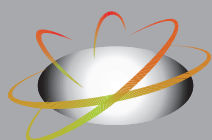


INSTITUTIONAL ENVIRONMENT FAVOURABLE TO TECHNOLOGICAL DIFFUSION

n.3

Brasília 2008



**INSTITUTIONAL ENVIRONMENT FAVOURABLE
TO TECHNOLOGICAL DIFFUSION**

NATIONAL INDUSTRY CONFEDERATION – CNI

President: *Armando de Queiroz Monteiro Neto*

NATIONAL INDUSTRY LEARNING SERVICE – SENAI

National Council

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General-Director: *José Manuel de Aguiar Martins*

Operations Director: *Regina Maria de Fátima Torres*



National Industry Confederation
National Industry Learning Service
National Department

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SENAI Prospecting Model

Methodological Studies Series

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SENAI/DN

Trends and Foresight Unit – UNITEP

Catalog Card

S491i

National Industry Learning Service. National Department.
Institutional environment favourable technological diffusion / SENAI.
National Department. – Brasília, 2008.
53 p. (Methodological Studies Series , n.3)

1. Technological diffusion 2. Institutional environment I. Title II. Series

CDU 658.5

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Presentation

The present document is a summary of all trend and foresight actions that SENAI National Department carried out in the past five years.

The first stage occurred with the development of methodologies that integrate SENAI's Foresight Model, which counted on the participation of SENAI's Regional Departments and with major research centers and universities in the country (UFRJ, USP, PUC RIO, FIPE), under the coordination of Unidade de Tendências e Prospecção do SENAI Nacional [National SENAI Foresight and Trends Unit].

The results generated by the application of the Foresight Model in SENAI, and so far in eight industry sectors, enabled us to see there is a vast field of applications, which have led to the development of technological diffusion and modernization actions within SENAI itself. Those actions feature a second stage in SENAI's performance based on prospective studies.

We hope that this document would further contribute towards the dissemination and consolidation of a prospective vision in the institution.

José Manuel de Aguiar Martins
SENAI/DN General-Director

1 Introduction

The prospective models – intensively used by large-sized companies – and the technological life cycle curve, used mainly by dynamic sectors, are a reasonably recent instrument, which application benefits have been reaped by larger size companies and by the public sector of more industrialized countries.

In the new paradigm of the current society of knowledge we can witness the intensification of processes such as: (i) innovation and incorporation of new technologies to productive processes; (ii) economic globalization; and (iii) training of regional economic blocks; factors that contribute towards the increase of uncertainties involved in the technology investment decisions of the different economy agents (companies, workers, vocational education institutions and the government).

In the private sector, the uncertainties are entailed to the process and timing of adoption of new technologies, reinforced by their trajectories and based on learning which involves different professional classes that tend to strongly condition the incorporation patterns of new technologies. This process is even more critical for smaller-sized companies, for their investment decisions will determine their survival in the market, given their scarce capital resources..

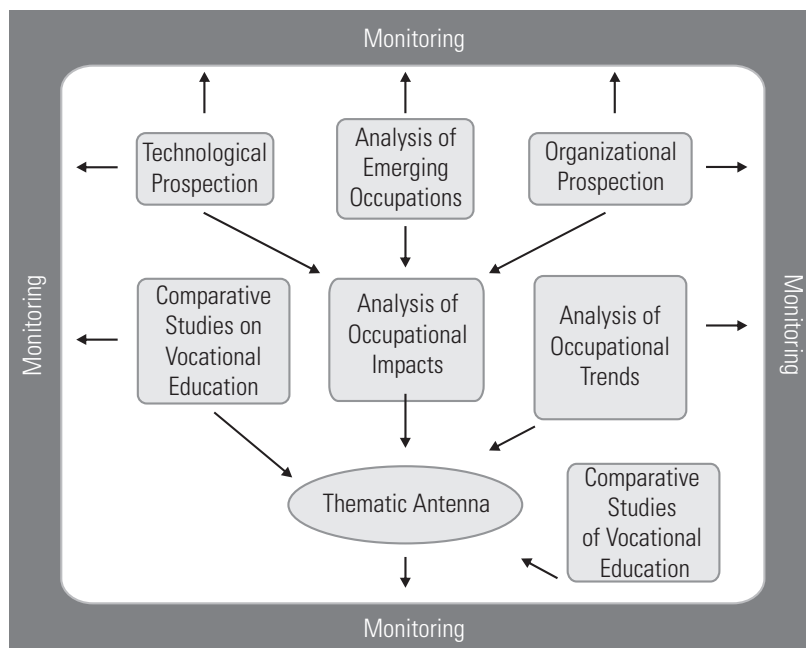
For the workers, the uncertainty manifests itself through the risk of the technical progress promoting significant alterations in the professional profile required by the industry and, consequently, in the personal decision regarding capacity building or re-qualification required to keep or improve their “employability” from the technical standpoint.

For vocational education institutions, to deal with uncertainty becomes a priority. The risk involved in the investment decision on physical infrastructure and on human resources varies proportionally to how quick the technical progress is incorporated to the productive systems, as well as the adoption of new ways to organize production. In this sense, these institutions must be “one step ahead” so they are able to respond in due time to company and worker’s demands, and failing to this provision in due time may affect both the local companies’ competitiveness and the “employability” of workers.

For the government, uncertainty manifests itself through the risk of seeing whole sectors lose their competitiveness with a direct impact upon the local product levels, tax collection, income and jobs.

Thus, so as to generate mechanisms that facilitate the decisions of economic agents, SENAI, together with the major universities in Brazil, developed the so-called SENAI Foresight Model. SENAI Foresight Model makes it possible to estimate the behavior of the diffusion rates of emerging technologies and the configuration of the organizational formats in the near future, as well as engender estimations on the number of jobs demanded every five years. From those technological, organizational, occupational and educational estimations, subsidies are generated so that they feed the development of proactive actions in the fields of vocational education and of technical and technological services. The general layout of SENAI’s Foresight Model can be seen below, followed by a description of its parts:

Figure 1 – General Layout of SENAI’s Foresight Model



Technological Foresight

Aimed at identifying Specific Emerging Technologies (TEEs) – characterized by the SENAI Foresight Model as innovations in

development phase, pre-commercial or recently introduced in the market or those with low degree of diffusion despite being known to the market – which will have a diffusion degree of up to 70% of the user market in 5 to 10 years.

