Chief Editor: Fauze Najib Mattar | Associate Editor: Claudio Alberto de Moraes
Evaluation System: Triple Blind Review | Published by: ABEP - Brazilian Association of Research Companies | Languages: Portuguese and English

Digital Transformation and the Fourth Industrial Revolution - Theory of Disruptive Innovation

Transformação Digital e a Quarta Revolução Industrial - Teoria da Inovação Disruptiva

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Submission: September 18, 2019
Approval: January 09, 2020

Abstract

Digital Transformation affects individuals, companies and societies as a whole. In particular, a rapid spread of digital technologies establishes a huge change of movement. It is essential that economies continually invest in developing digital infrastructures to meet existing and future demand. They use the foundation for many new services, applications, and business models. They are also crucial to supporting and enabling digital innovations that are transforming production, including in the context of Digital Transformation, Industry 4.0 and Disruptive Innovation. Ideally, these plans should address the main barriers to deploying high-speed networks and services and include measurable goals to meet the challenges associated with ensuring competition and investment. It is also important that these plans include goals related to key technical facilitators such as access to Internet exchange points and spectrum, among others. This article promotes a reflection on social, economic, and intergenerational management development, and a vision for developing, disseminating, and governing technologies in ways that foster a more collaborative, collaborative, and sustainable foundation in all of these transformations.

Keywords: Digital Transformation. Fourth Industrial Revolution. Disruptive Innovation.

Resumo

A Transformação Digital afeta indivíduos, empresas e a sociedade como um todo. Em particular, a rápida disseminação das tecnologias digitais estabelece uma enorme mudança de movimento. É essencial que as economias invistam continuamente no desenvolvimento de infraestruturas digitais para atender à demanda existente e futura. Elas fornecem a base para muitos novos serviços, aplicativos e modelos de negócios. Também são cruciais para apoiar e viabilizar as inovações digitais que estão transformando a produção, inclusive no contexto da Transformação Digital, Indústria 4.0 e Inovação Disruptiva. Idealmente, esses planos devem abordar as principais barreiras à implantação de redes e serviços de alta velocidade e incluir metas mensuráveis para enfrentar os desafios políticos associados à garantia de concorrência e investimento. Também é importante que esses planos incluam metas associadas aos importantes facilitadores técnicos, como acesso a pontos de troca e espectro da Internet, entre outros. Este artigo visa promover a reflexão sobre o desenvolvimento social, econômico e da administração intergeracional e uma visão para desenvolver, difundir e governar tecnologias de maneira a promover uma base mais colaborativa e sustentável em torno de todas essas transformações.

Palavras-chave: Transformação Digital. Quarta Revolução Industrial. Inovação Disruptiva.

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1 Introduction

In business theory, a Disruptive Innovation is an innovation that creates a new market and an exchange of value and eventually interrupts an existing market and an exchange of values, replacing companies, products, strategic alliances and market leaders (Berman, 2012). Not all innovations are disturbing, even if they are revolutionary. For example, the first automobiles, in the late 19th century, were not a disruptive innovation, because old automobiles were high-priced luxury items that did not appeal to the horse-drawn vehicle market. The transportation market remained largely intact until 1908, with the launch of the lower-priced Ford Model T. The mass-produced automobile was a disruptive innovation because it changed the transport market, while the first thirty years of automobiles have not changed (Maynard, 2015). Disruptive innovations are produced by outsiders and entrepreneurs at startups, rather than by existing market-leading companies. The business environment of market leaders does not allow the pursuit of disruptive innovations when they first appear, because they are not allowed in the beginning and because their development can prevent scarce resources to support innovations (requested to compete against the current one), according to Peters (2017). A disruptive process may take longer to develop the conventional approach and the risk associated with other forms of innovation that are more incremental or evolutionary, but, once implemented in the market, a much faster penetration and a greater degree of impact on established markets. In addition to business and economics, disruptive innovations can also be used to disrupt complex systems, including economic and business-related aspects (Schwab, 2017). Regarding the evolving technology process, West (2018) returned what Disruptive Innovation is and what is not: Interruption is a process, not a product or service, that occurs from the periphery to the mainstream:

a) They originate on low-cost bases (less demanding customers) or in new markets (where they did not exist);
b) New companies do not serve traditional customers until quality meets their standards;
c) Success is not a requirement and some businesses can be disruptive, but they fail;
d) The business model of the new company differs significantly from the current one.

Technological changes that harm established companies are generally not radically new or technologically difficult. However, they have two important characteristics: 1) they generally present a different package of performance attributes that, at least in the beginning, are not valued by existing customers; 2) the performance attributes that existing customers value improve at such a rapid rate that new technology can later invade established markets (Schwab & Davis, 2018).

