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TECHNOLOGY ROADMAPS

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Planning 2015-2020

January/2015.

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Planning 2015-2020

This publication is an achieved result from Technological Products and Processes Management (GPT), Innovation Directorship (DIN) of the Sistema FIRJAN.

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Acknowledgements
We wish to thank all the companies and institutions that have contributed to the preparation of Technology Roadmaps 2015-2020, supplying information (market and technological segments) related to their business.

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SUMMARY

PRESENTATION

Impelling the competiveness of companies

Innovation plays a crucial role in any successful company. Innovative companies are more competitive and, consequently, absorb a greater share of the global market. The fact that the innovation performance in Brazil has not been as strong as in other countries in the economic block, made up also by Russia, India, China, and South Africa (BRICS) as this is a solid justification for seeking new manners for impelling the competiveness of Brazilian industries, especially, the industries in our state.

In 2010, the Sistema FIRJAN defined as its vision "be recognized by society as private service providing organization, indispensible for the sustainable development in Rio de Janeiro". Several actions were created for putting this vision into practice. One of them is the Technology Roadmaps that in 2011 presented the first technological planning structured on a long-range scope for SENAI by opening doors for collaborative research and development, prospecting opportunities and identifying promising strategic domains for supplying the industrial demands in the state of Rio de Janeiro and our anticipation by facing the challenges imposed by the market.

The decisions on investments in technology, especially investments guided towards innovation, are becoming continually more complex. The uncertainties regarding the real benefit from innovations are great. Additionally, the competitive pressure in the industrial sectors forces companies to adopt an attitude of technological leadership.

Within this context of elevated uncertainty, it is even more relevant that technology is adequately generated, so that it can be one of the differential elements and sustainer of competiveness in companies. The success of technological management is continually more engendered to the strategic, marketing, and organizational dimensions.

If the innovative pace must be intensified, it is essential that there is a growing collaboration among the partners who share common objectives. The process to make the Roadmaps involves cooperation. It is a future delineated by market and technological demands. It is not a route for forecasting the future advances in science or technology; instead of this, it is the dynamic learning that forecasts and articulates the necessary elements for approaching new and indispensible innovations in companies.

An isolated route describes a determinate future, based on the vision of the people who develop something. A shared route provides a framework for decision-making and builds the pathway to the future is yet to happen. Therefore, continuing towards this precursor initiative, Technological Roadways 2015-2020 were conceived throughout the year 2014, for the four main business areas of SENAI – Environment, Metallurgy, Simulation, and Bioprocesses. The objective of this project is to prepare pathway maps for making choices to determine our technological flight plan constructed collaboratively. This means, tracing the pathways that will be traveled until 2020 for materializing the perceived potential in each one of the main technological trends and the market.

The following pages reflect our choices. However, understanding and building the future is a dynamic and collective task. And, for this reason, we invite all of you to participate jointly in this process and join the Sistema FIRJAN, so that we can transform our environment.

Enjoy your reading!

Bruno Souza Gomes

FIRJAN Innovation System Director

THE TRANSFORMATION OF SENAI

According to the document named "Decisão Rio" (Rio Decision), a Sistema FIRJAN publication maps the investments announced for Rio de Janeiro in the period from 2014 to 2016, the state is advancing towards a new level of development. This period is highlighted by the World Cup in 2014 and the Olympic Games will take place in 2016, and put together, they mark the consolidation of a series of investments.

In fact, 108 business ventures were announced during this period for a total amount of R$ 235.6 billion Reais. Both investments, public and private, national and foreign, are targeted to diverse sectors of the economy.

In this scenario, technology emerges as a strategic ingredient, so that Rio de Janeiro can maintain its noteworthy position and contribute in guaranteeing increased productivity and competiveness in "Fluminense" industry.

SENAI has had over 70 years of experience in the market and nowadays it is an important national center for generating and diffusing technical knowledge and applied technology to the industrial development. There are partnerships with companies and institutions from Germany, Canada, Japan, France, Italy, and the United States, providing consultancy to Industry in the technological field of processes and products through providing technology and innovation services, as well as promoting training in companies, providing qualifications and specialization to workers in all company levels.

Its business areas are prepared to offer companies technological solutions comparable to the first world, supported by highly qualified technical teams, sophisticated laboratories, and state-of-the-art simulators. Besides, the capillarity of the SENAI Units is spread out throughout the entire state of Rio de Janeiro, making it possible to provide even more personalized assistance.

This technological transformation was possible through investments made by SENAI. It increased its investment in technology over 6 times in 2014 compared to the investment in the three previous years. About R$17 million were invested in a modern infrastructure to face the challenges for development in Rio de Janeiro, making it possible to serve 720 assistance sessions in 432 companies. The new technological base demonstrates the current moment at SENAI, as it is inserted more and more as an articulator and innovation generator, seeking to apply new technologies to products and processes in companies.

SENAI increased its investment in technology over 6 times in 2014 compared to the investment in the three previous years.

It is aware of the changes in the market and the consumption behaviors, SENAI has traced technology roadmaps – pathways to be traveled in the next five years – choosing the main platforms and competencies in the Environment, Simulation, Metallurgy, and Bioprocess areas of knowledge, applied to industrial development.

The mobilization surrounding the modernization of SENAI involves people – who are essential for this transformation – methodologies, procedures, and equipment. In 2014, 37 new staff members were contracted, making a total of 203, among these there are members with 8 doctorate degrees, 20 masters degree, 25 college graduates, 60 post-graduates. 73 technicians, and 17 high school graduates. This team task is to generate solutions for industries, SENAI achieved over 84 thousand hours dedicated to value added services and over 29 thousand hours in laboratorial services.

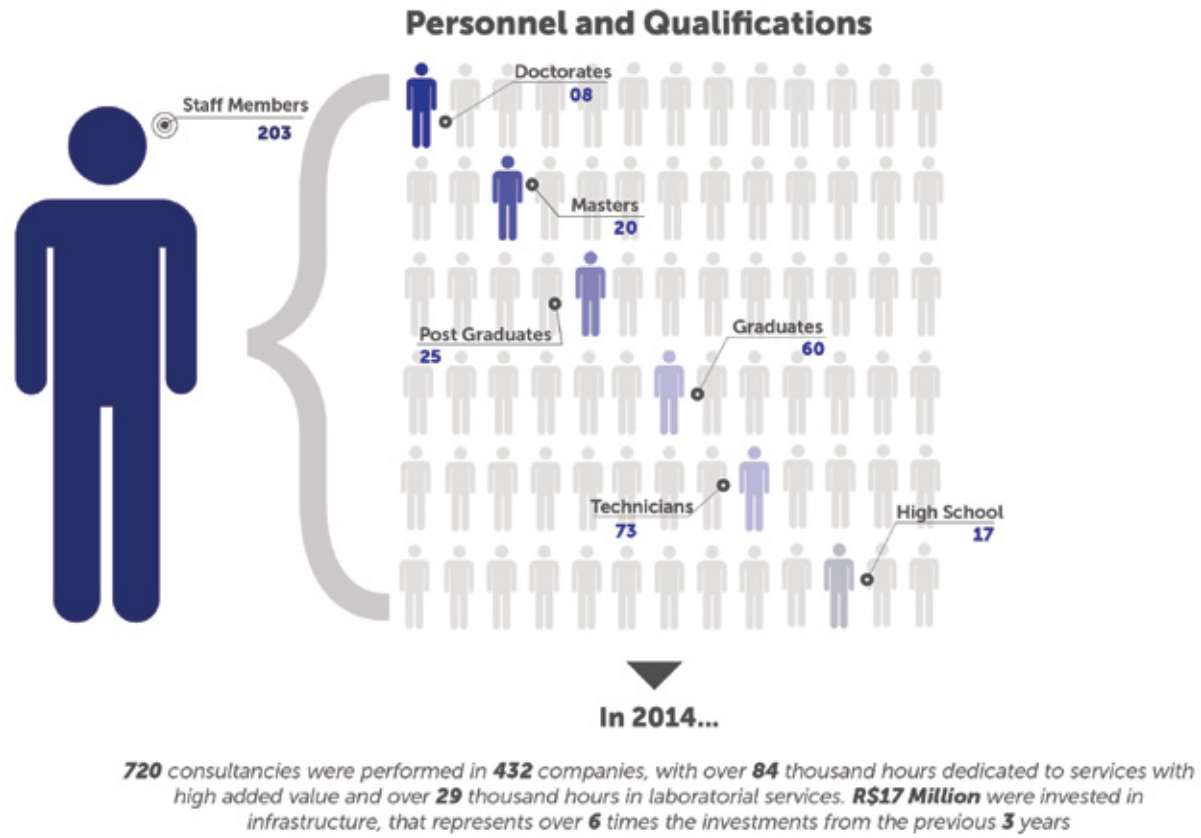


Figure 1 –Technology and Innovation Indicators

Another important aspect is the investment made in the valorization of research and technology transfer. SENAI technicians visit and make partnerships with institutes such as: VERSUCHS - UND LEHRANSTALT FÜR BRAUEREI (VLB) in Germany, AIR LIQUIDE WELDING, ITW OIL AND GAS, SLV MANNHEIM, EDISON WELDING INSTITUTE - EWI, ABNT, UNEP, CBPAK, FRAUNHOFER INSTITUT, among others.

Besides the technological solutions, SENAI promotes courses seeking to provide professional qualification and technical and technological preparation for professionals, and professional enhancement for companies. In 2014, around 170 thousand enrollments were made in a broad-based portfolio of over1,000 courses.

The next cycle in the development of SENAI will be from 2015 to 2020 and it will be prepared with indicators to reveal the effectiveness of the actuation of SENAI facing its role as a connector between Industrial opportunities and technological knowledge.

THE MOMENT FOR TECHNOLOGY AND INNOVATION

In the contemporary society, where markets, products, and technologies are subject to constant changes, the demand for products and sophisticated and personalized services is continually increasing. In this context, innovation is viewed as an important asset for seeking opportunities, as well as in developing necessary competencies and resources to guarantee the competitiveness and survival of organizations. Due to this, companies increasingly seek to know:

- What technologies will actually be used in the future?
- When will they become commercially relevant?
- What substitutes for technology could arise?

The answers to these and other questions need to be revised periodically to guarantee the pathways traveled by companies are truly aligned to the real necessities and wishes of the market.

In consonance to all this process, the Sistema FIRJAN perceives that companies are at the center (core) of Innovation, and through these technologies, inventions, products, and ideas are launched in the market. Thus, as a solution provider and partner to Industry, it is present throughout the entire Innovation cycle, developing actions to create a favorable atmosphere and, consequently, strengthen companies in Rio de Janeiro.

The Sistema FIRJAN perceives companies as the center (core) of Innovation, and through these, technologies, inventions, products, and ideas are launched in the market.

