IMPACTS OF THE TECHNOLOGY FORESIGHT IN THE ANTICIPATED VOCATIONAL EDUCATIONAL DEMAND: A CASE OF BRAZILIAN INDUSTRY

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Abstract

The process of technological changes being faced by industries poses new challenges for institutions involved in vocational education and provision of specialized technical services. The dissemination of new sorts of equipment, processes and techniques for organizing production causes deep changes in skills profile and quantity of labor force demanded by the labor market. Over last few years, Brazil underwent significant changes concerning level and occupational structure of industry-based employments, as a consequence of changes in both economic and technological contexts faced by the companies. On one side, the opening of economy to international competitiveness has induced to adopting new managerial and logistical techniques, which brought about changes to industry-based jobs and the profile of industry workers. On the other hand, the introduction of new technologies has affected industries' capacity to absorb workers. This paper shows the Foresight Model application on industrial sector as the aims to possibility the vocational education demand anticipation. The experience refers the civil constructions industry.

Keywords: Foresight, FTA, Industry, Brazil, Vocational education, Observatory

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1 Introduction

Being able to anticipate and shape the future is goal of every leader. “Fortune favors the prepared mind”, wisely advised Louis Pasteur more than 100 years ago. So, how well do modern institutions prepare? In recent decades, leaders have caught unaware by momentous events – oil shortages and gluts, the collapse of the Soviet Empire, and technology that quickly transformed whole industries. The age-old question is, how can organization learn to anticipate and find opportunity in such sudden crises? The future will always be unpredictable, but with the right techniques it can be imagined and managed. Leading companies and governmental units have learned a way to think smarter about the future.

Science and Technology are quickly changing. With regard to science the need to deal with more complex relationships, including the interplay of phenomena at different time and space scales, calls for new alliances of domains of knowledge. The change of systems boundaries and the need to take into account indirect effects, resulting from causal relationships not perceived earlier, drives the need to change the practice of science.

Foresight or perspective studies involve constructively brings awareness of long-term challenges and opportunities into more immediate decision-making. Foresight has attracted a great deal of attention in recent years. Prospective studies should be encouraged to help identify/anticipate potential risks, in order to alert policymakers, facilitate the corresponding formulation of policy or enterprise strategies, and help enhance dialogue with relevant actors. More generally developing further precautionary type research will benefit from the creation of appropriate incentive structures (providing new reward/recognition mechanisms, emphasizing interdisciplinary, stressing the study of uncertainty etc.). Funding of science and technology has to reflect these changes in terms of the design of institutions as well as in terms of priority-setting.

The need to involve normative considerations in dealing with precautionary oriented scientific issues is also an element that has a transforming capacity. Many of these issues call for various forms of participatory processes within which stakeholder involvement is important both for the formulation of concepts and questions as well as for the implementation. The broadening of what is really meant by a technology product, including the shift into providing services, changes the character of innovation characteristics. The designs should reflect both exploiting the potential benefits as well as the effort to avoid potential risks. Ethical considerations should be corporate already in the early phases of the design process. The perception and evaluation of risks and uncertainties should recognize their fundamentally contextual nature.

A scientific approach needs to be applied to the management of crises, not just their substance. The complexity of today’s crises means that many organizations and individuals are involved in

their resolution, posing problems of harmony and co-ordination. Modern crisis management needs to move away from traditional hierarchical "command & control" methods towards a more collective approach in which tasks and information are shared openly. This involves a significant change of working culture on the part of those involved.

The process of technological changes being faced by industries poses new challenges for institutions involved in vocational education and provision of specialized technical services. The dissemination of new sorts of equipment, processes and techniques for organizing production causes deep changes in skills profile and quantity of labor force demanded by the labor market. Over last few years, Brazil underwent significant changes concerning level and occupational structure of industry-based employments, as a consequence of changes in both economic and technological contexts faced by the companies. On one side, the opening of economy to international competitiveness has induced to adopting new managerial and logistical techniques, which brought about changes to industry-based jobs and the profile of industry workers. On the other hand, the introduction of new technologies – usually "saving" work – has affected industries' capacity to absorb workers.

