CATEGORIES AND CHARACTERISTICS OF PROFESSIONAL PROFILES OF THE FUTURE TO THE ICT SECTOR OF PARANÁ STATE IN BRAZIL

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ABSTRACT

The aim of this study was to categorize job functions, technical skills and trends related to professional profiles identified as bearers of future to the state of Paraná, Brazil, in Information and Communication Technology (ICT) sector. The professional profiles presented were not aimed to reflect future careers, jobs, or even the creation of new academic courses, but consist of complementary technical skills that future professionals need to have in order to monitor activities that do not exist yet in a well-developed form, and that are identified as required by society on the proposed timeframe for reflection, 20 years. To conduct the study three methodological steps were adopted: (i) bibliographic review for the sector trends; (ii) panel with 24 experts for the validation of the proposed profiles; and (iii) interviews with 46 professionals to further detail of each profile identified. The details of each identified professional profile can be analyzed in the final publication of the search (Souza et al., 2014), in other words, the results of the proposed analysis can be audited. The 198 trends related to the profiles, these were grouped into three: (i) technological; (ii) social; and (iii) socio-technical, wherein technological and socio-technical represented over 85% of the frequency which strengthens the power of transformation that ICTs currently have and will have in the future. Thus, the relevance of technological evolution poses a greater importance in the transformation of society than otherwise. The 199 technical skills were categorized into 12 groups, wherein the first four in the ranking of frequency were: (i) interactivity; (ii) project management; (iii) analytical techniques; and (iv) interdisciplinarity. The frequency of knowledge for user interactivity with technology demonstrates a concern for disseminating technologies among users, and how these same users also transform the technology itself with the interaction process. It might be conjectured with this finding that the ICTs sector is an extremely market-oriented industry, because they have as first concern the knowledge related to usability and understandability by their customers (users) for the different delivered and developed products. Regarding to the functions to be performed, they were grouped into four categories: (i) research and development; (ii) operational; (iii) strategic; and (iv) technological prospecting, wherein and functions related to research and development were the most frequent, reflecting only what the sector itself represents, the research and development of new technologies. However it also represents a desire for change, in other words, the development of national technologies in the industry for different purposes, and the end of the current model of technological dependence that is in the Brazilian scenario.

Key words: Professional Profiles; Information and Communication Technology; Brazilian Scenario; Strategic Foresight.

INTRODUCTION

Since the ancient times, men seek for ways to discover and to predict future events, with the concrete goal of controlling them and make them manageable. With this purpose the positivist scientific researches have focused on finding, or unveil, cause and effect relations that might occur between variables, which are often much more complex than the model itself or the method may explain, at risk of being classified as processes of rationalization and simplification of the reality (Canuto, 2009). It is noteworthy that this characteristic is a registered trademark of a positivist view of reality, i.e, attempt only to observable facts (Comte, 1978), and within reach for the men themselves to know (Arana, 2007).

According to Godet (2000), prospecting the future is a dream that fertilizes the reality itself, and that desire is the productive power to create our own future and the anticipation occurs in pre-activities or pro-activities. In other words, foresight is a reflection performed in order to identify the actions, especially those with strategic character. According to the same author, there are four attitudes to face the future: (i) passive: attitude of an actor who only suffers the change; (ii) Reactive: actor who waits for events and then take some action; (iii) pre-active: inherent to those who get prepared for changes; and (iv) proactive, characteristic of those who induce the desired changes.

To achieve a desired future for society, there is a need for educational changes that enable the development of professional profiles for the new scenarios that arise. And, within this context, the present study proposes to categorize and analyze professional tasks, technical skills and trends related to professional profiles identified as of future to the state of Paraná, Brazil, in Information and Communications Technology (ICT), presented in a research project conducted by SENAI/PR – National Service for Industrial Training of Paraná State in Brazil (Souza et al., 2014).

The choice of this sector in particular is due to the fact that ICTs are characterized as the current technological paradigm today (Lastres and Ferraz, 1999, Castells, 2010) and for the relevance of the selected project for analysis (Stake, 2000), since the researches that approach future professional trends in the Brazilian scenario are practically insignificant, even more taking into account the peculiarities of the specific industrial sectors.