This movement takes place aligned to the Sistema FIRJAN Strategic Plan and the Innovation Directorship, in turn; it contributes and coordinates actions based on three pillars:

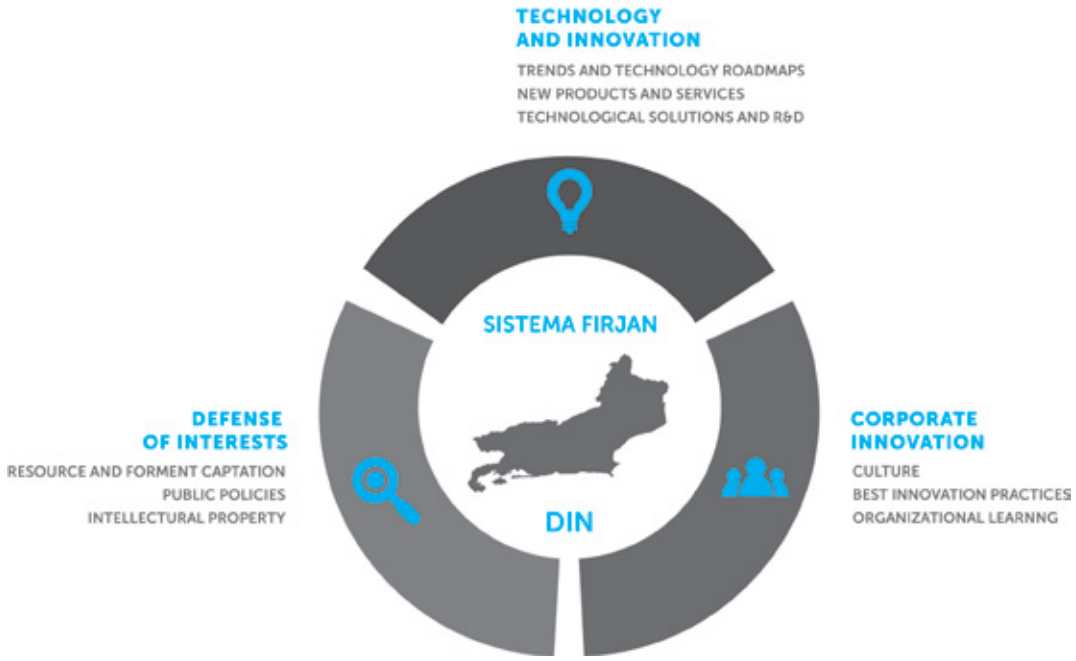


Figure 2 –Innovation Directorship Pillars

Studies and projects are developed in the Technology and Innovation pillar and they are focused on trends and technologies, which will impact the future, evaluating its applications and possible economic and social impacts on industries. The results will guide the construction of new horizons, anticipating and designing a series of actions to guarantee the companies competiveness and remain in an increasingly dynamic and transforming market.

In parallel, these actions unfold internally as an important input for modeling new fronts of actuation for SENAI and for updating the Technology Roadmaps - technological planning for the short, medium, and long term planning of the SENAI areas of knowledge (Simulation, Environment, Metallurgy, and Bioprocesses), in which investments in technologies are defined, according to the needs of the market, and mapping the necessary actions to internalize them, prioritize them on a temporal horizon based on current and future demands.

Thus, the Innovation area supports the SENAI areas so they can offer Industry state-of-the-art technology and differentiated technical capacity through providing consultancy service in research and development.

The second pillar is Defense of Interests and its objective is to identify available public resources, to foment the innovation in "Fluminense" companies. In other words, it is responsible for diminishing the gap between research and industry, linking industrial demands by innovation to public resource sources to generate new businesses in the state. Besides, it encourages executive training in innovation in companies and entrepreneurs in fundamental themes for innovation management.

In this context, stimulus to industry takes place through the following actions:

- Innovation Map – Empowering the positioning of the Sistema FIRJAN in the National Innovation System (SNI), it prepared the strategic plan to map the SNI member stakeholders (public policies, foment sources, specialized media, etc.) to narrow the relations between institutions and promote the exchange of competencies;
- Innovation Edicts - Guiding industry in raising resources for the development of technological solutions. In the past few years, 160 companies have been instructed and they raised R$ 27 million Reais in resources;
- Technological Caravans – Their purpose is to disseminate available financial sources to micro, small, and medium sized companies for Innovation Technology, as well as, provide support to entrepreneurs so that they can get access to these financial resources. Totally, 68 Technological Caravans took place in the entire state since 2006, and about 1300 companies participated in this Project.
- Innovation Study Guide – It was prepared in partnership with the FIRJAN "Conselho de Jovens Empresários do Sistema" (Young Entrepreneur Council System) (CJE), helping to identify sources to raise resources and setting up partnerships.
- Intellectual Property (Nucleus) Center – Guides companies and discloses the importance of Intellectual Property for the protection and valorization of products and products.

Besides these fronts, SENAI counts on a vast capital relationship, in the representation from Forums, Associations, and Institutions as:

anpei – Associação Nacional de Pesquisa e Desenvolvimento das Empresas Inovadoras

INSTITUTO NACIONAL DE TECNOLOGIA – INT
Scientific Technical Council

FAPERJ – Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro
Superior Council

ALERJ
Sectorial Chamber of Creative Economy

MCTI Ministério da Ciência, Tecnologia e Inovação
Scientific and Technological Development National Fund Board of Directors

INCUBADORA DE EMPRESAS COPPE/UFRJ
Board of Directors

Finally, representing the last pillar–Corporate Innovation–the Sistema FIRJAN encourages its staff member to innovate their processes and products, whether it is incrementally, disruptively, or through the generation of innovative ideas and projects. Thus, it is understood as contributing to more innovative organizational culture.

THE HISTORY OF ROADMAPS AT SENAI AND THEIR EVOLUTION

This is a time for accelerated changes and this is not any novelty for well-structured and informed companies. Thus, facing this reality, technology is an important asset to guarantee competitiveness and survival in the market, and the dynamic insertion for the preparation of strategic planning is not just a subject for high-tech companies. Traditional companies, research institutions, and technological center also do this as they intend to guide their development of technological planning.

Facing this scenario, in 2008, the Sistema FIRJAN identified the need for developing technological planning for SENAI, as a way to keep updated and offer high value added technological services and professional education.

The exploitation of opportunities which involves methods for the definition of technological planning is ample. Therefore, it is necessary to define a scope among the existing methods to make the investigation possible and then the initial path was to select the one, based on the objectives of the Sistema FIRJAN that would individually stand out and display potential for the application.

Among various existing methods, the process of the Technology Roadmaps has stood out as being a management tool useful for strategic planning of organizations.

It is commonly used for aligning technological capacity to its products and business plans, enabling the strategy of the organization and its respective technologies synchronous.

After defining the method, the area of Innovation began to dedicate itself, beginning in 2009, in develop activities inherent to the process of its application.

The launching of the Metallurgical and Environmental Technology Roadmaps in 2011 and Food and Beverages in 2012, was a positive mark in the application of the methodology, as it organized the proposal of SENAI and placed it facing an environment full of opportunities. Through this instrument, clients and partners could see how solid and well-structured its future vision was, transmitting confidence and sincerity. Due to the efforts made by the management and the technical staff to put the actions of the Technology Roadmap into effect, this perception was put into effect through contracts and concrete result, making it possible for SENAI to go ahead to another technological level and market.

In 2013, a visibility and highly promising investment stage was achieved and it was necessary to revise the Map for future expectations and challenges.

When reflecting on the application of the first MRT, it is possible to consider that this was a unique structure and easily replicated. It displayed the vision and the necessary subsidies for the development of the product portfolio for the temporal horizon from 2011 to 2014, integrated to the Balanced Scorecard (BSC) since its conception to the Sistema FIRJAN.

However, as this is not considered as the final objective but a means for achieving the results, it is extremely necessary that the roadmaps make sense to the company, as they do not operate independently and they must be supported by a technologic and innovative management model.

Thus, facing this issue, the continuity processes for monitoring the implementation of the Technology Roadmaps were founded and brought about new and important learning to assist in the revision process.

Fruit acquired from the knowledge and opportunities for continuous improvements evidenced during the processes previous to the application of the method, thus the second edition introduced some novelties.

The first one of them was the creation of the "Technological Platforms" aligned to the concept of integrated solutions for the Education, Technology, and Innovation services, for the purpose of making the expansion possible among the diverse maps and SENAI business areas.

The Technological Platforms are competencies that unite structural, intellectual, and relational capital for the development of products and market ranking. In this way, the intention is to prepare strategic sets for growth, competitiveness, and current and future sustainability for the business areas of the Sistema FIRJAN, as well as contributing to improved articulation between the individual priorities in each Technological and Innovation area of SENAI, in such a way as to guarantee the generated knowledge is transformed into products and sellable services.

Another novelty was the conception of monitoring processes for the consolidation of the Technological Platforms and, consequently, to demonstrate in real time adherence to the roadmaps, the internal necessities and market ranking (clients and partners). Regarding these novelties, there has been the consecration of a new format.

The relevance of the roadmaps is, mainly related to the fact of being an information structure that allows clear-cut communication and the comprehension of objectives. For this purpose, in addressing diverse options, the development of a simple and concise picture was focused on. See the sketch of the conception of the standard structure in figure 3.

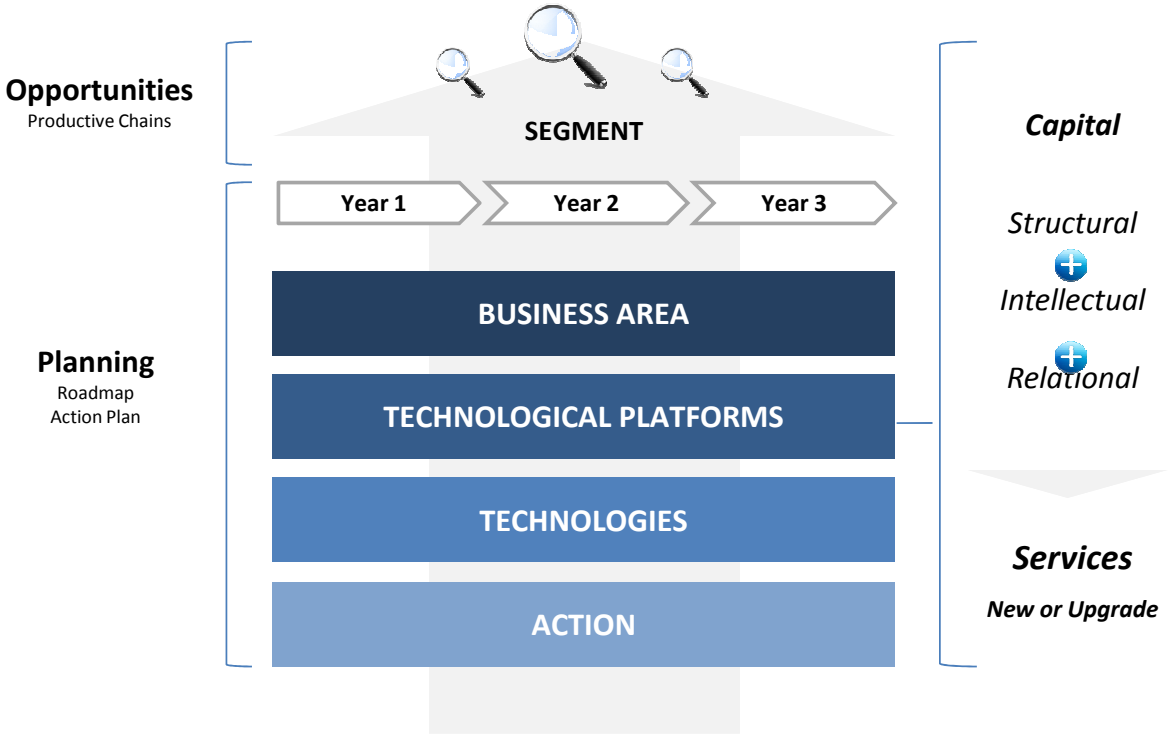


Figure 3 – Standard structure of the SENAI Technology Roadmaps

The first section of the map points to the Productive Chain Opportunities. As mentioned, the intention is to enlarge the planning model of the Sistema FIRJAN technological management, integrating all the spheres and delivering the best answer for the new challenges of the "Fluminense" industry.