To effectively comply with its mission, National Service of Industrial Apprenticeship - Senai should find new consistent ways to anticipate qualitative and quantitative changes, in fields where it provides regular courses and technical services. Furthermore, it should identify new areas of work to keep pace with potential demands by industry sector. It is not a trivial task, since future is uncertain and dissemination of new technologies depends on several factors that, *a priori*, are imponderable. Nevertheless, to run from the challenge of prospecting both direction and pace of diffusion of new technologies could jeopardize final results, since qualifying new professionals may take long years, from planning, teachers training and laboratories assemblage to the effective incorporation of students into labor market. Moreover, restricted capacity of investment demands for consistent decisions that optimize resources and minimize risks of professional obsoleteness and early infrastructural depreciation.

The results that will be presented, like the application of the Model for the Civil Construction Sector – Construction Segment, consolidate the methodological procedures adopted by the Senai Foresight Model and constitute an important source of information to guide managers, technicians and teachers of technical schools, as well as professionals who influence the production chain of civil construction in the planning of short-, medium- and long-term actions, aiming the effective increase of the competitiveness of the sector.

2 The Senai

The National Service of Industrial Apprenticeship – Senai is a private institution and having national coverage, geared to action *vis-à-vis* the Brazilian industry, and aimed at solutions and alternatives. Senai is aimed at carrying out the industrial learning that is mandatory for industries under its jurisdiction, in schools installed and maintained by Senai itself or under the form of co-operation; and the assistance to

employers in the preparation and execution of general training programs for the personnel of the different levels of professional qualification. The Institution maintains partnerships with organisations and international public and private, rendering feasible actions of co-operation at national and international level (Pauluci, 2002).

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Senai is distributed in the 26 States and in the Federal District, represented by the operational units. In addition to the service delivery carried out in the operational units. The institution also operates as the advisory body of the Federal Government in matters related to the education of workers of the industry and similar activities. It is responsible for results of continental dimensions, such as the training of circa 2,8 million professionals per year, the administration of a network of 726 operational units all over the country and the materialization of more than 30 million enrolments, in 59 years of existence.

The Senai National Department, knowing the challenge dimension and pursuing to ground its planning on the best techniques available for technology foresight, has signed cooperation agreements with several universities, aiming at developing surveys and methodologies suitable to its purposes. Since demand is multi-disciplinary, one single institution or field of knowledge could not meet all of its aspects. Thus, the foresight methods oriented to vocational education was developed through joint efforts with specialized research groups of the Brazilian's universities. The institutions were selected according to experience and academic excellence criteria, need of low-cost solutions, and commitment to fully transfer knowledge and methodologies resulting from the process, in such a way as to train and provide autonomy to Senai schools and regional departments to independently carry out new foresight studies.

3 Conceptual Premises

Future oriented technology analysis (FTA) is widely accepted as to be problem oriented research. This means a strategy should be developed to contribute to the solution of a social, political, ecological problem referring to technology (Drecker & Ladikas, 2004).

In recent years, the term Foresight has become widely used to describe a range of approaches to improving decision-making. As the term implies, these approaches involve thinking about emerging opportunities and challenges, trends and break trends, and the like. But the aim is not just to produce mor insightful futures studies, more compelling scenarios, and more accurate econometric models. Foresight involves bringing together key agents of change and sources of knowledge, in order to develop strategic visions and anticipatory intelligence. Of equal importance, Foresight is often explicit intended to establish networks of knowledgeable agents, who can respond better to policy and other challenges. This is made possible not only by the improved anticipatory intelligence they have developed, but also through the awareness of the knowledge resources and strategic orientations of other members of the network. The key actors involved can include firms, governments, business sectors, voluntary organizations, social movements and technical experts. The context in which Foresight can be employed are equally

wide-ranging: much work to date has focused on national competitiveness and especially the prioritization and development of strategic goals for areas of research in science and technology. But Foresight can and does also deal with issues like demographic change, transport issues, environmental problems and other social, political and cultural factors. Indeed, one of the main lessons of Foresight exercises to date is that science and technology issues are inextricably linked with a wider range of social factors – and vice versa. Social forces shape the development and use of science and technology and the social implications associated with this (Foren, 2001).