— **Analysis of the Conditioning Factors to Technological Diffusion:**

The objective of this activity is to identify, as representatives of the productive means and other specialists of the sector, factors that impact negatively on the diffusion of the TEEs selected in the foresight of technology.

— **Organizational Foresight**

Aimed at verifying the possible occurrences of certain organizational trends; in the same time horizon defined in the technological foresight.

— **Analysis of Emerging Occupations:**

The study is aimed at identifying occupational changes in the sectors surveyed in given countries, classifying them into emerging occupations, in progress and stable, according to definition of the Bureau of Labor Statistics (BLS) of the United States of America.

— **Analysis of Occupational Impacts**

The main objective of this activity is to discuss with companies and universities' representatives, the possible impacts of technological and organizational changes in occupations which were identified in the foresight activities.

— **Analysis of Occupational Trends**

This methodology is aimed at making a projection of the the demand for labor in the national and state labor markets, per sector and occupation. Such projection is done based on the building of macroeconomic and sector scenarios. The projections may serve as a reference for the adjustment and formulation of vocational training programs by the vocational education institutions.

— **Comparative Studies of Vocational Education**

The study aims (through comparative analytical research in countries that are a reference in education in the sector studied) at observing

the main changes in the vocational education structure in these countries and check for the possibility of adaptation to the professional education system offered by SENAI or by other vocational education institutions.

— **Thematic Antenna**

This is the final and analytical stage in the SENAI Foresight Model. All results obtained in the previous stages are discussed here. The analysis of those results will make it possible to draft Recommendations to aid decision-makers in the SENAI System, in regards to the actions of the Vocational Education and Technical and Technological Services, which will enable SENAI to act as a “inducing” agent of technological diffusion through actions that would reduce the degree of uncertainty of decision-makers at the TEEs acquisition stage.

— **Monitoring:**

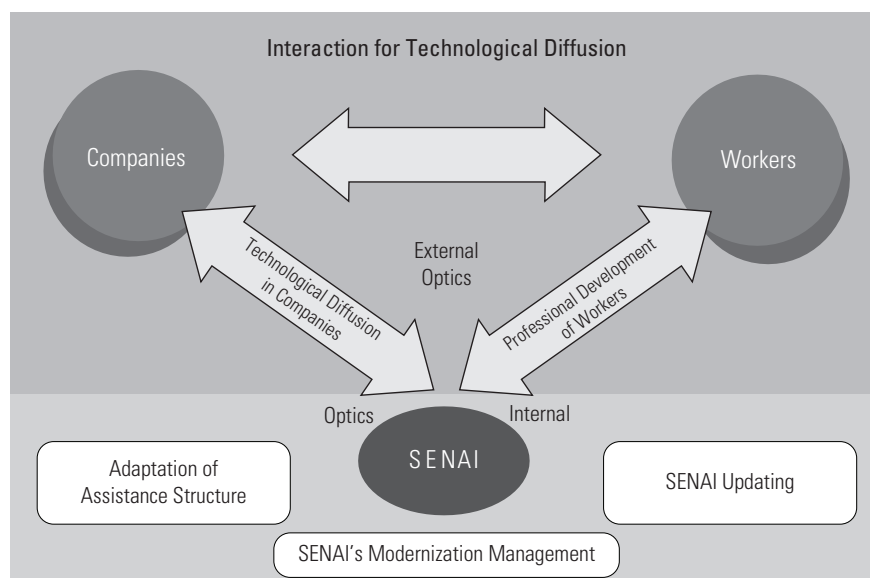
This activity enables feedback in the SENAI’s Foresight Model. In this phase, we seek to follow the results obtained along the prospective studies and occupational trends. These results enable SENAI to develop new actions aiming at providing support to the technological diffusion and to the modernization of its operational units.

The main results of SENAI’s Foresight Model reside on the technological, organizational, occupation and educational trends analyses related to the economic activity sector where it is applied.

This is the first step in order to reduce the uncertainties of the main economic agents involved in the decision-making processes linked to new technologies. In these decision-making processes there is a strong interdependence in the risks involved among those agents, centered in two common difficulties: (a) incomplete and case-based information about new technologies (its impacts, use conditions and relative advantages and disadvantages), amongst other characteristics; and (b) absence of an institutional environment that favors the investment decisions through the reduction of risks involved.

Thus, from the main results obtained through the SENAI Foresight Model actions are developed aiming at forming an institutional environment which enables technological diffusion, in which vocational training institutions play a central role, according to Figure 2 shown below:

Figure 2 – Institutional Environment Favourable to Technological Diffusion



In the upper part of Figure 2 above (Interaction for technological diffusion) we can see the products developed by SENAI destined to companies and workers and in the lower part (SENAI Modernization Management) includes the products destined to the institution itself (human resources capacity-building and technological updates).

A brief description of the main results of each one of these topics will be presented in the following section. In item II, a summary of the main results of the SENAI Foresight Model is presented; item III deals with Interaction for Technological Diffusion; item IV is related to SENAI Modernization Management; and item V will touch on the publications generated by those activities.

2 SENAI Foresight Model: result synthesis

The new paradigm of the knowledge society and the intense technological innovation process bring an accelerated incorporation of new technologies and organizational formats to productive processes. These factors create an ever more complex operation context to vocational training education institutions and technical and technological services companies, in which dealing with uncertainty becomes strategic.

