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The digital workers in Brazil: between creativity and precariousness[1]

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Abstract

This paper analyzes the work of software developers and the changes in canonical conceptions of regulated labor. To work is to stay most of the time connected on social networks as a means to stay on the market, as well as a condition of constant updating and qualification in the profession. The despatialization of the labor becomes a form of organization of capital and enterprises, with profound implications on the worker's lives and fragilization in the division between labor and personal life. The research studied these "symbolic analysts" "in companies with different sizes and customers aiming to recover the perception of these workers on" digital work" as "creative work" and your strategies to stay in career and in the labor market.

Keywords: Knowledge workers. Software industry. Work flexibility. Standardization.

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This paper seeks to analyze the new occupations that have emerged in recent decades as a result of the capitalist transformation into what has come to be called knowledge society, information society, or cognitive capitalism. It centers on the changes arising from new technology and its effects on work and workers.

We focus here on the work of Brazilian software developers and the changes taking place in dominant conceptions of regulated labor. Working means staying connected most of the time to the largest possible number of networks, as a way of securing one's place in the market, strengthening exchange networks, and keeping continuously updated. The developer's job is considered creative because it requires constant elaboration, despite the attempts at standardization made by large companies. It can be implemented in various spaces given its virtual character. It is flexible from inception, whether in regard to the tasks involved, the work relations or work spaces. Counterbalancing these positive aspects are intense working hours, a high worker turnover and somatic diseases.

Some concepts are representative of the growth and diversification of the service sector and the use of information technology: creativity, flexibility, mobility, qualification and precariousness. Such concepts, if we start from the subordination and exploitation inherent in capital-labor relations, allow us to grasp the speed and complexity of the ongoing changes.

The software sector is located within what Beck terms capitalism's second modernity – the transformation of an industrial

and service society into a knowledge and information one. This society's main feature is the centrality of knowledge as a production factor and economic resource. Knowledge, rather than work, is the source of social wealth. "Knowledge workers" are able to translate specialized knowledge into technological and organizational innovations that produce profit in terms of products and services, and as a consequence they become a privileged group within society (Urry, 2000, p.40). From another perspective, Cocco and Villarim (2009) argue that knowledge is living labor which cannot be fully appropriated by the capital due to the horizontality afforded by networking and creativity. It therefore eludes the capital-labor dialectic, which is marked by the use of temporal metrics in determining the value of work.

In Brazil, a few large multinational companies concentrate 50 percent of the work in this sector in what are known as "software factories" (SOFTEX, 2012). However, these multinationals account for only 4 percent of Brazil's total number of companies in this sector. The remaining 96 percent are small and medium-sized enterprises distributed throughout the country and dedicated to made-to-order software production (SOFTEX, 2012).

This research investigated software workers in companies of varying sizes in the state of São Paulo. Secondary data were collected to establish a profile of companies and workers from official statistics and agencies focused on software industry, and data for Professional Associations[2]. Four companies were visited and had

[2] We draw here on SOFTEX data. SOFTEX is a social organization designated by the Ministry of Science and Technology to manage the Program for the Pro-

their work process observed: two large multinationals (above 4000 employees) and two small companies (up to 20 employees).

Forty-five in-depth interviews were conducted in companies of various sizes at the São Paulo State. Preliminary results point to creativity as an element whose complexity is reflected in the difficulties faced by companies attempting to standardize work; in the workers' need to keep up to date through continuous training, in the social networks; and in the flexible hierarchies to be found in medium and small businesses, where the line between functions may be blurred. The high worker turnover in this sector can be viewed as a means to resist work intensification.

1. A brief overview of Brazil's software industry

The Brazilian software and IT services industry (IBSS) includes the following activities according to the CNAE classification: "made-to-order software development; customizable and non-customizable software development and licensing; consulting in information technology; technical support, maintenance and other IT services; data processing, internet-based application service providers and hosting; portals, internet-based application service providers and hosting; internet-based content and information

motion of Brazilian Software Excellence, mobilizing companies, the government and universities in support of software development. The data are estimates and only highlight the separate software workers from other workers in information technology, and are published with some delay.

service providers; repair and maintenance of computers and peripheral equipment; repair and maintenance of maintenance equipment" (2012, p. 26).