Until by Foren, Foresight involves five essential elements:

- Structured **anticipation** and **projections** of long-term social, economic and technological developments and needs.
- **Interactive** and **participative methods** of exploratory debate, analysis and study, involving a wide variety of stakeholders, are also characteristic of Foresight (as opposed to many traditional futures studies that tend to be the preserve of experts).
- These interactive approaches involve forging new social **networks**. Emphasis on the networking role varies across Foresight programmes. It is often taken to be equally, if not more, important than the more formal products such as reports and lists of action points.
- The formal products of Foresight go beyond the presentation of scenarios (however stimulating these may be), and beyond the preparation of plans. What is crucial is the elaboration of a guiding **strategic vision**, to which there can be a shared sense of commitment (achieved, in part, through the networking processes).
- This shared vision is not a utopia. There has to be explicit recognition and explication of the implications for **present day decisions** and **actions**.

In practice Foresight work can never be completely dominated by quantitative methods and their results. The task is to establish an appropriate role for such methods. With these premises and more Foresight methodologies and methods, was possible building a Model to observe and antecipaded vocational education demand for the Brazilian industry.

4 The Senai Foresight Model

4.1 The Model building

The Model was building as a national project, and it was grounded on close cooperation between universities and Senai experts, since the new methodology is being implemented in the institutions thanks to the participation of those experts, from the outlining stage. Considering the huge regional and sector diversity of Senai work, it would be necessary to institutionalize prospecting actions within regional departments, endowing them with flexibility and autonomy to work according to specialization needs and standards of each State's industry. On the other

hand, there is reciprocity between training provided by Senai and the Universities. The institution's technicians have practical experience, know the client enterprises and work everyday on problems solution, by providing educational, technical and technological services. The academics, on turn, contribute through research activities, by reviewing international literature and incorporating new techniques to complement the required capacity-building. To avoid the risk of academicism, committees of sector experts were assembled, with leaders of private sector, to participate in crucial decision-making processes, such as selection of specific emerging technologies to be prospected. The gathering of such competences is proving to be crucial to provide consistency and robustness to the model adopted.

Another issue of concern to the project is to pursue results applicable in the short run. The outlining of methodologies, manuals and capacity-building courses is based on sector results consolidated by the first cases analyzed, within the principle of "learn by doing" and "learn by using". We sought for balancing academic rigor and the model's practical nature, by simplifying, whenever applicable, the complexity of international models surveyed. Due to limited resources and the need for obtaining concrete results in short run, we have adopted a model where the experts view and the cost/benefit notion prevail, as follows.

4.2 Definitions and objectives [2]

The Senai Foresight Model is conceptual framework of the Technology Futures Analysis (TFA), where is possible to anticipate the vocational education and technological service demands for industrial sectors. The foresight Model has two main purposes:

(1) Foresee future needs for human resources in industry; and

(2) Anticipate vocational education actions. The following stages will be developed aiming at reaching the objectives:

Estimate on the amount of workers by job - It aims at identifying the expected rate of growth in employments by selected jobs, in selected industrial sectors, based on: 1) Estimates on final demand variation and prospecting variation of employment by sector (utilization of input-product matrix); 2) Estimates on variation of employment by job, in selected sectors and the States.

Identification of likely changes on job profile - It aims at identifying likely changes on professional profile for selected jobs, by: 1) Prospecting emerging technologies specific to industry sectors, for 5 – 15 years, and analysis on job changes; 2) Prospecting new ways of

[2] (Senai, 2000)

labor organization to industrial sectors, for 15 years, and analysis on job changes; 3) Identification of jobs and duties emerging in other countries, and analysis on its compatibility to Brazilian industrial reality; 4) Carrying out studies on topics that bring changes to professional profile of skilled jobs.

Identification of likely changes on provision of vocational education (training courses) - It aims at identifying changes in regular vocational education courses and in re-qualification programs, based on: 1) Identification of changes on the provision of vocational education in selected countries, to specific industrial sectors; 2) Integrated analysis of occupational and educational changes, within the scope of Thematic Antennas.

Generation of occupational information to several economic agents - It aims at structuring an occupational information system to reduce information asymmetry in labor market, oriented to the following economic agents:

- HR Managers
- Youth
- Senai technicians and teaching body
- Employed and unemployed workers.