In 1979, the futurist Alvin Toffler popularized the concept of a new information age, supported by several key ideas, including the demassification of the media. Information and Communication Technologies (ICT) have come to represent, in a comprehensive way, images and expectations of the future. Hopes for continued progress, economic growth, improved skills and, possibly, democratization, were linked to new ICTs as well as fears of totalitarian control, alienation, job loss and insecurity (Matt, Hess, & Benlian, 2015). Currently, the terms Industry 4.0 and Fourth Industrial Revolution (QRI), refer to the incipient transformation of the production of goods and services resulting from the application of a new wave of technological innovations (Hirschi, 2018). The essential element of this transformation is considered the crossing between production, processing, processes and information flows online, for example: Internet of Things (IoT), Cloud, Big Data and devices (sensors, chips) that communicate independently between along the entire value chain. Companies establish global networks and incorporate them into their machines, storage systems and production facilities in the form of Cyber-Physical Systems (SCF), according to Chung and Kim (2016). The World Economic Forum's Report on the Future of Labor (European Commission, 2018) portrays the changing nature of work and examines how technology shapes the relative demand for certain skills in the labor markets and expands the reach of companies, robotics and digital technologies. For example, it allows companies to automate, replacing human labor with machines to become more efficient and innovative, expanding the number of tasks and products.

Ransome (2019) explains the process of how disruptive technology, through its support network, dramatically transforms a given industry. When technology appears that has the potential to revolutionize an industry, established companies often see it as unattractive: it is not something that their main customers want and their projected profit margins are not enough to cover the cost structure of large companies. As a result, the new technology tends to be ignored in favor of what is currently popular with the best customers. But then, another company comes in to bring innovation to a new market. After disruptive technology is established there, innovation, on a smaller scale, rapidly increases technology performance in attributes that add value to customers (Westerman, Bonnet, & McAfee, 2014). The high-tech implementation is often resisted. This resistance is well understood by active participants. The electric car will be resisted by gas station operators in the same way that ATMs were resisted by bank tellers (Willcocks & Lacity, 2016).

According to the main representations of Industry 4.0, private and public institutions expect their effects to be mainly positive with regard to productivity, economic opportunities and the future of work (Ustundag & Cevikcan, 2017). According to the European Commission in Proceedings of the Open Round Table on the Future of Work, the Fourth Industrial Revolution has the potential to increase global income levels and improve the quality of life of populations worldwide. Workers will benefit greatly from this. In light of the impending shortage of skilled workers, older workers will be able to prolong their working life. The flexible organization of work will allow workers to combine their jobs and private lives to continue professional development, promoting a better balance between professional and personal life (Colombo, Karnouskos, Kaynak, Shi, & Yin, 2017).

The social consequences of the Industry 4.0 revolution, such as the problem of unemployment and the composition of the labor market, in terms of professional qualifications, are kept in the background (Chung & Kim, 2016). The processes, mechanisms, opportunities and threats that the literature has attributed in recent years to ICT, the digital economy, the knowledge economy and, in general, to the consequences of digital technologies in work and production, now become even more radical in the current representations of Industry 4.0 by public and private institutions (Bloem et al., 2014). Critical opinions on these institutional narratives mainly point to two problematic issues: 1) technological determinism is questioned. Technologies are not exogenous to social structures, but are incorporated into social and power relations. They are not neutral, but open to certain social options and closed to others; 2) the effects of technology on unemployment, working conditions and work organization are not predictable (Morrar, Arman, & Mousa, 2017). Such changes in the performance of workers serve to guarantee significant increases in productivity and to organize processes in which the driving forces are rapid problem-solving skills, creativity, cognitive, linguistic and social skills, as well as their total involvement in the work process (Ustundag & Cevikcan, 2017).

Excessively hierarchical and rigid structures in the control of work, according to these views, prevent the production and dissemination of knowledge and information. These changes in performance and work organization consider it manual and not manual in the industrial and services sector, as they are all, in different ways, affected by the current centrality of information, knowledge, communication and data within the production processes (West, 2018). The positive potentials, now attributed to the new innovation cycle, evoke and expand those attributed to the previous waves of innovation linked to ICT and, even before, to the transition from Fordism to post-Fordism (Schwab, 2017). Theories on ICTs mainly frame the new phase of capitalism as a knowledge-based economy, considering that digital technologies and organizational transformations in capitalism are at the origin of a general societal society of changes, defined alternatively, as a knowledge-based society, in the virtual society, in the Internet society, in the network society, in the cyber-society and in informational or digital capitalism (Berman, 2012). These definitions refer to the idea that the production processes related to Technology Investment (ITC) determine a decisive discontinuity between modern and contemporary society (Matt et al., 2015).