Around 95 percent of the IT sector production consists of made-to-order software development, which is based on service provision and data processing. This type of software is developed to suit a specific user's needs, taking into account his requirements in defining the software's general and specific features. In Brazil, ready-to-use software development accounts for less than the remaining 5 percent (Castro, 2013).

According to data from the Brazilian Association of Software Companies (ABES), in 2014 the Brazilian IT industry ranked 7th in the world, ahead of all Latin American countries, with almost half the market (46%). In that period, the application sector accounted for 44 percent of the revenue; businesses concerned with the development environment accounted for 31.3 percent of investments; infrastructure and security accounted for 22.7 percent, and software for export, 1.9 percent[3].

SOFTEX data estimate at 800 thousand the number of software workers in software development companies or divisions within companies. Most of these workers are young, as Table 1 below shows:

[3] http://www.abessoftware.com.br/dados-do-setor/dados-2014

Table 1 – Young workers in IT industry

Age	**%**
Up to 17	0,2
18 to 29	51
30 to 49	42,4
50 or above	6,7

Source: own elaboration based on SOFTEX data (2012, vol. 02).

Around 51 percent are up to 29 years old, and 42.4 percent are up to 49. One explanation given in the business literature lies in 'Generation Y', seen to be innovative, mobile and flexible, therefore suited to an industry marked by rapid technological innovation. Table 1 above shows a significant number of workers over 30 years of age who remain in the industry. This is more common in public enterprises or large companies with an IT division. In addition to their young age, it is important to add that these workers are predominantly male; the percentage of women is only 12. This reflects gender ideologies constructing science, technology and innovation as male concerns.

2. Software production, work and attempts at standardization

The information revolution made it possible productive sectors to be eliminated and several others to be created. This has given capitalism a new quality, for which it is now referred to as post-industrial society, postmodern society, cognitive capitalism,

informational society, networking society, among other terms (Castells, 2000; Harvey, 1993; Bell, 1977; Moulier Boutang, 2011). In common, these definitions carry the idea that knowledge and information, or technology, are to become factors of production and capital valorization.

The IT industry has grown globally. It can be characterized by software production (the production of programs to be used in all production and service sectors) and hardware production (the production of machines allowing programs to be "run"), as well as the production of personal computers, mobile phones, tablets and music players, which depend on software and largely on the internet to function. Hardware production is conducted by the electronics industry, which "embeds" software in products of several kinds. The work organization generally reflects industrial production in that it uses assembly lines, teamwork and other features common to most industry sectors.

The specificities of software production arise from the immateriality of its production process and final product. Oliveira (2009, p. 61) defines software as

> a set of semantic and syntactic rules used to develop a computer program. It consists of a set of instructions that build command lines in the chosen programming language. These turn the program's information, given in textual and readable form for the individual programmer, into machine language using Boolean logic [a form of writing based on binary logic (0,1,0,1,0) and used in software development].

In other words, software is a storage unit holding organized, sequentially-arranged knowledge, used by a processor (hardware) to transmit information (Ribeiro, 1998).

The software development process consists of procedures to create a program or enhance an existing one, beginning from the definition of the customer's needs. Arithmetic symbols are used as raw materials and ultimately a set of symbols aimed at solving problems is established which requires the use of four cognitive skills – conceptualization, formalization, data processing and implementation (Gutierrez & Toledo, 2010). This is done after the software's features and basic operational requirements have been determined. Next, the project's architecture and construction is developed according to the required specifications. This is followed by software validation, or testing, to check that it meets the customer's requests. Finally, software updating allows changes to be made according to operational needs. These stages require the definition of deadlines and required resources, as well as the organization, planning and monitoring of the "artifact" (name given to the final product)[4].