Following, a summary on the main actions of the Model related with each objective. The actions refer the parts of the Senai Foresight Model.

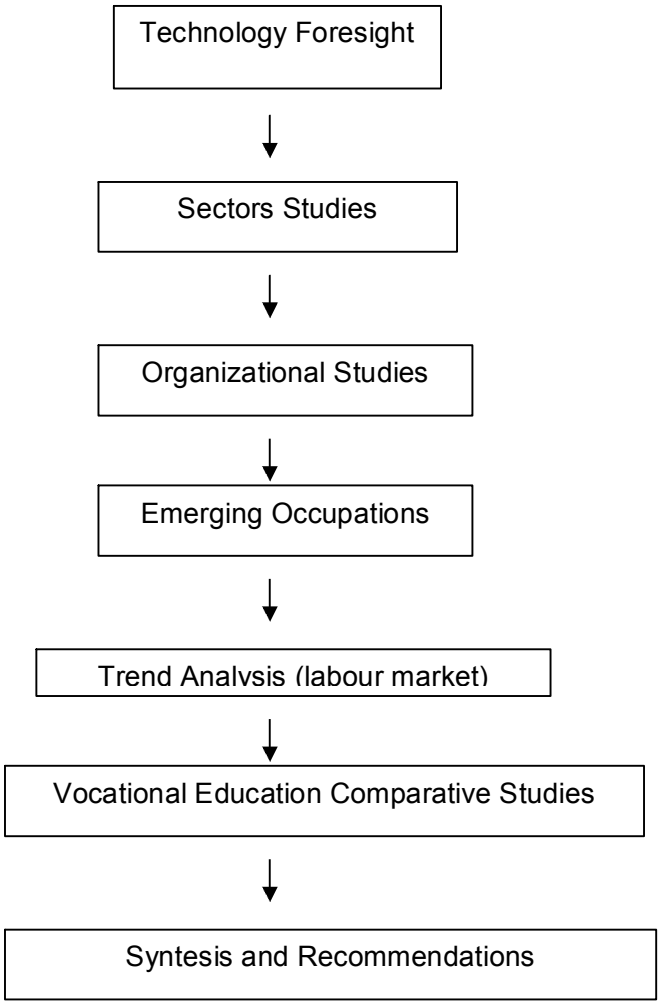
Table 1: Objectives and actions of the foresight Model

Objectives	Actions
Estimative on the quantity of skilled workers.	Analysis on Occupational Trends
Likely changes on the profile of skilled occupations	Technology foresight Organization foresight Analysis on Emerging Occupations Occupational Studies and Papers
Likely changes on the supply of vocational education (regular and re-qualification courses)	Compared Studies in Vocational Education – (benchmarking) Thematic Antenna (Expertise painel and scenario workshop)
Occupational information to several economic agents	Occupational Information System

4.3 Methodology and Model [3]

Senai Foresight Model is structured in such a way as to provide guidelines for increasing efficiency in the work of vocational education institutions, and may be adjusted to different sectors in the economic activity. The Model is being implemented through the participation of experts from Senai schools and Regional Departments, as well as experts from corporations, research institutes and universities.

Figure 1 – Senai Foresight Model



[3] (Caruso & Tigre, 2004)

The **technology foresight** is the Model base. It aims at prospecting emerging technologies specific to industry sectors, for 5 – 15 years, diffusion perspective at Brazil and analysis on job changes. Firstly, it makes bibliography analysis by the sector studies and produced a referencial paper, structuring all the Model activities related specifically to that industrial sector. They are fundamental to choose the technologies and attributes to be valued by the organization studies.

For that, to make use of three foresight methods: brainstorming (with university and schools experts); workshops and Delphi panels (technology and organizational). Main product: technologies emerging list, with possible diffusion and with considered impact on employ market;

The next stage, second, does **organizational studies** to observe new forms of the employ organization. The third stage is morphological analysis on **emerging occupations**; with aims to identify what occupations will more important on the long term for the respective industrial sector, and for the temporal horizon propose. Main product: emerging occupations, list and description (include mainly habitudes to work in specific industrial sector).