This more complex context derives from a greater mobility of productive capital, from varied and interdependent networks training of companies located in different regions of the country and even abroad (information and communication technologies facilitate this production decentralization process) and from rapid changes in the professional profile of workers. For vocational education training institutions these issues render the need to anticipate to technological, organizational and occupational changes imperative, so they can better manage their educational and technological processes.

SENAI Foresight Model was developed to reach these main objectives and is comprised of various methodologies, according to what was explained in the previous item. Up until now, the Model was applied in eight (8) industry sectors, and a ninth sector is in current progress. The sectors are as follows:

- a) petrochemical;
- b) textile;
- c) telecommunications;
- d) machinery and Equipment;
- e) construction (buildings);
- f) food (Meat);
- g) footwear;
- h) forging;
- i) construction and repair of embarkations and floating structures (in progress).

Below, there is a summary of the main results reached in each sector , with remarks to: 2006-2010 Economic Scenario; States with the largest employment rate growth in the Sector – 2006-1020; Participation in the Industrial GDP in 2004; Main Technological Trends; Main Organizational Trends; Main Occupations Trends; Main Educational Trends.

2.1 Sector: petrochemical

Participation of the Sector in the Transformation Industry GDP in 2004: 1%

States with largest employment rate growth in the Sector - 2006-2010:
Rio de Janeiro and Bahia

2006-2010 Economic Scenario

The tax policy will likely not affect Petrobras' investment capacity. Furthermore, inflation targets will most likely allow an alignment between the internal prices and international prices of oil derivatives during the entire 2006-2010 period. Petrobras will probably implement its multi-year plan of investments and expand the oil refinement capacity throughout the period, with a highlight to the refinement capacity of crude oil. However, in the short-run the performance of production of resins and elastomers will likely put negative pressure to the sector.

Main Technological Trends

- Increase in the importance of management technologies.
- Growth in the use of automation technologies and process controls.
- Growth in the use of technologies that reduce the emission of pollutants – gas and liquid.
- Increase in supply of new products based on new polymeric combinations.

Main Organizational Trends

- Approximation between 2nd and 3rd generation-companies.
- More importance given to Research, Development and Innovation stage of the products.
- The direction of investments is still guided towards the increase of production volume.
- The outsourcing process tends to grow.

Main Occupation Trends

- More importance given to environmental engineers and technicians.
- Growth in the number of professionals specialized in polymers.
- The workers directly involved in the operation of plants will operate full-time as regards the detection, diagnosis, actions and action follow-up.

Main Educational Trends

- On the job capacity-building sessions will be intensified in companies of the sector and will likely encompass all areas, including R&D.
- Introduction of knowledge related to environmental management and training of technicians.
- Incorporation of related knowledge to management technologies and risk analysis in the training of engineers and technicians.
- Broadening knowledge related to polymer materials.

2.2 Sector: textile

Participation of the Sector in the Transformation Industry GDP in 2004: 2%

States with largest employment rate growth in the Sector - 2006-2010: São Paulo, Santa Catarina, Minas Gerais, Mato Grosso, Bahia, Ceará and Paraíba.

2006-2010 Economic Scenario

Even though the elevation of real income may assure a greater demand for the sector in the period, on the other hand, the keeping of the currency (Real) valued tends to reduce its competitiveness. Furthermore, the termination of the textile and clothing (ATV) agreement will likely increase the competitiveness of imports, keeping the growth of the sector highly conditioned to the penetration of Chinese products in Brazil.

Main Technological Trends

- Development of new products through new textile fibers.
- Productivity increase through the automation of the threading and weaving processes.
- More Participation of “cleaner technologies” in the textile processing segment.
- Use of computer tools in the creation and development stages of garments.

Main Organizational Trends

- Greater concern with the needs of end customers.
- Supply of a greater variety of textile articles.

- Growth of retail companies' power
- Greater integration among the agents that are part of the supply chain, generating several production and distribution networks.

Main Occupational Trends

- Creation of Textile Fiber Engineer.
- More importance given to Textile Designers.
- Reduction of the importance of operational occupations due to the automation process.

Main Educational Trends

- Incorporation of knowledge related to informatics and electronics in the technical and operational education training.
- Increased importance of professionals with holistic vision of the supply chain.
- Incorporation of knowledge related to the management and commercialization in the training of engineers and textile technicians.
- Incorporation of behaviors skills – teamwork and creativity – when training textile technicians and engineers.

2.3 Sector: machines and equipment

Participation of the Sector in the Transformation Industry GDP in 2004: 3%

States with largest employment rate growth in the Sector - 2006-2010:
São Paulo, Rio Grande do Sul, Santa Catarina, Paraná and Amazonas

2006-2010 Economic Scenario

The sector will probably continue to present growth in face of the economic growth expectation (in case of investment goods), and of the expansion of credit to individuals (in case of durable goods). The reduction possibility of iron and steel commodities prices may benefit producers and machinery and tractor consumers in the coming years.

Main Technological Trends

- Use of information technology making feasible virtual manufacturing – remotely teleoperating or teleprocessing a certain equipment.
- Increase of product development, using modularization and standardization concepts.
- Increased use of near net shape technologies in which an ever larger number of operations is combined in a single machine.
- Increased use of technologies with high speed cutting concept.
- Increased use of conception technologies and quick prototyping

Main Organizational Trends

- Arising of subsystem assembly companies.
- Transfer of production process stages (plant manufacturing) to small manufacturers.
- Aggregation by level one companies (manufacturers) of post-sales services.
- Narrowing of relations among the productive chain links and greater integration within the various activities of the company.
- Increased services supplied by manufacturing companies.

Main Occupational Trends

- Operational occupations will be more multifunctional with the involvement of these professionals in support functions.
- Creation of the position of Materials Engineer.
- Creation of the position of Automation and Robotics Technician.

Main Educational Trends

- Incorporation of knowledge related to the management of processes when training technicians training.
- Incorporation of knowledge related to process control technologies when training operators training.
- Incorporation of knowledge related to the standards and processes of standardization when training engineers and technicians.
- Incorporation of knowledge related to environmental management when training engineers, technicians and operators.