The second section organizes the four basic layers of the map, as follows:

- Business area – the market area for doing business and offering a range of specific services developed to serve the needs of industrial sectors (Simulation, Metallurgy, Environment, and Bioprocesses).
- Technological platform – competence blending structural, intellectual, and relational capital for developing products and market ranking.
- Technology/methodology – specific type of knowledge which can be embedded or not in a physical artifact, such as a machine, a component, a system, or a product. It is the main characteristic that differentiates it from other generic types of knowledge, as this is what constitutes applied knowledge (people and methods), focused on the know-how of the organization. The technology/methodology is the basis for the development of product portfolio (new services and improvements in current services).

- Action – this layer corresponds to the internalization of the roadmaps by the organization. Five actions were developed based on the follow-up from the first edition of the roadmaps and this corresponds to the processes of acquisition, training, hiring, new relationships, or performance of work activities.
- Temporal horizon – the determination of the temporal period was guided by basically three criteria that guide the technological planning development in a horizon of five years (2015 to 2020) including the qualification in annual temporal marks: "maturity level/technological development", "internalization level by SENAI" and "necessary investment level".

According to the concept of a "live" and "dynamic" methodology, all and any important movement of the organization must be considered so that a new revision can be done on the planned roadmaps. During 2014, the Sistema FIRJAN defined it Strategic Planning for 2015-2020 and, due to this, a third edition of the Technological Roadway was prepared. In order to reach the strategic objectives of the organization, all the technological planning was revisited again and the actuation and action fronts were redefined to be aligned to the focus of the institution.

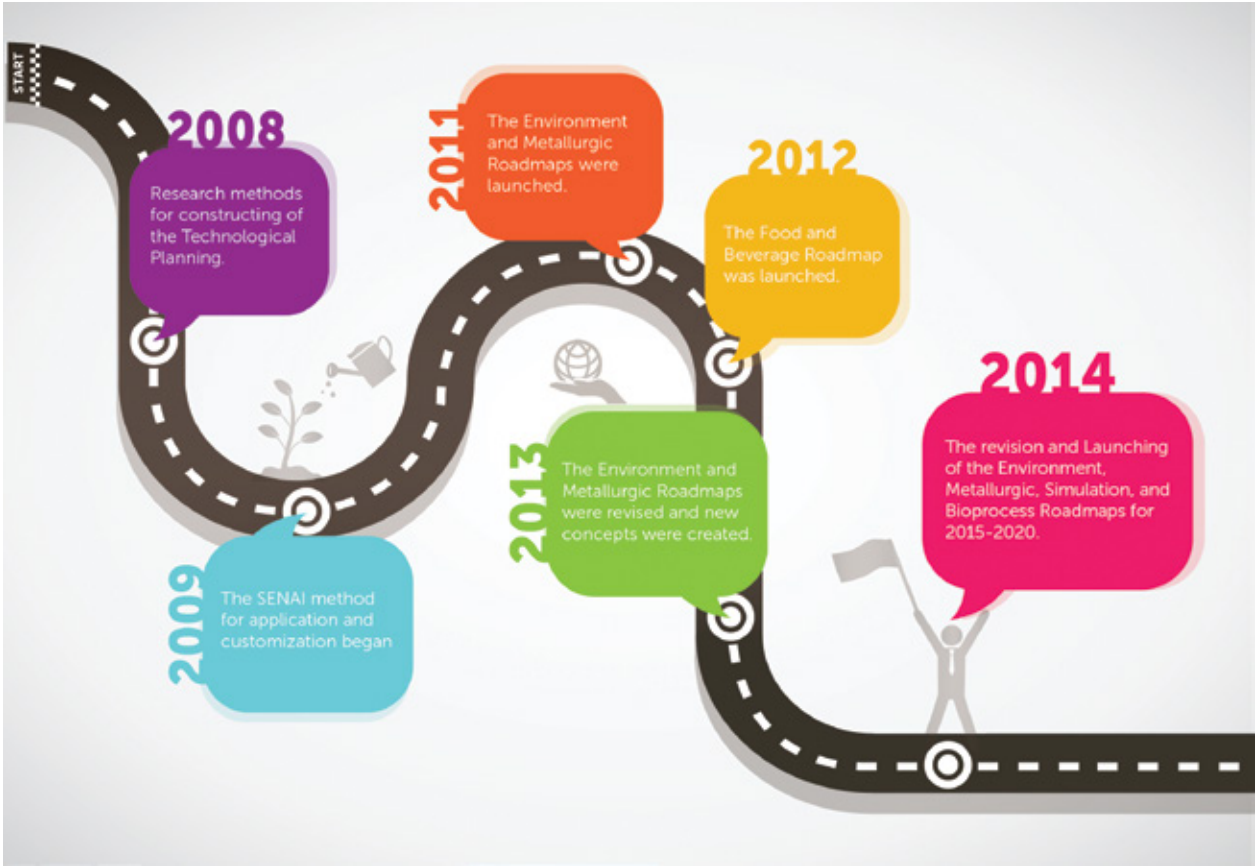


Figure 4 –The Development of the Technology Roadmaps

According to the concept of a "live" and "dynamic" methodology, all and any important movement of the organization must be considered so that a new revision can be done on the planned roadmaps.

In short, technological planning, through the roadmaps, organizes and maps the technologies which will be improved and/or developed to serve the needs of the market. This action results in the alignment to the technological capacities to the portfolio, whereas opportunities are identified for improvement and/or for development of services.

In 2015, in seeking increase adherence to the demands of the market, the roadmaps are being integrated in the Sectorial Visions – trend studies on the "Fluminense" industrial sectors -being developed by the Strategic Innovation area of the Sistema FIRJAN. From this, the technological management planning model will be enlarged, in response to new challenges and impel the "Fluminense" companies to become competitive. The services offered will be continually more customized to the demands of the sectors.

Figure 5 displays the integrated and exemplified model integrated into two or more Technological Platforms (Competencies) based on the demands of the sectors for developing integrated solutions.

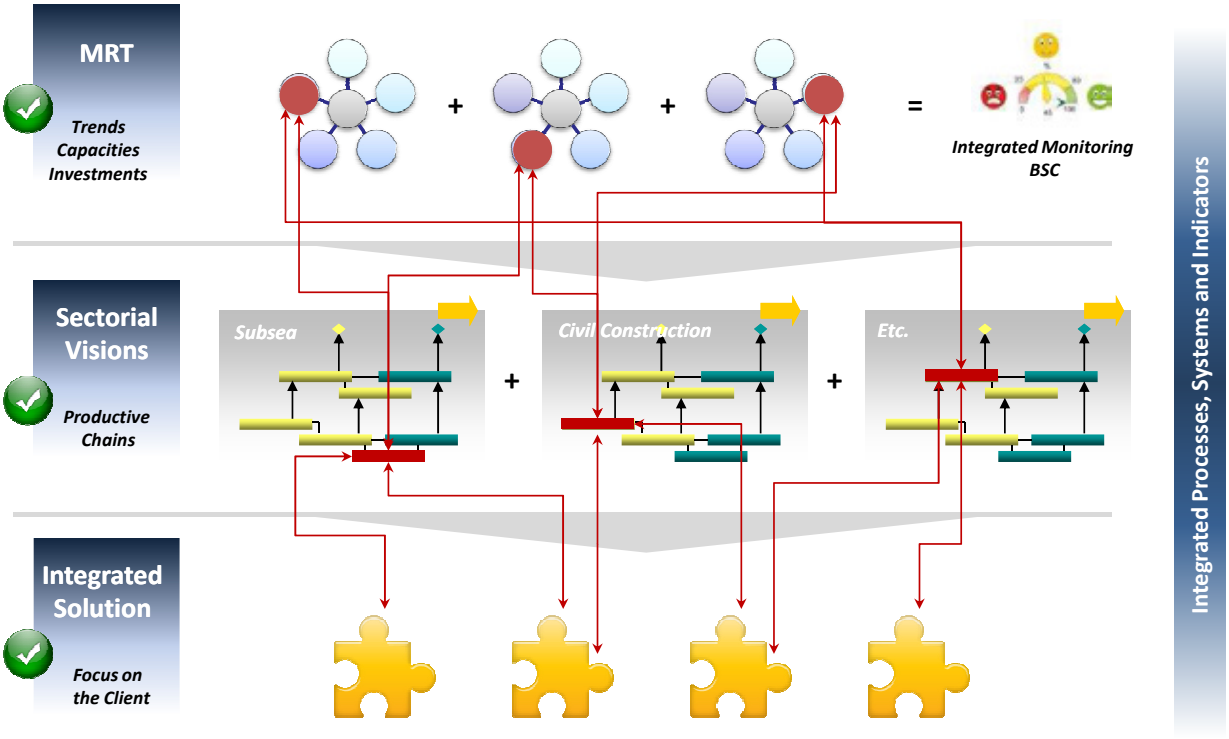


Figure 5 –Integrated Solutions

TECHNOLOGY ROADMAPPING

Technology Roadmaps, in the third edition, are the result from a collaborative process, based on the Technology Roadmap (TRM).

Technology Roadmap is a method used worldwide for planning product development, in order to consider the necessities and trends of the market, the business objectives of the company, and technological possibilities. Based on the application of TRM, companies are in fact capable of integrating results obtained from their planning.

It has been broadly disseminated by the British scholars Robert Phaal, Clare J.P. Farrukh, and David R. Probert through the T-Plan manual (The fast start to Technology Roadmapping), this method is a reference and it can be considered as state-of-the-art in its application in diverse companies. Thanks to the possibilities of its application, the scope in the utilization of the method is longstanding and currently, besides just technologies, there are references to roadmaps for products, policies, supplier chain, innovation, strategies, and competencies, among others.

Based on this logic, the Sistema FIRJAN, through the Innovation Directorship, has been developing the technological planning of the SENAI business areas, as a way of keeping it updated and offering Technology and Innovation services and high value added professional education.