For the development of this work, the two next sections present a theoretical outline of national studies on education for work and a reflection on the current paradigm of ICT, then the project which was used for the analyzes of this study is presented. Soon after, the methodology which conducted this study and the presentation of the results. Finally, are exposed the final considerations, the limitations of this study and suggestions for future researches.

EDUCATION FOR WORK

Considering the social transformations, particularly those inherent to the productive restructuring and the new dynamics of labor relations, the importance of education for work assumes even more a prominent role in academic discussions and debates in many fields of knowledge. Education for work is understood as an essential tool for the training of citizens for the performance of

productive activities, and it should provide conditions for the new challenges of the production system (Gílio 2000).

In its various manifestations, the education for work is indispensable to the student, regardless of the age or educational level that the individuals present. Thus, this should be part of every school curriculum, as well as the skills examination, initiation to work, vocational or theoretical qualification and practical knowledge (Souza 1984).

In fact, efforts should not be endeavor only for productive restructuring, especially for the relation between education and employability, but for the relation between education and work. The relations between education and work bring a new dimension to the issue of professional qualifications, valuing the intellectualized worker and encouraging continuous and permanent education, rather than the traditional training (Gílio 2000).

Therefore, new profiles and new concepts of competences emerge, bringing with it the need for a broader general education and also denser in technologies, requiring more than just manual skills and willingness of workers to follow orders. I.e, it is not enough that the workers merely “do”, but it is also necessary that the workers “know” and, above all, that “know how to learn” (Leite 1995).

It is ongoing, therefore, the transition from the classical concept of qualifications to the concept of competences, due to the new demands of the productive sector and the end of the old methods developed for the adaptation of people to the work market. The failure of the classical conception of qualification has been evident with the process of integration of the economies to the global market, with the demand for higher productivity and competitiveness that this process generates and with the incorporation of new technologies that make the worker more productive, it is required flexibility and versatility even larger from the workers (Valle 2003).

In this new configuration, even organizations that are not classified as leaders or as innovative, including micro and small enterprises, are influenced to adopt the concepts of competences, in order to request a new profile that seems to be spread in the market (Leite 1995).

The notion of competence is incorporated as a way to promote the worker’s autonomy on the instability of the contemporary world and of the changes in productive relations (Ramos, 2002). The competences are expressed by the condition of allocating knowledge into the most appropriate actions to the professional context, as resources or efforts tailored and flexible mindsets, such as analytical capacities, synthesis, inferences, generalizations, analogies, associations and others, then generating a more efficient performance (Brasil 2002).

The concept of competence is understood as a set of knowledge, skills and attitudes (human capacity) that enables a high performance (Fleury *et al.* 2001). According to these authors, the best performance would be based on the intelligence and personality of the individuals, in other words, competencies are perceived as a stock of resources that the individual possesses.

Thus, competence is understood as a way of acting that denotes mobility, integration, transfer of knowledge, skills and resources that add value to the organization and social value to the individual (Fleury *et al.* 2001). In other words, what are the characteristics of the professional profiles of the ICT sector that would allow adding greater value to organizations in Paraná state and Brazil and that could stand out in society? This is exactly the question that this study seeks to answer through

a categorization that is more intelligible to the interpretation by researchers, teachers, students and public managers.

PARADIGM OF INFORMATION AND COMMUNICATION TECHNOLOGY

To explain the joint diffusion of the innovation of Freeman *et al.* (1982) It was created the concept of technological systems, defining them as constellations of technically and economically related innovations that affect various sectors of the production. Rosenberg (1975) complements the idea, stating that technological systems are the way some innovations induce the emergence of others. Thus, the cited authors consider that the diffusion process occurs not only through the imitation of the innovation, but also for the development of the innovation. Its development does not happen in isolation and ad hoc, but following certain technological trajectory. In turn, it serves as "standard" to deal with the techno-economic problems that arise in the dissemination of innovations (Dosi 1982).

To Dosi (1982), the changes are related to the progress along a technological trajectory defined by a technological paradigm, while discontinuities are associated with the emergence of a new paradigm. According to the same author, the innovative process, and in particular the presumption of the market as a primary driver of innovation, are inadequate to explain the emergence of new technological paradigms. Thus, the history of a technology is contextual to the history of the industrial structure associated with that technology. Scientific paradigms can be defined in terms of their ability to fix procedures, definitions of relevant issues and specific knowledge related to their solution. It is also stated that each paradigm defines its own concepts of progress based on the specific relation between technology and economy (Kuhn 2000).