2.4 Sector: telecommunication

Participation of the Sector in the Transformation Industry GDP in 2004: 1%

States with largest employment rate growth in the Sector - 2006-2010:
São Paulo, Rio de Janeiro and Minas Gerais.

2006-2010 Economic Scenario

The improvement of the economic activity will likely bring new perspectives in the demand for data communication. In case of the so-called conventional communication, the perspectives are also favorable, considering

the income recovery scenario. We should experience intensification in the migration process of fixed to mobile telephony in the coming years. Before the increase of competition between two services, usage rates are likely to retreat, which may generate an additional stimulus in the demand for conventional calls.

Main Technological Trends

- Increase of technologies based on convergence of voice, data and multimedia (video) services and the interoperability of equipment, networks and software applications.
- Displacement of market focus to the flexibility of the passing bandwidth supply, besides quality assurance of services delivered.
- Growth of xDSL and fiber optics technologies to end users.
- Growth of technologies related to communication safety through the opening of platforms and offering of multi-services in telecommunication networks.

Main Organizational Trends

- Increased importance of specification activities of technical features and service management.
- Increased importance of Call-Centers.
- Increased importance of development of application software.
- Increased importance of the prototyping, test, validation and homologation activities of the system/solution.

Main Occupational Trends

- Creation of the position of Mobile Telecommunication Systems Engineer.

- Creation of the position of Mobile Telecommunication Systems Technician.
- Creation of the position of Microwave Transmissions Technician.
- Increased importance of professionals who harness the systemic view of the production flow.

Main Educational Trends

- Incorporation of knowledge related to quality control and production management when training operators and technicians.
- Incorporation of knowledge related to the consumer market when training engineers.

2.5 Sector: civil construction

Participation of the Sector in the Transformation Industry GDP in 2004: 17%

States with largest employment rate growth in the Sector - 2006-2010:
Many states, but the largest growth is seen in São Paulo

2006-2010 Economic Scenario

In the mid-run, the construction sector presents favorable expectations, considering the maintenance of the current status of real estate financing. The infrastructure sector only starts to gain strength from 2007 on after presidential elections. Private and Public Sectors Partnerships (PPPs) will only provide relief to the sector after 2010, given the legal obstacles intrinsic to the process.

Main Technological Trends

- Growth on the use of technologies based on subtle industrialization concept.

- Use of Web technologies for project planning, construction management and commercialization stages in the entrepreneurial effort.
- Growth on the use of integrated subsystems (finished bathrooms and doors).
- Growth on the use of technologies for the optimization of construction stages.

Main Organizational Trends

- Highly increased importance given to environmental protection, consumer rights and legislation referring to land use and occupation.
- Greater approximation and coordination between the links of the chain, thus generating a valued supply chain specific for a market niche or type of endeavor.
- Increased importance of the environment life cycle.
- Strong tendency towards outsourcing processes, making service suppliers earn greater importance.
- Growing importance of consultation projects & engineering companies.

Main Occupational Trends

- Increase importance of managerial activities for professionals of the technical area.
- Creation of the position of Productivity Controller in construction works.
- Creation of the position of Engineering Analyst.
- Creation of the position of Processes Foresight Engineer.

- Creation of the position of Information Manager.

Main Educational Trends

- Incorporation of knowledge related to the management of production when training technicians and engineers.
- Incorporation of knowledge related to information technologies when training technicians and engineers.
- Incorporation of behavioral skills when training operators.
- Incorporation of knowledge about metrology, modulation, rationalized processes and constructive systems when training workers, technicians and other professionals of the Civil Construction sector.

2.6 Sector: foods

Participation of the Sector in the Transformation Industry GDP in 2004:
10%

States with largest employment rate growth in the Sector - 2006-2010:
Ceará, Minas Gerais, Rio Grande do Sul, Paraná, Pernambuco, Bahia, Rio Grande do Norte, Santa Catarina, Bahia, Pernambuco and Rio Grande do Norte.

2006-2010 Economic Scenario

This sector will likely be mainly influenced by three factors: a) heating up of the domestic demand; b) maintenance of the competitiveness of the gross national product in the foreign market; and c) world economic growth. It is worth highlighting that the sector exports have been gaining room in a way to represent approximately 40% of the total national production.

Main Technological Trends

- Increase in the development of innovation in the areas of genetics, nutrition and animal health.
- Increased use of technologies that enable a strict monitoring of the sanitary and food security items.
- Increased use of technologies that aid prolonging the expiration date of products traded.
- Growth of technologies based on new materials and packaging methods.

Main Organizational Trends

- Increased importance of environmental legislations and inspections in importing countries.
- Diffusion of certification systems.
- Increased importance of policies related to the control and regulation of genetically modified products.
- Increased importance of traceability systems.

Main Occupational Trends

- Operation of the sector's cross-cutting occupations, such as Biotechnologists, Biotechnology Laboratory Technicians and Logistics Analysts.
- Increased importance of professionals who have knowledge about clean technologies and group vision.
- Increased importance of professionals who study the consumers, their expectations and demands.

- Arising of new activities related to genetically modified organisms (GMO).

Main Educational Trends

- Inclusion of environmental and social aspects when training all professionals in this sector.
- Inclusion of knowledge related to the end consumer characteristics of when training food engineers.
- Inclusion of knowledge related to certification processes when training technicians training.
- Inclusion of knowledge related to hygiene, health and safety when training operational professionals.

2.7 Sector: footwear

Participation of the Sector in the Transformation Industry GDP in 2004: 1%

States with largest employment rate growth in the Sector - 2006-2010:
São Paulo, Ceará, Minas Gerais, Bahia and Goiás.

2006-2010 Economic Scenario

Despite of the fact that the increase of real income has assured a larger demand for the sector in the period, the maintenance of the valued currency exchange may result in a reduction of growth potential. The valued currency has reduced the competitiveness in the sector, and negotiations between the Brazilian Government with China and Argentina have also led to this picture.