Information and Communication Technology (ICT) is probably the most emblematic sector of progress and innovation across society, both technologically and economically. In fact, using technology, employment and work practices, the sector organization is a pioneer in developments in other sectors (Morrar et al., 2017). The obvious reason is that this sector develops a large proportion of the technologies that, visibly, change work and life in all societies and economies. He builds his practices on the self-application of his own inventions. At the same time, they spread to other sectors and spheres of society, changing these contexts and being adapted to them (Schwab & Davis, 2018). In the current representations of Industry 4.0, the nexus between technological innovation and horizontal decision making, diffusion of responsibilities and increased autonomy, creativity and skill among workers, is further extended.

According to Kane et al., (2015) employees are supported at work by multimodal assistance systems that facilitate the user interface. In addition to comprehensive training, organization and work design, models are critical to enabling a successful transition that is welcomed by the workforce (Maynard, 2015). These models must combine a high degree of self-regulation, autonomy with decentralized approaches to leadership and management. Employees must be more free to make their decisions, become more actively involved and regulate their workload (Cherry, 2015). According to most of the literature on knowledge-based economics, digital capitalism and techno-optimistic narratives about the Fourth Industrial Revolution, humanity is largely free from the burden of hard manual labor and workers' autonomy and creativity are disaggregated (Bloem et al., 2014).

The Fourth Industrial Revolution creates a set of technological slaves, that is, machines and robots capable of responding to vocal commands or unplanned behavior, oriented towards the purpose function. Thus, the ability to manipulate symbols, specifically of a logical-mathematical type, becomes the guiding value of new specialized laboratories. Knowledge workers, those who organize and manage work processes constitute the new elite, based on merit and not on social classe or capital control (Schwab & Davis, 2018).

Do these representations, in the current scenario, correspond to real phenomena? This is the question at the heart of this study that aims to analyze the current and potential impact of technological innovation. First, a review of the institutional representations of Industry 4.0 will be presented based on official reports produced by public and private institutions (Peters, 2017). Second, the state of the art, digital work will be analyzed based on literature and evidence. As the Industry 4.0 process is still incipient and its impact on work is unpredictable, an analysis of its possible consequences can only focus on the current scenario, that is, on the ongoing trends and on the already observable consequences of digital technologies at work (Ransome, 2019). The analysis focused on the relationship between academic and institutional rhetoric about Industry 4.0 and digital capitalism, which, as seen, rigorously evokes and expands on previous rhetoric about the post-Fordist knowledge-based economy and empirical evidence in digital work (Morrar et al., 2017).

2 Institutional and Corporate Narratives in Industry 4.0

Industry 4.0 is considered an integral part of the broad economy. According to Colombo, Karnouskos, Kaynak, Shi and Yin, (2017), most of the emerging sketches of the literature on the digital economy, such as the arrival of information and knowledge long announced, recently underwent a reinterpretation, while others were debated in the substantial body of the published literature on the new economy or digital economy around the first decade of the new century. According to Ransome (2019) these sketches can be summarized as follows:

a) Digital information has become a strategic resource, and the network has become the main organizer, principle of the economy and society as a whole;
b) The digital economy follows the principles of growth and returns (positive externalities of the network) and zero or almost zero marginal costs. Criticism has been made of this principle. First, it focuses exclusively on positive network externalities and ignores negative externalities, in particular environmental concerns, such as the consumption of electricity and scarce mineral resources and the production of electronic waste. In addition, the gains in efficiency and profitability generated by technological investment in any technical system are initially very high, but then decline and become increasingly incremental, as innovation becomes widespread. In the long run, this technological "depletion" means that innovations generate diminishing returns until technical systems are regenerated by radical innovations;
c) New business models are emerging to take advantage of the two-sided markets and the economy platform, particularly those involving collaboration or sharing and a new competitive dynamic, dominated by the “winner takes everything” model, they are taking over the goods markets and digital services. The platform itself is therefore the primary place of value creation for both sides. The value of a service for actors on one side of the market, correlates with the number and quality of actors on the other side. For example: Google, Booking, Uber, Amazon and many others. The newly developed system based on a business model platform has rewritten the rules of competition in the market sectors in which these platforms operate, promoting a “winner takes everything” approach;
d) Industry 4.0 involves short runs of mass personalized goods, the global fragmentation of the value of chains, the creation of productive capacity networks and the limitation of boundaries between producers, sellers and consumers, on the one hand, and industry and sectors services, on the other;
e) The link between cause and effect between technological innovation and productivity gains has not yet been directly established and the relationship between technology and productivity is still strongly dictated by society as an acceptance of innovations and organizational changes within companies.