Software can be of three types: a) embedded software; b) business solutions c) professional services. Embedded software is built into devices or machines. Automated equipment is controlled by software. There is also packaged software, or standardized sets of programs catering to the general public. These are sold in stores through marketing and sales strategies similar to those used with

[4] Definition found in "Software: conceitos básicos". PrimeUp/LES/PUC-Rio

hardware equipment. Among the business solutions, made-to-order or custom software is designed to suit a specific user's needs, taking into account his requirements in defining the product's general and specific features (Freire, 2002; Oliveira, 2009). Software production is therefore not restricted to IT companies, since products as diverse as cars and household washing machines are increasingly relying on embedded software. Usually, however, software is developed by specialized network companies, which may be outsourced, or not.

The customer is key in software production. He dictates what he needs, although he rarely understands the technical process involved. This sometimes leads to conflicts with developers. Once the "artifact" is delivered, the company is expected to continue offering technical assistance by "support" personnel who know the process well and strive to answer queries and provide solutions.

The support function in smaller companies often serves as a starting point for new employees. This initial post is followed by those of programmer, analyst and product manager, respectively. Development *per se* is the responsibility of the programmer and analyst. The product manager outlines the project plan and scope, establishes the details of the service agreed with the customer and its analytical framework, estimates the costs and amount of work required, draws up a budget and sets a schedule.

As the project is carried out, the so-called "task" of execution and monitoring involves time management. Time estimates do not always converge to the actual amount of time required for pro-

ject completion. Time is therefore a key element if we wish to understand the relationship between customer-user and developer, or the regulation of working time by contract. Perceived as a stress factor at work, the project's deadline requires workers to get the project done within a predefined time limit, even if that takes extended shifts or weekend sacrifices. Tasks have a set time to begin and end, and one task may involve projects within projects. Quality and productivity are measured by time and end result, that is, software functionality and fulfillment of customer needs.

Task standardization is considered a quality factor. It is achieved using diagrams, organization and flow charts aimed at defining and specializing tasks. Accreditation to quality standards such as ISO, which specify procedures to be followed, are also sought.

Cocco and Villarim (2009, pp.173-90) claim that there have been two "Fordization" attempts in software production. The first relied on work fragmentation into tasks and functions and on functional verticalization between analysts, designers and programmers to eliminate control of production as a whole. The second was software "componentization", using methodologies and techniques which divided the process into standardized, independent parts. This led to developers having to carry out repetitive tasks. Still according to the authors, the pinnacle of these attempts was reached by software engineering, which draws on a set of metrics and methods to quantify and control the work done (2009, pp. 183-184).

More common in large companies, standardization faces its own obstacles nonetheless, and these are due to the strong cognitive nature of tasks. Even where tasks are specialized, the software professional can perform almost all functions in the company. Some limitations can be pointed out, according to Cocco and Villarim: software can be downloaded from the internet itself, without the need for material support; it is not interchangeable and can be passed on; its use does not mean its exhaustion; and it is intelligible. Living labor can by no means be appropriated, given the horizontality afforded by developer networks and creativity, as well as by the strongly cooperative nature of this type of production (2009, pp.184-185).

There is a tendency to divide the work, with the appointment of leaders, but this has its limitations given the high uncertainty and complexity of the means of work. Thus, planning and control functions are integrated in the workflow, even if formally concentrated in the project manager. Skills and knowledge vary considerably and some jobs require more routine tasks than others. Workers' abilities, analytical skills and knowledge, as well as rapidly evolving programming languages, are key to characterize the complexity of the tasks involved in technical problem solving (Mayer-Ahuja & Wolf, 2007).