Main Technological Trends

- Increased supply of new products incorporating new materials.
- Increased use of “cleaner technologies” in the gluing and finishing stages.
- Increased use of information technologies in the development, distribution and commercialization stages.
- Increased use of management technologies in the production management.

Main Organizational Trends

- Increased importance of labor legislations and inspections in importing countries.
- Increased importance of government programs on environmental control.
- More intense use of standardization and certification systems through stamps to award quality, for environment respect and social responsibility actions.
- Larger adoption of lean manufacturing systems.

Main Occupational Trends

- Increased importance of the position of Fashion Designer.
- Increased importance of professionals with a managerial and sales view of the sector.
- Creation of the position of materials technician.
- Creation of the position of materials engineer.

Main Educational Trends

- Inclusion of knowledge related to supply chain management when training technicians training.
- Inclusion of knowledge related to computer tools for developing and modeling when training technicians and fashion designers.
- Inclusion of knowledge related to biomechanics when training technicians.
- Inclusion of knowledge related to environmental management including topics about legislation, waste treatment, recycling and environmental responsibility when training technicians.

2.8 Sector: forging

Participation of the Sector in the Transformation Industry GDP in 2004: 1%

States with largest employment rate growth in the Sector - 2006-2010:
Minas Gerais, São Paulo, Pará, Bahia and Maranhão.

2006-2010 Economic Scenario

The possible increase of the real income of workers may provoke an elevation in the consumption of durable and non-durable goods, which use mostly copper and aluminum as inputs. International prices may decline from 2006 on, in face of a possible elevation of the US interest rate and of the increased supply of the main producers of non-ferrous metals. In Brazil, investments in the increase of copper and aluminum production of Companhia Vale do Rio Doce and the investments of Grupo Votorantin (aluminum) will likely ensure a production expansion in the sector as far as projections are concerned.

Main Organizational Trends

- Increased use of new materials in forged pieces.
- Increased use of cleaner technologies in the molding process.
- Increased use of management technologies related to the certification systems and managerial tools.
- Increased use of technologies for the reuse of forging rejects.
- Increased use of management and process simulation software.

Main Organizational Trends

- Increased importance of environmental legislation and inspection in importing countries.
- Increased importance of the safe-guarding actions of importing countries.
- Growth of product sales through electronic transactions (Internet, B2C, among others).
- Adoption of cell-based production systems, by forging companies..
- Establishments of environmental stamps by the manufacturers of end products.

Main Occupational Trends

- Increased employment opportunities in the sector for occupations in the environmental area.
- Increased importance of Research and Development Professionals.

- Increased importance of professionals involved with costs management.
- Increased importance of professionals involved with certification and quality systems.

Main Educational Trends

- Inclusion of knowledge related to Brazilian Regulating Standards (NRs) and environmental and quality certifications when training technicians and engineers.
- Inclusion of knowledge related to quality and environmental management tools when training operators.
- Inclusion of knowledge related to the management of technological innovation when training managerial level professionals.

3 Interaction for technological diffusion

SENAI's actions to assist the creation of an favourable environment for the diffusion of new technologies are established considering two different levels. One is external, in which SENAI acts together with companies and workers through the dissemination of technological information, curriculum reforms and occupational information (Interaction for technological diffusion), and the other is internal, where SENAI creates a permanent process of modernization management in a way as to supply the current demand and get prepared for the demand that is being stimulated through its diffusion actions (SENAI's Modernization Management).

Working with companies and workers is based on the premise that the diffusion process of new technologies begins with the dissemination of technical and market information, which contribute to reduce the degree of uncertainty in the decision-making process for purchasing these technologies. For such, SENAI's National Department created the SENAI Technological Diffusion Project, which organizes a series of activities and elaborates specific documents to operate in technological diffusion processes together with companies and SENAI's teachers and technicians. In the following lines, we present the diffusion actions for companies, given that the actions for teachers and technicians will be presented subsequently, in a specific item.

3.1 Technological diffusion in companies

SENAI's Technological Diffusion Project seeks to disseminate to businessmen of specific industry sectors (and also to teachers at SENAI itself, as we will see in the next item) information about Specific Emerging Technologies, prospected by the SENAI Foresight Model, which will provide greater likelihood of diffusion in the next 10 years. For the dissemination of that information five supplementary tools were selected: SENAI's Technical Diffusion Workshop; Guided Visit to Technological Fairs; "INTIME Technological Diffusion"; Technological Diffusion Bulletin; Technical Study about Specific

Emerging Technologies. Those tools are detailed below.

3.1.1 SENAI's technological diffusion workshop

It is aimed at presenting SENAI Foresight Model outcomes as to sectors considered and, in a more detailed fashion, supply information about a set of Emerging Technologies prospected by SENAI Foresight Model. That information is presented by technicians through panels. Businessmen have their participation guaranteed in those events. During that time, the participating businessmen fill out questionnaires that seek to map their knowledge about Specific Emerging Technologies and identify the technologies that have greater diffusion potential.

3.1.2 Guided Visit to Technology Fairs

Proceeding with the technical information dissemination process, a visit is planned to the main suppliers of the Specific Emerging Technologies. For such, the participants will have to fill in a script that was established in the end of SENAI's Technological Diffusion Workshop. Furthermore, the visit to the Technological Fairs is one of the tools used by the technological diffusion monitoring methodology used by SENAI. As a complement to this activity, the participants fill out another questionnaire that – based on the premise that the Technological Fairs may be considered indicators of innovation for industrial sectors – seeks to identify, according to the perception of the participants, new technological trends for the sector considered.

3.1.3 "In Time Technological Diffusion"

This publication results from workshops and visits to the fairs and it has been adapted to the journalistic jargon. It is elaborated by a journalist that is used to summarizing information generated during the workshop, and interviewing participants so as to seek their impressions and perceptions about the events. The "In Time Technological Diffusion" is distributed through the Technological Information Centers of Regional Departments to Operational Units and companies of the sectors considered.

