An Exploratory Analysis on the Spatial Heterogeneity of the Brazilian Software Industry

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Abstract--**This study explores and characterizes the spatial distribution of the Brazilian software industry making use of a framework based on the concept of industrial cluster, highlighting the importance of location for the strengthening of the innovation and industrial competitiveness. This paper is presented in three parts. The first section presents the theoretical framework and a general characterization of the software industry in Brazil. The second section discusses aspects related to the spatial distribution of the software industry. Finally, the last section summarizes the main conclusions of the paper, revealing a set of important strengths, weaknesses, opportunities and threats, and some strategies have been suggested to make the agglomeration better.**

I. INTRODUCTION

In the context of an economy increasingly "knowledge-based", the importance of software production derives not only from its role as a tool that enables the incorporation of knowledge in products, services and systems, but also because of its importance in the dissemination of information and telecommunication technologies among organizations, institutions and the general population.

In 2001, the activities of software in Brazil reached approximately $ 7.7 billion. Between 1991 and 2001, the participation of the Brazilian software industry in GDP increased from 0.27% to 0.71%. Already in 2012, Brazil surpassed China to become the seventh largest domestic market in the world in the sale of software and information technology services, according to Abes[1].

With a total market of $ 24.9 billion, the country jumped three positions 2011 to 2013, and surpassed the way, besides the Chinese, Australians and Italians. The growth recorded for 2011 was 28%. The jump was due to the 53.5% growth in software sales, which totaled U.S. $ 9.48 billion. The sector of information technology (systems development done at the request of an enterprise) advanced 16% and reached $ 15.44 billion. Meanwhile, China's domestic market grew by 12.2%, reaching $ 23 billion. The global crisis that affected mainly Europe and the United States hurt growth in key markets software. Italy, on the way from Brazil, grew by only 4%, France 6%, Germany 9%, and the UK, 5%. The United States, for example, the greatest power in the segment and headquarters of major companies, advanced 3.63%.

Throughout the recent trajectory of evolution in the industry, significant investments were made in the accumulation of productive and technological skills and the development of inter-industry linkages with various activities. This evolution has benefited from a set of policies that, despite some vicissitudes, allowed the formation of skilled labor and the assembly of a significant infrastructure, creating important incentives for the emergence and consolidation of new businesses in the sector.

In this sense, this article seeks to articulate discussion of the process of building skills in software production in Brazil to the spatial distribution of these activities, making use of an analytical framework based on the concept of industrial clusters, which would be associated with the spatial clustering of agents economic, political and social interests with a specific set of productive activities, which are structured linkages and interdependencies.

Through these links, originates a learning process that enables the introduction of innovations in products, processes and organizational formats, generating greater competitiveness for integrated companies to the arrangement. The methodological approach of industrial clusters highlights the central role of innovation and interactive learning, as sustained competitiveness factors [3]. This analytical perspective, particular emphasis is given to the investigation of learning, cooperation and innovation processes that occur in specific geographical areas.

A key aspect of the dynamic operation of these clusters relates to consolidation of cooperative practices between agents, which result in joint learning and training processes responsible for accelerating the pace of innovations and the generation of various types of gains (in terms increasing production efficiency and expanding markets, for example) that reinforce the competitive performance of the integrated companies such arrangements. Despite the perceived importance of localized learning processes as a central characteristic element of these arrangements, there are still considerable gaps in the analysis of both forms of measurement of these processes as their effective impact on the innovative performance of firms inserted in them.

II. THEORICAL FRAMEWORK

The software is an intangible product whose main ingredient is embedded in specialized technical personnel knowledge, whose creativity and intellectual capacity allows the development of technical solutions for certain purposes. The main attribute of this "product" is its flexibility, built-in applications tailored to the needs of manipulating information from a wide variety of economic activities.

The dynamism and impact of innovations generated by the software industry are reflected in high rates of birth and death of firms, as well as a tendency to earnings volatility and

[1] Brazilian Association of Software Companies

market-shares. At the same time, the structural heterogeneity of the sector can be linked not only to the variety of products and services generated, but also the diversity of competitive conditions attached to its various segments.