Standardization, even when attempted by big companies, is never absolute due to the very character of the activity. Thus the "creative" character of the activity, albeit with varying levels of standardization, is dominant and representative of the flexibility of production and the ways in which the workforce is used in project

development; in the allotment of flexible hours and shifts, depending on the company; in the choice between the home work system, with occasional visits to the company, or standard working hours. This does not necessarily engender more autonomy, considering the limitations imposed by the work organization, the control imposed by technology and the incorporation of subjective criteria such as trust, which implies the internalization of responsibility.

3. Networks, training and work relations

The importance of personal relationships is highlighted by Benner, for whom the tasks involved depend on information and knowledge. This requires strong social interaction and communication among workers, not only in the workplace but also with peers working in other companies. This ongoing interaction and presence in the social networks ensures workers' place in the market, shaping their work trajectory (2005, p.138).

The need to remain in the market leads workers to seek proficiency in different languages[5], pursuing certifications and other strategies to improve their qualifications and status in the work market. Usually these certifications and refresher courses are searched for in the network itself and through the constant exchange with other professionals.

[5] Languages are a set of syntactic rules that define a program, allowing the computer to receive instructions on actions to be taken, on how the data should be used and transmitted. There are over 100 languages, varying according to their applications. Two very popular examples are Java and Oracle.

In smaller companies there is less internal hierarchy, hindering specialization in separate functions. A more informal environment predominates, and there are only four basic functions and corresponding wage levels. Usually, the worker is first hired as a "support" employee, then moves up to "programmer" or "analyst" and finally to "product manager". However, because worker turnover is high in the industry, workers are often hired for the positions that the company actually needs from the start.

These particularities reflect the organizational features of fixed-term project work, regardless of contract type. Even workers on open-ended contracts depend on continued participation in projects to keep their jobs. In this individualized employment relationship, temporality is immediate (Cocco & Villarim, 2009; Mayer-Ahuja & Wolf, 2007).

Among older workers, recent studies conducted in Brazil show a concern with stability and access to labor rights, which become a priority. Within companies, hierarchies and formal careers may ensure relative stability, but given the volatility of knowledge and new technology, obsoleteness is a permanent threat to workers (Martins, 2013; Oliveira, 2009). A different situation occurs in public or state enterprises, which offer career plans and greater stability.

Since the 1980s there has been an effort to understand the new productive processes arising from computerization. Taking industrial work as reference, the discussion has both questioned the status of software work as a creative and autonomous type where the worker has strong agency, and, conversely, emphasized these qualities. In the first case, the constant search for standardization is viewed as a demeaning element of the work, equaling it

to other repetitive and alienating jobs; in the second, the work is viewed as intellectual and creative, with a collective character fostered by the setting up of online developer "communities", where several developers contribute to problem solving. It represents the paradigm of positive flexibility in the way it is carried out, in the highly informal training that is received continuously, and in its deterritorialization, or the fact that it can be done anywhere – at home, at work, at university, and to customers all over the world.

However, this does not mean that the scope of work of these professionals[6] is not becoming more formalized and/or regulated. Among Brazilian software workers there is now a trend toward seeking training in technical or undergraduate IT degree courses. Although these do not guarantee entrance and sustainability in the industry, they do act as a filter for entrance into the market.

Data from 2009 on software workers' level of education show that 25.6 percent had secondary education and 22 percent had an incomplete university degree. Around 51.7 percent had completed a university degree and 0.6 percent had a graduate degree. This varied training can be ascertained by looking at the range of university degrees considered of interest for the sector.

In addition to core areas such as Computer Science, Engineering, Electronics and Automation, Information Processing

[6] Here we are using the term 'professionals' to refer to software workers who are actually not professionals in the strict sense of the word. This would involve establishing criteria of access and permanence in the area, as well as a system of symbols characterizing a profession in the sense given by Freidson (1998).

(Systems Analysis, Data Processing), majors such as Visual Techniques and Media Production, Library Science, Information and Archives, Mathematics, Social Communication, Commerce and Administration, Accounting, Linguistics, Translation, Economics, Law, and others, are also found (SOFTEX, 2012).

