last position in the admission exam enrolled in the course	2.3. Incoming students in double degree programs	
1.4. Percentage of women applying for the course	2.4. Incoming students in credits exchange programs	
1.5. Ratio between approval rates of men and women	2.5. Internship by industry sector	
1.6. Percentage of women accepted	2.6. Internship in new companies	
	2.7. Percentage of female nominees to the best thesis award	

4.3 Analysis of the KPIs

This section will look at the developed KPIs and analyze them according to the basis for comparison established above, and propose target values for them. The timeframe for the targets is until 2020, that is, the department goal should be to achieve these targets until 2020. The graphs for the indicators compare 15 different courses of the Polytechnic School of São Paulo, displayed with the color scheme showed in figure 4.2. The Production Engineering Course is highlighted with a thicker line in the color green.

The admission exam to the Civil and Environmental engineering course is the same, candidates are admitted to the "Civil and Environmental study area" and choose Civil Engineering or Environmental Engineering in the end of their first year. The same happened with Chemical, Metallurgical, Materials, Mining and Petroleum Engineering, but in 2012 the Petroleum Engineering Course, taught in the city of Santos, decided to split its admission from the other courses. There was a further split in 2014, with only Materials and Metallurgical Engineering still admitting students together. The same happened with Mechanical and Marine Engineering, which also held their admission exams together until 2013, splitting in 2014. The old groupings are showed in the graphs to better demonstrate the trends in these courses.

Figure 4.2 – The various engineering courses of Poli-USP

Production Engineering

Computer Engineering

Civil and Environmental Engineering

Mechanical and Marine Engineering

Computer Engineering (quarterly course)

Mining Engineering

Marine Engineering

Computer engineering (corporative systems)

Chemical, Metallurgical, Materials, Mining and Petroleum Engineering

Electrical Engineering

Mechatronics Engineering

Petroleum Engineering - Santos

Materials and Metallurgical Engineering

Mechanical Engineering

Chemical Engineering (quarterly course)

Source: author

4.3.1 Candidates indicators

The first three indicators in the area "Attraction" measure the demand for the course, looking at both the quantity and the level of knowledge of the students applying for the Production Engineering Course. As seen in the review of the literature, attracting the best talents is crucial for the excellence of the university.

4.3.1.1 KPI 1.1 - Candidates / Opening

This is a simple indicator to measure the demand for the course. The number of openings generally stays the same over the years, so changes in the number of candidates will make this number increase or decrease reflecting the changes in desirability of the course. Changes in the

number of openings from one year to the other are noted below. One important change will occur in 2016, when the number of openings for production engineering will increase from 70 to 75. We measure "candidates / opening" and not simply "candidates" for a better comparison with other courses with a different number of openings.

As we can see in figure 4.3, the Production Engineering Course was the one with the most candidates per opening until 2012, and now it is in the fourth position, behind the mechanical, chemical and the quarterly course of computer engineering.

There are two different phenomena contributing to this. First, those three courses have seen an "artificial" rise in demand. "Artificial" because it comes from changes in the admission exam, the "*vestibular*". Before, mechanical engineering admission was done together with marine engineering, a much less desired course, as we can see in the graph. The same goes for chemical engineering (used to be done together with mining, materials, petroleum and metallurgical engineering) and computer engineering (used to be done together with electrical engineering). Therefore, this apparent raise in demand comes not from an increase in the number of candidates wanting these courses, but from the changes in the admission exam.

The second reason is the decreasing number of candidates for the production engineering. This is a pressing issue, and this decrease is seen every year since 2009, when the number of candidates per opening was 27.2, arriving at 19.9 in 2015 – a decrease of 5.1% per year. It is not yet clear why this is happening, but other courses of Production Engineering in the University of São Paulo are also experiencing a decrease in demand, so it is possible that this is a problem for the Production Engineering subject, not only for the course in Poli.

Whatever the reason is, it is important to bounce this indicator back up, as our students benefit from the reputation of going through the most concurred admission exam for engineering in Poli, and it is also a good indicator of the course's desirability by high school students. The average number of candidates per opening in the years 2008-2015 was 24. The proposed target for this indicator will be to return to this average of 24 candidates per opening until 2020, reverting the falling trend of the last years.

Figure 4.3 - Graph for the KPI 1.1 – Candidates / Opening.
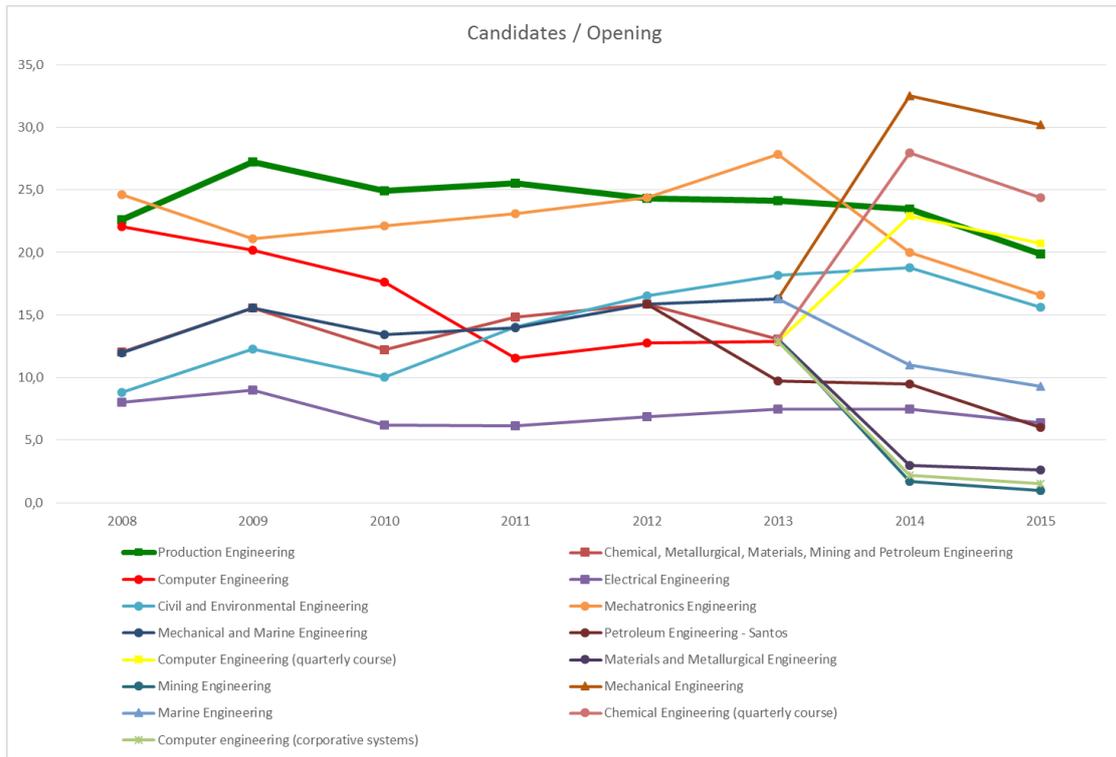
Source: adapted from (BAIN, 2015)

4.3.1.2   KPI 1.2 - Percentage of approved candidates actually enrolled

This indicator measures the priority that students give to the course. It is common that students apply for various courses in different universities, and after the admission exams results they choose the one they prefer. Because of this, many courses seen as easy to get into have a high number of candidates, which think of that course as a safe second option to get into the university if they are not approved in their first option. This situation is not a desirable one for the course, as students who are not in their preferred option are more likely to lag behind or drop out of school.

Figure 4.4 - Graph for the KPI 1.2 - Percentage of approved candidates actually enrolled.
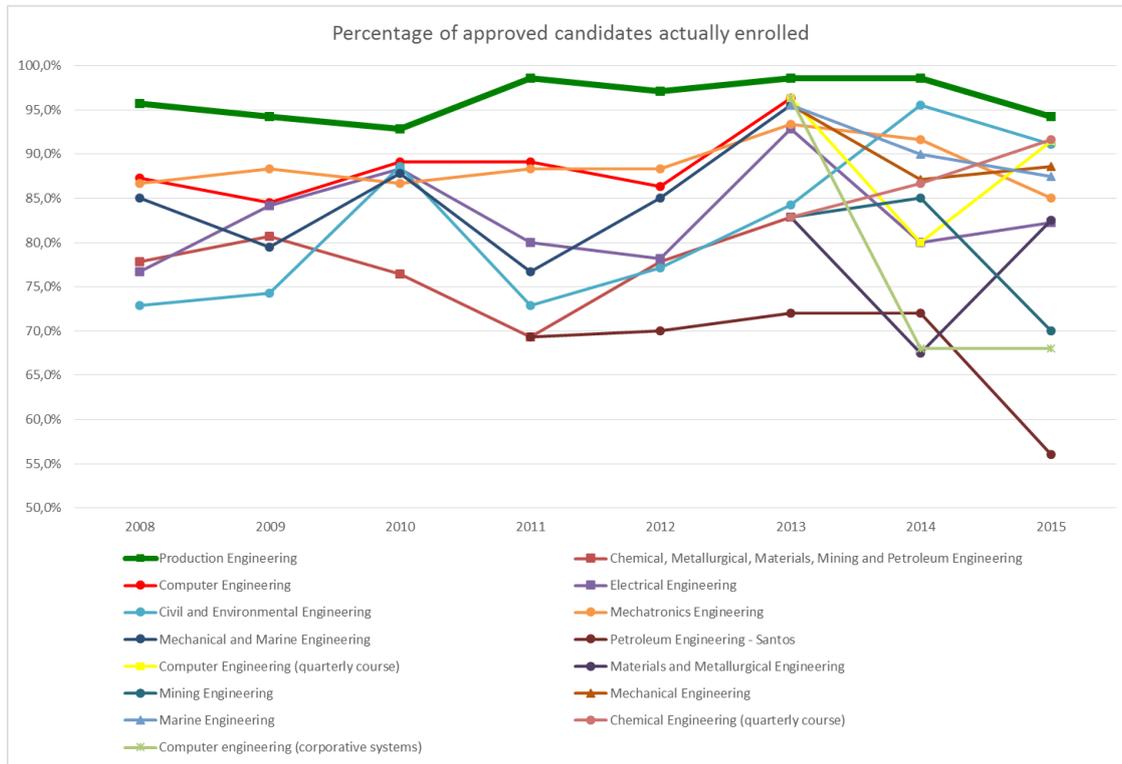
Source: Adapted from (BAIN, 2015)

The Production Engineering course does extremely well in this indicator, as we can see in figure 4.4. It has been the course with the highest "conversion rate" of approved candidates between those of the Polytechnic School since 2008, always staying above the 90% mark. This indicates that the candidates are highly certain of their preference for Production Engineering. There is little room or necessity for improvement in this indicator, so the target will be set at 95%, approximately the average value of the last years (the actual value is 96.3%), in order to keep the high level of conversion from approved to enrolled students seen in the last years.

4.3.1.3   KPI 1.3 - Last position in the admission exam enrolled in the course

In the admission exam for the Polytechnic School, all candidates are ranked according to their scores, and those of higher ranking pick the course they want to enroll first. Therefore, the courses wanted by the best students will be picked first. This is a better indicator of the

difficulty to be admitted in a course than the "candidates / opening" indicator, as this indicator also demonstrates the level achieved by the students on that exam.

Figure 4.5 show the position of the last candidate admitted into each course in the admission exam. As this indicator measures the position in a ranking, the lower the number, the best, and that is why the vertical axis is reversed in the graph. As with the first indicator analyzed, we see a small deterioration of the Production Engineering position, caused both by an increase its last position and a decrease of the position for computer and chemical engineering. The reasons for that have already been explored in the analysis of the "candidates / opening" indicator.

Figure 4.5 – Graph for the KPI 1.3 – Last position in the admission exam enrolled in the course.
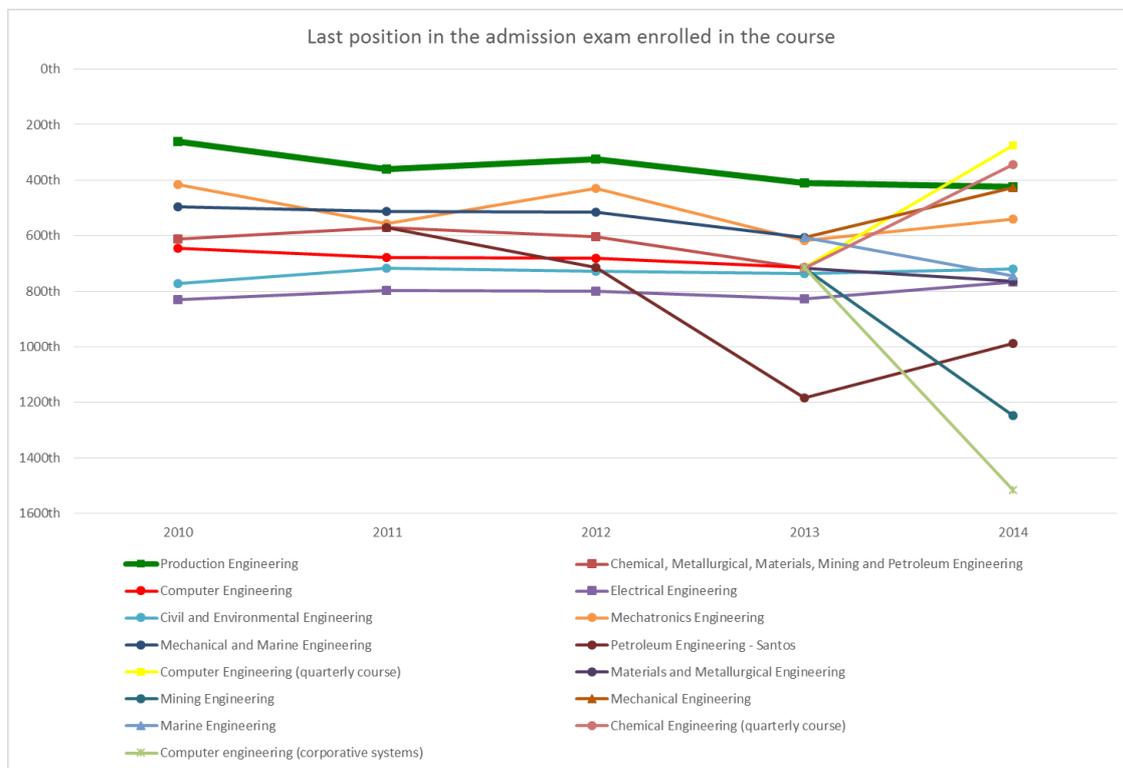
Source: Adapted from (BAIN, 2015)

This indicator, however, shows a better picture than the other one. Although the indicator is in a slightly decreasing trend, the Production Engineering Course (PEC) students in 2014 still came from the 424 top rated candidates in the admission exam, between the thousands that apply to the Polytechnic School. However, it is important to revert this trend,

and preferably to return to the first position in this indicator, today held by the quarterly course of Computer Engineering, with its worst ranked student being in the 275th position.