The question "What are the future possibilities of synergy among the business areas? Modeled the revision process of the roadmaps and this has helped to envision the paths for preparing the planning. This issue is on the SENAI agenda, making it possible to guide the horizon pathway. However, after the direction is defined, a new question arose: "How is it possible to plan and define the areas of SENAI in an integrated manner?".

In this phase of considering this issue, SENAI methodology was idealized as the objective for guiding the pathways to prepare individuals in each technological area and achieve the possibility of synergy and integration.

The methodology was adapted and designed in four separate moments: Market, Platform, Technology, and Roadmap. There are intermediate meetings, between these meetings, the results are analyzed from each step and reflect on the continuity of the process.

Figure 6 –Technology Roadmap Methodology adapted by SENAI

SENAI methodology was idealized as the objective for guiding the pathways to prepare individuals in each technological area and achieve the possibility of synergy and integration.

Market

The objective of the Market meeting was to introduce the application process focusing on the sources related to the "Business Area" layer in the roadmaps. At this time, the market pointers were analyzed (external environment), displaying the reason and the motivation for planning new products and for the internalization of new technologies by the organization.

Each business area held specific workshops for presenting the SENAI actuation and leveling the understanding and comprehension of the participants on the roadmap process.

After understanding the context, discussions were promoted on the market pointers, considering these general trends until the specific necessities and requisites of the clients arose in each segment. Through these brainstorming sessions, the behaviors were mapped on consumption, immediate necessities of the industrial sectors, laws and regulations, public policies, among others. The opportunities define the motivation for the increase of competencies in the development of the services and solutions emphasizing the importance of technologies in the following steps.

The activities counted on the presence of the SENAI technical team and the main companies from diverse industrial sectors.

Platform

The next meeting was focused on the PLATFORM layer in the Technology Roadmaps, when the market pointers, which were defined in the previous workshop, were crossed with the business pointers (internal environment) of the organization. These were identified based on the objectives derived from the Sistema FIRJAN strategic plan.

Based on this crossing, the choices were made on which competency base would be employed (Technological Platforms) would be incremented or developed. The platforms were prioritized related to the potential to supply the needs of the business market pointers.

Based on the results, the team could understand which the priority competencies were and, consequently which characteristics of the products are more critical. Thus, the technological platforms were defined and the market positioning to maintain the current competiveness of SENAI and adhere to the future pointers.

The meetings were held only with the internal SENAI team members in order to have specific and strategic discussions.

Technology

The third workshop was focused on the Technology layer, guided by the decisions from the previous meetings. In this workshop, the necessary technologies and methodologies were identified to order to make the defined competencies feasible as priority for the platforms. Such technologies and methodologies define how the organization intends to develop and deliver its products.

In this meeting, the results from the Platform workshop were used as a dynamic exploratory method (brainstorming) seeking to identify the technologies and methodologies for expanding SENAI in each competency.

The activities included the presence of the SENAI technical teams, as well as specialists and researchers from important companies and technological institutions.

Roadmap

The transition from the collection step to the information analysis step, as the team studied the described environment and defined objectives, targets, and actions for the technologies to then to be put into effect in the last meeting, when the choices were also materialized by employing the figure: the Roadmap.

In this session, the necessary actions were planned for the internalization of each technology in the temporal horizon from 2015 to 20120, based on the prioritizations defined in previous workshops.

The activities were performed, collaboratively, by the SENAI technical team.

Implementation and Continuity

For the purpose of guaranteeing good performance from the planning, a monitoring process was developed – a method considered as a basis for effective and continuous control for the consolidation, implementation, and continuity of the technology roadmaps.

In order to guarantee the roadmaps selected by the business areas of SENAI would comply with the changes in the markets; prospective studies are performed by the Strategic Innovation area to identify trends that converge on the SENAI objectives. The result from these studies is the technological map (the identification of the future technological bearers) and the market changes that will feed the roadmaps and they can interfere with the courses defined for the next five years.

THE ROADMAPS

The Technology Roadmap must be "alive" and "dynamic" and change according to changes in new teams, the dynamic of the technology, concepts, and capacities, external and internal pointers. Otherwise, they become just static records, and they will not be fundamental tools for technological planning. The conception of the final figure was created to clearly and objectively illustrate the future perspectives of SENAI. Thus, four maps were prepared, one for each business area:

Environment, Metallurgy, Simulation, and Bioprocesses. Figure 7 shows the created model.

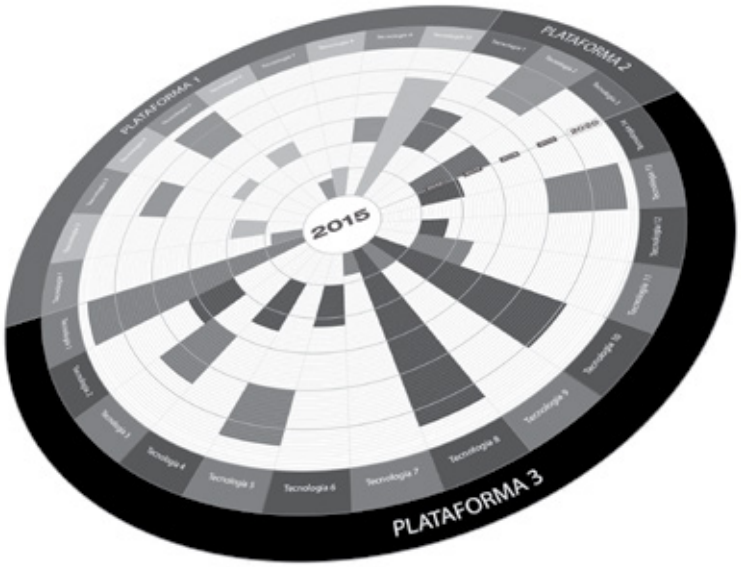


Figure 7 – Technology Roadmap

It is important to emphasize that the map is based on a temporal horizon beginning in the year 2015, located in the midpoint of the figure. Beginning from the point, it displays the next years until 2020, are marked based on the increased values on the scale.

In the outermost layer are the Technological Platforms, which are actuation fronts for each business area and the owners of all the structural, intellectual, and relational capital for the development of the products. Right below that, are the technologies and methodologies necessary for developing or incrementing the platforms.

Finally are displayed the necessary actions for internalizing the technologies (works, acquisitions, hiring, training, and partnerships) trace the course, the beginning and ending of the joint actions, to be traveled by each technology throughout the years.

In the next pages, the conceived roadmaps are displayed for each SENAI business area for the next five years.

ENVIRONMENT ROADMAPS

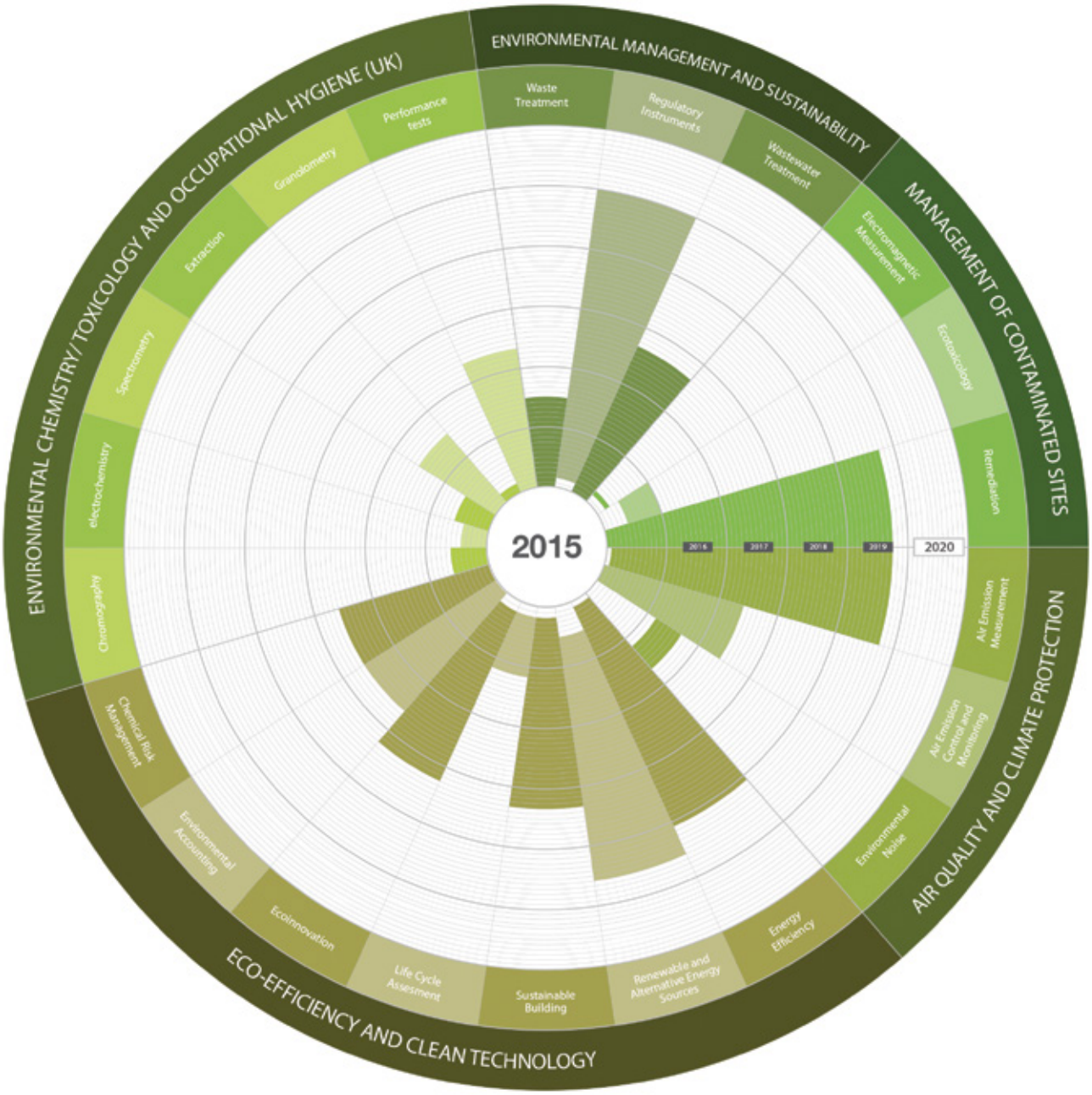
Currently, it is possible to notice a cultural change in companies, identifying investments in environmental service and research, as an Innovative asset for adding value to their image, products, and processes. Besides just adhering to regulations, the actions of the Environment area of SENAI is to make companies more competitive, using technological solutions to reduce costs and wastes in production, using natural resources rationally, employing more efficient processes, and mainly, reaching new markets.

In consonance to the objectives of the area, looking at the market and making choices according to the guidelines of the organization, the developmental process of Technology Roadmaps 2015 - 2020 and there are six Technological Platforms indicated:

- Eco-efficiency and Clean Technology
- Environmental Management and Sustainability
- Management of contaminated sites
- Air Quality and Climate Protection
- Environmental Chemistry
- Toxicology and Occupational Hygiene (UK)

Based on this definition, potential technologies were chosen and invested in during the next five years.