Parallel to this, it does **trend analysis on sector occupation**. To estimate the changes in the amount of employments in the various sectors of the economy, the Model makes use of the occupational trend analysis methodololy, based on the matrix of the product input of the Brazilian economy, using for its construction two macroeconomic and sectorial sceneries that estimate the variation of the final demand per sector for the years 2005, 2006 e 2007.

The third stage is **vocational education comparative studies**. It aims at analyzing curriculum structures of countries which are a reference in the sector, looking for indicators of possible tendencies in the supply of courses and in the changes of curriculum outlines. The indication of the countries is done by sector specialists. The selection is based on previously defined criteria.

The final stage is the **synthesis and recommendation**s from expert panel and scenario workshop (Thematic Antennas) shall guide how future activities in the field of vocational education will be developed. All the results were discussing in that stage.

5 The Model and Civil Constructions Results

The application of the Foresight Model in the civil construction sector has resulted in many products related to each phase of the Model, which are presented next.

5.1 Prospective Sector Studies [4]

The segment is characterized by a great consume of construction material and by the large concentration of labor. There is a predominance of residential construction, followed by other non-commercial constructions such as schools, hospitals, hotels and garages, industrial constructions and commercial establishments. The other types of services – assembling of pre-built constructions, sports constructions and building of part of a construction – are residual. The growth of the internal market of civil construction is connected to the economic growth as a whole, especially in the investments.

In the last ten years, the portion of civil construction in formal employment has been decreasing, according to RAIS - Annual Relation of Social Information – of the MTE - Ministry of Labor and Employment. Despite the decline in the participation in the sum of formal employment of the country, civil construction is still responsible for an expressive number of employments. In 2003, there were 1.05 million formal job workplaces. Formal employment indicators show changes in the profile of the worker, which are detailed next. The construction segment in the country has historically shown a slow technological evolution in comparison with other industrial sectors. The characteristics of the production in the construction plot bring about low productivity and high levels of materials and labor waste.

5.2 Technology and organizational foresight [5]

Senai Foresight Model has technology and organizational foresight as their first activity. The researches seek for the identification of new technologies that will reach a greater degree of diffusion, as well as the analysis of technological tendencies and the main organizational tendencies of the sector. There were two Delphi panels: a technological and an organizational one, each of which with two turns that counted on the participation of sectorial specialists – universities, government, vocational education schools and owner industry. These specialists were related to the technological and organizational areas in order to allow the identification of emerging technologies and organizational tendencies for the temporal horizon defined.

Five topics changed the civil construction principles substantially, particularly the construction of buildings:

- the Concept of quality control, based on Ford's and Taylor's models, used by advanced industrial sectors at that time;
- the Deterministic approach, substituted by the Probability approach, modifying the criteria of structural project;

[4] (Abiko, 2005):
[5] (Senai, 2005a)

- the Concept of performance of the constructions, substituting the prescribed ideas and bringing the demands from the users to the technical scenery; the Concepts of quality management also influenced upon the building construction, with the proper adaptations;
- the Concept of sustainable construction, a consequence of the international movement for the environmental sustainability, which was marked by the Rio 92 meeting.

In relation to organizational tendencies, most of the organizational changes are associated with the competitive criteria established beforehand such as the increase in the technical content and in the technological complexity of the constructions, the greatest supply of new construction processes and the new productive orientation of the demand, substituting the one posed by the supply. From these analyses, a view of continuity from the specialists is noticed as the answers reflect organizational changes related to the new demands of the globalized market. This means that it's not possible to notice any organizational change of disruption for the temporal horizon established.

5.3 Emerging occupations

In the civil construction sector, emerging occupations were not identified, as far as the technological development focused mainly on the rationalization of the processes and on the use of new materials, and construction systems does not modify the content of work radically. In the case of the occupations in course, it is noticed that the changes in the content of work are principally associated with the use of technologies for the rationalization of the construction processes, of integrated subsystems, new materials and construction systems. The following developing occupations for the sector were Identified: Architects; Civil Engineers; Civil Construction Technicians; Installers of Flexible Construction Materials; Installers of Hard Construction Materials; Tillers; Finishing workers of Civil Construction; Electrician; Installers of Hydraulic Systems and Piping; Installers of Heating, Air Conditioning and Solar Energy Systems.