To return the PEC to the first position in this indicator, we will set the better value of the last years as the target. That is the value of 2010, a target of 260 as the last position in the admission exam to be enrolled in the course, until 2020.

4.3.2 *Indicators of gender diversity*

The next four KPIs refer to gender diversity, with the first three being in the area "Attraction" and the last one being in the area "Formation". The ones concerning Attraction will shine light on the reasons for the low proportion of female students and how to address that, while the one on Formation will look at their performance in the university.

4.3.2.1 *KPI 1.4 - Percentage of women applying for the course*

As seen in the review of the literature, gender diversity is desirable and beneficial for both the university and the students (RICE, 2011). This indicator and the next two will look into the number of women in the course.

This indicator measures the percentage of women between the candidates of the course. It counts people applying for the course as their first, second, third or fourth option. If there were no gender bias in the preferences for different courses in higher education, this percentage would be similar to the percentage of women in the population, around 52%. As seen in the review of the literature, this is not the case, as STEM courses are known to usually have many more male students than female (BEEDE; JULIAN; LANGDON, 2011).

As we can see in figure 4.6, the Polytechnic School of São Paulo is no exception to that, as all of its courses have many more male candidates applying to the course than female. However, it is interesting to notice that there are two clearly distinct groups of courses, one with percentages roughly between 30% and 40%, and another with percentages between 10% and 20%. With an average of 32.9%, Production Engineering is in the first group, along with the courses of chemical, civil, environmental, petroleum, mining, metallurgical and materials

engineering. The second group is composed of the courses of electrical, marine, mechatronics, mechanical and computer engineering.

Figure 4.6 - Graph for the KPI 1.4 – Percentage of women applying for the course.
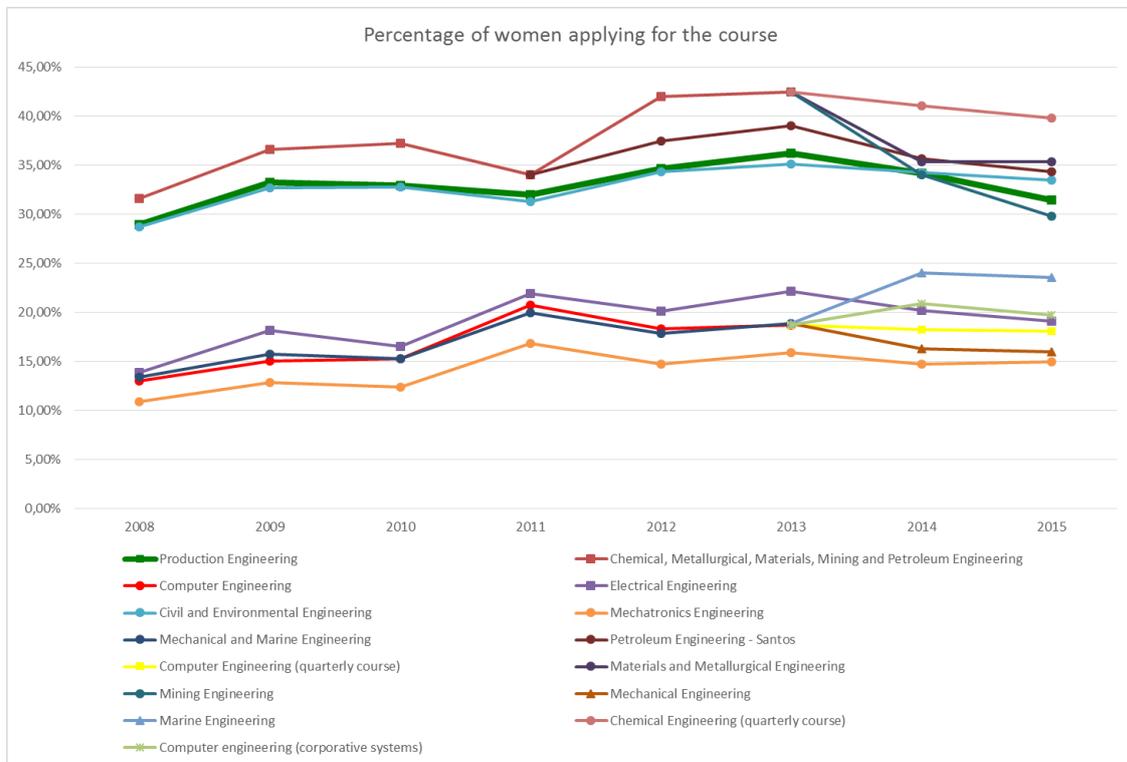
Source: Adapted from (BAIN, 2015)

Production Engineering is already in the upper group, but at 31.4% female candidates in 2015, it is still far from equality in candidates' preference. To define the target we will use the average value of the top three courses in these indicators, for the last two years (after the 2012 split of admission exams). Therefore, the proposed target is 36.9% until 2020, which will elevate the PEC position in comparison to the other courses and contribute to bring more women into the course.

4.3.2.2   KPI 1.5 - Ratio between approval rates of men and women

This indicator measures the difference of performance in the admission exam between genders. The formula used to calculate this indicator is reproduced below (1):

$$Ratio\ between\ approval\ rates = \frac{\dfrac{Number\ of\ women\ approved}{Number\ of\ women\ applying}}{\dfrac{Number\ of\ men\ approved}{Number\ of\ men\ applying}} \qquad (1)$$

With the number of approved being the number called in the first list, and the number applying referring to people applying to the course even with it as second, third or fourth option.

If the difference in the percentage of women in the course was originated only from differences in preferences between the genders, this ratio would be always equal (or almost equal) to one. This is not the case. It seems that the performance of women in the admission exam is generally worse than that of men, and the intensity of this difference varies between courses and over the years. With all the data we have, there are only five exceptions; all the other points indicate a worse performance of women in the admission exam, usually by a large margin (ratio smaller than 75%). The average for Poli in this period is 64.7%, showing that a large reason for the relatively small percentage of women in the school is the difference in approval rates.

For the Production Engineering Course of Poli, the average is 56.6%, with a lowest of 31.5% in 2012 and a highest of 84.9% in 2008, the only year when the indicator stayed over the 75% mark, as seen in figure 4.7 below.

Figure 4.7 - KPI 1.5 - Ratio between approval rates of men and women.
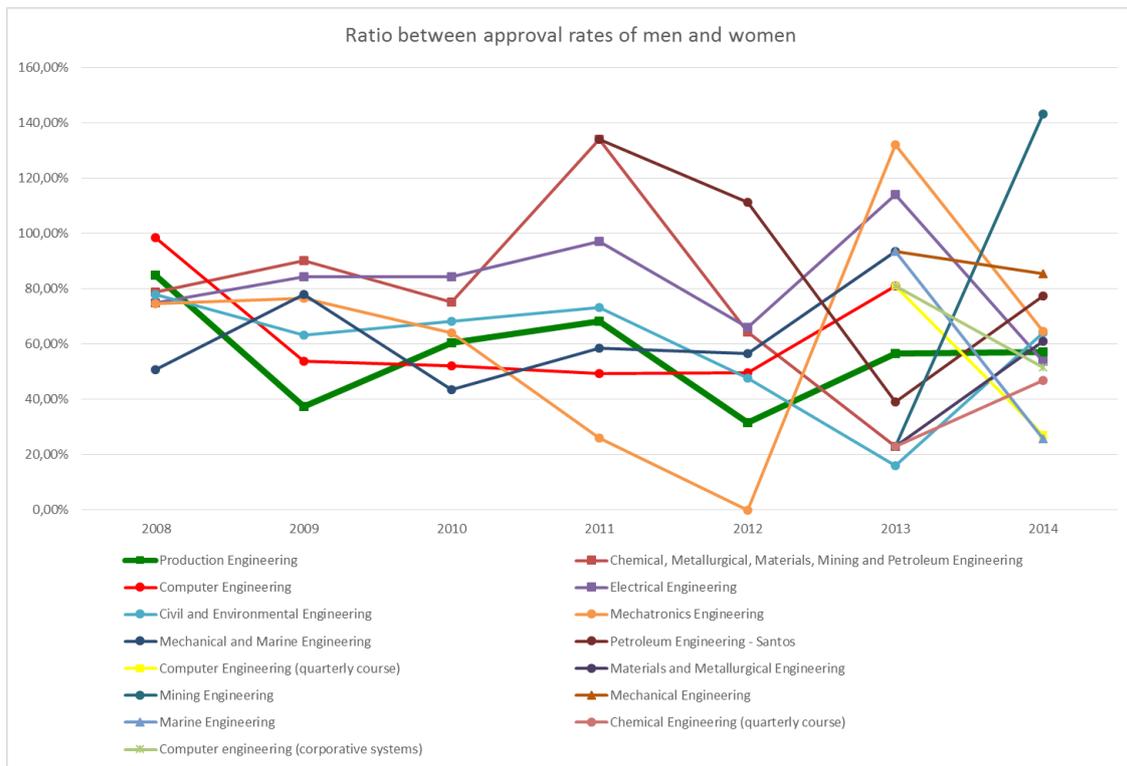
Source: Adapted from (BAIN, 2015)

It is hard to improve this indicator, as there are many factors influencing it. However, it is possible, as it will be shown in the "Strategic Actions" section. To guarantee that the PEC does not perform worse than the other courses, the proposed target will be the average of the indicator for all the courses, in all the years between 2008 and 2014. Hence, the proposed target is 65.7%.

4.3.2.3   KPI 1.6 - Percentage of women accepted

This indicator measures the percentage of women accepted into the course of Production Engineering in the first list. Of the three indicators of gender diversity, this is the most important one, and is of course directly influenced by the other two.

As we can see in figure 4.8, the course of Production Engineering is near the middle of the pack regarding this indicator. At an average of 21.4% from 2008 to 2014, with some variation every year and no recognizable trend.

Figure 4.8 - Graph for the KPI 1.4 – Percentage of women accepted into the course.
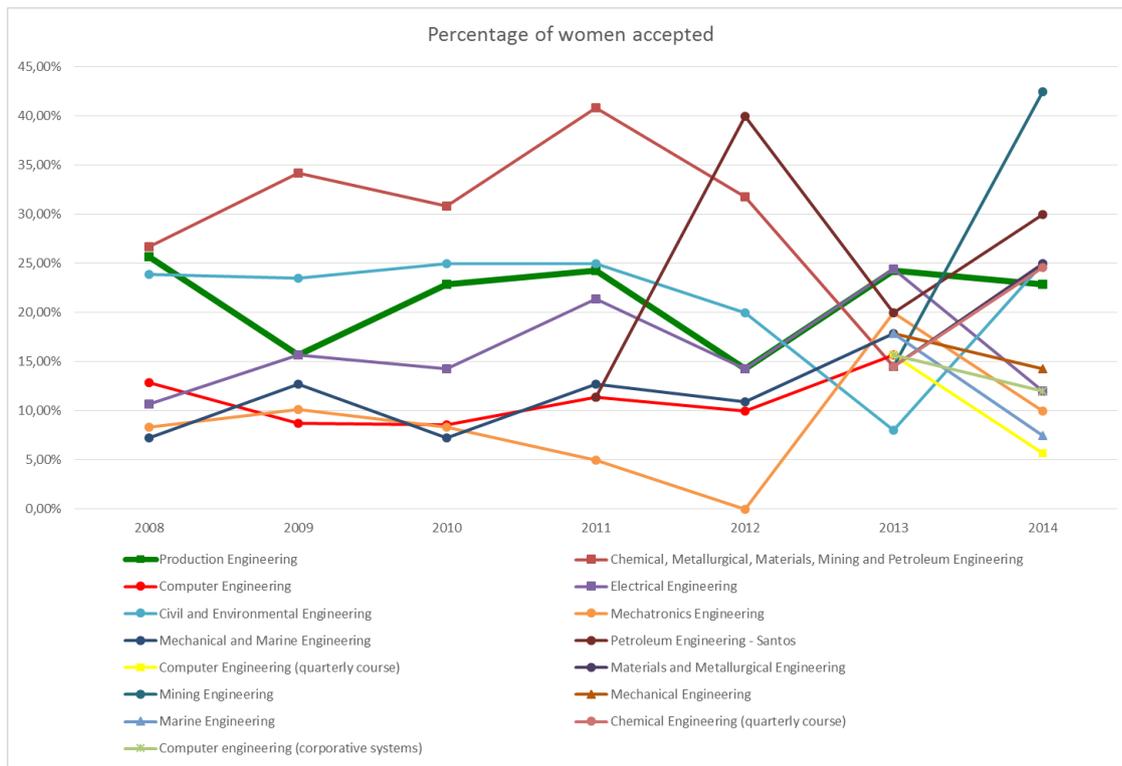
Source: Adapted from (BAIN, 2015)

The average of 21.4% means 15 women in a class of 70. The number of women in the years between 2008 and 2014 varies between 10 and 18. The proposed target will be to raise this number to 20 women, 2 more than the maximum number in the last years and 5 more than the average. That corresponds to 28.6% of the class. This is a high number considering the history of the course, but is lower than the numbers of the engineering courses with the most women, as we can see in figure 4.8.

4.3.2.4   KPI 2.7 – Percentage of female nominees to the best thesis award

We will jump ahead in the order of the KPIs to analyze this last indicator of gender diversity together with the other three ones. This is the only indicator of women performance that was possible to be developed so far. Other indicators such as average grade for both genders, employability and first job pay might have been more enlightening, but the data for that are not available.