3.1.4 Technological Diffusion Bulletin

The Technological Diffusion Bulletin seeks to increase the dissemination of information on Specific Emerging Technologies. The Bulletins are released every quarter and their distribution is done electronically or hard copied. This bulletin is sent to a group of interest companies of each Regional Department, as well as to sector teachers and institutions through the Technological Information Center or SENAI Schools.

3.1.5 Technical Studies about the Specific Emerging Technologies

These studies – developed by universities – are aimed at generating more detailed theoretical and empiric information about the purchase and use of emerging technologies. For such, secondary sources and case studies are used for they present real data about the importance of technologies for the companies which hold them. The study addresses the following topics:

1. Technical Description

In this topic, TEEs of each technological segment will have its technical description presented, taking into account: the technological composition or structure; working principles and functioning; functions and functionality (in case of product technologies); possible new products generated by technology; relative advantages (cost x benefit) in face of the technology replaced (in case there is replacement); list of suppliers, their main characteristics and their national or regional distribution; financing lines for acquisition of TEEs.

2. Case Study

In this topic, we will present case studies of companies that use TEEs. In this study, the possible real productivity and market gains of the company after purchase, use or development will be presented; new products generated from the technology (if any); relative advantages in face of the replaced technology according to the users' perception; the technology transfer process and eventual care during the process.

3.1.6 Summary of Technological Diffusion Actions in Companies

In 2007, there were four workshops and five guided visits to technological fairs, involving 42 people and 25 lecturers. A summary of the technological diffusion actions in the companies carried out in 2007 is laid out on Table 1.

Table 1 – Technological diffusion actions: workshops and fairs (2007)

Events	2007		
	Number of events	Participants	
		Businessmen	Lecturers
SENAI's Technological Diffusion Workshop	4	42	25
Technological fairs	5	42	-

We can have a close idea of the effectiveness of these actions by analyzing the questionnaires that filled out by the workers in the end of those events. If we consider in the questionnaire items related to the “importance of themes to the sector”, “applicability of the themes in their activities” and “inclusion of new knowledge”, 93% of the businessmen evaluated those activities either as excellent or good. That is, in the businessmen’s perspective, these events have helped understanding new technologies.

Another questionnaire applied during these activities contributes to the monitoring of the prospected emerging technologies diffusion rates. Considering all the businessmen who filled out that questionnaire, we identified a current diffusion rate of about 33% for emerging technologies in their companies. When we asked about the diffusion in the next 5 years, the diffusion rate reached 79%. That trend is precisely the expected rate for the technology diffusion curve, since we expect those technologies to present a lower diffusion rate in the present, but a higher rate in the future.

Considering the technological diffusion actions, within the publications that contain more detailed information about emerging technologies, we reached 23 distinct headings with some 11,800 issues published; as seen in Table 2 below.

Table 2 – Technological Diffusion Actions: publications (2007)

Publications	2007		
	Number of Publications	Copies per Publication	Total
Technological Diffusion Bulletin	13	600	7.800
“In Time” Technological Diffusion	5	600	3.000
Technical Studies	5	200	1.000 *
Total			11.800

* Forecast for 2008

3.2 Professional development of workers

The actions derived from SENAI Foresight Model directed towards the Professional Development of Workers may be grouped based on curriculum updates and SENAI’s Occupational Information System (SINO)

3.2.1 Curriculum Updates

Curriculum Updates are within the design of new occupational profiles, which occur under Sector Technical Committees, coordinated by National SENAI’s Vocational Education Unit. These committees are consultation forums aimed at debating on education and employment. They are comprised of professionals from various internal and external segments to SENAI, which practical and theoretical know-how and vision of the future contribute to guide the decision-making process in what regards the professional education actions. The main functions of the committees are:

- Define professional profiles based on competencies, addressing parameters that enable performance assessment.
- Permanent update of professional profiles.
- Supply subsidies for the elaboration of standards for professional certification.

The information generated by the application of SENAI Foresight Model to the occupation considered in the industry prospects a scenario in which the occupations in question will probably exist. That information is fundamental for the fulfillment of a given stage of the professionals' profile definition methodology based on competencies, which seeks "to identify and diagnose trends related to the sector, upon the type of necessary academic training and future perspectives". So, the profiles generated by the committees will be able to assist not only the current needs of the industrial demand, but also future needs conditioned by the diffusion of new technologies and organizational changes.

That information has already been taken to the Sector Technical Committees - eight in the construction sector and one in the textile sector (Table 3). The occupations which were inserted in the SENAI Foresight Model are as follows:

Table 3 – Sector Technical Committees with information inserted in SENAI Foresight Model

Sector	Occupations
Construction	Undertaker
	Shapes Carpenter
	Low Voltage Building Installer Electrician
	Building Gas Plumber
	Foreman
	Bricklayer
	Industrial Installer
	Construction Painter
Clothing Confection	Technician in garment manufacture

The effectiveness of that insertion in the sector technical committees may be verified by the analysis of new performance¹ patterns and competency elements² established for the occupations in focus, according to what is described below.

¹ Performance standards, according to the established methodology, are actions that together enable the professional to reach a competency element

² Competency elements – Are groups of activities that together enable the professional to execute a certain task

3.2.2 Curriculum Updating Results

Once the information generated by the SENAI Foresight Model is related to the possibility of change of activities (tasks) of certain occupations, indicators can be established as to the modifications identified in the performance standards and competency elements that are related to the information generated by SENAI Foresight Model. Below, we find some examples of information use generated by SENAI Foresight Model in selected occupations of the construction sector are presented.

Occupation: Bricklayer

Competency element: Carry out structural masonry

Information generated by SENAI Foresight Model: Structure masonry was a Specific Emerging Technology that will have greater likelihood of diffusion.

Occupation: Foreman

Competency Element: Manage work teams; participate in the construction work executive planning

Information generated by SENAI Foresight Model: trend of increased use of management tools in the construction site; trend of approximation between the technical and operational levels.