The new paradigm of information technology is seen as based on an interconnected set of innovations in electronic computation, software engineering, control systems, integrated circuits and telecommunications (Lastres *et al.* 1999), which dramatically reduced the costs of storage, processing, communication and dissemination of information (Freeman *et al.* 1994). The information technology, as well as other paradigms of the history, affect, albeit unevenly, all economic activities.

The advancement and diffusion of the techno-economic paradigm of information technology have led to a reformulation of the formats and the organizational strategies, therefore, require increasing load of information and knowledge to perform their duties. Thus, the needs for information and knowledge are seen as key features within this new scenario (Lastres *et al.* 1999). For this reason it is justified the fact that several authors refer to the new world order as the era, society or economy of information and knowledge (Castells 2010).

Finally, Lastres *et al.* (1999), based on a review undertaken by Freeman (1988), Lundvall & Foray (1996) and Lastres (1997), show the following characteristics of this new paradigm and the consequent effects of the diffusion of the ICTs in the economy:

i. the increasing complexity of the new knowledge and technologies used;

ii. acceleration of the process of generation and fusion of new knowledge, as well as the intensification of the process of adoption and diffusion of innovations;

iii. increased capacity of encoding knowledge and greater speed, reliability and low cost of transmission, storage and processing increasing amounts of these and other types of information;

iv. deepening the level of tacit knowledge;

v. increasing flexibility and control of the production processes, which allows the reduction of errors, downtimes, failures and destructive tests, as well as increasing the variety of inputs and outputs;

vi. fundamental changes in forms of organizational management, allowing greater flexibility and greater integration of the different functions of the business, as well as greater interconnection between these;

vii. changes in the profile of the different economic agents, as well as the human resources; and

viii. demand for new strategies and policies, new forms of regulation and new forms of government intervention.

PROFESSIONAL PROFILES TO THE FUTURE

The project that was the basis for the development of this analysis was undertaken by the Observatories of SENAI/PR during the period of 2010 and 2013, and aimed to identify occupational profiles that will be required for thirteen industrial sectors considered strategic for the state of Paraná industry (Souza *et al.* 2014).

The research sought to expose the needs of the industrial sectors under analysis, as well as the changes in the work sphere and the corresponding social and technological trends for each sector analyzed. The professional profiles presented do not necessarily reflect future professions, positions, jobs, or even the creation of new academic courses, but consist of complementary technical skills that the future professionals need to possess in order to monitor the activities that do not exist yet in a well-developed form, and are identified as required by the society in a timeline proposed for reflection, 20 years.

The professional profiles identified were detailed under the following headings: (i) justification; (ii) indicators; (iii) tasks; (iv) technical skills; and (v) related trends. Wherein, the justification reflects the social, economic, technological and environmental transformations that are occurring and show the need for specific technical skills profile. The indicators refer to measures of awareness regarding the importance of the profile for the sector, the importance of the related trends, the current situation of this profile in the state of Paraná and Brazil, and the time that will take to increase the industry demand for those characteristics. The activities are described by actions that will be demanded and performed by each profile. Trends that influence are accompanied by a detailed description, and technical skills are presented as the most important for each profile described to perform the activities previously proposed.

For all the sectors analyzed the logic of construction of each profile followed the same steps. At first, the literature analysis to identify the trends that were related to the sector, followed by the proposition of “proto-profiles” was held. Secondly, panels to debate and collective validation of the “proto-profiles” proposed by the industry experts (from the academic, corporate or public area),

followed by interviews for a deeper description of each profile were performed. Later, with the systematization of all the material collected it was again presented to the 46 experts for final validation of the content (Souza *et al.* 2014).