However, this indicator shows interesting information. From 2008 to 2014, an average of 47% of the best thesis award nominees were women. When we consider that only 21.4% of the accepted students were women during this period, this indicates a much higher female representation among award nominees than expected.

Of course, this must not be seen as a direct measure of the level of knowledge of the students, as there are many factors that can explain this difference. Nevertheless, it does indicate that there is some difference. If women are indeed performing better than men are, this could be one more reason to promote gender diversity in the university. It is important, though, to investigate the reasons for that, especially to be sure that there is no discrimination towards men playing a role in this difference.

As this indicator is already in a better level than it was expected, and as we have yet to understand better the various factors influencing this indicator, we propose no target for it, leaving it only as an informative indicator. This should be revisited after the development of other indicators concerning the differences in performance between genders.

Figure 4.9 summarizes the last four indicators, showing the average of female participation in all steps of the academic cycle for the period of 2009-2014.

Figure 4.9 - Gender split in each step of the course.
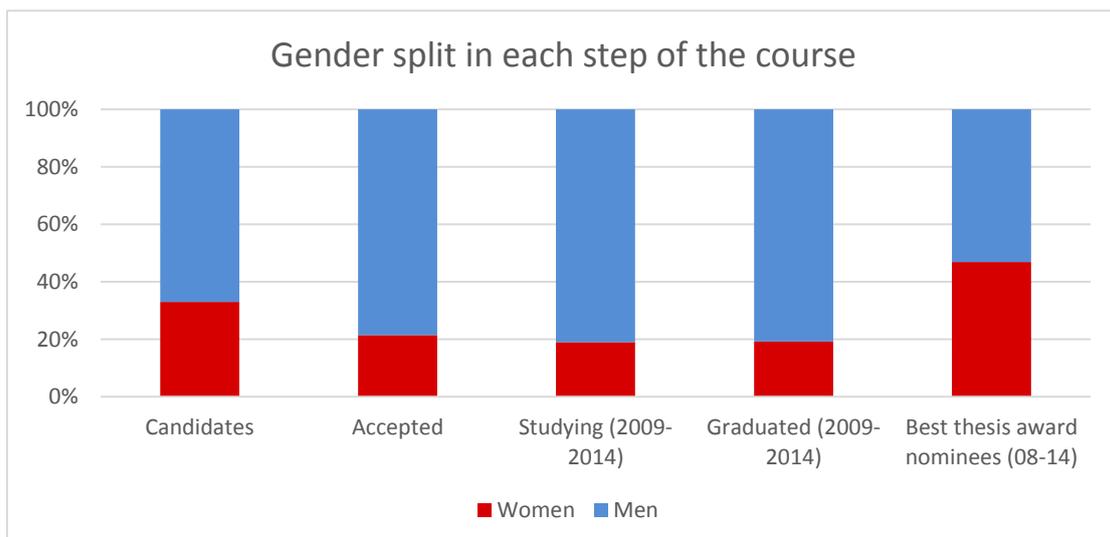
Source: Adapted from (BAIN, 2015)

4.3.3   *Indicators of course internationalization*

The next four indicators will look at the level of internationalization of the course. As shown in the review of the literature, there are many benefits to be reaped from sending students abroad and receiving foreigner students. This is why the next indicators are important.

To compare the different courses, the numbers presented in table 4.2 have been used for the number of students in each year of the course.

Table 4.2 - Number of students enrolled in each course per year.

Civil Engineering and Environmental Engineering	Electrical Engineering	Mechanical Engineering and Marine Engineering	Chemical, Metallurgical, Mining, Materials and Petroleum Engineering	Computer Engineering	Mechatronics Engineering	Production Engineering
180	140	110	120	70	60	70

Source: Adapted from (BAIN, 2015)

4.3.3.1   *KPI 2.1 - Outgoing students in double degree programs*

The Polytechnic School of São Paulo has a large number of double degree agreements with universities around the world. In this kind of agreement, the student goes abroad for a period of 18 to 24 months (most commonly 24), and can use the time abroad to compensate the equivalent of one year's worth of subjects in Poli. Therefore, instead of graduating in 5 years, the student graduates in 6 years, but with two diplomas: that of Poli and that of the foreign university.

As we can see in figure 4.10, Production Engineering was the course with the highest percentage of the students going to double degree programs in the beginning of the century. There was a decrease between 2006 and 2009, and then from 2010 to current day the KPI's behavior was somewhat erratic, but still being in the top of the graph until 2014, when other four courses surpassed it.

It is still early to say if 2014 is an exception or the beginning of a downward trend. The other courses seem to be in an upward trend in this indicator, and if nothing is done, the Production Engineering Course might lose its position as a leader in internationalization. Hence, we propose a target of 25% for this KPI until 2020. It is a completely plausible target, which should be enough to keep the tradition of sending the best students of the course to double degree programs.

Figure 4.10 – Graph for the KPI 2.1 - Outgoing students in double degree programs.
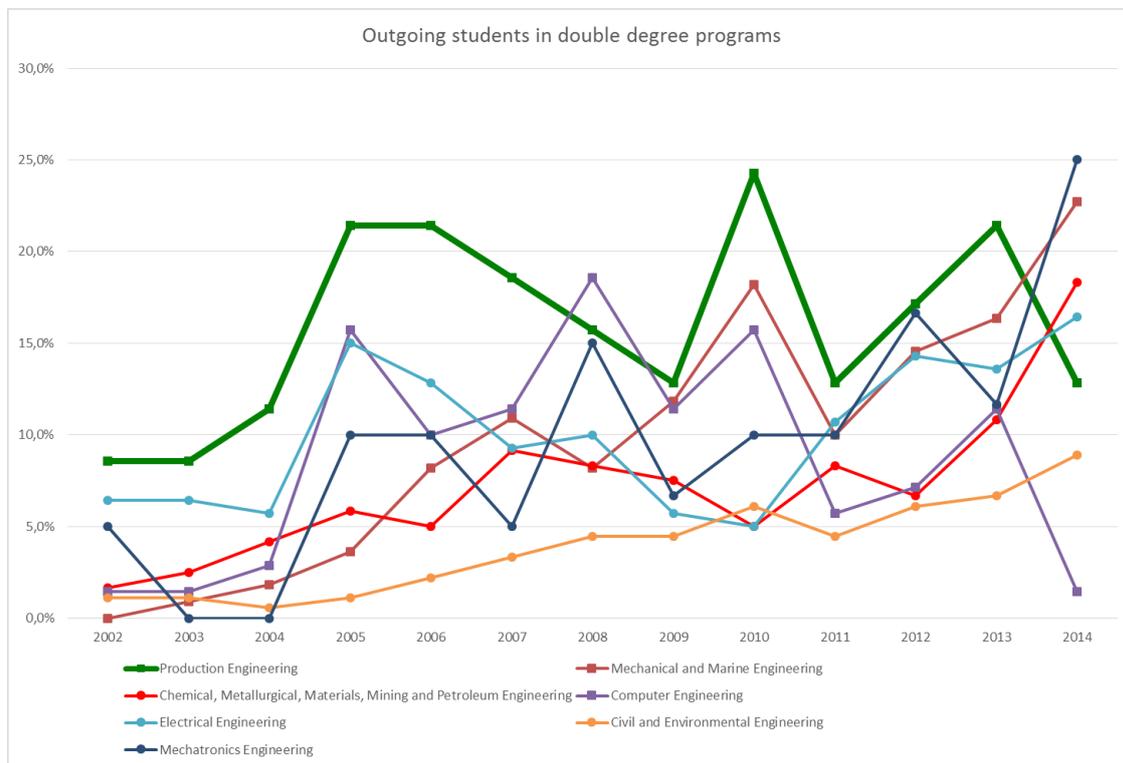
Source: Adapted from (BAIN, 2015)

4.3.3.2   KPI 2.2 – Outgoing students in credit exchange programs

The other modality of international exchange offered by Poli is the "credit exchange", in which the student spend from 6 to 18 months abroad (most commonly 12) and can use some of the credits acquired from subjects in the other country towards their graduation in Poli, but are not awarded a diploma from the foreign institution.

In figure 4.11 we can see a pattern that is very similar to the graph of indicator 2.1. Again, Production Engineering was the course with the highest percentage of students going to

exchange programs in the first years of the century, and then experiences a small decrease in 2008 and 2009. However, there is an upward trend after 2010, with a drop in 2014, being surpassed by two courses. This might be explained by some saturation of the students wanting to go to exchange programs, as 40% of the class went abroad to study in 2013. This KPI will also be kept as an informative indicator, with no target set as of now. If by any reason the number of students going to credits exchange programs abroad start falling in the next years, this can be revisited.

Figure 4.11 – Graph for the KPI 2.2 - Outgoing students in credits exchange programs.

Source: Adapted from (BAIN, 2015)

4.3.3.3   KPI 2.3 – Incoming students in double degree programs

Just as the Polytechnic School offers the opportunity to students to do the double degree abroad, in the terms explained above, many universities send their students to study at Poli. This indicator shows the number of incoming students in double degree programs relative to the class size.

The graph for this indicator (figure 4.12) shows some interesting patterns. There was a peak in 2005, followed by a sharp decrease arriving at zero students in 2007. After that, there was another increase, with the Production Engineering Course and the Mechanical and Marine Engineering Courses standing out from the pack as the courses with the most incoming double degree students.

To consolidate our lead in this KPI, the proposed target for this KPI is 14.3% until 2020, which corresponds to 10 foreign students per year, and would be more than enough to jump ahead of the other courses in this indicator. This might seem too ambitious, but as we will see in the next section, the Production Engineering Course already receives an extremely large number of foreign students in credits exchange programs. It should not be hard to make some of these students do a double degree program instead.

Figure 4.12 – Graph for the KPI 2.3 - Incoming students in double degree programs.
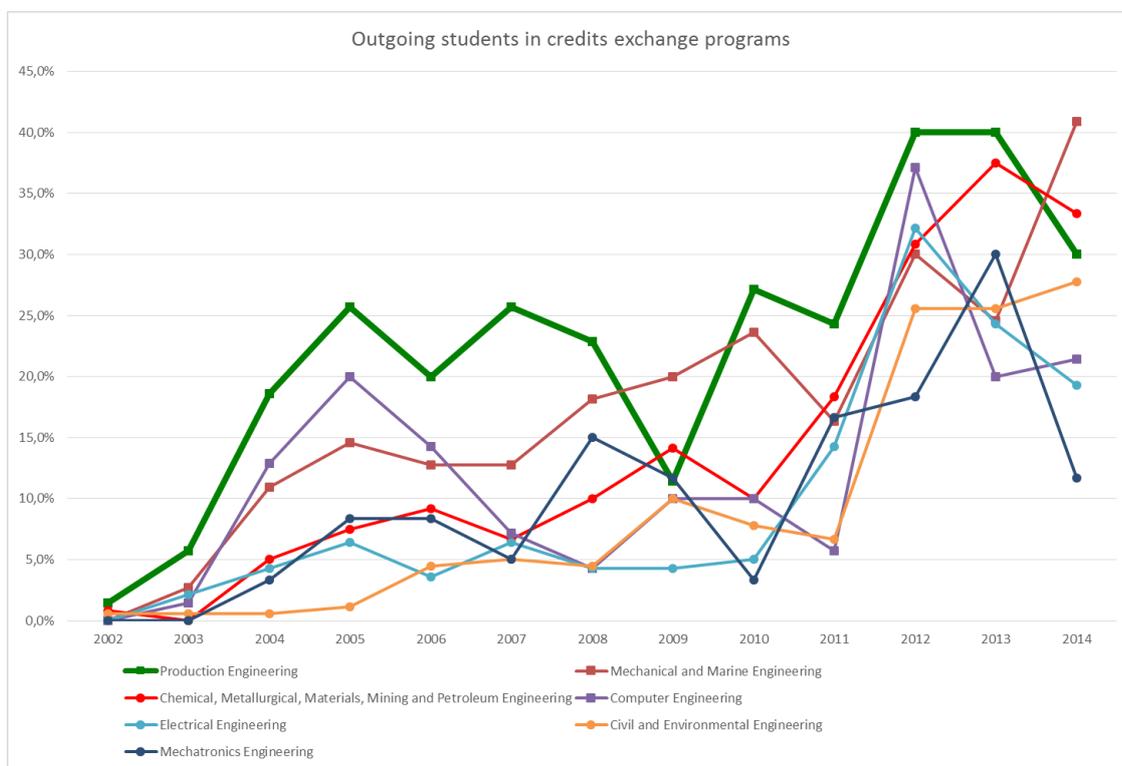

Source: Adapted from (BAIN, 2015)

4.3.3.4   KPI 2.4 - Incoming students in credits exchange programs

This indicator looks at the number of incoming students in credits exchange programs relative to the class size. As we can see in figure 4.13, the Production Engineering Course is way ahead of the other courses in this KPI, and with an extraordinary average annual growth rate of 31.6%.

As said above, it is desirable that some of the students coming to credits exchange programs switch to double degree programs, as these keeps the student for a longer time – which opens more possibilities of research and learning, besides developing stronger bonds with Brazil – and also builds more reputation for the course and the university.

Since this KPI is already in an excellent value, and decreasing it might contribute to improving the KPI 2.3 (if students change the modality of exchange), we will not establish a target for it, keeping it just as an informative indicator.