This heterogeneity implies difficulties of internal compartmentalization (due to the different segments of the industry) and external (related to the tenuous boundaries between software and other products and services associated with the microelectronic industry), reflecting the difficulty in searching and rigorous systematization of statistics on the industry, which are usually scarce and unreliable. In this sense, it is usual to establish a distinction between three main industry segments: Products (package and custom), services (high value and low value) and embedded.

The first segment (software package) corresponds to the "software itself," one that is designed for computers of people and businesses involving the sale of a license. The "software package" standardized products are developed from a strategy of offering that aims to meet the needs of a large group of users, involving high costs of prior development (accompanied, in general, negligible marginal costs) and heavy investments in marketing and promotional activities.

In this case, the power of branding and outreach effort are decisive factors of competitive advantage, resulting in a market structure characterized by the presence of large corporations (usually multinational) that dominate the major market segments. Have the "custom software" are developed to meet the unique needs of a single user.

The market for custom software tends to be highly diversified with large multinational companies works closely with local businesses. In this segment, aspects such as reputation and accreditation are key to the development of the business, but the knowledge still remains a major strategic asset. The company interacts with the client for each project, with the initial specifications of the software is modified during the development process so that it exactly matches the expectations and needs of the user.

The "custom software" is located in the middle ground between the software package and custom software, characterized by the development of modules (parts) that constitute a standardized solution, from which adaptations and special product developments are made for each user.

The "software services" correspond to the execution of tasks requiring knowledge related to software technology, among which are: consulting, application development / components, integration, training, technical support and maintenance, among others. This angle refers to the aggregated software technical services, which are essential for it to perform a required function effectively and meets the needs of users.

According [12] and [14] it's possible to distinguish between low and high-value software services. The services of "low value" software are less dense in terms of technology, involving routines or functions that do not depend on specific knowledge, usually related to routine activities feed information systems, eg, maintenance and processing of stock data to third parties. These services are characterized by a clear separation between conception (centered on the applicant's service) and implementation (developed by the provider), demanding the domain of codified knowledge, obtainable with a technical background in programming.

For these services, the competition is usually based on price and quality signaling process (involving certifications). This segment is attractive to micro, small and medium enterprises that operate through subcontracts, following the trend of growth in outsourcing and offshore activities, arising from the strategies of large multinational companies seeking to reduce costs with the internationalization of production. In contrast, the services of "high value" software are those that include more complex stages of development, often involving specific knowledge of software engineering and systems analysis, through which it performs architecture modeling solutions.

The services of high value refers to the hiring of specific activities that require a higher level of technological knowledge, reinforcing the importance of reputation, which causes the market to be dominated by large multinational consulting systems.

The embedded software is one that comes embedded on any product and is not perceived or treated separately from the equipment to which it is integrated. It is present in cell phones, DVD players, automobiles, capital goods, etc.. Any product that incorporates electronic control modules carries with it an embedded software. Each of these segments has productive, innovative and different competitive strengths, as well as dynamic learning and different market structures.

It is common stratification of the market depending on the characteristics of each segment, implying the coexistence of forces that link to their fragmentation and concentration. However, the most common trend is that companies will behave the same time in different segments. Companies developing work packages usually also offering customized products and services adding to their products.

At the same time, the software companies to order also include the cost of the software package of infrastructure and other tools used in development (database, server applications, network managers, security, compiler, etc..) In their costs. Other companies operate simultaneously with hardware and software, selling complete systems solutions (including software packages or custom), including equipment and installation of networks.

Given these trends, it is difficult to accurate targeting in the industry, making it difficult to obtain reliable statistics of each segment. In summary, the software industry is an activity where knowledge is the critical competitive factor, constituting the main generator of competitive advantage and monopolistic positions.

Although the most profitable segments and standardized being dominated by large multinational companies, the sector also presents great opportunities for MSEs, especially in local operations where they can position themselves competitively

in niche markets, or establish partnership agreements and / or provide services for large enterprises.

In addition, the industry structure tends to be constantly reconfigured due to the emergence of new products and new segments and niche markets, through a dynamic commanded by the technological innovation process, which defines the extent of the life cycles of products, opening new opportunities for producers and defining new needs for consumers.