Still on the subject of education, it is interesting to note that some companies hire hackers to test their products. These "professionals" do not always have an IT training, which in theory should define them as such. But they master the codes allowing them to crack closed-source software, damaging software reliability and requiring counteraction in reliability testing. These hackers exemplify non-systematic training received through the computer network (Castells, 2003).

The workers interviewed for this study tended to view technical or university-level training as "complementary" to that obtained directly through the use of computers since childhood. They argued that formal education systemizes knowledge rather than add to it. This is one of the reasons many software workers choose this job – to be able to continue doing something they know and enjoy doing. On the other hand, it is common to find workers who were first drawn into the business accidentally, without having planned to do so or being particularly attracted to the job or the technology involved.

In his study of Silicon Valley in the US – considered the largest, most dynamic and exemplary exponent of information economy – Benner (2005) highlights the increasing socialization of work and individualization of contracts. High levels of self-em-

ployment, temporary contracts, high worker turnover and the absence of unions have led to negotiations between companies and workers hinging on individual negotiation skills. In the US, networking, mobility and non-standard or atypical employment are typical features of the sector (2005: 38). The author also claims that the labor market of the new information economy is substantially different from that of the so-called industrial age, although the policies, programs and institutions shaping labor markets today still reflect those industrial origins. As a consequence, working conditions are poorly regulated and workers are scarcely protected from the sector's characteristic volatility, given the high levels of obsolescence of programs and tools, in a highly informal, high-risk market that leaves workers vulnerable (2005, p.143).

In Brazil, the large number and varying types and sizes of software companies results in distinct employment contracts or simply in the absence of one – as is the case with freelancers, who are free to work for several different companies, performing specific tasks. An operative can delegate specific tasks to another who is more skilled at it, whether as an independent contractor/freelancer or legal person[7]. However, data from SOFTEX (2012) indicate that around 70 percent of the workers are on regular fixed-

[7] When the worker is registered as sole proprietor, the services agreement becomes a deal between companies rather than an employment contract, and this reduces costs for the contracting party.

term contracts, making up the permanent staff of companies, regardless of size[8]. In the remaining enterprises, different contract types coexist, and employees range from "permanent" waged staff to service providers recruited for specific jobs, under formal or informal contracts. Service outsourcing is common, whether to other companies or individual service providers with specialized knowledge. This high degree of formalization can be partly explained by the fact that government tenders for services establish that only formalized enterprises with regular employment contracts are eligible to enter into contracts with public bodies.

Small businesses usually have a fixed number of employees doing regular shifts, although the number may vary depending on projects' funding and development. These shifts have varying flexibility, fixed hours being more common. However, the projectification of work leads to extended shifts that can be done at the workplace or at home, in addition to weekend shifts for customer support. The distinction between work/not work, personal/professional life gets blurred, mobile devices making it possible for a worker to access his tasks anytime, anywhere. As reported by Mayer-Ahuja and Wolf (2007) regarding Germany, hierarchical social relations prevail in these companies as a means to control task

[8] Different bodies show different data on the sector due to the use of distinct methodologies. We draw here on SOFTEX data. SOFTEX is a social organization designated by the Ministry of Science and Technology to manage the Program for the Promotion of Brazilian Software Excellence, mobilizing companies, the government and universities in support of software development.

completion or sanction uncompleted tasks, although with no rigidity due to the porous character of functions.

Large multinationals host development labs for what they call customized "services" to large customers, and facilities for the monitoring and maintenance of such services. They also keep sites acting as workspaces where several services are maintained by different types of workers. Some recruit researchers with specific academic credentials to work in laboratories and multilingual call centers, where language skills are foremost along with specific training about the company's products. These operate 24 hours a day to serve global customers, their main feature being global customer service, sometimes delivered by centers located in several countries.

The individualistic character of contracts echoes the configuration described by Benner (2002) regarding the Silicon Valley. Trade unions play a weak role. However, there are specific websites where software workers can follow, share, compare and discuss their wages and working conditions. In a booming work market, however, constant job change can be seen as a form of resistance.