Figure 4.13 – Graph for the KPI 2.2 - Incoming students in credits exchange programs.
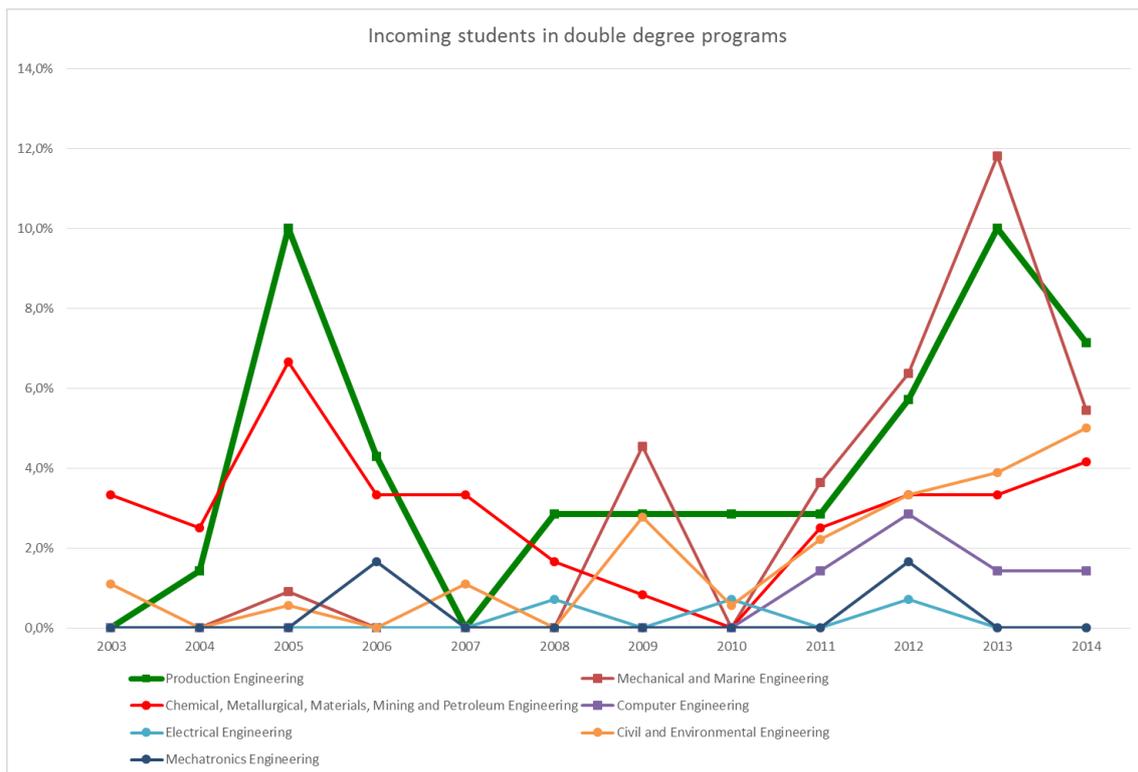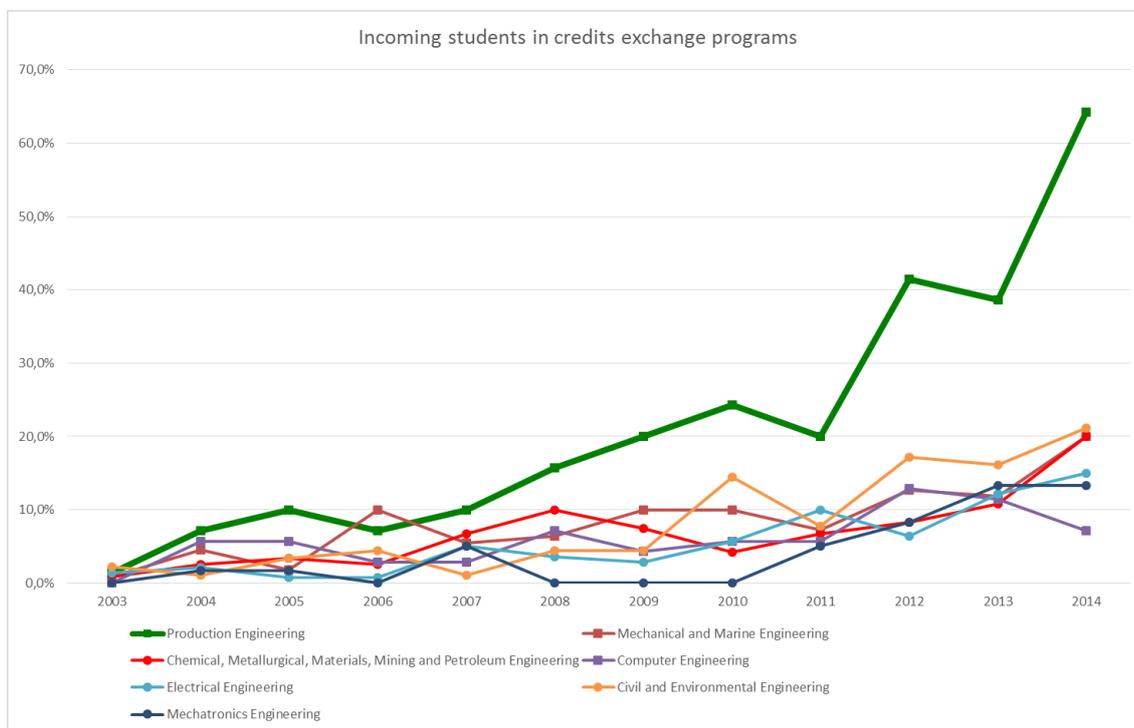

Source: Adapted from (BAIN, 2015)

4.3.4   Internship indicators

The next two indicators will try to bring insights on the kind of industry our students usually work at. These indicators will have a much more positive nature rather than a normative one. That is, they will be used more as means to obtain information and to understand the situation than as means to propose actions and improvement opportunities.

4.3.4.1   KPI 2.5 – Internship by industry sector

The first indicator on internship will look at the kind of industry in which the students of the course do their internships. It is important to note that the internship is mandatory, thus almost all students take part in internships in their last year, with some students starting to work in earlier years.

As we can see in figure 4.14 in the next page, the preferred sector for internships is the "Financial" one. Many banks seek to employ engineers for their strong mathematical and analytical skills. The Production Engineering students are especially sought as they combine this with a good formation in accounting and economics.

The other two sectors that attract the most students are "Consulting" and "Manufacturing Industry". Together, these three sectors represent approximately three quarters of all internships during the studied years.

It is possible to see a trend of students switching from "technical" positions to jobs more related to managing and business. Thus, areas as logistics and IT are losing space, while Consulting, Finance and Commerce (especially e-commerce) are growing. The larger salaries and better career expectative in these sectors – with a widening gap in relation to the other sectors due to economic crisis in Brazil – might explain this.

As this indicator shows the distribution between the various types of industry, and at this point there is no reason to believe that a certain type is preferred, this indicator will be left as an informative one, with no set target.

Figure 4.14 - Graph for the KPI 2.5 - Internship by industry sector.
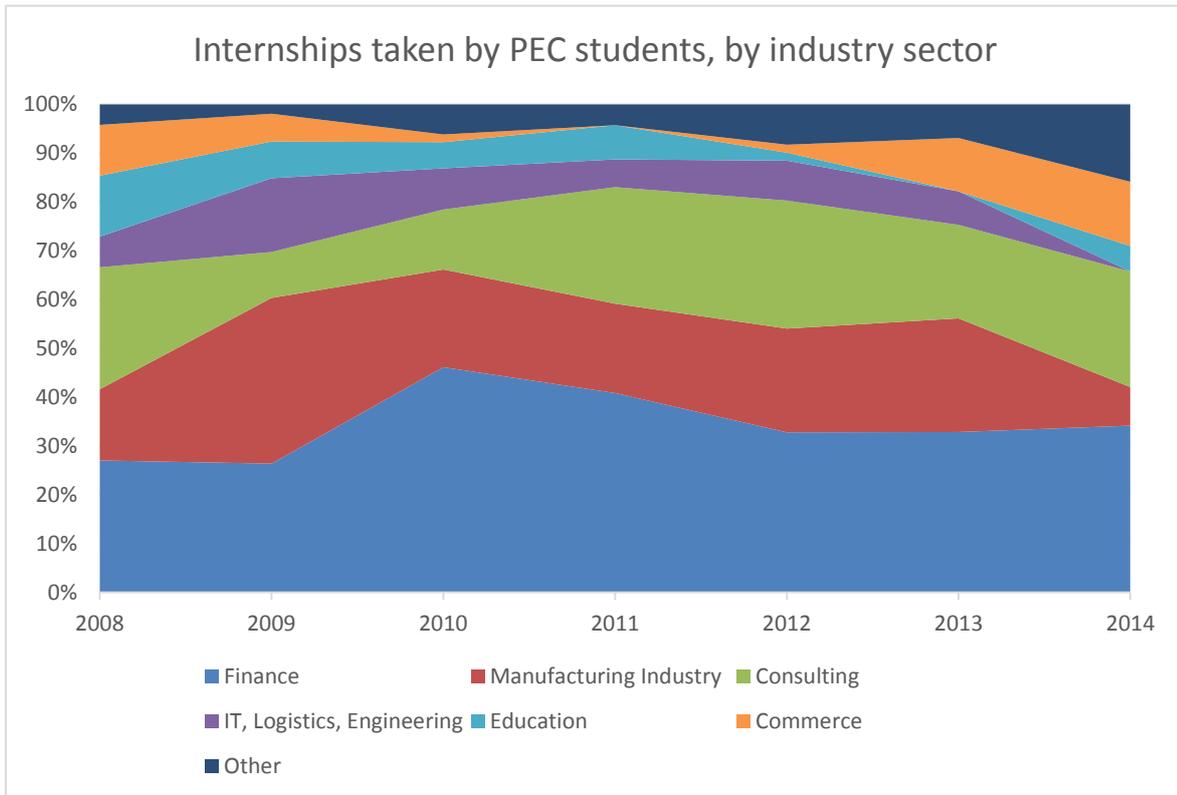
Source: Adapted from (BAIN, 2015)

4.3.4.2   KPI 2.6 – Internship in new companies

This indicator look at the age of the industries in which the students do their internships. This work will consider companies with less than 10 years of existence as "new", and with more than 10 years as "established" companies. The presence of students in "new" and "start-up" companies is desirable as a way of promoting the entrepreneurship among students and former students.

It is possible to see in figure 4.15 that there is a positive trend in this indicator, as the number of students taking internships in new companies have been growing since 2010. Many of these internships are in e-commerce companies, as we said above. The Compound Annual Growth Rate from 2008 to 2014 is an impressive 39.5%. However, when looking at the year-to-year growth it is noticeable that the growth is slowing down: the value of 2013 is 45.7% larger than that of 2012, but the value for 2014 is only 21.6% larger than that of 2013, so the yearly growth roughly halved from 2013 to 2014.

If the department succeeds in keeping this trend, with the growth halving every year, the percentage of students taking internships in new companies will stabilize at 33.3% just after 2020, or one third of the students. This value will be the target for this indicator.

Figure 4.15 - Graph for the KPI 2.6 – Internship in new companies.
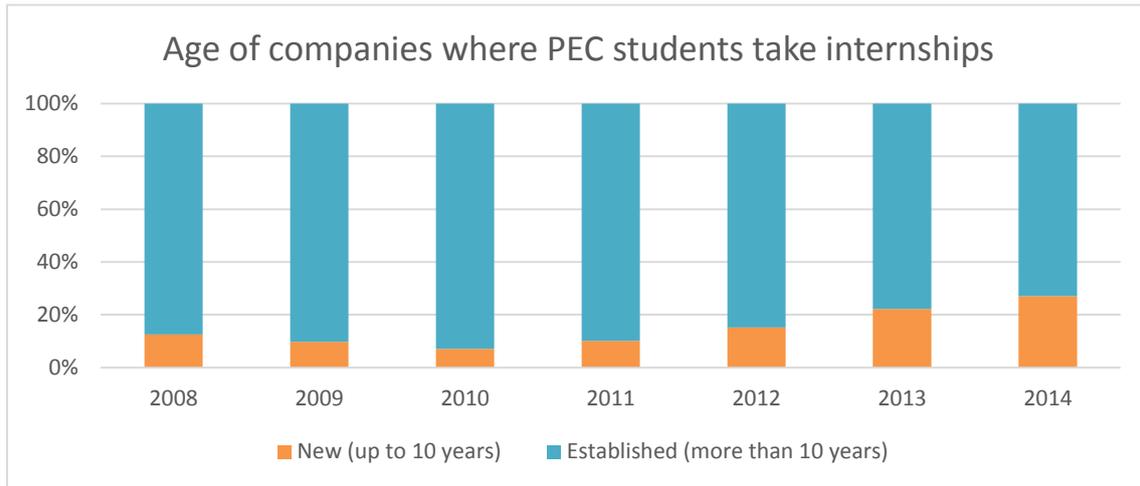
Source: Adapted from (BAIN, 2015)

4.3.5 *External rankings*

The last two indicators will look at the course's position in rankings elaborated by independent institutions. These indicators are in the area "Professional performance" because they show an external view of the course, which reflects the students' reputation within the labor market.

4.3.5.1 *KPI 3.1 – Evaluation in the "Guia do Estudante Abril"*

"Guia do Estudante", which translates to "Student's Guide", is a collection of publications aimed to help high school students in choosing their university. One of Brazil's biggest publishers, Editora Abril, publishes it yearly with detailed information on over 13,000 courses in more than 900 universities (GUIA DO ESTUDANTE, 2015).

For the last nine years, the Production Engineering course of Poli received the maximum grade of five stars, as seen in table 4.3. Only 18 courses of Production Engineering were awarded five stars in 2014, and this number fell to 13 courses in 2015, indicating a high acknowledgment of the course's excellence. The proposed target for this indicator is to keep the five star rating for the next years.

Table 4.3 - Rating of Production Engineering in Escola Politécnica da USP - Guia do Estudante Abril

Course rating - Guia do Estudante Abril	
2007	★★★★★
2008	★★★★★
2009	★★★★★
2010	★★★★★
2011	★★★★★
2012	★★★★★
2013	★★★★★
2014	★★★★★
2015	★★★★★

Source: Adapted from (GUIA DO ESTUDANTE, 2015)

4.3.5.2 KPI 3.2 – Ranking in the "Ranking Folha de Universidades"

"Folha de São Paulo" is the second largest newspaper in Brazil, and since 2012, it has published a yearly ranking of the best universities and the best courses in the country, the

"Ranking Universitário Folha" (RUF). In 2012, the ranking grouped all of Poli's courses together, and the school was awarded the first position in the ranking. In 2013, the courses were evaluated separately, and the Production Engineering Course of Escola Politécnica was ranked the best in the country for production engineering.

In 2014, the course came second, behind the course of production engineering in the Federal University of Rio de Janeiro (UFRJ). The detailed indicators for the three first courses of production engineering in Brazil are reproduced in tables 4.4 and 4.5, to allow a better understanding of the reason behind this second place in the ranking.