We have also asked the technicians responsible for the conception and implementation of the works of the Sector Technical Committees to make an evaluation of the insertion of the foresight data in the meetings of the Construction Committees. One of the persons in charge informed us that:

The information supplied represents a rich source of data that subsidized and provided scientific basis to the work developed with the various National Sector Technical Committees for the elaboration / validation of the following professional profiles: Undertaker, Shapes Carpenter, Low Voltage Building Installer Electrician, Building Gas Plumber, Foreman, Bricklayer, Industrial Installer and Construction Painter. The Committee was comprised of several specialists from the technological area under study and they brought forth

their technical know-how and expertise in the marketplace for the elaboration / validation work of professional profiles. Their support was added on to the research data and granted greater scientific validity to the information gathered, for it enabled us to check the information when doubts arose and at times they confirmed the information gathered. (Person in charge 1, Sector Technical Committee).

Another person in charge who also evaluated the process, declared:

The results after foresight the Construction area were presented with power point slides to the Committees in a summarized form. This meant an important stage along with SENAI's methodology for the establishment of professional profiles based on competencies, serving as Input for defining profiles. Without a doubt, this has become a relevant documented source, drawing the interest and questioning participants, beside other sources as the Brazilian Classification of Occupations (CB) and national Classification of Economic Activities (CNAE).

Having said that, it is desirable that the foresight studies related to professional profiles to be defined by the Sector Technical Committees – national or regional – if any, would be presented to the Committee members, given that they subsidize the establishment of the Professional Profiles, both as to the Professional Competencies itself and to the Qualification Work Context." (Person in charge 2, Sector Technical Committee).

3.2.3 SENAI occupational information system

The occupational information system works as an important reference for the elaboration of strategies and action plans for companies, workers, students, vocational training institutions and governmental bodies to be able to face the challenges of an ever more competitive marketplace. Moreover, the more information is generated in a context that incorporates signs of future market behavior, the more valuable that information is.

For these reasons, SENAI developed an occupational information system, which services as an efficient indicator of marketplace trends. It is elaborated through a detailed data survey, made from the Industry Occupational Families, identified in the Brazilian Classification of Occupations from RAIS (Annual Social Information Registration of the Labor and Employment Department) from PNAD (Annual Sampling Survey per Domiciles) and from the occupational trends analyses.

SENAI's Occupation Information System comprises three Websites, with the following names: Almanaque de Profissões [Professions Almanac], Profissões Industriais [Industrial Professions] and Sentinela Ocupacional [Occupational Sentinel].

The Professions Almanac is destined to the youth. In times of intense marketplace competition, those who possess greater knowledge about the profession and who present the necessary competencies required by companies have a head start. The choosing of a profession and the first job opportunity are dilemmas faced by our youth. To know more about a given profession and invest in professional training may be excellent steps for those who want to grow professionally.

SENAI is intended at helping young adults by clearly explaining about industry professional careers, in its Professions Almanac. The young candidate obtains information about the activities performed in the daily routine of the job, what companies expect from a certain type of professional, where he/she may prepare to exert the job and what disciplines will be emphasized through the training program.

The Industrial Professions website contains occupational information for human resource managers, while the Occupational Sentinel website is destined to the professionals who are employed or unemployed and suggests some occupational mobility possibilities. The Occupational Sentinel Website is under development.

4 SENAI Modernization Management

SENAI Modernization Management represents SENAI most effective way to operate towards an Institutional Environment which enables Technological Diffusion. It means that SENAI not only seeks technological diffusion in companies, but also tries to adapt itself to that diffusion process.

Thus, SENAI Modernization Management objective is to render flexible, adaptative and permanent update for vocational education actions and technical and technological services within SENAI units.

In order to reach this objective a methodology was developed to consider a set of indicators that take into account the current and future dynamics of the productive system in each SENAI unit. Some types of modernization actions are defined due to the needs of the Regional Departments and associated to the behavior of these indicators (nine types of modernization actions were defined). Thus, a unit may not be eligible for any one of the modernization action types, but it could be eligible to more than one. For each type of modernization action there is a technological module and a capacity-building module defined.

SENAI Modernization Management methodology is used in SENAI System's Modernization Program for Industrial Competitiveness, which focuses on an industrial sector in which SENAI operates. The first stage of that process is based on the elaboration of Regional Updating Plans and a National Plan.

In order for the Modernization Management methodology to be efficiently applied, a System was deemed necessary.

4.1 Permanent modernization management system

The Permanent Modernization Management System makes it possible to apply the modernization management methodology and was organized considering the following:

- a) Establishment of rules for the elaboration of updating plans defined by the technical and executive instances and divulged to all Regional Departments;
- b) Definition of indicators and criteria (showing the current and future behavior of demand and supply of each Unit) to be applied to all units, in a way that an alteration in any indicator or criteria may be valid for the group of units;
- c) Elaboration of an operational procedure manual containing the procedures for filling out questionnaires, as well as details of all indicators and eligibility criteria.

A portion of the indicators used in SENAI's Modernization Management is linked to the future behavior of employment in the area which encompasses each unit, obtained through the Analysis of Occupational Trends. The main purpose of the Occupational Trends Analysis is to estimate the demand for skilled manpower, in a way as to anticipate professional training, and technical and technological services.

The analysis of the occupational trends uses the input-output method that, in general, consists of calculating the impacts on the national and state employment rates per sector, from aggregate demand variations projected for various sectors of the Brazilian economy, based on technical coefficients of the input-output matrix. Thus, the projection on the number of jobs in each unit is based on the input-output matrix of the Brazilian economy.

Another set of indicators is associated to the effective rate of diffusion of given technologies, which will be dealt with on item IV.3 (Technological Updates).

The operationalization of the System is done with a set of tools choosing from the units to be modernized.