Following this, the presentation of the Environment Roadmaps 2015-2020 contains the details on each one of these six technological platforms.


ENVIRONMENTAL MANAGEMENT AND SUSTAINABILITY
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Regulatory Instruments
Wastewater Treatment
MANAGEMENT OF CONTAMINATED SITES
Electromagnetic Measurement
Ecotoxicology
Remediation
AIR QUALITY AND CLIMATE PROTECTION
Air Emission Measurement
Air Emission Control and Monitoring
Environmental Noise
Energy Efficiency
ECO-EFFICIENCY AND CLEAN TECHNOLOGY
Renewable and Alternative Energy Sources
Sustainable Building
Life Cycle Assesment
Ecoinnovation
Environmental Accounting
Chemical Risk Management
ENVIRONMENTAL CHEMISTRY/ TOXICOLOGY AND OCCUPATIONAL HYGIENE (UK)
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electrochemistry
Spectrometry
Extraction
Granulometry
Performance tests
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2016
2017
2018
2019
2020

THE ENVIRONMENT PLATFORMS

Environmental Chemistry

The Environmental Chemistry is part of Classic Chemistry that studies the changes that occur in the environment, but more precisely the chemical processes that take place in nature, whether they are caused naturally or by man and thereby provoke serious damages to humanity. In other words, Environmental Chemistry exists in order to study the mechanism that define and control the concentration of chemical species which need to be monitored.

Due to the growing index of pollutants, there is a negative impact on the environment and these contribute to a series of climatic changes throughout the entire planet. The environmental issue has become a theme for discussion and concern by all segments of society. Environmental Chemistry has become an important area of interest as it deals with environmental impacts caused by pollutants, which is worrisome to the organization and management of measures for environmental protection, inspection, control, and working towards the prevention and conservation of the environment, as well as defining the necessary corrective measures.

Environment Chemistry area of SENAI makes it possible for the industries in the state of Rio de Janeiro adhere to demands and requisites established by the municipal, state, and federal environmental legislation and regulations, envisioning the analytical capacity to achieve the objective of continual decreasing levels of toxic chemical substances present in the environment.

CTS Environment has a modern laboratorial "nucleus" (center) providing analytical services to detect extremely low detection limits, achieving up to one part per trillion (PPT) in some analytical techniques.

The analysis services also provide competitive prices and period, as well as being accredited by INMETRO, by the ABNT NBR ISO/IEC 17025:2005 standard, a world reference for confirming laboratory quality in tests and calibrations.

We also wish to stress the competency for performing RD&I seeking the characterization of samples, identifying substances in the environment and developing methodologies for pre-salt samples, among others.

Eco-efficiency and Clean Technologies

The area of Eco-efficiency and Clean Technologies supports Industry in developing goods and services, reducing or eliminating the impacts on the environment with economic advantage. This concept introduces a cultural change, as possible environmental problems are treated since the beginning of the production process or in the development stage of the product/service.

In other words, these are actions related to the products while still in project development (ECODESIGN), or solutions focused on causes in the beginning of the production process (Cleaner Production), instead of just treating the consequences. It is a program that empowers knowhow in the industry and in the company value chain, aligned to innovative technological solutions with great potential for financial return on investment for the entrepreneur.

Additionally, the preventive actuation is reverted in improving the company image and its products at its customers, adding value to its actions in the capital market, as the company will be recognized as being proactive and eco-efficient. Another benefit from eco-efficiency for companies is to eliminate penalties and achieve greater legal security (due diligence). By dealing with a program that involves the employees of companies, the action includes the improvement of products and services quality, occupational health and safety, reduction of chemical risks and wastes and additional costs for waste treatment and disposal, especially hazardous wastes.

Finally, the optimization of water usage, raw materials, and energy grant increased productivity, as companies produce and sell with fewer resources, which represents a preponderant factor in industrial competiveness.

There are countless cases of participating companies reporting avoided costs and economic benefits favoring expansion investments and improvement of processes.

Thus, the SENAI Eco-efficiency and Clean Technologies area have developed environmental solutions for products and productive processes, customized for each client, with the capacity to serve any size of company. For small-scale companies, many times as they have little access to information and technology, so SENAI has developed the Cleaner Production programs partnering with Associations, Unions, and SEBRAETEC (SEBRAE Innovation and Technology Services), seeking improvement in productivity and, consequently, improved competiveness.

Besides this, it will guarantee the industries of Rio de Janeiro States access to all the most up-to-date concepts on the area of Eco-efficiency and Clean Technologies from SENAI, as it is a member of the global program for disseminating the practices of Cleaner Production (CP), as it is a national and international reference on this theme. This program includes the participation of over sixty countries and it is sponsored by the United Nations for Industrial Development Organization - UNIDO, that encourages actions promoting the development of a green industry, based on an sustainable economic basis, whereas industrial competitiveness is related to the improvement in the quality of life and conservation of strategic resources, such as water, energy, and mineral resources.

Management of Contaminated Sites

The management of contaminated sites is made up by a set of actions for the purpose of evaluating the environmental conditions in any given area, providing the necessary instruments for decision-making regarding the most appropriate intervention, especially in cases where the area is proven to be contaminated and it is necessary to mitigate the risks to the population and the environment.

The management of contaminated sites, as stated in the agreement with the Brazilian law (CONAMA Resolution n° 420/09), includes the following steps: identification, diagnostics, intervention, and monitoring; seeking to rehabilitate based on the desired usage:

- Identification: the areas suspected as being contaminated will be identified based on a preliminary evaluation and, those which display evidence of contamination, then a confirmatory investigation must be performed;

- Diagnosis: this includes the detailed investigation and risk evaluation, for the purpose of subsidizing the intervention step, after the confirmatory investigation has identified chemical substances above the acceptable investigation value;
- Intervention: execution of actions for controlling the eliminate the danger or reduce to tolerable levels of the identified risks as stated in the diagnosis step, considering the current and future uses in the area;
- Monitoring: follow up and verify the effectiveness of the executed actions.

International competition and the accelerated process of mergers and acquisitions of companies have made strict verifications necessary, so that existing environmental liabilities can be evaluated and their value added to business deals. This fact is not only associated to the increased concern on the environment and the more active role environmental bodies play, as well as the high costs involved in the remediation of areas, ranging from environmental damages to the negative impact on the image of a company.

Facing this, SENAI Management of Contaminated Sites, which is a reference due to its environmental authority agency, investigates if the company is compliant with the reference environmental legislations and if there are problems which can depreciate its value to the market, if it seeks to benefit the environment, population, and consequently the company itself. This area seeks to serve the demands of industries, shipyards, landfills, companies in the process of deactivation, construction firms, petroleum companies, and waste handling companies, public institutions, building projects in progress or in the installation phase.

Environment Management and Sustainability

The Environmental Management and Sustainability provides tools helping companies to identify environmental and social aspects and impacts generated in their productive processes and the management of these issues, in such a way as to mitigate and prevent environmental and social problems, seeking to adopt sustainable practices and, thereby comply with legal requisites they are subjected to.

The growing pressure from the market for becoming compatible to productive quality while conserving the environment, which is a demand from society for increasing the level of quality of life and the increasing environmental legislative strictness in combating the degradation of natural resources constitute factors, which impel companies to invest in the adoption of environmental management systems and eco-efficient processes.

The adoption of such tools is recognized by the market, suppliers, and customers and adds a competitive edge to maintain the level of credibility and quality of their processes and products through the obtainment of certifications. This is because public opinion exerts pressure on companies, so that they seek alternatives for development of their economic activities more rationally. Starting when the company places its product on the market and demonstrates its concern for the conservation of the environment, that company, together with its products becomes a reference.

The market consumer begins to select consumption products based on the factor of social responsibility of manufacturing companies.

SENAI Environmental Management and Sustainability area offers technological solutions to the industry for the adherence of requirements from environmental authority agency, for increasing their competiveness, and consequently, avoid penal, civil, and administrative penalties, as well as develop and implement environmental and social programs and help companies seek solutions for adherence related to sustainability.

Air Quality and Climate Protection

Generally, Air Quality and Climate Protection is a product of the interaction of a complex set of factors and one of the noteworthy factors, is the magnitude of emissions, topography, and the meteorological conditions of the region, as these are favorable or not in the dispersion of pollutants.

The monitoring of atmospheric emissions and the evaluation of the quality of the air is a determinant legal obligation for environmental licensing, which ultimately, authorizes the operation of any industrial activity. Besides, industries must monitor their greenhouse gas emissions and propose actions to reduce them, as part of their obligations for protecting the climate.

Recently, there have been new regulations introduced by environmental authority agency, such as the Pollutant Transfer and Emissions Report, the Environmental Monitoring of Particles smaller than 10 µm, and the INEA Resolution n° 64/2012 (Greenhouse Gas (GEE) Inventory). Especially, for the GEE Inventory, the SENAI Air Quality and the Climate Protection Area has a staff of consultants who are certified internationally, for the preparation as well as the verification of Inventories and Emission Reduction Projects. This qualification is integrated to the cleaner production and contributes, so that the company can optimize its processes, especially related to the consumption of fuel, energy, and water.

Generally, the SENAI Air Quality and the Climate Protection area support industry, so they can adhere to regulations/resolutions by developing solutions for the mitigation of atmospheric emissions, and methods for preventing such emissions by the application of concepts and technologies, and equipped with its own an accredited laboratory, for increasing the dependability and reliability of the acquired results.

Toxicology and Occupational Hygiene (UK)

Toxicology is an area of toxicology that studies the principles and methods for the identification, management, and control of chemical compounds in the occupational environment. It seeks to adequately and safely use chemical agents that can be hazardous to workers. Thus, Toxicology has focused on studying the worker, while Occupational Hygiene complements Toxicology on studying occupational environments.

Due to the accelerated growth of industry and the constant increase in the use of chemical products, therefore no type of occupation is completely free from exposure to a variety of substances capable of producing undesirable effects in biological systems. For this reason, the industries in the state of Rio de Janeiro and other states are subjected to compliance with occupational regulation to define the monitoring of toxic substances in the productive environment. In this aspect, the Environmental Risk Prevention Program (PPRA) is for this and it must be prepared and implemented in all companies, regardless how many employees there are or the risk level of the activity.

The SENAI Environment area is prepared with an excellent analytical infrastructure and specialized professionals to perform analyses at high metrological standards, serving the market and its routine demands in the area of Toxicology and Occupational Hygiene, as well as the preparation of the PPRA, by performing analyses of chemical agents as specified by the Labor and Employment Ministry standards (NR-15 and NR-7) and the American Conference of Governmental Industrial Hygienists (ACGIH). It is also possible to adhere to the new industrial demands as well as the new chemical agents which need to be monitored through the development and validation of analysis methodologies, as well as actuation in the area of RD&I.

METALLURGY ROADMAPS

Facing a scenario where access to technology is an important asset to guarantee Industrial competiveness and survival, the SENAI Metallurgy area, as an integration area, provides Technological and Innovation solutions to sectors, which need metallurgical knowledge, such as the naval industry, civil construction, oil and gas, automotive, and offshore, which require the operationalizing of high technology for the development of highly complex and extensive projects.