The first table shows the ranking of the course in each of the indicators used. There are two major indicators: labor market evaluation and teaching quality. The second indicator, teaching quality, is composed of four other indicators, the four in the right side of the table. The second table shows the grade given for the courses in each of the indicators.

Table 4.4 - RUF for Production Engineering. Detailed indicators ranking 2014.

Ranking in the country	Name of the Institution	Labor Market Evaluation	Teaching Quality	Teachers with PhD or Masters	Enade	Modality of teachers dedication	Ministry of Education evaluators
1	Universidade Federal do Rio de Janeiro (UFRJ)	2	**1**	7	**2**	**1**	2
2	Universidade de São Paulo (USP)	**1**	3	**3**	-	**1**	**1**
3	Universidade Federal de Santa Catarina (UFSC)	12	2	14	6	**1**	2

Source: Adapted from (RANKING UNIVERSITÁRIO FOLHA, 2014)

Table 4.5 - RUF for Production Engineering. Detailed indicators grades 2014.

Final grade	Name of the Institution	Labor Market Evaluation	Teaching Quality	Teachers with PhD or Masters	Enade	Modality of teachers dedication	Ministry of Education evaluators
97,96	Universidade Federal do Rio de Janeiro (UFRJ)	35,74	**62,22**	7,87	**3,98**	**8**	42,37
95,96	Universidade de São Paulo (USP)	**36**	59,96	**7,96**	-	**8**	**44**
95,08	Universidade Federal de Santa Catarina (UFSC)	33,13	61,95	7,71	3,87	**8**	42,37

Source: Adapted from (RANKING UNIVERSITÁRIO FOLHA, 2014)

It is possible to see that the Production Engineering Course is the best among these three in all indicators besides "Enade". The Enade is the National Evaluation of University Students Performance, a national test used by the Ministry of Education to evaluate the universities in Brazil. The University of São Paulo did not participate in this exam in any year before 2015, and that is why there is no grade for it. When we discount the points awarded by the exam to the other courses, Poli's course goes up to the first position in the ranking.

In 2015 USP rose to the first position of the ranking, even without the "Enade" exam. Tables 4.6 and 4.7 reproduce the same information of tables 4.4 and 4.5, respectively, but for year 2015.

It is important to notice that USP's grade was almost the same in both years, falling slightly from 95.96 to 95.92. UFRJ, on the other hand, had it grades reduced both for the Labor Market Evaluation (from 35.74 to 35.00) and for the Teaching Quality (from 62.22 to 59.92), losing its position on the top of the ranking.

Table 4.6 - RUF for Production Engineering. Detailed indicators ranking 2015.

Ranking in the country	Name of the Institution	Labor Market Evaluation	Teaching Quality	Teachers with PhD or Masters	Enade	Modality of teachers dedication	Ministry of Education evaluators
1	Universidade de São Paulo (USP)	**1**	4	**4**	-	**2**	**1**
2	Universidade Federal do Rio de Janeiro (UFRJ)	2	**1**	5	**2**	**2**	2
3	Universidade Federal de São Carlos (UFSCAR)	2	2	8	11	**2**	2

Source: Adapted from (RANKING UNIVERSITÁRIO FOLHA, 2015)

Table 4.7 - RUF for Production Engineering. Detailed indicators grades 2015.

Ranking in the country	Name of the Institution	Labor Market Evaluation	Teaching Quality	Teachers with PhD or Masters	Enade	Modality of teachers dedication	Ministry of Education evaluators
95,92	Universidade de São Paulo (USP)	**36,00**	59,92	**7,94**	-	**7,98**	**44,00**
95,74	Universidade Federal do Rio de Janeiro (UFRJ)	35,00	**60,74**	7,92	**3,98**	**7,98**	40,86
95,45	Universidade Federal de São Carlos (UFSCAR)	35,00	60,45	7,86	3,75	**7,98**	40,86

Source: Adapted from (RANKING UNIVERSITÁRIO FOLHA, 2015)

The proposed target for this indicator is to mantain the first position of the ranking.

4.3.6   Summary of the analysis of the KPIs

From the analysis of the KPIs it is possible to see that there are two areas which require more attention from the department: Candidates attraction and Gender diversity.

The indicators regarding students' attraction have been slowly deteriorating in the last years. The Production Engineering Course is still ahead of most of the other courses, but if the trend for KPIs 1.1, 1.2 and 1.3 persists, this situation might change within a few years.

On the other hand, the situation of gender diversity is no way worse than it was some years ago, but is not improving either. The gender split in the course is far from the 50/50 ratio one might expect to find in an unbiased sample of students. The chosen KPIs shed a light on the

causes of that: applicants are more likely to be male than female, and the approval rate for those women who do apply is lower than that of their male peers.

For these KPIs and for the others as well we proposed targets to get the PEC to a better position in relation to the other courses of Poli. Table 4.6 summarizes the current value of the KPIs and the proposed targets for them.

Table 4.8 - Summary of targets for KPIs.

KPI	Current Value	Proposed target (2020)
1.1. Candidates / opening	19.9	24
1.2. Percentage of approved candidates actually enrolled	94.3%	95%
1.3. Last position in the admission exam enrolled in the course	424th	260th
1.4. Percentage of women applying for the course	31.4%	36.9%
1.5. Ratio between approval rates of men and women	57.1%	65.7%
1.6. Percentage of women accepted	22.9%	27.5%
2.1. Outgoing students in double degree programs	12.9%	25%
2.2. Outgoing students in credits exchange programs[1]	30%	-
2.3. Incoming students in double degree programs	7.1%	15%

Continues in the next page

Table 4.8 continued

KPI	Current Value	Proposed target (2020)
2.4. Incoming students in credits exchange programs[1]	64.3%	-
2.5. Internship by industry[2]	-	-
2.6. Internship in new companies	27%	35%
2.7. Percentage of best thesis awards given to women[1]	46.9%	-
3.1. Evaluation in the "Guia do Estudante Abril"	★★★★★	★★★★★
3.2. Ranking in the "Ranking Folha de Universidades"	2nd	1st

Source: author

Notes on the table:

[1] – As explained before, these indicators will only be kept as informative indicators, with no target set for them.

[2] – This is an indicator on the distribution between the various types of industries, so there is not a single value for it, nor a target. It will be only an informative indicator.

5 STRATEGIC ACTIONS

This chapter will present specific strategic actions designed to help the Production Engineering course of Poli achieving the objectives established in the last chapter. The topic of each action will present the action, the justification for it, the benefits expected to arise from the action, the objectives and KPI's that will be affected and the tactics for implementing the strategic action. Before discussing the actions, a small topic will explain the order of prioritization of actions.

5.1 Prioritization of Actions

Before discussing the actions, it is important to discuss the priority that they should be given. There are two main points to considerate here: the areas that demand more immediate action, and the strategic actions complexity.

As seen in the Situational Analysis, the area demanding the most attention is the attraction of talents. The Production Engineering course has been slowly falling behind other courses in the KPIs connected to students' attraction, and as so actions that remedy this should be prioritized.

Concerning the complexity of the actions, some are really simple and can be started implemented right away, whereas others are more complex and should be well thought and designed before implementation, possibly with pilot programs being used first to evaluate its effectiveness.

With these two things in mind, we can separate the actions in three levels of priority. The first level of priority consists of important actions that should be implemented as soon as possible. These are the actions described in chapters 5.2 – High school and prep courses lectures, 5.3 – Women focused lectures and reunions and 5.4 – Candidate-dedicated website.

The second level of priority includes two actions: the mentoring program, which is a complex action that should be first tested on a pilot program, and the lectures with former outgoing exchange students, a simple action that targets an area in which the course is doing well, internationalization, and because of that this action is not so urgent.

Finally, the third level of priority includes more complex actions with a lower urgency, and higher complexity. These actions are the marketing plan for incoming students and the official stage & jobs portal, and as such these actions will not be discussed in the same depth as others.

5.2 High School and Prep Course Lectures

In Brazil there is a high concern among high school students about the admission exam for colleges, the "*vestibular*". The exams of the top universities are highly competitive and demand a broad knowledge of all subjects taught in school. To better prepare for the admission exams, many students turn to prep courses, known as "*cursinhos*" (little courses), which revisit the content that students are required to know and teaches specific techniques to improve performance in the exam.

Many of the students in both high schools and prep courses are not sure of which course they should apply to for college and many other students know what they want to study but have doubts about what the best universities are for that course. Giving lectures on Production Engineering will make the first group more prone to choose this career and the second group more certain that *Escola Politécnica* is the best place to take this course. This is important to ensure that the Production Engineering course receives well-prepared and motivated students.

5.2.1 *Specific tactics for implementation*

The students' union for the production engineer course (CAEP) already gives lectures about the course to schools where its members studied in high school. Through interviews with professors of the course and members of the students' union, it was made clear that the best option for the department is to use CAEP's know-how by sponsoring and expanding its current lecture program.

The material suggested to use in this presentations is included in the ANNEX. It consists of a 22 page PowerPoint presentation, which will be the same presentation used in the women focused lectures (action 6.2) and will be available in the candidate-dedicated website (action 6.3), with some small adaptations. Since this presentation is important to three of the proposed

actions, it will be detailed here. It is important to keep in mind that the presentation is only a guideline for the lecturer, who should add insights from his/her perspective on the material and conduct the lecture according to the audience expectations and interests.

The presentation starts with a small introduction of the *Universidade de São Paulo*, and the reasons why one should want to study in this prestigious institution. Then, there is an explanation on the admission exam, the *vestibular*, as well as some tips for succeeding in it. Following that, there is some information on how to choose your career, a common issue on the minds of high school students. After that, there is an explanation on what exactly does it mean to "be an engineer", followed by an explanation on what Production Engineering is, and why should one study it. The lecturer shall then speak on the labor market opportunities for production engineers, highlighting the most common paths taken by Poli graduates. In sequence, there are some slides to show all that Poli offers its students, including extra-curricular groups, sports activities, exchange programs, academic events, social events, etc. The next subject should be the daily routine at the Polytechnic School of São Paulo and the subjects studied, showing what the students might expect during their university years. This should also include a note on the woman's life at Poli, which will be discussed in more depth on the next chapter. Finally, the lecturer should give contact information for him/her, for the students' union and for the Production Engineering Department.

The lecturers should be three to five students of the PEC, with at least one per lecture being enrolled on the third year or higher. This number of lecturers was the one with the best feedback from schools in past lectures, as fewer students may have a hard time coordinating activities and interacting with the audience, while more students would risk creating confusion in the lecture. If there are students willing to give the lecture who have studied in the school/prep course receiving the lecture, they should be given preference, as they will have more easiness to build rapport with the audience. Also, it is better to have at least one woman among the lecturers, and this will be looked upon on the next chapter. To create an incentive for students to become lecturers, the PRO could issue certificates of participation in the lectures, which could be included in the students' curriculum.

Regarding the choice of schools to receive the lectures, it should be easier to start with schools which already have programs to receive former students to talk about universities, or who have in the past received lectures of the students' union, and which have former students in the PEC. These schools include but are not limited to the Colégio Santa Cruz, Colégio

Bandeirantes, Colégio Dante Alighieri, Colégio Etapa, Colégio Vértice, Escola Móbile and Colégio Visconde de Porto Seguro. However, the lectures should not be limited to these schools, as this would only reinforce the same student pool we have today. With time, public schools in São Paulo should be aimed. It would also be good to do specific lectures aimed at informing public school teachers, so that they can inform their students, creating a multiplying effect for each lecture. As said before, the material and video versions of the lectures should also be available online to broaden the range of schools reached, which will be discussed on chapter 6.3.

In order to maximize the efficiency of this action, it would be good to schedule the lectures between April and August, when the candidates are choosing which course to apply to. After August, this choice has already been made and we can no longer influence it. To allow this scheduling, I propose the following timetable (figure 5.1):

Figure 5.1 - Proposed Timetable for action 1: High School and Prep Course lectures.
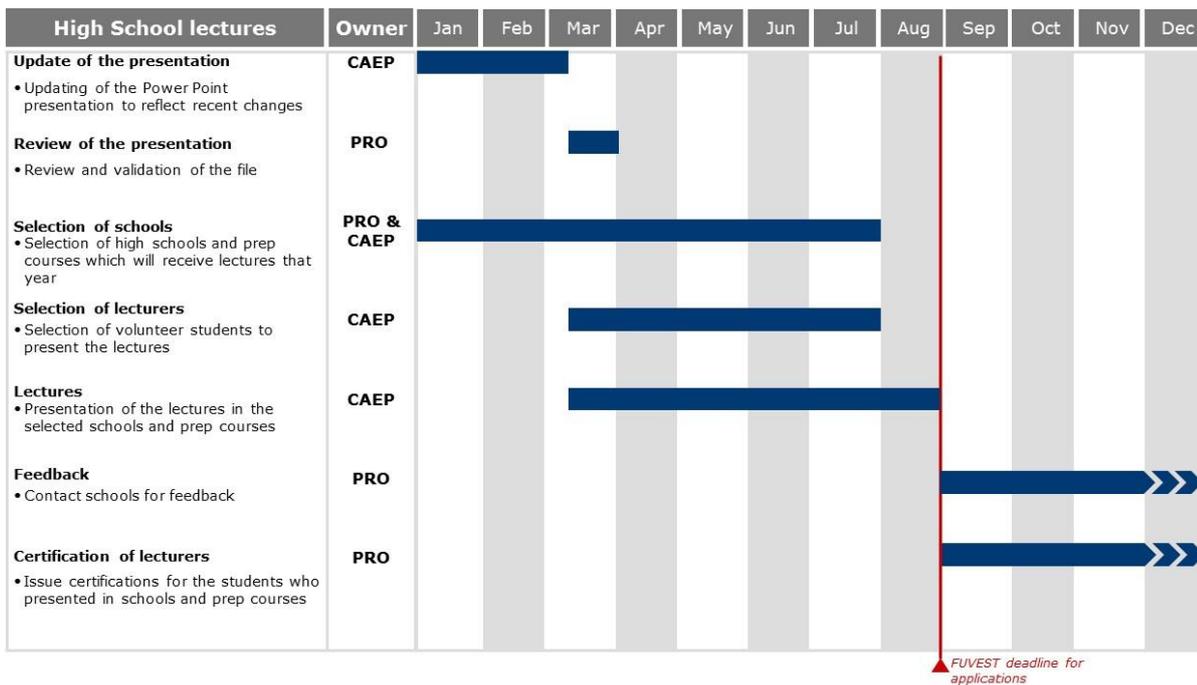
Source: author

The first column on the timetable states the action to be performed and a short description of it. The second one shows the "owner" of the action, that is, the agent responsible for performing it. Then the month columns show when is the action supposed to take place. The FUVEST deadline for applications is showed in red, but it is important to note that the exact

they varies from year to year. Historically, it is usually between August 15th and September 15th.