Concentration is now at the point of greatest interest in this article, Industry 4.0, summarizing its main perspectives included in institutional reports, institutional and corporate narratives. The innovation process, according to Schwab and Davis (2018), defined as Industry 4.0 or the Fourth Industrial Revolution is based on a new wave of technological innovations: interconnected collaborative robots; machine learning; Artificial Intelligence (AI); 3D printers; simulation of interconnected machines; integration of the information flow along the value chain, from the supplier to the consumer; multidirectional communication between manufacturing processes and products (Internet of Things); management of large amounts of data in open systems (cloud computing); and analysis of large databases to optimize products and processes (Big Data and Analytics).

The final objective of Indústria 4.0 is to reach a new level of automation based on decentralized and intelligent parts of the production chain, capable of reacting autonomously to external stimuli. The reason for this conception is to manage the increasing demands for flexibility in the final markets, the increasing individualization of products, the increasingly short life cycles, as well as the increasing complexity of the process chains and the products themselves (Ustundag & Cevikcan, 2017). In other words, the technological and economic limits of existing automation must be broken and extended precisely in response to the new demands placed on flexibility. Industry 4.0 is, therefore, a project to integrate production across the value chain. The tight flow is made possible by the digital connection of different parts of the production line, not only the internal one of the company, but of the entire supply chain; the connection does not happen only between machines, but between machines and men (Hirschi, 2018).

For Chung and Kim (2016), the Fourth Industrial Revolution is building in the third, the digital revolution that has been taking place since the middle of the last century is characterized by a fusion of technologies that is blurring the lines between the physical, digital and biological spheres.

There are three reasons why today's transformations represent not only an extension of the Third Industrial Revolution, but also the arrival of a Fourth Revolution based on: speed, scope and impact systems. According to Matt, Hess and Benlian (2015), the speed of current advances has no historical precedent. When compared to previous industrial revolutions, the Fourth Industrial Revolution is evolving at an exponential and nonlinear.

In general, according to these views, the effects that the Fourth Industrial Revolution can have on business considers four main domains, according to Morrar, Arman and Mousa, (2017):

a) Customer expectations;
b) Product improvement;
c) Collaborative innovation;
d) Organizational forms.

Physical products and services can now be enhanced with digital features that increase their value. Meanwhile, a world of customer experiences, data-based services and asset performance through analytics requires new forms of collaboration, particularly given the speed with which innovation and disruption is taking place. The emergence of global platforms and new business models mean that talent, culture and organizational forms have to be rethought (Maynard, 2015).

Industry 4.0 implies a double vertical integration process. In the fields of production engineering, automation and IT, horizontal integration refers to the integration of the various IT systems used in the different stages of the manufacturing and business planning processes, which involve an exchange of materials, energy and information within a company (for example, inbound logistics, production, outbound logistics, marketing) and between several companies with different value networks (Peters, 2017). The purpose of this integration is to provide an end-to-end solution. In the fields of production engineering, automation and IT, vertical integration refers to the integration of the various IT systems at different hierarchical levels (for example, actuator and sensor, control, production management, manufacturing and execution and levels of corporate planning) to provide an end-to-end solution (Morrar et al., 2017). Schwab and Davis (2018) claim that Industry 4.0 has the following potentials:

a) Meet the client's individual requirements - Sector 4.0 would allow customization according to the client's individual and specific need (Hirschi, 2018);
b) Flexibility - The ad hoc network allows the dynamic configuration of different aspects of business processes. This means that engineering processes can be more agile, manufacturing processes can be changed, temporary shortages (for example, due to supply problems) can be compensated and huge increases in production can be achieved in a short time (Colombo et al., 2017);
c) Optimized decision making - Industry 4.0 provides end-to-end transparency in real time, allowing for early verification of design decisions in the engineering sphere and more flexible responses to interruption and global optimization on all sites of a company in the sphere of production (Chung & Kim, 2016);
d) Resource productivity and efficiency - Allows manufacturing processes to be optimized, case by case, throughout the value chain. In addition, instead of having to stop production, systems can be continuously optimized during production in terms of resources and energy consumption or by reducing their emissions (Kane et al., 2015);
e) Creating value opportunities through new services - Industry 4.0 opens up new ways of creating value and new forms of employment, for example, through downstream services. Intelligent algorithms can be applied to large amounts of diverse data (Big Data) recorded by smart devices to provide innovative services. There are particularly significant opportunities for SMEs and startups to develop B2B (Business to Business) services for Industry 4.0 (Schwab, 2017);
f) Responding to demographic data and change in the workplace - In conjunction with work, organizational and skill development initiatives, interactive collaboration between human beings and technological systems provides companies with new ways to turn demographic change to their advantage. In the face of a shortage of qualified labor and the growing diversity of the workforce (in terms of age, gender and culture), Industry 4.0 enables several flexible career paths that will allow people to continue working and remain productive for longer (Ustundag & Cevikcan, 2017);
g) Work-life balance - The more flexible models of work organization in companies that use cyber-physical systems mean that they are well positioned to meet the growing need for employees to find a better work-life balance and also between continuous personal and professional development (Schwab & Davis, 2018).