At the same time, there is a process of increasing internationalization of markets and strategies, which converts to quality and productivity determinants of corporate competitiveness. It is also worth noting that software development is not necessarily an intensive R&D activity, involving more directly the accumulation of knowledge, the technical qualifications of the personnel, conducting methodological efforts and deepening interaction with more sophisticated clients.

In recent decades, Brazil has developed an extremely dynamic software industry, becoming an important actor on the international scene in the industry. Even before the increased participation of the software industry in the Brazilian GDP, it should be noted that a precise mapping market size of this industry in the country is a complicated task.

Two elements reinforce this difficulty. Firstly, the sector's activities are usually highly integrated with other activities associated with, so that some of the major companies operating in the market do not have the development and production of software as its core business of information technology. Furthermore, the business model of the main actors active in the sector is very heterogeneous, sometimes being based products and other times with the provision of services and is responsible for the largest share of sales.

The main focus of the Brazilian software industry is geared towards the domestic market, as opposed to other countries where we observe a clear orientation towards the export market industries. This emphasis can be explained by the growth of domestic demand, the spread of information technologies and by the very sophistication of the productive structure of the Brazilian economy, despite the drawbacks generated by macroeconomic instability and low growth in decades.

The origin of Brazilian companies producing software is quite diverse, and we can see a process of accelerated business creation during the 1990s, which tended to be replaced by a trend towards concentration and specialization of companies in recent years, due to intensification of competitive pressures.

The structure of the Brazilian software industry follows a pattern in which multinational companies tend to strengthen its position in key segments of the industry, leaving domestic companies the possibility of occupation of vertical segments, such as the development of solutions that meet the needs of the system financial.

Most Brazilian software companies emerged from existing firms, as "spin-offs" of a parent company, often at the initiative of former employees who saw an attractive business opportunity.

Three alternatives have also assumed importance as "standards" for the creation of Brazilian companies producing software. The first involves individual (start-ups) initiatives of professionals with talent and creativity to explore new opportunities arising from the growth of the industry. The second alternative consists of a limited number of "spin-offs" from the university environment, usually targeted to sectors where prior experience of market action does not seem to be a relevant factor. Finally, it is possible to mention the existence of government enterprises often specialized in handling a large volume of data. Given this standard, local businesses tended to expand into various business lines simultaneously developing both products and software services, creating a fragmented structure with many small and medium enterprises.

Despite the possibilities of sustaining attractive gains from these strategies and tendencies to fragmentation of markets persist, it is possible to observe a trend towards industrial concentration in the sector in recent years, explained by the intensification of competitive pressures, the increasing sophistication demand from major consumer markets and by strengthening the process of internationalization of the industry. Consequently, it becomes more difficult for domestic companies sustain their market share without some sort of association with companies operating abroad.

Using an analytical approach based on the concept of clusters [10] is based on the assumption that the spatial agglomeration of economic activities in a given region provides the accumulation of expertise, much of which tacit and specific nature, that reinforce the productive skills, techniques technological and local actors.

The cumulative process of knowledge creation and capacity building at the local level gives rise to complex systems that evolve according to the incentives of the competitive environment, and may have varying degrees of development, in terms of the integration of supply chains, joint and productive interaction between agents and local institutions, and the consolidation systemic capacity for innovation [9].

The structural and institutional complexity is an inherent characteristic of these arrangements to the extent that they admit "characterizations varied as its history, evolution, institutional organization, social and cultural contexts in which they operate, productive structure, industrial organization, forms of governance, logistics, partnership, cooperation between agents, forms of learning and degree of dissemination of the local expertise" [18].

Depending on the complexity of this object, it is natural that efforts to exploit their analytical potential unfold in multiple directions. A first direction - a source of some controversy in the vast literature recently developed in Brazil based on that concept - refers to the search for greater

precision in detailing key aspects to characterize the structure and modes of operation of these arrangements.

Reference [2] for example, highlight the central role of innovation and interactive learning as sustained competitiveness factors in these arrangements, arguing that the relationship between companies (and other local institutions) enables the amplification of endogenous generation capacity, diffusion and use of new knowledge, a process that transcends the individual firm and depends on continuous interaction between local actors.