For the objectives proposed in this study, it is noteworthy that only the activities, technical skills and related trends for each professional profile identified for the ICT sector will be analysed. And the professional profiles identified for the sector to be analyzed were:

i. Architecture of electronic circuits
ii. Integration architecture
iii. Biotechnology applied to microtechnology
iv. Mobile Computing
v. Performance of systems
vi. Development of applications in home automation
vii. Interaction Design
viii. Photonic Devices
ix. Electronics for quantum processing
x. Management of innovation
xi. Management of technological waste
xii. Knowledge management in ICT
xiii. Instrumentation ICT
xiv. Human-computer interaction
xv. Digital Games
xvi. Marketing in digital media
xvii. Nanoengineering
xviii. New educational technologies
xix. Prototyping of technological artifacts
xx. Social Networks
xxi. Information Security
xxii. Embedded Systems
xxiii. Intelligent Systems
xxiv. Smart City Systems
xxv. Sustainable ICT Solutions
xxvi. ICT for knowledge management
xxvii. Security Technologies

xxviii. Technologies for healthcare

METHODOLOGY

To conduct the original study (Souza *et al.* 2014), three methodological steps were adopted: (i) bibliographic review to the ICT trends and a description of "proto-profiles"; (ii) panel with 24 experts (from universities, companies and political institutions) identified according to their knowledgement and skills to validation of the proposed profiles; and (iii) interviews with 46 professionals to further details of each professional profile.

For this analysis, the categories created for trends, technical skills and tasks were based on the reading of the results presented in this study based analysis. For the development of this process, we sought to maximize the homogeneity within each category created and that these, in turn, were heterogeneous when compared to other exposed categories (Bardin 2011).

The proposed analysis are based on the publication presented by Souza *et al.* (2014), however, the author of this article was a member of the research team that conducted the entire project to the ICT sector, partaking of both preparing the documents that supported the discussions of the experts invited to the panel theme, as well as interviews and systematization of the final document. Ie, two sources of evidence were adopted for the development of this study: (i) participant observation, where the researcher is immersed in the field of the studied phenomenon; and (ii) documents: the use of the final report generated by the project (Corbetta 2003). However, it is emphasized that the primary source of the data is still the final project document, as the participant observation conducted took place in the period of 2009 and 2010.

Obviously, the readers of this paper may not follow the same steps that the researcher present regarding the participation of the working group, however, it can be observed the same final document which is guided on categorizations and analysis of this study. In other words, the results can audited following the same track of the document analysis (Merriam 2009).

RESULTS AND FINDINGS

Initially, it will be presented the categories identified for trends, necessary technical skills and activities to be performed, then the frequency distribution of these research.

Trends related to occupational profiles were classified into three categories, being:

i. social: social movements that result in changes in production, demographic, cultural or associative characteristics of the community;

ii. technological: incremental or radical development that results in new technological options in the market and society diffusion; and

iii. socio-technical: social and technological overlap causing an increasingly intense interaction between man and machine in different ways.

The frequency distribution of the 198 trends for the proposed categories can be seen in Figure 1.

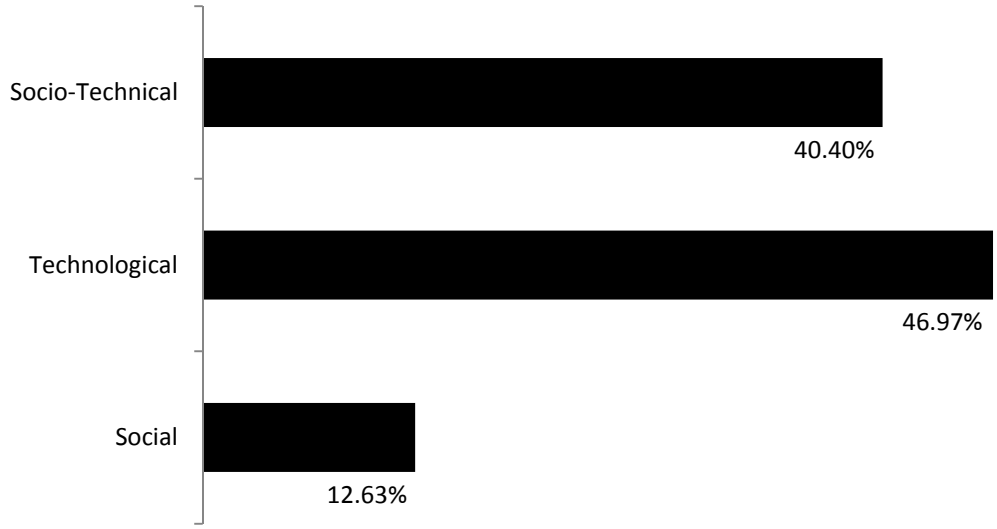

Figure 1: Frequency distribution of the classification of the trends, Source: Authors

Wherein the six most common trends presented in the original document were: (i) connectivity; (ii) ubiquitous and pervasive technologies; (iii) amount of data; (iv) collaborative development; (v) embedded systems; and (vi) robotic. These, in turn, represent nearly 30% of all the 198 identified and described trends.