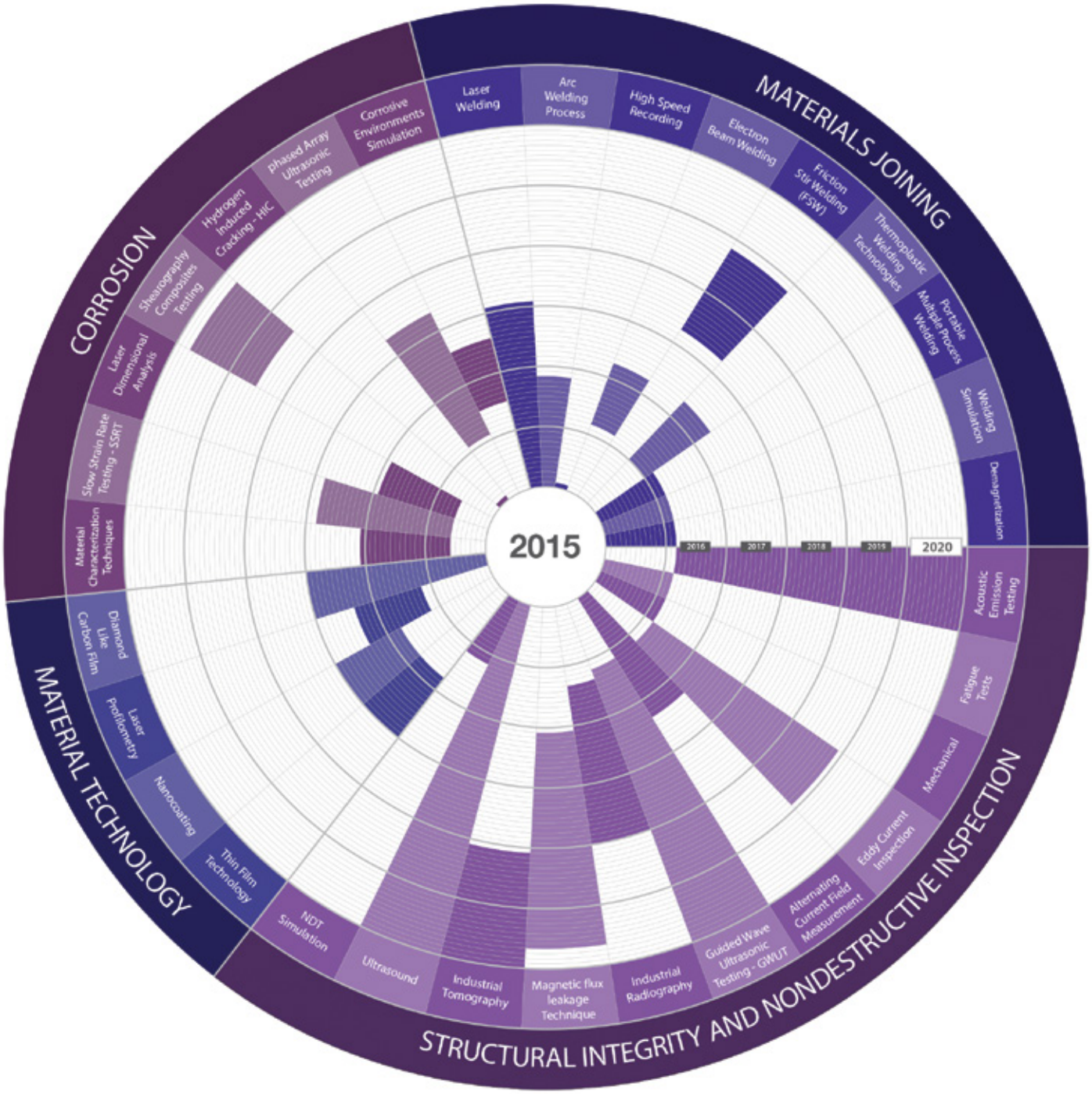
Thus, the area has set to provide access to these new state-of-the-art technologies as its objective that are not very accessible or even restricted to research institutions and industrial sectors in the state seeking customized solutions.

In consonance to the objectives of the area and looking at the market and making choices based on the guidelines of the organization, the development process of Technology Roadmaps 2015 2020 has indicated four Technological Platforms:

- Materials Joining;
- Material Technology;
- Structural Integrity and Nondestructive Testing;
- Corrosion.

Based on this definition, potential technologies have been defined for investment in the next five years.

Following this, the presentation of the Metallurgy Roadmaps 2015-2020 contains the details on each one of these four technological platforms.


MATERIALS JOINING
STRUCTURAL INTEGRITY AND NONDESTRUCTIVE INSPECTION
MATERIAL TECHNOLOGY
CORROSION
Laser Welding
Arc Welding Process
High Speed Recording
Electron Beam Welding
Friction Stir Welding (FSW)
Thermoplastic Welding Technologies
Portable Multiple Process Welding
Welding Simulation
Dimensionalization
Acoustic Emission Testing
Fatigue Tests
Mechanical
Eddy Current Inspection
Alternating Current Field Measurement
Guided Wave Ultrasonic Testing - GWUT
Industrial Radiography
Magnetic flux leakage Technique
Industrial Tomography
Ultrasound
NDT Simulation
Thin Film Technology
Nanocoating
Laser Profilometry
Diamond Like Carbon Film
Material Characterization Techniques
Slow Strain Rate Testing - SSRT
Laser Dimensional Analysis
Shearography Composites Testing
Hydrogen Induced Cracking - HIC
phased Array Ultrasonic Testing
Corrosive Environments Simulation
2015
2016
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METALLURGY PLATFORMS

Structural Integrity and Nondestructive Testing

The work in the Structural integrity area consists in the application of techniques to classify the damage grade in a structural component by identifying the discontinuities. The non-destructive testing consists of a testing applied to either finished or semi-finished materials to verify the existence of discontinuities or defects. These testing are based on physical principles pre-defined, with no modifications in the physical, chemical, mechanical or dimensional material characteristics, without any interference in the post-usage of the material.

The main objective of the activities mentioned before is to guarantee the workers, general public, and environment safety, since equipment and structures are part of the society daily life. The activities are also significantly important in assisting industries, since they involve a set of technologies focused on the analysis of equipment, structural components, and materials. The analysis seeks to establish safe conditions in a component at any given time. In a component at any given time, predicting its future behavior, and subsidizing decisions related to inspection, monitoring, eventual repairs or even replacement of the component. The application of structural integrity analyses generates conditions for extending the useful life of components, materials, and entire industrial installations, generating significant economic savings for governments and private companies and especially, reduction in operational failures.

The SENAI Structural Integrity and Non-destructive Testing area pursues excellence and national and international recognition for its specialized technical services in consultancies, applied research, and technological developments. The SENAI team counts on qualified professionals with the broad-based experience in the area of Physical structure and Structural Integrity of equipment and materials, as well, skilled collaborators for attending the industry. Additionally, our facilities include diverse analysis laboratories equipped with cutting-edge technology equipment, in just one location.

Materials Joining

The mechanical manufacturing process, applied to materials joining area – welding, brazing, and adhesion – objective the joining, coating, and/or maintenance of materials (metallic, ceramic, polymers, or a combination of these), on an atomic scale, with or without (isolated or jointly) heat and pressure application.

In light of the expectation of investments in the national productive sector, which estimate about R$235 billion just in the state of Rio de Janeiro, there will be a growing demand for new technologies and innovation. It will result in a great impact on applications in industrial segments involved in this area. Considering the Oil and Gas segments and the Transformation Industry will get 77% of this investment, the naval construction sector, the exploration of the pre-salt layer, the construction of COMPERJ, and even the automotive sector will be leveraged. All these investment will, certainly, lead to studies on the usage of new materials in order to guarantee the productive operation in the new conditions of application, as the welding being one of the most utilized in Materials Joining. Regarding the challenges arise, it is imperative the investment in new technologies to turn the welding engineering projects, in their boldest and innovative conception, a solution for industry.

The SENAI Materials Joining area seeks to keep the excellence and recognition for its specialized technical services in consultancies, applied research, and technological developments. Through cooperative projects with companies in the industrial segment and fomenting innovative initiatives, SENAI objectives technological improvements for customized industrial solutions in serving the new demands. Furthermore, participation in seminaries, expositions, and technical visits to national and international partnering companies, as well as counting on a modern Welding Laboratory, Inspection, and Tests, integrated software programs, joint projects, reverse engineering, using state-of-the-art gauges and equipment, and even promoting important partnerships with renowned international institutions is a tool to SENAI reaches the excellence aimed.

Material Technologies

The importance of materials is closely linked to humanity evolution, as society has always sought means to transform these materials in order to fulfill its needs. Human beings in the past, onlyhad the materials supplied by nature for millions of years, such as wood, rocks, and bones, among others. In the current scenario, the quantity of materials and techniques for production is growing. In order to choose the most adequate material for any given application, it is necessary to know the materials main properties, considering its performance, synthesis and processing, structure and composition, and cost.

The characterization technique and the materials selection are imperative in the search for materialswith differentiated properties to satisfythe new challenges of the market and the industry requirements, which are continually more demanding. Characterization correlates the chemical composition and material structure, in a contextual relevance to a process or product. Thus, it is possible to select the most appropriate material and estimate its performance for determined operating conditions, thereby minimizing the possibility of failures, during its utilization and reducing maintenance costs.

The SENAI Materials Technology team focuses on keeping national and international recognition in technical consultancy, applied research, and technological development in the area of mechanical, micro-structural, and chemical properties. The material technology team is engaged to partnerships and cooperative project to achieve SENAI´s aim. Regarding this, innovative initiatives have been developed in order to offer the best technologies for industrial solutions. SENAI is able to provide integrated solutions to fulfill industrial needs in a customized mode and performing laboratorial tests in the characterization and selection of new materials area.

Corrosion

Corrosion is the deterioration of materials by chemical or electrochemical action.

The corrosive processes provoke great economic, social and environmental losses worldwide since they reduce the goods used lifetime significantly and they demand industry produces more of the same metal in order to substitute the goods damaged.

It is known that one fifth of the steel global production is used to replace the losses caused by corrosion. Studies in different countries have come to similar conclusions, estimating variable costs between 1 to 5% of GNP to substitute some deteriorated structures due to corrosion. This loss is just a fraction of the impact caused by corrosion problems in worldwide economy. In Brazil, the expenses reach about US$ 10 billion, most part in the Oil industry.

Diverse methods are used to prevent corrosive processes, almost all of them are based on engineering practical actions and the usage of materials protective coating. The materials used to construct equipment and/or installations should resist to corrosive action and present adequate mechanical properties and fabrication characteristics.About the protective coatings, new improvements in the surface preparation and coating curing time should be studied, new coating systems should be proposed, and technologies should be developed in order to prevent, monitor, and extend the equipment and installations lifetime.