5.2.2   KPIs affected by the action

By boosting interest in the course, this action will affect mostly the indicators related to attraction of students. The rise in demand expected from this action will improve the KPIs 1.1 – Candidate / Opening, 1.2 – Percentage of students actually enrolled and 1.3 – Last position in admission exam enrolled in the course. The first, KPI 1.1, is the most directly affected, as there will be more candidates for the same number of openings. KPIs 1.2 and 1.3 will be also affected by the higher priority given to the course by the students, in relation to other courses. In addition, the better information about the course will lessen the chances of students being frustrated over misplaced expectations about the contents of the course, also improving KPI 1.2.

If the lectures make the potential students more interested in exchange programs, they will also have a small effect on the internationalization KPIs for outgoing students, KPIs 2.1 and 2.2

5.3 Women focused lectures and reunions

This action is very similar to the first one, but with a focus in female candidates and students. It consists of lectures in high schools and prep courses given by female students to female candidates, as well as informal reunions with the same focus: creating interest in Production Engineering and showing through personal experience that it is possible for women to be successful in the course.

### 5.3.1   Specific tactics for implementation

In the review of the literature, it was shown the importance of female role models for young women (LOCKWOOD, 2006). This action aims to put female potential candidates in direct contact with female students who succeeded in being admitted into the course.

The implementation of the lectures is quite similar to the previous action, with the only difference that the lecturers and the target audience will be female. The content of the lecture must also be modified, including a bigger focus on being a woman in the university. To broaden the interested audience the lecture might cover also some aspects of other engineering courses, but always with Production Engineering students and focusing on this course.

The informal reunions are socializing events that can be done immediately after the lecture, or in a completely different day, according to the high school or prep course preference. It would also be good to organize one official event to welcome the female students to the course, in order to ensure that they enroll for it and to minimize any anxiety they might have concerning university life. This event shall be held before the school year starts, inside the university, so the new students can feel safe in this environment. Older students must be invited to share their experience with the new students. Again, CAEP can help the department with the invitations and organization, but it is the department's responsibility to make the event happen.

The proposed timetable for this action (figure 5.2) is exactly the same for the first one, but including the organization of social events parallel to the organization of the lectures.

Figure 5.2– Proposed timetable for action 2: Women focused lectures and social events
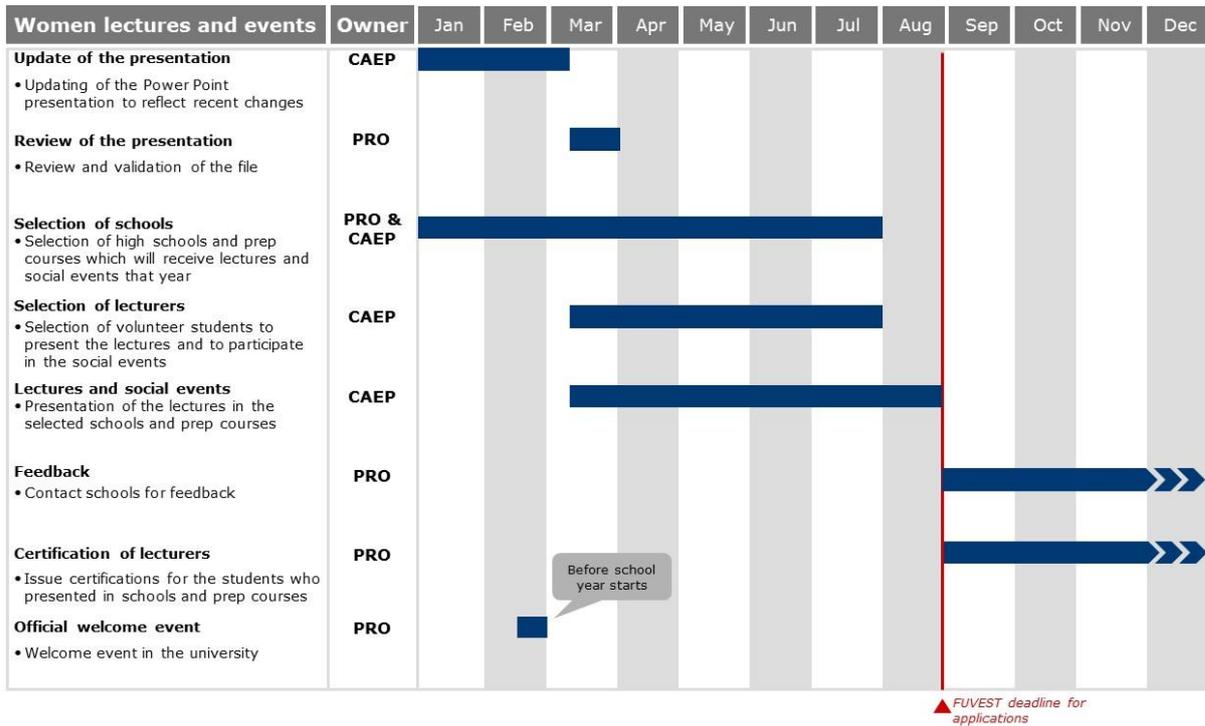
Source: author

5.3.2   *KPIs affected by the action*

This action aims to attract female candidates, so it will affect the indicators related to gender diversity. Those are KPI are KPIs 1.4 – Percentage of women applying for the course, 1.5 – Ratio between approval rates of men and women, 1.6 – Percentage of women accepted and 2.7 – Percentage of female nominees to the best thesis award.

As demonstrated in the review of the literature, bringing female talent into the course will also improve the overall level of knowledge of students entering the course, as well as their satisfaction and performance during the course. Hence, it is expected that this action have an indirect effect on KPIs 1.1 – Candidates / Opening, 1.2 – Percentage of approved candidates actually enrolled, 1.3 – Last position in the admission exam enrolled in the course, 3.1 – Evaluation in the "Guia do Estudante Abril" and 3.2 – Ranking in the "Ranking Folha de Universidades".

Finally, by the same reasons of the previous action, this action may have a small impact on the number of outgoing students, improving the KPIs 2.1 – Outgoing students in double degree programs and 2.2 – Outgoing students in credits exchange programs.

5.4 Candidate-dedicated website

This is a simple action designed to better inform potential students about the admission exam and the course. It consists in the creation of a website dedicated to the candidates, bringing together all information that is relevant to them. It should target not only high school Brazilian students, but also foreign students trying to gather information on the course with the intention of taking part in an exchange program.

5.4.1 Specific tactics for implementation

The Production Engineering Department already has a website; the simplest way to implement this action is to create a page in this website dedicated to candidates, with a link to it in the home page. There are many private universities of Brazil which have candidate-dedicated pages and which can be used as an example to draw inspiration from.

Figure 5.3 shows the current state of PRO's homepage. The most useful information for candidates in this page is "*O Curso*" (the course) and "*Disciplinas*" (subjects), the latter still displaying outdated information from 2013.

Figure 5.3 – Homepage of PRO's website
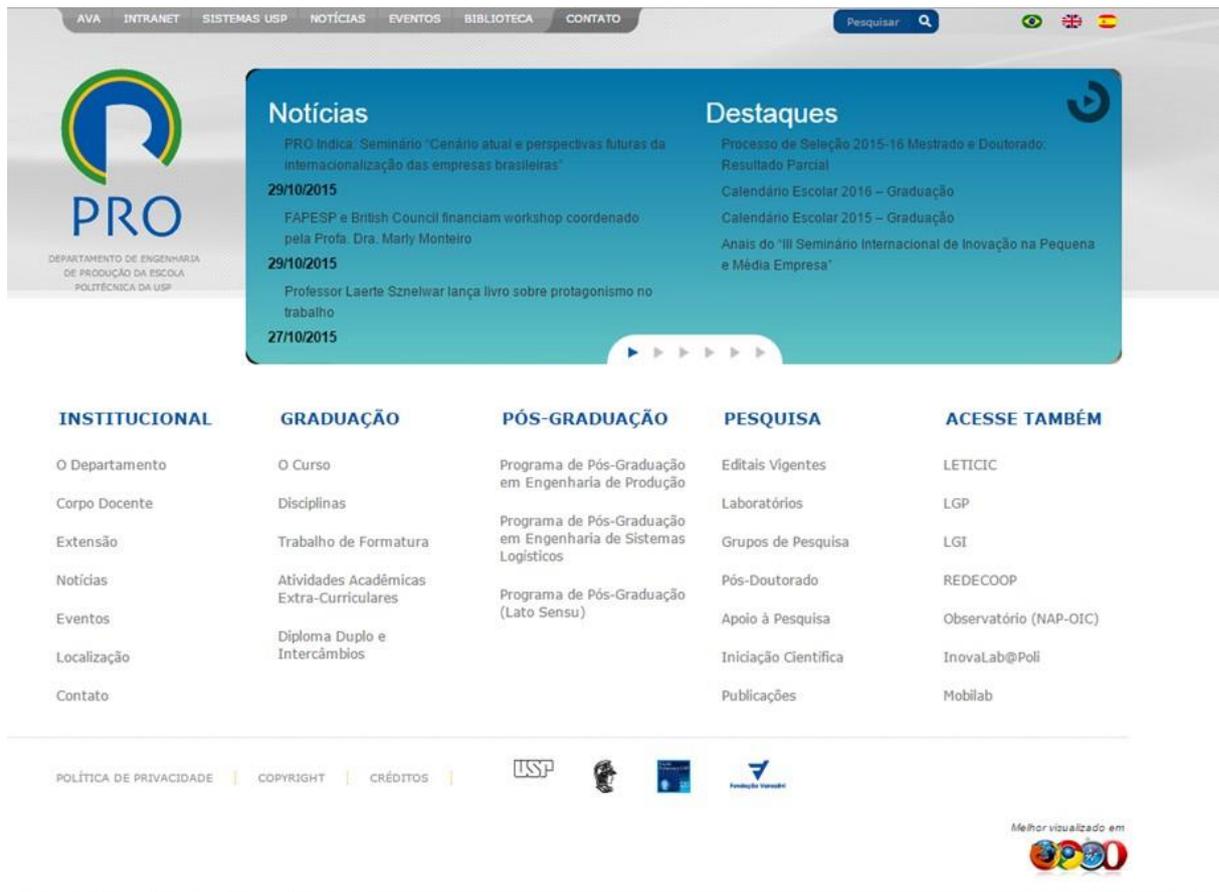
Source: (PRO, 2015)

Adding a "*Candidatos*" (candidates) section will help candidates looking for information. This section shall have four subsections:

- "*O Curso*" (the course), moved from the "*Graduação*" (undergraduate course) section.
- "*Por que Poli?*" (why Poli?)
- "*Mercado de trabalho*" (labor market)
- "*Vestibular*" (admission exam)

Figure 5.4 shows a suggestion of the homepage with the addition of this information.

Figure 5.4 – Homepage of PRO's website with suggested section added
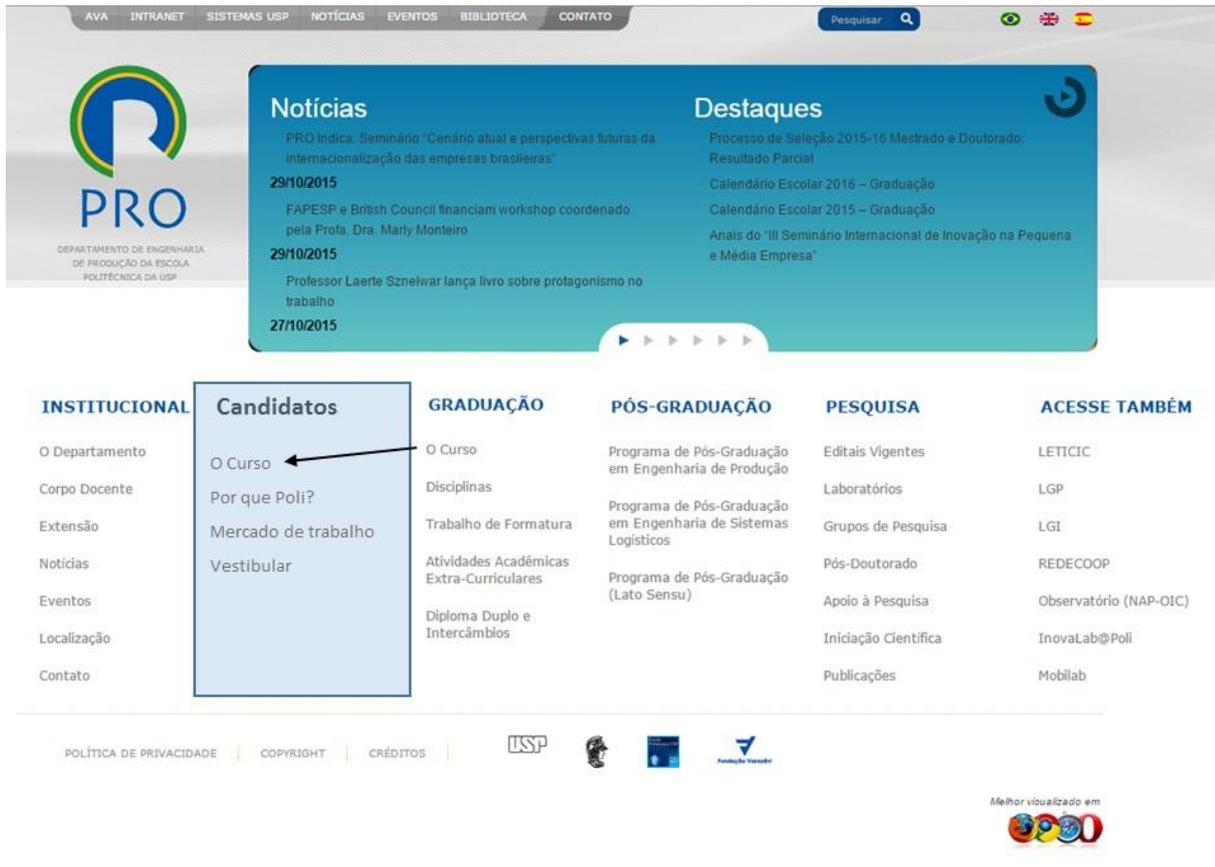
Source: adapted from (PRO, 2015)

Figure 5.5 shows the navigation header of the website with the added suggestions:

Figure 5.5 – Navigation header of PRO's website with suggested section added

Source: adapted from (PRO, 2015)

"The course" should have information on the Production Engineering Course, concerning the lessons, the way the course is structured, what to expect from the course, who are the professors and why the course is the way it is. There should also be links to the subject pages with the syllabus and times.