The fact of the technological and socio-technical trends represent more than 85% of the frequency reinforce the power of transformation that ICTs currently have and will have in the future. In other words, the relevance of the technological change poses a greater importance in the transformation of the society than otherwise.

Regarding to the technical competences, these were grouped into categories based on the detailed description presented in the study analysis. And the 12 categories identified were:

i. project management: disciplines and techniques to accelerate the development of technologies;

ii. analytical techniques: focused on research and implementation of new technologies, as to the use in analysis of large data and information;

iii. interactivity: knowledge related to the study, research and development of increasingly oriented interfaces to better usability for final users;

iv. technological strategy: competences related to marketing analysis of products/services, analysis of economic and financial viability of projects and articulation with institutions for fundraising and protection of intellectual property;

v. interdisciplinarity: knowledge of other areas of science that will be demanded for use in the ICT sector, or which will be modified by the area of ICT;

vi. programming languages: knowledge of different levels of language applied to development;

vii. automation: set of competences applied to industrial automation processes;

viii. embedded systems: applied to the development of embedded software in hardware;

ix. regulations: knowledge of rules and laws that govern the ICT sector;

x. security: the application of techniques related to the information security or to define policies and access control;

xi. Connectivity: disciplines related to increase availability of technology services as well as, mobility of the users; and

xii. environment: a set of techniques aimed at optimizing the use of natural resources, thereby reducing the environmental impact.

The frequency distribution of the 199 technical competences for the proposed categories can be seen in Figure 2.

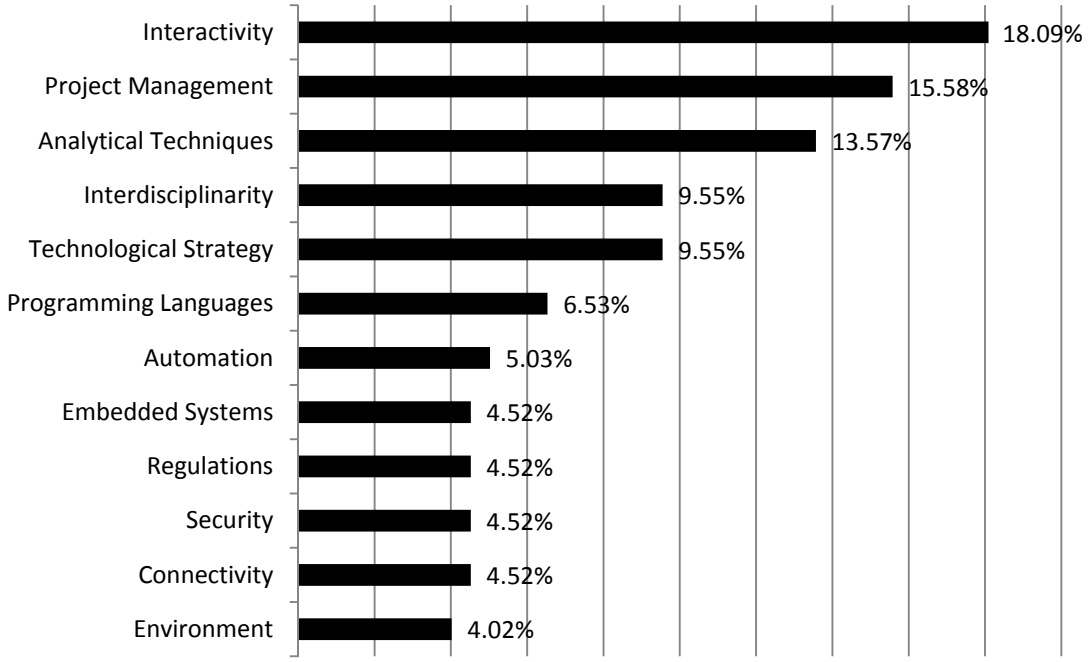

Figure 2: Frequency distribution of the classification of technical competences, Source: Authors

The frequency of knowledge oriented to the interactivity of the user with technology demonstrates a concern for technology diffusion among the users, and how much these same users also transform the technology itself in this interaction process. It can be conjectured with this finding that the ICT sector is an extremely market-oriented industry, because it has such concern for first knowledge usability and understandability by their customers (users) of different products they deliver and develop.