In this perspective, we emphasize the importance of learning, cooperation and innovation, relating to specific geographical areas processes, which generate a potential for strengthening competitiveness and local development. The emphasis on consolidation of cooperative practices and processes of learning by interaction is linked to systemic view of the innovation process.

Reference [18] analytically explore the concept from an emphasis on the ability to generate external economies [8] and their impact on the sectoral and spatial dynamics. Noteworthy, in this sense, the distinction between incidental external economies or deliberately created, which strengthen the competitiveness of companies included in these arrangements.

Incidental external economies are related to several factors such as the presence of skilled labor, specialized suppliers of raw materials, components and services in the region, as well as the tendency of dissemination of knowledge, skills and information concerning the business of activity among local producers.

Deliberate external economies are related to joint actions that strengthen the competitiveness of local agents, involving the purchase of raw materials, the promotion of managerial and professional training, export activities, hiring specialized services and structuring of credit unions, among other aspects, generating a "collective efficiency" [14] that strengthens the competitiveness of integrated companies such arrangements.

The literature presents a varied typology of productive agglomerations of companies, since they have different applications according to the concept of multiple contexts. However, there are some elements that are key ones in defining agglomerations:

i) Geographic Concentration: organizations are located in different geographical regions due to factors such as external economies, social capital, availability and quality of resources, communication facilities and transport;
ii) Specialization: agglomeration is the core of the main activities, to which all other agents are connected;
iii) Multiple agents: agglomeration is not only related to companies, but it involves public authorities, educational institutions, financial sector, among other industry-specific vocation;
iv) Competition and Cooperation: that characterizes relations among the agents involved in the agglomeration;
v) Critical mass: required to ensure the dynamism of agglomeration and external economies;
vi) Life Cycle: agglomeration is not a temporary, short-term factor. This is something progressive, continuous, with long term prospects;
vii) Innovation: the cluster of organizations are involved in processes of technological, commercial and organizational nature. The intensity with which it occurs depends on the sector of activity;
viii) Culture: element of great value for the effective development of the dynamics of agglomeration. Widely recognized in the literature, but little regarded by public policies to support clusters.

Clusters can also be defined and conceptualized according to their level of development. Level of development, an important factor for the success of clustering is the way in which it provides its governance. The factors that determine the form of governance in clusters are supported by various types of analytical approaches. Many of these approaches specifically address governance in production systems organized in networks or supply chains led by leading companies, which are often outside the local system. Among the authors following that line of analysis can be included: [5], [7], and [17]. In contrast to these approaches, [6] analyzes the strategic control exercised by agents on local production systems by controlling the flow of information and knowledge about characteristic demands, type of product and market trends. Finally, [15] demonstrates the importance of the social construction of political and cultural assets located as a basis for collective action.

Based on the original contributions of [19], [16] the issue of governance by analyzing the hierarchies that are formed within the chain of production and distribution of goods is addressed. Using the concept of production system, which defines how the coordination structure that is formed from the interactions that occur along the supply chain, where there are vertical and horizontal relationships among firms, these relationships can be governed by purely market mechanisms or result from interactive processes between agents, even with the conformation of strong hierarchies.

From this concept, to try to analyze the governance structure present in these relations, ie the degree of hierarchy, leadership and command (or, alternatively, collaboration and cooperation) among the companies participating in the system. The governance structure is shaped by power relations (or cooperation) along the chain of production and distribution of goods.

Therefore, the authors seek to establish whether, and to what extent, the relations within the production system resulting hierarchies imposed by agents participating in the process, or if some coordination structure prevails in the market and hierarchies are replaced by more frequent

interactions between agents involved, resulting in a higher degree of collaboration and cooperation in the relationships between companies.

Reference [16] incorporate the territorial dimension in the analysis of productive activity and conformation of clusters of firms. The concentrated presence of companies in the same industry or industry segment, which in turn attracts suppliers and service providers makes intense interactions develop among local businesses. These interactions can be controlled by a great leader or even more by a large company coordinator, or there may not be large companies coordinators. The high frequency of interactions arises from the division of labor between specialized producers and suppliers, resulting in competitive gains for firms participating in the production system and various externalities.