Acting in this platform, it has become possible to develop research in anticorrosive protectors and their effectiveness in the protective process. The search for solutions to upgrade processes and products should be done in partnership with industry seeking to maximize the lifetime of equipment in operation and to minimize the environmental risks due to the accidents caused by equipment corroded failures.

The SENAI Corrosion Laboratory is a new area of operation, which seeks recognition as a center of excellence in research and development of anticorrosive processes, trained in the

performing of physicochemical testing in painting, varnish, and protective coating and in the corrosion prediction area. The aim to industry is to increase the lifetime of factory equipment, utilizing the most advanced techniques, through the monitoring and improvement in protective coating, anticorrosive study, corrosion prediction, and nationalization of testing, which are performed just in exterior.

SIMULATION ROADMAPS

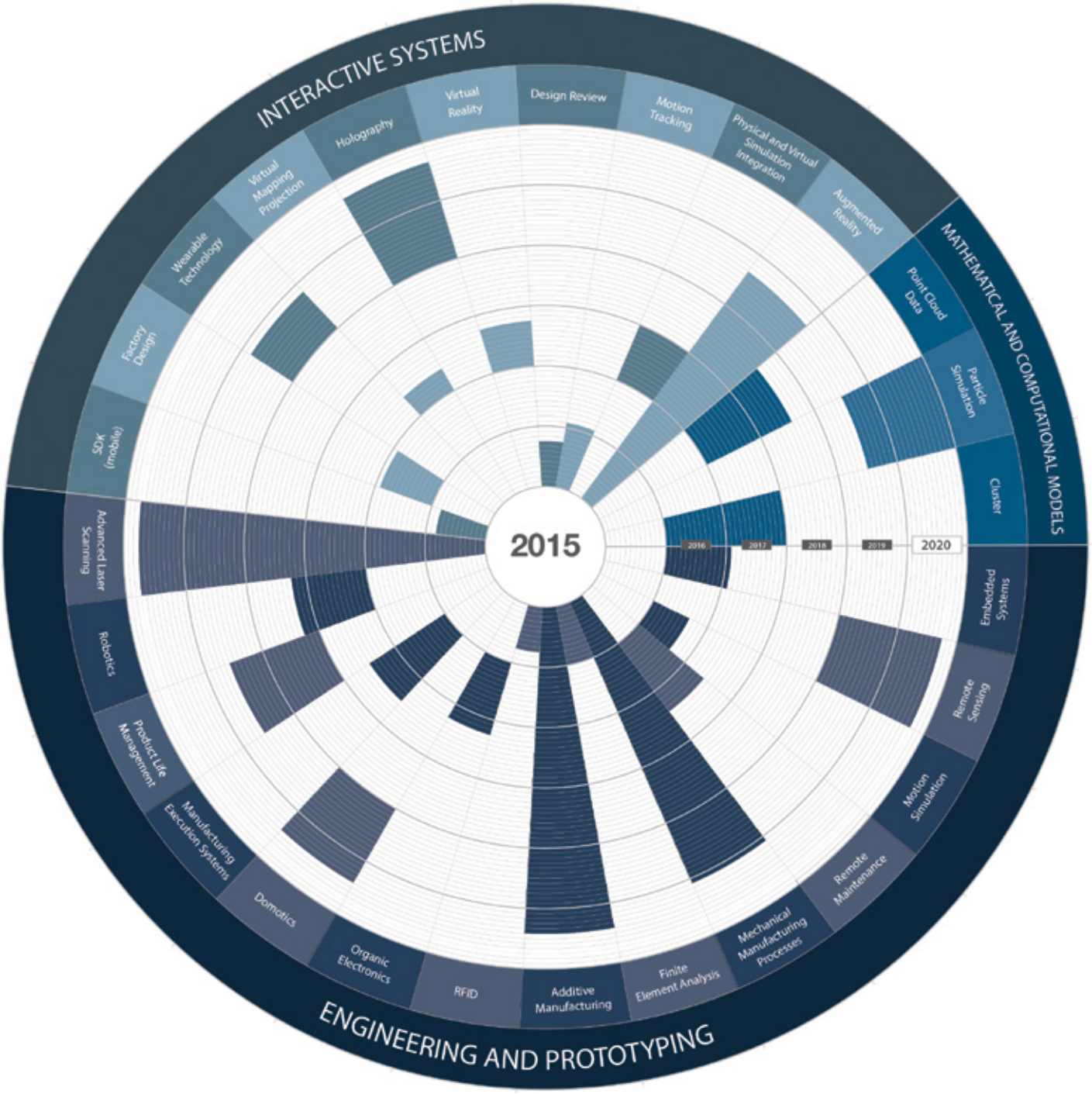
This area is made up by a highly qualified technical staff and infrastructure capable of serving small to large-sized companies. The SENAI Simulation area provides training rooms and consultancies focused on the specific needs of each industry. And, it is exactly this capability for finding customized solutions for each business that makes the cutting edge difference in our work, undeniably contributing to increased industrial competiveness.

In consonance to the objectives of the area, looking at the market and making choices according to the guidelines of the organization, the development process of Technology Roadmaps 2015-2020 and there are three Technological Platforms indicated:

- Interactive Systems;
- Mathematical and Computational Models;
- Engineering and Prototyping.

Based on this definition, potential technologies were defined for investment in the next five years.

Following this, the presentation of the Simulation Roadmaps 2015-2020 contains the details on each one of these three technological platforms.


INTERACTIVE SYSTEMS
MATHEMATICAL AND COMPUTATIONAL MODELS
ENGINEERING AND PROTOTYPING
Virtual Reality
Design Review
Motion Tracking
Physical and Virtual Simulation Integration
Augmented Reality
Holography
Virtual Mapping Projection
Wearable Technology
Factory Design
SDK (Robotic)
Point Cloud Data
Particle Simulation
Cluster
Embedded Systems
Remote Sensing
Motion Simulation
Remote Maintenance
Mechanical Manufacturing Processes
Finite Element Analysis
Additive Manufacturing
RFID
Organic Electronics
Domotics
Manufacturing Execution Systems
Product Life Management
Robotics
Advanced Laser Scanning
2015
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SIMULATION PLATFORMS

Interactive Systems

The Interactive System area provides solutions for viewing and manipulating information in order to facilitate decision-making and improve technical skills through simulations and training. Therefore, 2D and 3D human-machine interfaces are used for interactive and immersive devices valorizing the involvement of the user to the system. In the company, each developed application is considered as unique and designed to supply the needs of the client, using a variety of hardware and software tools, in such a way as to provide different levels of complexity and costs.

The investment in this area optimizes learning and provides similar conditions as actual industrial environments. The use of technology for simulation reduces the learning interval by up to 30%. Physical simulators, included augmented and virtual reality, as well as immersive environments for professional training, adhere to the safety requisites of the market and they are extremely effective for the familiarization of new professionals in their new worksites, project efficiency, and strategic operations.

The FIRJAN Interactive System area has tools that can be used for the training of operators and the certification of professions, for testing and development of research, new products, and remote operation of industrial processes. There is constant technological updating, as we sketch a solid learning curve for developing simulators and interactive systems, such as for Forest Harvesting using the Harverst simulators, Feller Buncher, and Forwarde, which were designed based on the topology and actual scenario in Brazil. There are even complex simulators and large-scale for the exploration of the pre-salt layer, as well as for production, atmospheric explosives, and vessels.

Mathematical and Computational Models

This consists in the art of describing a phenomenon mathematically.

There are different forms and methods of modeling. We have the automated cellular pathway and differential equations, partial and/or ordinary, to study the simulation of real system for the purpose of predicting their behavior, and these concepts are utilized in diverse fields of study, such as physics, chemistry, biology, economy, and engineering.

Mathematical and Computational Models are subsidized, for example, to the physics laws or experimental data and frequently reach a level of sophistication that justifies computerized tools, involving differential equations.

Besides naturally presenting a concise language, which can be easily manipulated, a Mathematical and Computational Models introduces such aspects as the possibility of confirming or rejecting certain hypotheses related to complex systems, reveal contradictions from obtained data and/or formulated hypotheses and predict the behavior of a system under non-tested conditions or not yet tested, among others.

On the contrary, the more similar a model is to reality, the more complex the created model will be. This means, the more parameters there are, then consequently, the more difficult the model will be, in the obtainment of data from the model, as well as the interpretation of the data from the respective model.

When developing a mathematical and computational models, the optimal point is sought between the representation of reality and the complexity of the model, in order to obtain as coherent results as possible, as well as its interpretation.

The main objective in the actuation of this platform is its capacity for providing our production of mathematical and computational models for equipment, processes, and industrial plants, aligned to the expertise of the Sistema FIRJAN, as a federation of industries. Consequently, we have the following proposals to offer:

- Once created, a model can be used countless times for the evaluation of proposed projects and policies;
- The analysis methodology used makes it possible to evaluate the proposed system, even if the data input is in the form of "schemes" or rough notes;
- As the models can be almost as detailed as real systems, new policies, and operational policies, decision trees, information flow, etc., they can be evaluated without disturbing the real system;
- Hypotheses on how or why certain phenomena occur can be tested for confirmation;
- The time can be controlled, compressed, or expanded, allowing the reproduction of the phenomena slowed down or accelerated, so that it is possible to study them better;
- It is possible to understand which variables are more important related to performance and how they each interact and interact with other elements in the system;
- The identification of "bottle-necks", as these are the greatest concern in managing the operations in countless systems, such as material, information, and product flows, and they can be obtained easily, especially using visual aids;
- It usually shows how a system really operates, as opposed to how everyone thinks it operates;
- New situations on what is not known and experience can be considered, so that it can have, theoretically, some preparation regarding future events.

The Sistema FIRJAN Mathematical and Computational Models area has a direct actuation in the simulation of complex operation of countless systems and processes. As it is broad-based, we can construct specific models for any type of industrial need related to advanced simulation in the areas of physics, chemistry, and applied mathematics. Through the generated models, we can construct any visual system and present it in the best possible format for the performed test.

Através de modelos gerados, podemos construir qualquer sistema visual e apresentar da melhor forma possível o ensaio realizado.

Engineering and Prototyping

The Engineering and Prototyping area provides the materialization of prototypes for the most diverse types of projects, developing mechanical devices and electronic circuits. For this purpose, there are different types of equipment, such as 3D printers for fast prototyping of parts and devices, 3D scanners for scanning equipment and printing electronic circuit boards, and providing automation and mechanical services for industry.

The Engineering and Prototyping area is also a big service provider for the Interactive Systems and Mathematical and Computational Models areas, as it creates devices and equipment used for product designs.

In the last few years, the use of fast prototyping has displayed rapid growth throughout the world, as it reduces the cost and manufacturing by 70% in prototypes of parts and devices, from the simplest to the most complex ones, as functional conceptual proofs and acceptance tests of products. Nowadays, one of the big players in this sector is NASA (North American Space Agency), as it is easier to send raw material to the space station to produce tools and parts than tons of the same parts for an eventual need.