The trend of accelerating the development of new process technologies, corroborates what was previously presented by Lastres *et al.* (1999) and justifies the appearance of competences in project management in the second position. The ICT sector presents methodologies used to develop proprietary projects currently (SCRUM, *Agile* etc.) that reinforce even more this order, and probably have a large potential impact on other sectors regarding to these management techniques in the future.

Regarding to the analytical techniques, these are characterized by different skills that are not typically studied in the field of ICT, but in areas of applied social sciences. I.e, techniques oriented to the analysis of large masses of data for the discovery of patterns or abnormalities. This presents itself as an area of investment in terms of training of human resources, as ICTs are only a "way" that enables increasingly complex analyzes with a shorter response time, thus, the research on how to apply these techniques may not be connected to this sector.

The interdisciplinary reinforces the break with the traditional model of teaching focused on the separation of the knowledge into "boxes" since the multiple application of knowledge to the same area, or even the application of ICTs in other areas of knowledge reinforces a model of focused multidisciplinary technological development.

The increased use of ICT by organizations, whether this is applied to infrastructure, automate processes, generation of information or by creating new channels of communication, corroborates the competence strategic technologic to appear prominently in this analysis. As more organizations should have an understanding of how to invest in technology, because their business, regardless of the industry sector which are linked, will be increasingly guided by technology and, particularly, in information and communication.

The fact that the project management, analytical techniques, interdisciplinarity and technology strategy are found among the top five competences that were most repeated shows how much other areas of knowledge appropriate, or will appropriate of the benefits that ICT can bring to the organizations. Likewise, it demonstrates how much the professional profiles need to suffer adjustments to the demands presented by the market, since currently the focus is still very technological.

Subsequently, there are three technical competences in the ranking that are directly linked to the current profiles (programming languages, automation and embedded systems). Sometimes more focused on certain types of languages, sometimes less, but the fact of appearing in intermediate positions confirms what was said above, that other competences should be developed in the professional profiles of this sector, in other words, a more multidisciplinary training.

The point, perhaps, negative of the analysis is to identify competences in security and connectivity among the last of the ranking. With the diffusion of ICTs in society, one of the primary concern should be the aspects related to digital safety. Finally, regulations and techniques aimed at preserving the environment representing the understanding that industry professionals should have to understand the social changes caused by the technological progress itself, and the application of this knowledge in the coercive adequacy standards imposed.

Regarding to the activities mapped of the professional profiles, based on their description in the original document, it was created four categories for the grouping:

i. research and development (R&D): repertoire of activities related to the use of various techniques and skills aimed at the development of applied technologies (interfaces, informational architectures, integration, devices, etc.) as well as the development of custom-made or by order products;

ii. operational: application of techniques, standards, methodologies and use of technologies with different purposes, but which are routine to the professional assignments;

iii. strategic: activities related to the articulation with other institutions to establish technical and commercial partnerships, development of potential new markets and managing the portfolio of projects from a financial and marketing point of view; and

iv. technological foresight: studies related to market surveillance in order to identify and analyze techniques, methods or technologies that are technological strategic interest of the organization to which the professional is bound.

Detailed activities related to management processes were fitted according to the categories proposed above. The frequency distribution of the 211 activities presented in the study for the proposed categories can be seen in Figure 3.