5.4 Trend analyses on sector occupation [6]

The civil construction sector lies among the eight best generators of formal employment, considering the sectors from CNAE - National Classification of the Economic Activity – which allows that the sector presents a significant expansion of job supply and a moderate tendency to growth over the next three years. It is expected that the sector generates between 100,000 and 300,000 jobs during 2005/2007. Considering this growth, it was possible to set apart the most representative occupation projections of the sector, generating a new group of projections. This stratification was done considering three groups of occupations, classified as follows: Occupations that increased in the occupational structure of the sector; Occupations that suffer or will suffer the direct impact of the technologies that will have a great probability of being spread

[6] (Senai, 2005b)

fast, according to a prospective research made in the bounds of SENAI Model of prospect; Dedicated and transversal occupations which had more notability in the occupational structure.

Among the occupations that increased in the occupational structure of the sector the most are: Managers of Commercial Operations and Technical Assistance; Work Security Technicians; Supervisors and Storekeepers; Masonry Structure Workers; Steel Concrete Fitters; Workers on the assembly of structures of wood, metal and civil constructions composite; Isolating materials appliers; Plasterers; Fitters of ceramic, stone and wood coverings; Plumbers and Pipe Fitters; General electronic equipment fitters; Operators of machines and elevation equipment; Operators of sheets and metal finishing equipment; Electronic maintenance wiremen.

5.5 Vocational education comparative studies [7]

The studied countries were the United States and Portugal. The main results of this study are presented next.

United States

Through the study, it was observed that the professionals who work in the sector have various formations. These professionals generally start as operators, assistants or apprentices. The amount of workers who enter the civil construction industry without having had formal training after high school is still large. Professional training programs are offered and managed by employees or class associations. They usually take from 3 to 5 years and consist on the on-the-job training and on 144 hours or more of theoretical formation in the classroom per year. Sometimes a training program is used to develop basic competences in a specific working situation and can be done in a shorter time. To access these programs, the young has to be 18 years old and have good physical conditions. The occupations related to the groups of workers on Civil Construction - carpenters, masons, plumbers – develop high tacit knowledge, acquired after years of on-the-job experience and of specific trainings. The higher the education, the chances of a job in the sector.

Portugal

The country counts on a well-organized supply in specific schools for the civil construction sector. In this case, the two schools that most satisfy the sector are the Center of Professional Formation of the Civil Construction Industry and Public Constructions of the North – CICCOPN, and the Center of Professional Formation of the Civil Construction Industry and Public Construction of the South – CENFIC. These Centers belong to the Professional Formation

[7] (Pauluci, 2005)

Centers of sharing management. The supply of professional formation of the centers is defined from the demand from de associated companies to the maintainers, including the small and medium companies. The following sorts are offered: Initial qualification, addressed to the young who looks for the first job; Continuous, presencial and distance formation, addressed to the active population; Continuous formation of teachers; Formation for the unemployed. The centers structure their supplies seeking to apply the guidelines of the established Curriculum Matrix, aiming to include in the curriculum content the components of the social-cultural formation, components of the scientific-technological formation, specific technologies and practices in the formation context. Moreover, it tried to reach the two main sides: the active – already in the market – and the young.

6 Vocational Education Demand

6.1 Changes in the occupational profile

In a first moment, there is a general search for qualified labor by companies, a fact that implies a fast exhaustion of the stock of professionals with a better qualification profile. In a second moment, there are differences between the profile of the position offered by the company and the profile of the workers who apply for it. These differences are structural and show a demand of professionals with qualification profiles of the so called new economy. On the other hand, there is a supply of workers that don't meet this profile. This unsteadiness brings harm to the companies, workers and government, as far as it can inhibit, delay or even hinder the expansion of the economic activity and social development. The identification of such profiles includes the technological and organizational influences and their respective impacts on the work, as well as the tendencies of professional education in other countries, which will be observed next.

In relation to the organizational tendencies, the changes reflect the necessity of the worker of the sector. The worker needs to have: the ability to work in other teams; polyvalence; enterprising ability.

The analysis of occupational tendencies showed a high growth level expected from some duties and positions that may possibly be being executed by the Construction Technician, such as special sales technicians, production control, planning and control of processes, logistics, job security, production control and environment control. The potential of these changes enables monitoring actions that may allow the understanding of occupational trajectories and changes.