The Sistema FIRJAN partnering with SEBRAE, developed Sibratecshop, a completely structured laboratory for service providing of fast prototyping and reverse engineering, whereas SEBRAE finances up to 80% of the price of the service for manufacturing the prototype. Moreover, the automation and mechanical services design and manufacture machines and equipment for industry, as this is the case of the 6-degree-movement simulator for TV Globo and the machine for folding and gluing small sized cardboard boxes.


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BIOPROCESS ROADMAPS

Based on the market trends and the potential demand noted by the food and beverage area, SENAI opted for enlarging and verticalizing its actuation to Bioprocesses. The new area deals with the industrial application of roadmaps in biochemistry, catalyzed by entire live cells, microorganisms or enzymes under controlled conditions for the conversion of natural raw materials into products and food ingredients, pharmaceuticals and cosmetic products, fuels, among others.

The objectives of the Bioprocess area are to support innovation, transfer, and apply innovative technological solutions, as well as contribute to clients, partners, and the scientific community to achieve growth in the bioproduct industry in the state of Rio de Janeiro.

The following expected results can be mentioned:

- Increase the added value of the industrial production in the target chains of the state;

Increase the skill level of the human resources in biotechnological industries in Rio de Janeiro;

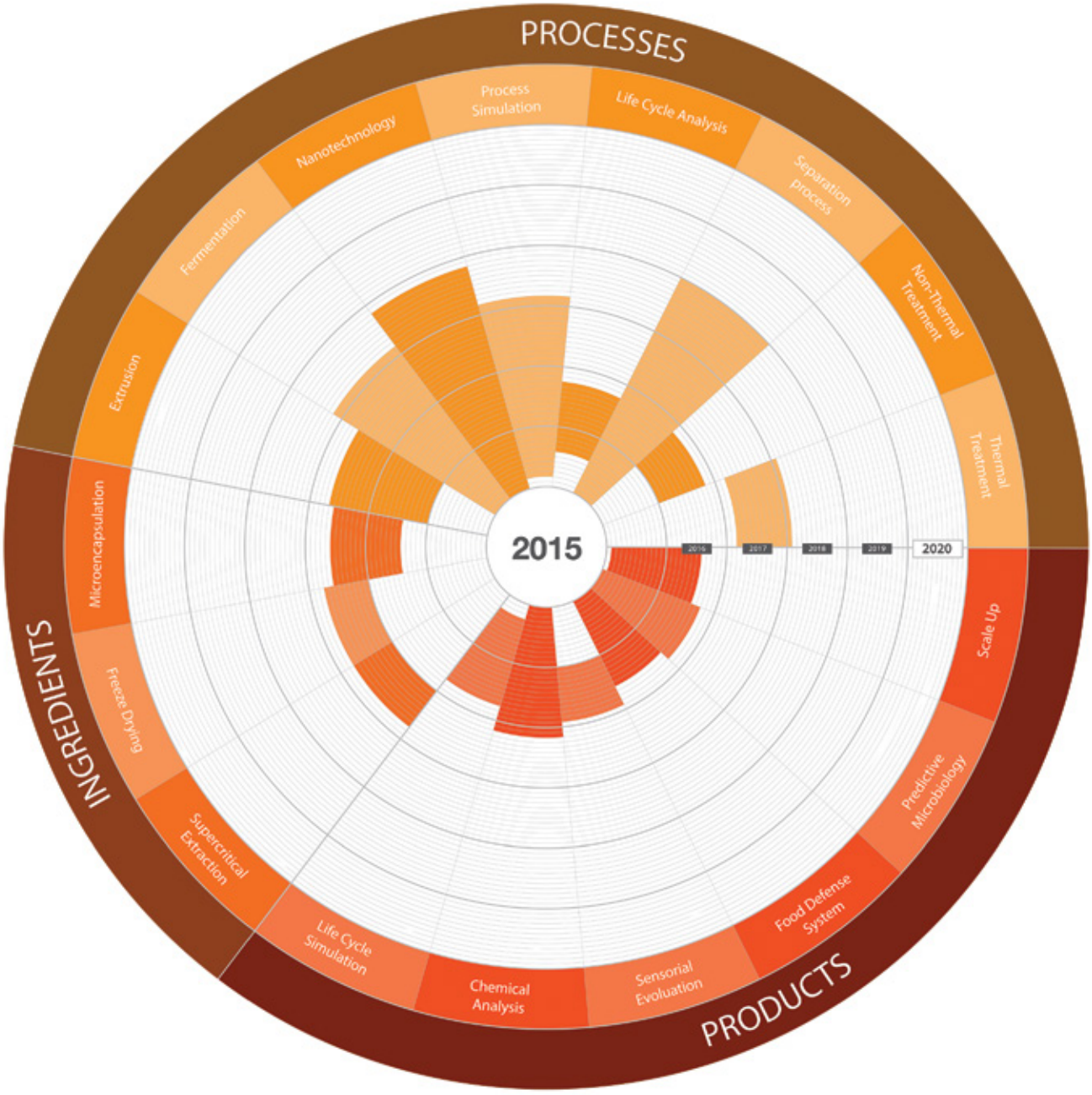
- Increase accessibility of emerging technologies and advances in industries in the target segments in the state;
- Strengthen and improve the production basis of bioproducts in the state and competiveness of the regional target sectors;
- Encourage the generation of innovative products and the development of new production technologies;
- Encourage increased productivity and quality by the utilization of new products, processes, and services.

In consonance to the objectives of the area, looking at the market and making choices according to the guidelines of the organization, the developmental process of Technology Roadmaps 2015 - 2020 and there are three Technological Platforms indicated:

- Products;
- Processes;
- Ingredients.

Based on this definition, potential technologies were defined for investment in the next five years.

Following this, the presentation of the Bioprocess Technology Roadmaps 2015-2020 contains the details on each one of these three technological platforms.


PROCESSES
Process Simulation
Life Cycle Analysis
Separation process
Non-Thermal Treatment
Thermal Treatment
Scale Up
Predictive Microbiology
Food Defense System
Sensorial Evoluation
Chemical Analysis
Life Cycle Simulation
PRODUCTS
Supercritical Extraction
Freeze Drying
Microencapsulation
INGREDIENTS
Extrusion
Fermentation
Nanotechnology
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BIOPROCESS PLATFORMS

Processes

The Process area is composed of a set of technologies seeking to obtain industrial bioproducts, as they are nanotechnologies, high pressure, and ultrasound, among others. This includes all the process steps, beginning with the treatment of raw materials, then the preparation methods, for selecting the catalyzers, until the transformation of the substrate into the bioproduct(s).

The majority of the bioprocess chain includes plants in the operations for the production of substances resulting in high value technological solutions for the productive sector.

The actions for the implementation of the "Process" platform for the SENAI bioprocess area, includes the purpose of equipment, advanced instruments and gauges, and the highly trained technical staff, for supplying adequate technological solutions to serve industry in the state of Rio de Janeiro.

Products

This Product area is responsible for scheduling practices of the pilot industry, laboratorial tests, process control, and the implementation of programs and safety systems of the bioproducts.

The Products platform in the SENAI Bioprocess area provides industries in the state of Rio de Janeiro the entire and advanced structure necessary for adhering to their legal requisites, providing standardization and product safety supplied to the consumer market.

The SENAI analytical service providing is equipped with a complete state-of-the-art laboratorial structure and quality accreditation by INMETRO, in compliance with the ABNT NBR ISO/IEC 17025:2005 standard – a global reference for confirming laboratorial quality in tests and calibrations. Consultancies, developing products and optimization of processes are some of the other available solutions.

Ingredients

The Ingredient platform includes the use of technologies to obtin substances with functional properties and involves processes on micro and nano-scales for the extraction, conservation, and encapsulation of refined food, pharmaceutical, cosmetic, fuel bioproducts as well as other types.

The ingredient industrial chain is an important productive transversal sector and it displays a big demand for the obtainment and application of new compounds for diverse types of products.

The objective of the Ingredient platform in the SENAI Bioprocess area is to supply the existing demand in research for studying new substances and additives as ingredient substitutes and traditional additives, such as – sweeteners, fat substitutes, gluten free, sodium reducers, etc. or as promoters of new technological and nutritional functionalities (prebiotic and probiotic).

NEXT STEPS

The methodology developed by SENAI for the consolidation of technological planning instituted a structured process for the future collective construction and since 2008. It prepared four maps on the Environment, Metallurgy, Simulation, and Bioprocess areas.

Technology Roadmaps are being put into practice by technical academic cooperation of the government and important companies, and it is supported by technological trends and the international market and studies performed by the Sistema FIRJAN. Up to now, it has counted on the collaboration from about 120 specialists who have actively participated in the construction process in diverse steps to make the pathways possible.

Through this initiative, SENAI has significantly contributed towards the fulfillment of this mission of the Sistema FIRJAN to promote education and industrial competiveness in the state of Rio de Janeiro.

Technology Roadmaps are pathways to be traveled systematically by everyone in the company and the success depends a lot on the appropriation process of this work by diverse areas directly or indirectly linked to the Innovation area.

Technology Roadmaps 2015-2020 will be unfolded into the following areas:

- Diffusion of the Technology Roadmaps by publishing in forums and technical events;
- Articulation of the participants for the feasibility of the planned actions in the defined roadmaps;
- Holding the cycle of meetings among the SENAI technical teams for discussion on the methods for the internalization of technologies/competencies;
- Crossing the Sectorial Visions, serving as an input for constructing new roadmaps for the development of Industries in the state of Rio de Janeiro.
- Revision and updating the indicators on the Strategic Panel;
- Defining the strategy in monitoring the planned actions in the action plans;

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LIST OF CODES AND ABBREVIATIONS

ACFM – Alternating Current Field Measurement

ACGIH – American Conference of Governmental Industrial Hygienists

BRICS – Brazil, Russia, India, China, and South Africa are noteworthy on the global scenario as developing countries

BTD – Low Rates of Deformity in Tests

CJE – Young Entrepreneur Council System

COMPERJ – Rio de Janeiro Petrochemical Complex

CONAMA – National Environmental Council

CTS – SENAI Technology Center

CTS Food and Beverages – Technology Center SENAI Food and Beverages

CTS Environment – Technology Center SENAI Environment

CTS Automation and Simulation – Technology Center SENAI Automation and Simulation

CTS Welding – Technology Center SENAI Welding

DLC – Downloadable Content

EIRMA – European Industries Research Management Association

END – Nondestructive Test

GEE – Greenhouse Effect

INEA – Environment State Institute

INMETRO – National Metrology Institute, Quality and Technology

MFL – Magnetic Flux Leakage.

MRT – Technology Roadmaps

NASA – National Aeronautics and Space Administration

UNIDO – United Nations for Industrial Development Organization

R&D – Research and Development

CP – Cleaner Production

RD&I – Research, Development, and Innovation

GDP – Gross Domestic Product

PPRA – Environmental Risk Prevention Program

RFID – Radio Frequency Identification

SEBRAE – Brazilian Support to Micro and Small Company Service

SEBRAETEC – Innovation and Technology Service to Micro and Small Company Services

SENAI – National Service of Industrial Training

SDK – Software Development Kit

TRM – Technology Roadmapping

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