III. METHODOLOGY RATIONALE

This paper presents some results of an exploratory study that integrated information gathered through documentary searches and interview scripts applied the stakeholders involved with some arrangements to capture the main characteristics of their interactive processes. The analysis is an attempt to obtain, from the instruments used, some kind of understanding of the forms of interaction, cooperation and learning in industrial agglomerations, using the software sector as an illustration.

These elements can be integrated in order to capture a particular underlying the operation of different clusters associated with the software industry "internal dynamics". From this type of procedure, it is possible to evaluate the possibilities of a particular cluster evolve along a "virtuous" path of strengthening the innovative capacity of agents embedded in them.

IV. RESULTS

In order to support the analysis of local clusters in the software industry, it is important to consider an overview of the spatial distribution of the industry in the country. The Brazilian software industry is concentrated in the more developed regions of the country. Considering a spatial area by different regions of the country, one realizes that the four regions with the highest revenue concentrate 87% of the national income of these activities, and the state of São Paulo alone accounts for almost half that. It should also highlight the importance of the Federal District, which has only about 2% of companies in the country but accounts for about 8% of total revenue related to these activities, concentrating larger public companies.

When considering indicators for mid-sized businesses and revenue per employee it appears that there are significant differences between the states. In this sense, the larger enterprises in the Distrito Federal is not accompanied by a greater amount of revenue per employee (labor productivity), which is significantly lower than in Rio de Janeiro and São Paulo. Moreover, information gathered in the study by SOFTEX[2] pointed to the existence of very significant wage differentials for different types of professionals involved in the software industry in different regions of the country.

It must be considered that the territorial proximity is an important factor that induces acceleration mechanisms of learning and strengthening corporate competitiveness. This spatial proximity is also important in that it tends to induce the emergence of institutions and firms with complementary competencies, from which interactive practices can be strengthened in this case primarily related intangible flows of information and knowledge, able to sustain innovative dynamism and competitiveness.

Despite this general trend, there are indications that the possibility of generating these gains lies conditioned by the pattern of specialization and the specific characteristics of institutions and other local actors. In the specific context of the software industry, the concern about formatting policies to support the sector to consider the importance of the spatial dimension was reflected in stimulating the consolidation of technological "poles" targeted for these activities, usually based on some process of incubation companies. The emphasis in granting incentives to the creation of these centers is present in both actions SOFTEX Program as government bodies such as FINEP[3] and MDIC[4], resulting in the creation of 21 cores spatially dispersed throughout the country.

Considering this context, it is possible to use some procedures to identify and analyze spatially localized production agglomerations in the software sector, which constitute preliminary evidence about the presence of clusters in these activities [1]. The analysis below uses as its basic source of information RAIS-MTE[5] [11], contemplating the registered formal workers, the number of establishments present in the various fields of activity and the total amount of remuneration generated. The methodology uses as the basic spatial reference microregion (defined by IBGE[6]) in which are located the main productive activities of software

[2] Society for Promotion of Brazilian Software Excellence: created with a focus on supporting the export of software developed in the country, actively seeking to contribute to capacity building, creation of new software companies and marketing support of the Brazilian software in domestic and foreign markets

[3] Financier of Studies and Projects: Brazilian public company to promote science, technology and innovation in companies, universities, technology institutes and other public or private institutions based in Rio de Janeiro

[4] Ministry of Development, Industry and Foreign Trade: is a public agency responsible for promoting, guiding, protecting, regulating and inspecting industrial, national and regional development, the expansion of domestic and foreign trade and operations of private insurance and capitalization

[5] Annual Report of Social Information: This is a report of socioeconomic information requested by the Ministry of Labour and Employment to Brazilian corporations and other employers annually

[6] Brazilian Institute of Geography and Statistics: is a public foundation of the Brazilian federal government created in 1934, with assignments related to geosciences and social, demographic and economic statistics.

(4 digits / CNAE[7] 2.0): (1) Class 62015 - Development of custom computer programs; (2) Class 62023 - Development and licensing of customizable computer programs; (3) Class 62031 - Development and licensing of computer programs not customizable. The basic objective of the analysis is to measure the agglomeration process of producing software activities in space, describing the clustering according to the size and activities in relation to total employment and total earnings from those activities. A total of 30 clusters (micro) with more than 0.3% of total employment generated in producing software was selected activities.