The "Why Poli?" section should list the reasons why one might want to study production engineering at the Polytechnic School of São Paulo, including Poli's and USP credentials and advantages in comparison with other universities

The "Labor Market" section should show what the candidates can expect after graduation. There should be a list of the most common careers chosen by graduates – finance, consulting, IT, logistics, manufacturing industry, academic, entrepreneurship, etc. – expected levels of salary, examples of famous/successful alumni, etc. This section is especially important in attracting students because the career outlook after graduation is justifiably one of the most important drivers in choosing a college course.

Finally, the "*Vestibular*" section must include pertinent information on the admission exam, including the demanded knowledge, dates, deadlines, exam format and fees.

It is important to highlight that both national and foreign candidates will use the page, so it should also be available in English to facilitate the understanding of the information to foreign candidates.

Ideally, this webpage should be available before August 2016, so candidates applying for the class of 2017 can use it. To make it possible, the following timetable is proposed (figure 5.6):

Figure 5.6 – Proposed timetable for action 3: Candidate-dedicated website
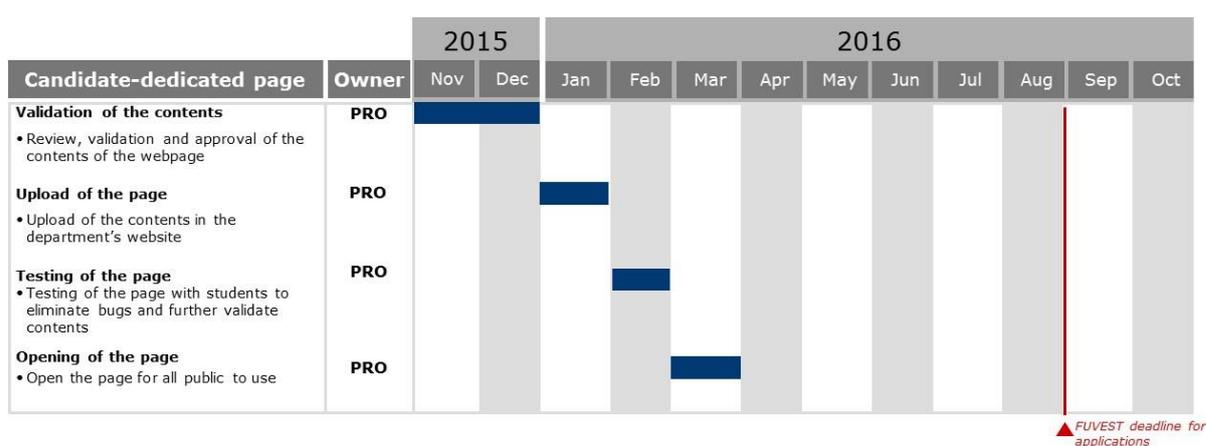
Source: author

This timetable will allow the candidates to access the page in April, around the time when most candidates start thinking about their career choice more seriously.

5.4.2 KPIs affected by the action

This action is aimed at potential candidates for the course, national and foreign, and as such will affect the indicators related to the attraction of students and the incoming foreign students. It is expected a small effect on the KPIs 1.1 – Candidates / Opening, 1.2 – Percentage of approved candidates actually enrolled, 1.3 – Last position in the admission exam enrolled in the course, 2.3 – Incoming students in double degree programs and 2.4 – Incoming students in credits exchange programs.

5.5 Mentoring

This action consists in the establishment of a peer-mentoring program, with older students mentoring younger ones, similar to those of the University of Michigan and University of Sheffield, as shown in the review of the literature. As it was seen, such programs provide various benefits for both the mentor and the mentee.

5.5.1 Specific tactics for implementation

The proposed structure for the mentoring program is to have volunteer third-year students mentoring small groups of first-year students. In the third year, the student is in the middle of the five-year course and should be already used to the university life. If mentors were younger, they might not have enough experience to help the mentee. If older, they would be more likely to end the mentorship early or fail to put the required effort in it, due to internships or exchange programs.

The third part of the mentorship besides the mentees and the mentors will be the supervisors, one or two professors whose role is to train and orientate the mentors, and oversee their relationship with the mentees.

This action is more complex, and as such before its full implementation it would be beneficial to first implement a pilot mentoring program, analyze it, and only after its benefits are verified and its flaws are corrected implement the full mentoring program. The main

difference between the pilot and the full program will be the scale, for the full program all first year students will be automatically assigned a mentor. In the pilot, the program will be optional, and only students who opt-in for the mentoring will be assigned a mentor. We will first look at the pilot program.

This action is not a priority (full discussion on prioritization can be seen on section 5.8), so its beginning can be delayed until the second semester of 2016. Figure 5.7 shows a proposed timetable for the pilot program. The first step is to designate two or three Supervising Professors who will be responsible to make sure the following steps are taking. It is important to note that this professors will not be responsible for personally completing the required tasks (for example, they will not design the training themselves), but instead they are responsible for ensuring the tasks are completed. Ideally, these Supervising Professors should be volunteers.

Figure 5.7 – Proposed schedule for the pilot mentoring program.

Source: author

The second step is to design a training program for the mentors, which should cover aspects such as:

- what a mentor is and what it is not;
- how to handle the mentees and how to motivate them;
- who to go to for help if something is going wrong;
- how, where and when to meet the mentees;

- information on the University that must be passed on to the mentees.

The design of the training program should involve students who can give valuable inputs on the topics to be covered and the difficulties the mentees will face when entering the university.

The third task required is the selection of volunteer students to be mentors. Given the smaller scale of the pilot program, a reduced number of students (between 5 and 10) is required. The production engineering course has a high rate of involvement of students in academic programs, and as such, it should not be hard to find this number of volunteers.

The training of said mentors will take place during the summer vacations, in a week convenient for professors and mentors. Besides coaching the mentors, the training will also be useful to collect information on the mentors, in order to assign them to better fitting mentees. In addition, the training will be an opportunity for the mentors to know each other better.

When the school year starts in February, new students should be given the option of participating in the mentoring program. Students who opt-in for the mentoring should be assigned to the mentors during the first two weeks of lections, and their mentors should contact them as soon as possible. The exact number of mentees per mentor will depend on the number of mentors that volunteered.

After that, the mentor should meet the mentees at least once a week to follow their progress and make sure they are settling well. When the time for exams arrive, the mentors should orientate the mentees and give tips on different ways to study for the various subjects of the course.

The mentorship will officially last for one year, ending when new students are admitted into the course in the following year. However, it is expected that mentors and mentees bond, and that mentors continue to support the mentees during their next years in the university.

To encourage volunteers and to ensure their commitment, mentors will be awarded two activity credits after the mentorship, which count towards the completion of the course.

When classes resume on August, after winter vacations, all mentors and Supervising Professors should schedule a feedback meeting to discuss the merits and flaws of the pilot

program, and start designing the full-scale program for the next year – or recommend terminating it, if it is the case.

5.5.2 *KPIs affected by the action*

The mentoring program is expected to improve student satisfaction and performance, which in turn will improve retention. Unfortunately, the KPIs that measure these factors have not yet been developed. Between the already developed KPIs, the ones that will be affected are the indicators concerning the reputation of the course, and the internationalization ones concerning outgoing students.

The indicators 3.1 – Evaluation in the *"Guia do Estudante Abril"* and 3.2 – Ranking in the *"Ranking Folha de Universidades"*, which are external evaluations of the course, will be affected as the mentoring program is expected to improve the general conditions of the course. In addition, the establishment of the mentoring program is a signaling of commitment to the quality of the course, and will certainly be seen positively by the labor market and by these evaluators.

The indicators 2.1 – Outgoing students in double degree programs and 2.2 – Outgoing students in credits exchange programs are also likely to increase. First, because mentoring is known to improve performance, and the selection of students for these programs factor in the academic performance of the candidate. Moreover, the increased contact with older students will put the younger ones closer to exchange opportunities and will likely increase their interest in participating in exchange programs.

5.6 Lectures with former outgoing exchange students

This action consists of organizing lectures with former students who participated in exchange programs before their graduation. These former students would be able to talk about not only the experience, but also how it helped them in the search for jobs and in their professional lives, raising both awareness of the existence of different exchange programs and students' interest in participating.

5.6.1   Specific tactics for implementation

To organize these lectures, it is essential to keep a record of the students who participated in exchange programs, which in the future can also be useful to measure the impact of the exchange programs in the students' career. This record keeping should start as soon as possible, recording the students who are now in exchange programs abroad or who have recently returned to Brazil. In the next years, the department should update these records when authorizing students to go study abroad.

After this information is recorded, the department will be able contact former students who participated in exchange programs and compile a list of the ones interested in sharing their experience with the younger students.

The targeted group for these lectures would be mainly the students of the first three years, as most exchange programs start between the middle of the third and the middle of the fourth year. The ideal timing for that would be on the first semester of each year, when the students are looking at exchange options and deciding whether to participate in them, and should take into account the common appointments of the students, such as classes, academic events and exams.

The next step is to choose the lecturers. A number of 3-5 lectures would be enough to cover a wide range of countries of destiny, modality of exchange programs, economic sector of employment and years since graduation. The selection of lecturers should maximize the diversity of the group according to these criteria. They should then be contacted and agree on what topics each of them will cover.

Before the actual lecture, the department should publicize it widely, trying to attract the most students to watch it. The students' union can be asked to help in this, increasing the number of media through it the lecture is divulgated. The divulgation should start at least one month before the lecture, and be reinforced in the last days before it.

Finally, the lecture should be organized like any other lecture held by the department, providing all resources necessary for it to occur without any setbacks and providing food and

drinks for a socializing event after the lecture. After the lecture, it is important to get feedback from lecturers and students to constantly tweak the program to increase its effectiveness.

Figure 5.8 summarizes the recurring steps to be taken to ensure that the lectures happen every year. The first step, the initial consolidation of records, is not on the figure because it will be taken only once, to start the records, which will be then only updated every year.

Figure 5.8 – Timetable for lectures with former outgoing exchange students

Source: author

5.6.2 *KPIs affected by the action*

This action specifically targets the KPIs related to the number of outgoing students, KPI 2.1 – Outgoing students in double degree programs, and KPI 2.2 – Outgoing students in credits exchange programs.

5.7 Marketing plan for incoming exchange students

This action consists in the elaboration of a marketing plan targeted at foreign students to attract more incoming students to the university, while making the institution name known to more people worldwide, improving its reputation.

5.7.1 *Specific tactics for implementation*

The complete marketing plan will be developed in a subsequent work, as it is a lengthy and complex task, which exceeds the scope of this work. Nevertheless, some guidelines can be set, as well as some suggestions on the way of doing it.

The plan can be developed as a student's thesis, preferably a student who have participated in an exchange program, and as such will have some international experience. The student can draw examples from many universities worldwide that actively reach out to foreign students.

It is important to determine which foreign countries and universities will be targeted, and how the marketing plan has to be tailored to meet the different expectations of the various kinds of students who might be interested in studying Production Engineering at Poli.

5.7.2 *KPIs affected by the action*

The two KPIs targeted by the action are the ones measuring the number of incoming students, KPIs 2.3 – Incoming students in double degree programs and 2.4 – Incoming students in credits exchange programs.

5.8 Official stage & jobs portal

This action consists in the creation of a stage & jobs portal, in which companies will be able to announce openings both for interns and for newly graduated students, and the students in turn would be able to see a complete listing of available openings, compare the positions, check the requirements and apply for the jobs that interest them.

5.8.1 *Specific tactics for implementation*

The portal is a two-sided interface connecting companies and students. On the companies' side, there must be a form to fill with the information on the company and on the opening, such as work hours, compensation, job description, company description, requirements for the job and candidate profile wanted. The companies also need a way of receiving the applications and replying to the candidates.

On the students' side, they should be able to see a complete list of the available openings, with the name of the company and the position. Clicking on the openings will allow the students to see the details described above and to apply for the job, attaching any required document, such as the transcript of records or curriculum vitae. Figure 5.9 presents a screenshot of Polito's stage application, which may be used as a model to be based on.

Figure 5.9 – Screenshot of the list of job openings for newly graduates in the Polito's student portal

Source: (POLITO, 2015)

The Production Engineering department currently uses a web application to communicate with its students, called AVA, an acronym in Portuguese for "Virtual Learning Environment". The Stage & Jobs portal could be nested in this application, as all students already use it.

Many companies already advertise their openings in Poli through e-mail and recruiting events, these companies would certainly be interested in a new channel to reach the students. The department can easily persuade these companies to register their openings in the Stage & Jobs portal.

The administration of the openings can be made by the students' union, as they receive many offers through alumni and companies that have already stablished relationships with the union. They would be responsible for adding new entries and removing old ones.

A great advantage of this action is the ease for students and former students to register their companies in the system, as they will be already used to using it. This will help startup companies created by students to recruit people, boosting entrepreneurship between students and former students.

5.8.2   *KPIs affected by the action*

By providing students with a higher number of companies in which they can do their internship, this action will affect the KPIs 2.2 – Internship by industry sector and 2.6 – Internship in new companies. It is expected that the higher number of options will result in a higher diversity between industry sectors, and a higher proportion of students going to work in new companies.