6.2 Employee Accreditation

The building segment has a great amount of workers with low level of training and education. These professionals have a large tacit knowledge, but an almost inexistent formal professional formation. However, the technological and organizational changes through which the segment

has gone will force the companies of the sector to search for strategies that bring competence to the workers without interrupting the professional activities.

6.3 Comparative Studies

An interesting aspect of the professional formation for the sector in the United States refers to specific qualification in constructions for professionals who are working exclusively with administrative and financial matters. More than one reference to the formation of these professionals was noticed in the researched bibliography. Still in the United States, another relevant aspect refers to the inclusion of commerce content in the professional formation of the workers who will operate in the goods industries, such as in the construction sector, in the occupations related to mechanics – this includes maintenance and precision – and in the occupations related to the transportation of materials.

The changes in the economy are modifying the practices in the workplaces, which have implications for the abilities required from the workers, in a way that implies changes in the professional education. The global competition increases the necessity to create high performance workplaces, where flexible and decentralized practices are imposed, as well as multi-skilled workers. The relationship between industry and school is intensified and even becomes indispensable. Either in the United States or in Portugal, the technical or training education is still an alternative way, generally followed by the ones who could not enter high academic education or the job market directly. Another demand for the technical education refers to the necessity for the already employed professional to improve or reconvert professionally.

7 Impact and Learning

The impacts of foresight exercises can be measured by general impacts and sector impacts. These general impacts refer to the difficult to think the future, the organizational culture – difficulty to put collective mind to think “out of the box”, to think strategies to approach the future vision. The more interesting aspect of this perspective is the naturalist that results were applied on Senai schools.

The sector impacts refer the relationships between sector actors: government, Senai, schools, university. With the foresight exercise was possible building a network for discussing sector aspects and others possibilities that necessary deep studies.

Mains impacts:

- Development of new ways of thinking

- Creating a language and practice for thinking about the future
- Creation of new networks
- Better informed strategies in general
- Stimulation regional departments to conduct their own foresight exercises after being inspired

Many learning perspectives were observed. The first perspective is related to the cultural organizational aspect, which improves on the vision and the necessity about future studies, its utilities and possibilities. The results were essentials to imagine the Senai school futures, and to work better for the main client: the national industry. The outlining of methodologies, manuals and capacity-building courses is based on sector results consolidated by the first cases analyzed, within the principle of "learn by doing" and "learn by using". We sought for balancing academic rigor and the model's practical nature, by simplifying, whenever applicable, the complexity of international models surveyed. Due to limited resources and the need for obtaining concrete results in short run, we have adopted a model where the experts view and the cost/benefit notion prevail.

The other perspective is related to train Senai Regional Departments and Senai Sector Schools in foresight methods, and improve the benefits for approach with national industry. The technicians were training in the Model application for industrial sectors, mainly technology and education dimensions.

8 Syntesis and Recommendations for Vocational Education

In order to attend the demand for professional education for the civil construction sector – the previously mentioned segment - some actions are recommended:

- Update the curriculum outline of the qualification courses for basic level with subjects related to the following topics: metrology, modulation, rationalized processes, construction systems, attitudes and behaviors;
- Update the curriculum outline of the technical courses of constructions with curriculum units related to the following topics: services and relationship with clients and development of projects for production, environment management, job security and technical assistance – post-sales and maintenance services;
- Offer continuous education courses for workers, technicians and other professionals of the sector about the following topics: metrology, modulation, rationalized processes, constructions systems, logistics, services and relationship with clients, development of projects for production, environment management, technical assistance - post-sales and maintenance services, retrofiting, for technicians and other professionals of the sector;
- Offer qualification courses of operation of transportations for basic level, related to technical assistance;
- Offer technical courses with emphasis on: services and relationship with clients and development of projects for production and logistic projects;

- Improve the ability of professionals related to services suppliers – the sub-contractors; Professional certification of workers of the sector;
- Apply the drywall system for the subjects and areas associated with the construction system – costs, construction planning, building systems and production projects;
- Design a manual of metrology applied to the Civil Construction sector;
- Increase the supply of laboratory technical services.

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