These clusters were responsible for approximately 93% of total employment of software development activities recorded by RAIS, with 55.5% in the custom computer programs segment, 12.9% in the computer programs customizable segment and 31.6 % in the non-customizable computer programs segment. These clusters, operated 2,281 companies, which paid a monthly salary of around US$ 1,171 for their employees in 2006. Compared to the set of local economic activities associated with software development activities are particularly well paid, with salaries being approximately 54% higher than those of all the productive activities of those regions. The average size of firms producing software reached 19 employees.

From an inter-regional comparison of this information, some aspects can be highlighted. Firstly, it should be noted that, as expected, most settlements are located in more developed regions of the country. In fact, 11 clusters were located in the state of São Paulo, comprising approximately 37.9% (23.7% in the micro only the state capital) for jobs in the industry. São Paulo was accompanied by Federal District with 12.8% of the jobs generated by the software industry (due to the presence of businesses that cater primarily to the public sector, as already mentioned), Belo Horizonte (11.7%) and a set of clusters located in the southern region of the country (including the states of Paraná, Santa Catarina and Rio Grande do Sul) which accounted for 11.4% of the jobs created in those activities.

Secondly, it is possible to observe significant differences in the pattern of specialization of activities devoted to software development in selected settlements. Whereas an index of "relative specialization" calculated for the total jobs created, it is observed that in 11 microregions this index was considered high, indicating a strong specialization of the local economy in activities dedicated to producing software: Brasilia, Blumenau, Osasco, Joinville, Linhares, Campinas, Belo Horizonte, Campo Grande, Uberaba, Serrana (RJ) and Florianopolis.

These patterns of specialization can also be linked to the differentiation between custom software, customizable and non- customizable in two groups of micro-regions . The first consists of 11 cities with over 70 % of employment in software activities focused on custom software or custom segment: Campos dos Goytacazes, Brasilia, Belo Horizonte, Campinas, Joinville, Curitiba, Vitoria, Uberaba, Florianópolis, Osasco, Uberlandia. The other group consists of seven agglomerations with more than 60% of the concentrate in the software sector employment is not customizable: Goiânia, Mogi das Cruzes, Blumenau, Salvador, Campo Grande, Linhares and Maringa.

Thirdly, it is also possible to observe significant differences in the average size of firms in the selected clusters. While the overall average (19 employees per establishment) denote a predominance of SMEs (small and medium enterprises), it is possible to contrast significant differences between two groups of agglomerations.

The first group involves agglomerations with more than 30 employees per establishment, located in the regions of Linhares, Campos dos Goytacazes, Brasilia, Campo Grande, Campinas, Belo Horizonte and Uberaba.

The second group includes agglomerations with less than eight employees per establishment, located in the regions of Ribeirão Preto, São José dos Campos, Londrina, Curitiba, Vitoria, Caxias do Sul, Uberlândia and Sorocaba. Finally, the evidence collected showed that the salaries paid in the selected clusters also exhibit significant variations.

It can be observed that only seven clusters were paying over US$ 1,350 a month per employee: Sao Paulo, Mogi das Cruzes, Rio de Janeiro, Florianopolis, Osasco, Joinville and Uberaba. Moreover, eight agglomerations lower paid monthly wages of US$ 765. These salaries were particularly smaller in agglomerations located in some microregions and Caxias do Sul, Maringa, Caxias do Sul, Salvador, São José do Rio Preto, Serrana (RJ), Belo Horizonte, Campo Grande and Londrina.

From the general statement of clusters is possible to advance the discussion on the localized nature of the innovation and learning process in the production of software. Depending on the availability of information collected in empirical research conducted in the study, it is possible to consider four agglomerations identified from the previous procedure, for which there is some degree of coordination of consistent local agents with stylized definition of "clusters", which are located in the micro Recife-PE, RJ-Serrana (which has as its core the city of Petrópolis), Curitiba-PR and Brasilia-DF. These micro-regions are responsible for the generation of 8,830 jobs in the software industry, bringing together 259 companies. In terms of relative specialization patterns, are observed higher rates in Brasilia and in the Serrana region-RJ, compared to microregions of Recife-PE and Curitiba.