Helping the students finding a job will also have a positive effect in the external indicators of performance, KPIs 3.1 – Evaluation in the "Guia do Estudante Abril" and 3.2 – Ranking in the "Ranking Folha de Universidades".

5.9 Monitoring the progress of the plan

To make sure the proposed actions are bringing positive results to the course, it is essential to monitor the impact they are having on the KPIs and consequentially on the objectives defined in chapter 5.

The Undergraduate Course Coordinating Committee should control the monitoring process, by updating the KPI data once a year and comparing it with the targets. Feedback from

teachers, staff and students must also be taken into account during the yearly monitoring. Most indicators can only change once a year, as this is the frequency of admission exams and other evaluations, so it is pointless to monitor them more frequently than that.

The second step after accessing the state of the KPIs is to take corrective actions. KPIs that are not improving as expected might be signaling that the strategic actions were not suitable to improve them, or that they were not undertaken as they should. The Committee should judge what the case is and act to put the Strategic Plan back on its tracks. If the Committee decides that the targets will not be met, they might be adjusted, but this must be a last resort. On the other hand, if targets are met early the Committee could propose new, more ambitious targets.

By monitoring the progress, the Committee will be in position to decide when and how to implement each of the proposed actions, and to cancel them if they prove to be counter-effective. However, to do so, it is important to be able to link the effect on the KPIs directly to the actions, and this can be hard, as most KPIs are targeted by more than one action. To be sure about which action is having the observed effect, it is important to gather feedback from all stakeholders, with special attention to students, as they will be able to tell the Committee which actions have had the most impact on them.

6 CONCLUSION

A set of strategic actions for the Production Engineering Course in *Escola Politécnica* have been proposed, along with specific implementation actions for them. They were developed based on the review of the literature presented in chapter two and on the situation analysis presented in chapter four, using the methodology explained on chapter three. The actions were also discussed and validated with the professors of the Course Coordinating Committee, to ensure their viability and effectiveness.

The situational analysis yielded interesting information. It is possible to see from the Key Performance Indicators that the Production Engineering Course (PEC) is comparatively in a favorable situation, although the attraction KPIs have suffered a small decrease in the last decade. Other courses in the Polytechnic School have improved their numbers in this area, demoting the PEC from the most wanted course position to the fourth position in candidates / opening and the third position regarding the rankings of the students in the admission exam.

The situation is different regarding the internationalization KPIs. The overall trend of these indicators is positive, and if the PEC is not in the first position in some of these KPIs anymore this is due to a faster growth in other courses, fueled by the federal government's exchange scholarship programs. This scenario is expected to change in the next years, as most scholarship programs are being cancelled or dramatically reduced, due to the Brazilian economic crisis.

Still, the course holds its position as one of the best production engineering courses in Brazil – arguably the best – and one of the most prestigious courses of USP. The strategic actions developed in this work aims to strengthen this position and improve the course, by drawing inspiration from other successful Higher Education Institutions globally, and referring to the literature on the subject. All of the actions are within the resources of the Production Engineering Department, even though some are complex and may need more time and better planning before their actual implementation.

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ANNEX A – Proposed presentation for schools and prep courses

Presentation elaborated by the production engineering students' union

Por que USP?

- Maior Universidade da América Latina

- Entre as 100 melhores Universidades do mundo, segundo a Times.

- Uma das Universidades mais antigas no Brasil

A USP em números

- Criada em 1934

- 92.064 alunos matriculados

- 5.860 professores

- R$ 4.376.193.120,00

Vestibular

- Dedicação, persistência
- Estudo contínuo e de qualidade
- Simulados
  - Preparação física;
  - Conhecer melhor as provas;
  - Lidar com o tempo de prova.
- Refazer provas de anos anteriores.
- Redação
- Atualidades

CAEP

No dia da prova

- Chegar cedo ao local de prova;

- Manter a calma;

- Aproveitar bem o tempo;

- Atenção aos documentos e às restrições de cada prova.

CAEP

Como escolher minha carreira?

- Mercado de trabalho;

- Estrutura curricular;

- Conversar com alunos e pessoas formadas

- https://uspdigital.usp.br/
- http://ec3.polignu.org/

CAEP

O que é ser Engenheiro?

Raciocínio lógico

Conectado

Comunicativo

Conhecimento técnico

Resistente psicológicamente

Líder

Organizado

Bem relacionado

Multicultural

Empreendedor

CAEP

O que é Engenharia de Produção

- O curso de Engenharia de Produção tem como objetivo formar profissionais habilitados ao projeto, operação, gerenciamento e melhoria de sistemas de produção de bens e serviços, integrando aspectos humanos, econômicos, sociais e ambientais.

CAEP

Por que produção?

- Engenharia interdisciplinar

- Mais envolvida com pessoas

- Diversidade no mercado de trabalho

CAEP

Mercado de trabalho

```
                    Engenharia de Produção

        Indústria      Consultorias    Mercado Financeiro    Empreendedorismo

     Bens de Consumo      Processos          Varejo

     Indústria Pesada     Estratégica        Fundos

                                              IB
```
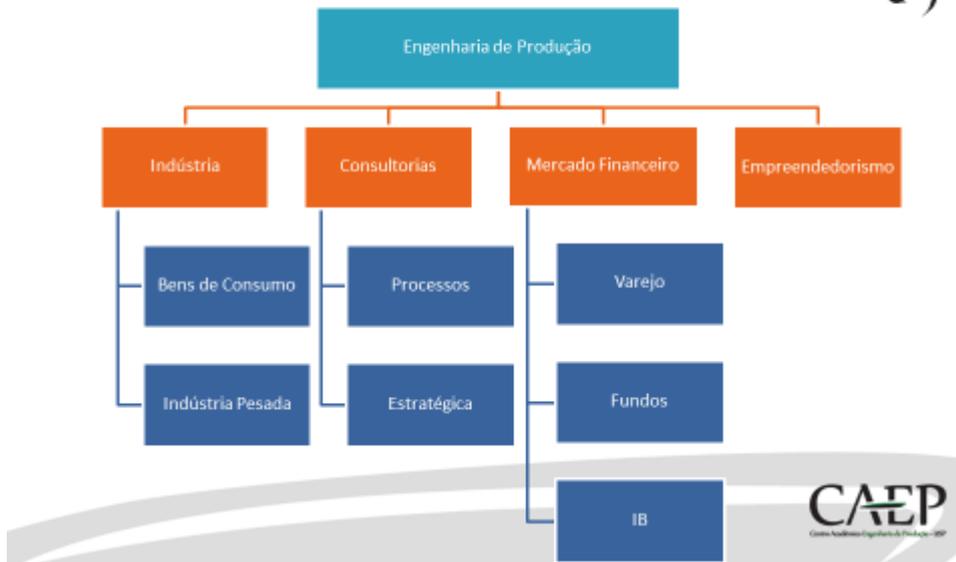
CAEP

O que a Poli oferece?

- Grupos de extensão

- Atividades esportivas

- Intercâmbio

- Eventos acadêmicos

MELHORES UNIVERSIDADES 2012
Engenharia de Produção
Universidade de São Paulo – São Paulo
★★★★★

CAEP

Grupos de extensão

PoliMilhagem

POLI
CONSULTING
CLUB

poli
júnior

EQUIPE
POLI
RACING

KEEP FLYING

iPoli

ThundeRatz

CAEP

Atividades Esportivas

- 30 modalidades diferentes

- Estrutura do CEPE-USP

ATLÉTICA
POLI - USP

CAEP

Intercâmbio

- Duplo diploma

- Aproveitamento de estudos

- Ciências sem fronteiras

- Bolsas de estudo

CAEP

Eventos acadêmicos

- Palestras

- Debates

- Viagens

CAEP

Dia a dia na Poli

- Período integral
    - 7:30 às 16:40

- Restaurantes

- Atividades extracurriculares

CAEP

A mulher na Poli

- 23% de bixetes na produção em 2014

- Participação em diversas atividades

CAEP

Estrutura curricular

Áreas

- Matemática
- Física/Química
- Mecânica
- Gestão da Produção
- Gestão de Empresas
- Outros
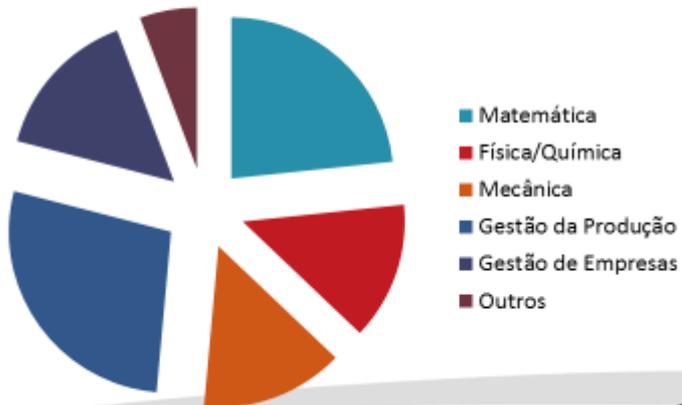
CAEP

Festas, eventos, outros

- Centros Acadêmios

- Atlética

- Vivência

- IntegraPoli

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Visitem nosso Site!!!

- http://caep.poli.usp.br/

- Caep Poli Usp
- https://www.facebook.com/caep.poli.usp/

- Osni Patrão(mascote)
- https://www.facebook.com/profile.php?id=100009593289605&fref=ts

CAEP

Obrigado pela atenção!!

Perguntas??

CAEP

ANNEX B – All proposed KPIs

Table AB.1 – KPIs in the stakeholder perspective, area attraction

Stakeholders: students, potential students, society		Area: Attraction	
Objectives	**Objective is demonstrated through:**	**KPIs**	**Measurement unit**
Attract the best candidates	Demand for the course	**Candidates / opening**	Ratio between number of candidates and number of openings
	Enrollment priority	**Percentage of approved candidates actually enrolled**	Percentage
	Admitted students' performance	**Last position in the admission exam enrolled in the course**	Position of the last candidate in the admission exam
Diversity in the composition of classes	Balance between genders	**Percentage of women applying for the course**	Percentage
		Percentage of women accepted	Percentage

	Ratio between approval rates of men and women	Ratio between rates
Balance between students from public and private schools	**Percentage of students from public schools applying for the course**	Percentage
	Percentage of students from public schools accepted	Percentage
	Ratio between approval rates of students from public and private schools	Ratio between rates

Source: Adapted from (BAIN, 2015)

Table AB.2 – KPIs in the stakeholder perspective, area formation

Stakeholders: students, companies, university		Area: formation	
Objectives	**Objective is demonstrated through:**	**KPIs**	**Measurement unit**
Foster international experiences	Outgoing exchange students	**Outgoing students in double degree programs**	Percentage of the class going to other countries
		Outgoing students in credits exchange programs	Percentage of the class going to other countries
	Incoming foreigner exchange students	**Incoming students in double degree programs**	Percentage of the class that comes from other countries
		Incoming students in credits exchange programs	Percentage of the class that comes from other countries
Ensure diversity in internships, understand where students are working	Diversity in industries where internships are held	**Internship by industry by year**	Percentage of students in each industry sector each year
		Aggregated internship by industry	Percentage of students in each industry sector in total
	Diversity of companies age where internships are held	**Internship in new companies**	Percentage of students who take internships in companies with less than 10 years of existence

Understand student satisfaction levels	Evaluations made by the institution	**% of satisfaction in institutional evaluations**	Percentage
	Evaluations made by the students	**% of satisfaction in student evaluations**	Percentage
Understand the role of diversity in performance	Women performance	**% of best thesis awards given to women**	Percentage
	Public school students performance	**% of best thesis awards given to students from public schools**	Percentage
Foster students involvement in extracurricular activities	Research participation	**Percentage of students involved in research**	Percentage
	Participation in other groups as Junior Companies, Students' Unions, Sports groups, theater group, etc.	**Percentage of students involved in extracurricular activities**	Percentage
Improve graduation rate and decrease time to graduation	Average time to graduation	**Semesters to graduate - by year of enrollment**	Number of semesters
	Dropout rates	**% of dropouts - by year of enrollment and by gender**	Percentage

Source: Adapted from (BAIN, 2015)

Table AB.3 – KPIs in the stakeholder perspective, area professional performance

Stakeholders: Students and former students		Area: Professional performance	
Objectives	**Objective is demonstrated through:**	**KPIs**	**Measurement unit**
Ensure positive outlook for graduates	Ease of obtaining employment	**Rate of employability in the first year after graduation**	Percentage
	Remuneration	**Average salary in the first year after graduation**	Brazilian Reais (R$), adjusted for inflation
	Job satisfaction	**% of satisfaction in the first job after graduation**	Percentage
Have a high level of acknowledgment of the course	Performance against similar courses in university rankings	**Evaluation in the "Guia do Estudante Abril"**	Number of stars given to the course
		Ranking in the "Ranking Folha de Universidades"	Position in the ranking
Inspire leadership in the students	Former PRO students starting companies	**Companies started by former students per year**	Number of companies
	Former PRO students leading companies	**Number of former students in C-suite positions per year**	Number of students

Source: Adapted from (BAIN, 2015)

For the other perspectives, André Bain draw indicators from the literature and from meetings with the Undergraduate Course Coordinating Committee, presented in the following table:

Table AB.4 – Additional indicators

Indicators in the perspective…				
Financial	Stakeholders	Internal Business Process	Learning and Growth	Social Responsibility
1. Total cost per student	**1. Number of prizes received by students**	**1. Activities to avoid dropouts and their effectiveness**	**1. Professor exchange programs**	**1. Number of students participating in or contributing with social activities**
2. Revenues from training and consulting directed to teaching		**2. Number of patents, brands, intellectual property rights and spin-offs created in the undergraduate course**	**2. Professor satisfaction**	**2. Number of social impact projects created by students**
3. % of resources allocated to teaching		**3. Class size**	**3. Non-teaching staff satisfaction**	**3. Number of employees participating in or contributing with social activities**
			4. Expenditure with professional development	**4. Number of complaints / accusations in the last five years**

Source: Adapted from (BAIN, 2015)