We can attribute the sector's high turnover to three factors reported in the study: first, the heating up of the sector during the period analyzed, with a wide offer of jobs giving workers a wide range of choice; second, workers' constant demand for qualification and updating, which leads them to seek those companies offering more challenging opportunities; and third, unattractive or intense working conditions such as weekend shifts and intense shifts, which lead to job hopping as a form of resistance.

Table 2 – Software developers' turnover rate compared with other jobs – Brazil, 2008

Economics Sector	% of job change
Construction	32,8
BSSI	**31,5**
Information and **communication** (except BSSI)	26,9
Transportation, storage and mail	26,9
Trade, automotive and motorcycle repair	23,5
Total	**22,9**

Source: SOFTEX, 2012

The survey data show that job change is more common among younger workers, decreasing significantly as family responsibilities increase.

Call centers may be part of software factories for customer follow-up and support, differing from those call centers offering outsourced service to banking, telephone and other companies geared to customer service and product sales. The latter employ workers with language skills and software knowledge to aid product sales globally. Countries like India stand out for this type of call center, but Brazil too has a reasonable number of centers of the kind, working for large companies. In the opposite situation are those call centers operating as third parties for banking, energy, telephone, credit card and collection companies in general. Here, technology is used to standardize workers' activities and interactions with customers and to control service quality. Work resembles an "informational" assembly line, which Antunes and Braga (2009) have termed infotaylorism.

In conclusion

As much as we seek to affirm that the new software industry reproduces the conditions inherent in capitalist production, i.e. labor exploitation and worker subordination, empirical data point to a number of distinct configurations requiring a reflection on the changing world of work. These new sectors of employment and occupation must be analyzed based on their specificities.

Because of their flexibility, informational and, particularly, software work are marked by features that distinguish them from factory and service work, even though we use the term "software factory" to refer to production and work in large software companies. Such flexibility does not necessarily reflect on working hours, but perhaps also on them depending on the worker's type of employment contract. He may be subject to fixed shifts and project deadlines or enjoy the alleged autonomy of home office, where he is able to "choose" how and when to work. The standardization – or attempt at standardization – of procedures acts as a way to control quality and time spent on project execution.

This type of work is also flexible in its training requirements. Although a formal IT education is considered relevant, it is not mandatory; the industry also welcomes specialists in programming languages used to develop software, games and related content. For these, formal education is a complement to knowledge acquired since childhood through the use of digital devices.

There is flexibility also with regard to the kind of learning fostered by computer networks, where open-source software is developed and made available for use by individuals and companies

(even though they are sometimes enhanced and "closed" for private use later on). Online communities are used not only for the exchange of software-related information and learning, but also to discuss the software market, working conditions and wages. Online associations act as virtual trade unions, although these exist.

It is not appropriate, however, to speak of precariousness in labor relations since, as yet, there is not a process of rights loss taking place in Brazil. We might refer instead to the intensification and fragility of employment bonds, though most of the industry's workers are on regular contracts, and there are several laws projects seeking more regulation of employment contracts. Illustrative of this trend are measures to combat worker cooperatives, seen as fraudulent and as a way to use wage labor in disguise, and measures for the regulation of student internship by determining the number of hours to be completed.

The software developer's work scenario involves creativity, innovation and subordination, if not to a specific employer then to a competitive and fragmented labor market, despite the existence of large multinational corporations. Digital companies and centers are spreading throughout the country in the wake of society's informatization as a whole.

Could the standardization and fragmentation of work become dominant? It is possible, but we must keep in mind that the industry depends on creativity for the design and development of its "artifacts". Thus, the immateriality of production and its reliance on living labor bring back up the issue of work, the notion of work value as linked to time expense and the workers' level of alienation as well as their possibilities of resistance. In other words,

a discussion of the ways in which cognitive or creative work are subordinated to the capitalist logic.

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