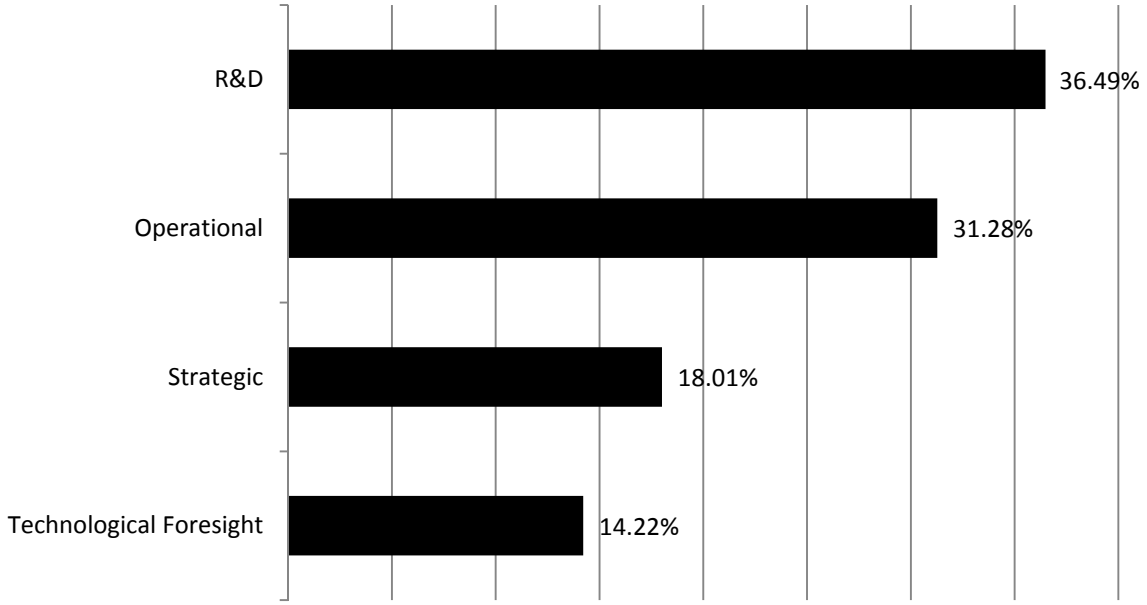

Figure 3: Frequency distribution of the categorization activities, Source: Authors

The fact that R&D activities appear in the first position reflects just what the industry itself represents, the research and development of new technologies. However, it also represents a desire for change, in other words, the development of national technologies in the industry for different purposes, and the end of the current model of technological dependence that exists in the Brazilian scenario.

The operational activities will still be present, however, they will continue to be regularly modified and will require professional profiles with ability to understand the new technologies that come to use and define policies for using in their organizations. The term “operational” only puts them as routine application for the sole purpose of distinguishing from the development activities, but they will also require deep knowledge and practices of research and study for implementation by the distinct professionals profiles identified.

The activities related to strategy and technological foresight have a strong connection with the R&D activities, however, they are performed differently. That is, one thing is the daily work activities of researching and developing a technology, the other, exploring new techniques,

methods or technologies to be used in R&D process itself or for the use by an organization. For this, technical knowledge is required and the strategic vision as a market analyst.

Regarding to the strategic activities, reinforce the demand for more articulators professional profiles, whether for fundraising to their projects or for new market development. So, to strategically manage the technological portfolio of projects in their organization, as well as, position the organization in order to gain competitive advantage through technology.

CONCLUSION

This research, firstly, reinforces the power of transformation that technology itself has on the society and therefore on the organizations. And, secondly, it seeks to open the "eyes" of the readers on the curricula of the educational programs for possible changes, whether in any field of knowledge and level of education, because ICT is no longer a time of responsibility only for professional profiles in this sector, and began to impact professional profiles of other areas of knowledge, as well as organizations from different economic sectors. Thirdly, highlights the relevance of R&D activities will increasingly have for this sector, which perhaps demonstrates a lack and, especially, attention because it is a sector with high added value for the Brazilian economy.

The base project that originated the analysis was focused on the state of Paraná, however, the properties observed in the trends, technical skills and activities do not refer only to the characteristics of this state of the federation, and represent constitutive properties and essences of professional profiles for the ICT sector. Therefore, by analytic induction (Pires 2010), these analyzes can be generalized to the Brazilian context.

The proposed categorization without adopting any process of validation by other researchers studying the same subject can be identified as a limitation of this research, however, because it is a first exploratory essay justifies the attempt presented.

As suggestions for future researches it could be performed a similar analytical work of trends categorization, competences and activities for the other industrial sectors surveyed in the Project Professional Profiles the Future of SENAI/PR. It is noteworthy, that the proposal of trends and activities classification could be replicated for content analysis, however, the categorization of technical competences refers exclusively to the ICT sector. As a result of this proposal a comparative work could be done across the sectors to analyze similar and divergent characteristics between them. Another proposal of work, with more practical implication, would be undertake an investigation of the curriculum of the courses (technical, graduation and postgraduation) linked to ICT compared to the categorization of technical competences and activities presented, which would enable the efforts identification that could be made in order to adapt the demand for professional profiles which is presented in the market.

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