Regarding the distribution of employment by the development of various types of software, it is observed in Recife and Curitiba greater importance of employment in developing custom software, while in the region of Serrana (RJ) the same shared between the development and licensing of customizable software and not customizable. Finally, in

[7] National Classification of Economic Activities: is the instrument of national standardization of codes of economic activity and the ground rules used by the various organs of the Tax Administration of Brazil.

Brasilia, employment is divided between the development of custom software and customizable.

In the case of Recife, there is a clear predominance of employment in micro and small enterprises. In the region of Serrana (RJ), employment is concentrated in the range of medium-sized enterprise, while in Curitiba there is a more equal distribution of employment between the different size ranges.

Finally, in the case of Brasilia (Distrito Federal) there is a clear concentration of employment in the range of large companies. These differences reflect particularities of the way they have structured each of these agglomerations.

In the case of Reef, there is a confluence of MSE technology around the "Porto Digital" region. This arrangement was structured from the governance promoted by the Center for the Management of Porto Digital[8] (NGPD), a nonprofit civil association, the establishment of business incubators that brings together companies in the software that operates in the area of ICT since 2003, support of scientific infrastructure provided by the Center for Advanced Studies and Systems of Recife (CESAR[9]), associated with the Computing Centre of UFPe and support the Secretariat of Science, Technology and Environment (SECTMA) of the Government of the State of Pernambuco. This core also articulates the Softex Recife (Technology Center of Software Export Recife) whose origin is linked to the Softex Program in 2000 and brings together about 50 companies working in partnership with the Porto Digital projects in software development for export.

The cluster in the region of Serrana (RJ) arose from the idea of starting a center of high technology in the city in the mid-1980s, which spurred the creation of the Park Foundation High Technology Petrópolis (Funpat) em1986, from which structured the Petropolis-Technopolis project. Studies conducted [3] indicated the presence of approximately 30 micro and small firms in place, still highlighting the "indirect" presence of Microsoft and IBM that implemented training centers in the region, as well as the presence of National laboratory for Scientific Computing (LNCC).

Evidence suggests that the arrangement consists mainly of young, micro and small enterprises, most of which attracted mainly by tax exemption policies, low installation cost and especially the prospects of private institutional support, public and even due to the proximity institutions of education and research with the potential to develop qualified human resources for the sector.

In the case of Curitiba, the cluster has been structured in a relatively natural way, as a reflection of the demands created from companies located in the Industrial City of Curitiba and the availability of a wide scientific and technological infrastructure. In this case, we highlight the actions of educational institutions as CEFET[10], UFPR[11] and PUC-PR[12], well as the role of the Technological Incubator of Paraná, located in the premises of Institute of Technology of Paraná, as well as the establishment of the International Centre for Software Technology (CITS), the first structured core from SOFTEX Program [13].

Finally, the case of Brasília (DF) is characterized by the presence of some large companies that provide services to various government agencies and a number of small and medium enterprises in a secondary position. This arrangement was structured from the need for secure storage and transmission of data and encoded by various government agencies. This demand was strengthened by the attraction to the DF of large companies and large state-owned banks, with their IT centers, and international agencies, embassies and NGOs.

Thus, the federal government created a market for software that stimulated the creation of local businesses. The process continued with the departure of skilled technicians federal government departments and their agencies, who provided skilled labor and some capital to the private sector, which led to several small businesses, whose growth was linked to investments the federal government in iT which often require customized solutions, in which the interaction with the customer is key. In this dynamic policies with the greatest impact in the arrangement are performed by TECSOFT, local agent of Softex, which involve the export support (particularly through an export consortium called Brains - Brazilian Intelligence Software), the training in management, financing, and increasing quality and productivity in software development.

The structure of the cluster, we highlight, besides the software companies and the federal government, local government, the Society for Promotion of Brazilian Software (Softex), the Centre for Software Technology of Brasilia (TECSOFT), regional representation Softex and various educational institutions. More recently, the competition generated by the demands of the public sector intensified division of labor within the arrangement, specializing large firms in serving the demand for certain organs and restricting the field for a broader role of MSEs (Fernandes; Balestro; Motta, 2004).