The tools are as follows:

- Database: a relational database was structured with themes such as Projections of New Jobs, Technological Diffusion, data about SENAI's Assistance, Competition etc. It also services as reference for the Business Intelligence (BI) platform;
- The Business Intelligence (BI) Tool: a tool supplied by Hyperion, which is considered the global leader in Business Performance Management software;
- WEB consultation mechanisms: WEB DR enquiry mechanisms were developed (validation of scope areas and choosing of Units for Modernization), connected to databases and to BI tools.

4.2 Human resources capacity-building

An important contribution of SENAI Foresight Model to the capacity-building of human resources has to do with SENAI's Modernization Management. There are other equally important contributions, so we decided to organize a specific item to deal with that theme (Item V).

4.3 Technological updates

SENAI's Modernization Management includes a permanent process of technological updates, characterized by dynamic productive system in the each unit.

So far, technological updates occur in basic and technical vocational education levels and for technical and technological services. According to the need and to the dynamism of the productive system, the modernization may enable the expansion, supplementation, replacement and improvement of equipment and facilities. For each type of modernization action, we

have defined technological modules, comprising mature and emerging technologies.

As SENAI's Modernization Management believes in low investment risk, the demand indicators are very important for the decision of choosing modernization actions in each unit. One of these indicators refers to the effective rate of diffusion of technologies within each technological module.

In order to calculate the effective rate of diffusion of technologies within each technological module we have developed a survey, with a statistically representative sample in machinery and equipment sector, based on interviews with closed-question questionnaires. The technological diffusion survey for the Machines and Equipment sector was taken in the whole country with the participation of all SENAI Regional Departments.

4.4 "In Time modernization"

In order to announce all modernization actions, we created a tool called "*IN TIME Modernization*". Written in journalistic jargon, that instrument summarizes the actions developed in each stage of the modernization process and links interviews with participants of the process and institution directors. In 2007, three of these publications were elaborated totaling 1,800 issues.

5 Human resources capacity-building

The Human Resources Capacity-Building together with an Institutional Environment which enables Diffusion has four dimensions: SENAI's Modernization Program; SENAI's Technological Diffusion Project; Contribution to the National teachers training Program; Publications.

5.1 SENAI's modernization program

Under SENAI's Modernization Program the capacity-building of human resources is guided towards the use of technical basis which should modernize each participating unit. In this case, the training includes for each technology a module into the following dimensions: leveling; suppliers and technical delivery. According to the technology, the number of hours varies for each component, provided that for some technologies the leveling capacity-building program will not be needed.

5.2 SENAI's technological diffusion project

Under SENAI's Technological Diffusion Project, SENAI's Technological Diffusion Workshop and the Guided Visit to Technological Fairs also count on the participation of SENAI technicians and teachers, which represent a very efficient mechanism characterized by updating and dissemination of information on emerging technologies.

In that opportunity some questionnaires are applied, and one of them is intended at mapping the teachers' know-how on Emerging Technologies and suggestions about possible updates and capacity-building strategies. In 2007, the participation of SENAI's teachers and technicians in the diffusion activities reached 62 participants, as shown in Table 4 below.

**Table 4 – Participation of SENAI’s teachers and technicians
in technological diffusion activities**

Events	2007	
	Number of Events	Participating
SENAI’s Technological Diffusion Workshop	5	62
Technological Fairs	5	62

5.3 Contribution to the national teachers training program

SENAI National Department’s Vocational Education Unit develops a National Teachers training Program. The information derived from SENAI’s Foresight Model has also been incorporated in this Program, such as the case of the Program guided towards construction teachers.

5.4 Access to publications

All the publications generated by SENAI Foresight Model, particularly the Recommendations deriving from the Thematic Antenna (see item 6) are distributed to SENAI’s teachers and technicians.

In the same manner, the publications generated in SENAI’s Technological Diffusion Project are also sent to SENAI’s teachers and technicians: *“In Time Technological Diffusion”*, based on SENAI’s Technological Diffusion Workshop, where discussion panels are set up about new technologies and in Guided Visits to Technological Fairs; *Technological Diffusion Bulletin* and the *Technical Studies about Specific Emerging Technologies*. Furthermore, these publications are available at the UNITEP’s website.

6 Publications

SENAI Foresight Model comprises a set of methodologies for prospection and trend analysis and generates structured and contextualized information to aid the institutional decision-making process. In order to direct and map future trends, there are studies according these methodologies, which have led to numerous publications.

The studies and main results in SENAI Foresight Model have led to the publications category named Série [Series]. They are:

- Thematic Antenna;
- Technological and Organizational Diffusion;
- Sector Studies;
- Emerging Occupations;
- Technological and Organizational Studies;
- Occupational Studies;
- Occupational Papers;
- Educational Studies;
- Methodological Documents;
- Modernization

The publications featuring the results of SENAI Foresight Model with a defined frequency are grouped in the category named Periódico [Journal]: They are:

- Occupational Bulletin;
- Technological Diffusion Bulletin;
- Formal Employment Projections;
- Publications Catalog;

Besides the Series and Journal categories, the studies deal with themes which increase their importance in the future and are organized in the EmTempo [InTime] category, divided up into three parts:

- INTIME;
- INTIME Technological Diffusion;
- INTIME Modernization.

Finally, there is a line of publication editing with other institutions that have to do with the themes included in SENAI Foresight Model. The publications Em Parceria [In Partnership] are the following:

- SENAI's Foresight Model – Methodological Document (SENAI/CINTERFOR);
- Industrial Professions in Brazil (SENAI/UnB);
- Research and Development at SENAI: Impacts on Industry and Professional Education (SENAI/CINTERFOR).

Between 2003 and 2007, 103 distinct editions have been published, totaling approximately 60 thousand copies. Fifty thousand folders have been published, besides the elaboration of CDs and DVDs about SENAI's Foresight Model and other themes. That material was first distributed to the Regional Departments and their Units, besides other institutions of the Industry System. Unions, Associations and university specialists were directly involved in the foresight activities and have also received these publications.

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