[8] Porto Digital is a technology park development software and Creative Economy located in the city of Recife, Pernambuco

[9] CESAR is a private center based in the state capital of Pernambuco that uses advanced engineering in Information Technology and Communication (ICT) innovation to solve complex problems for businesses and financial sectors of many industries, such as telecommunications, consumer electronics, office automation, media, energy, healthcare and agribusiness

[10] Federal Center of Technological Education: is the name given to Brazilian education institutes belonging to the federal level and directly linked to the Ministry of Education, offering courses at various levels such as secondary education, technical and higher

[11] The Federal University of Paraná: is one of the oldest educational institutions in designing university in Brazil, founded in December 1912, originally under the name University of Paraná

[12] The Pontifical Catholic University of Paraná: is a Brazilian higher education institution private and Catholic

V. CONCLUDING REMARKS

A more careful analysis of the Brazilian software industry reveals an important set of strengths, weaknesses and opportunities. Besides the amplitude of the internal market, which itself is an important stimulus to strengthening the dynamism of the industry is associated with the flexibility and creativity of enterprises and technical personnel, to the sophistication and attractiveness of some of its segments and the ability to generate satisfactory solutions to a wide range of economic activities.

Among the main weaknesses of the industry, we highlight the excessive fragmentation of the industrial structure and the difficulties to implement a more effective internationalization strategy, able to translate into increasing exports.

Despite these problems, it is possible to identify a number of opportunities that can be exploited to maintain the dynamism of the industry, which include not only segments in which Brazilian companies already consolidated a favorable position - as in software development for the financial sector, ERPs, e-business applications for telecommunications, e-government software and formatted for specific activities such as agribusiness and retail - as well as new segments that present a potential attractive - such as those related to complex outsourcing activities, the development of free software, digital games, virtual reality software and solutions for broadcasting activities. In the context of an economy increasingly "knowledge-based" software industry is of particular importance.

The main threats related to the software industry are related to the exigencies of quality and certification of products and services that exist in other nations with very competitive price, the low degree of innovation financing, including investments in research and promotion of new ventures, and especially the lack of skilled labor.

Based on this findings, the analysis developed aimed to highlight the complexity, diversity and sophistication of the Brazilian software industry, not only from the point of view of the diversity of products and services generated, as well as considering their enterprise configuration and its spatial distribution.

Despite the problems and challenges that the industry has faced in recent years, it maintains its momentum, having potential to amplify its economic impact and to encourage the adoption of innovations by different economic activities, contributing to increased productivity and competitiveness of these activities.

Through analysis, we tried to emphasize that the process of accumulation of powers in the software industry has an important spatial dimension, also reflecting the essentially heterogeneous structure of this activity.

In this respect, there is evidence that the territorial proximity is an important factor that induces acceleration mechanisms of learning and strengthening corporate competitiveness in that sector. This spatial proximity is also important in that it tends to induce the emergence of institutions and firms with complementary competencies, from which interactive practices can be strengthened - in this case primarily related intangible flows of information and knowledge - able to sustain innovative dynamism and competitiveness.

Despite the highly exploratory nature of the empirical exercise performed, it points towards the heterogeneity of skill-building process in the sector analyzed. This heterogeneity can be partly explained in terms of the breadth and complexity of the internal market, enabling the survival and performance of firms producing extremely disparate software in terms of specialization patterns, strategies, skills and innovative performances.

Accordingly, there is evidence that existing channels for exchanging information on those arrangements must be enabled - through appropriate policy instruments and the mobilization of local management of governance - in order to enable a quantum leap in terms of the definition of technological standards, procedures for quality improvement and certification practices, driving companies to deepen their innovative efforts and the adoption of more aggressive, targeted, including marketing strategies for expanding exports.

Finally, some strategies can be considered for maintaining competitiveness in the software industry in Brazil: a) training of manpower; b) managerial training; c) better market share; d) better culture of cooperation; e) product design; f) investments in technology and innovation; g) better performance in foreign markets.

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