According to Ransome (2019) Digital Transformation is constituted by the Internet of Things: it decentralizes production, allowing flexibility, programmable and incorporated forms of manufacture.

The real-time machine-to-machine communication offered by IoT synchronizes complex and advanced production systems, creating highly innovative value chains spanning traditional sectors and domains. Advanced forms of manufacturing drive the design of new materials, blurring the line between manufacturing and assembly (Hirschi, 2018). With this, the industry gives a big boost to life cycle management and recycling. Based on the next step in digitization, a business focus may be the use of information as a new source of value creation, since sensors and the network-centric approach lead to a quantity of data (Bloem et al., 2014). This information can be used to further align value chain activities and improve communication between organizations. It can also be used to enhance the qualities of the product with new services. With the help of intelligent sensors and IT, the manufacturer can predict the need for maintenance and help customers around the world with updates (Cherry, 2015).

The collection of all types of data (for example, on the environment) can be translated into groups of new and unexpected intersectoral services. According to the European Commission (2018, p. 74,):

In the future, technologies and innovation will also lead to a supply-side miracle, with long-term gains in efficiency and productivity. Transport and communication costs will fall, logistics and global supply chains will become more effective, the cost of trade will decrease, all will open new markets and drive economic growth.

According to Peters (2017) on Artificial Intelligence (AI) and automation economics: “AI-driven automation can help drive total factor productivity growth and create new potentials to improve people's lives in general”. With respect to work, according to these reports, the implementation of the Industry 4.0 vision allows employees to control, regulate and configure networks of manufacturing resources and manufacturing steps based on situation and context sensitive targets (Maynard, 2015). Employees are freed from having to perform routine tasks, allowing them to focus on creative activities, with added value. Thus, they retain a key role, particularly in terms of quality assurance. At the same time, flexibility and working conditions allow greater compatibility between work and life (Westerman et al., 2014). Work organization and design models can be the key to enabling a successful transition that is welcomed by the workforce. These models must combine a high degree of self-regulated autonomy with the decentralization of leadership and management approaches (Willcocks & Lacity, 2016). Employees must have greater freedom to make their own decisions, become actively involved and regulate their own workload. There is, therefore, an additional confirmation that, from the point of view of work, the rhetoric about Industry 4.0 is the same as that related to post-Fordism, the knowledge-based economy and digitalization (Morrar et al., 2017).

Chung and Kim (2016) also portray a crucial point of analysis regarding the issue of unemployment. This is the only point where optimistic forecasts from the public and private institutions in the new innovation cycle show some uncertainties, although in a context that seeks to highlight more opportunities than risks. The Organization for Economic Cooperation and Development (OECD) highlights that automation targets tasks and not occupations. Many occupations are likely to change, as some of their associated tasks become automated. Thus, the OECD analysis concludes that relatively few are fully automated, estimating that, in the USA, only 9% of jobs are at risk of being completely displaced. If these estimates of threatened jobs translate into job displacement, millions of Americans will have their livelihoods significantly altered (Ransome, 2019). The study by the World Economic Forum (World Economic Forum, 2018) predicts that 5 million jobs will be lost before 2020, such as Artificial Intelligence, robotics, nanotechnology, socioeconomic technologies and other technologies that replace the need for human workers. According to this study, these same technological advances can also create 2.1 million new jobs. But unemployed workers are unlikely to have the skills to compete for new roles. Most of the new jobs will be in more specialized areas, such as computing, mathematics, architecture and engineering. Skills like sharing and negotiating will be crucial. The future workplace, in which people move between different roles and projects, will resemble preschool classrooms in which social skills such as empathy and cooperation are learned. According to Hirschi (2018), in recent years, many jobs requiring only mathematical skills have been automated. Bank tellers and statistical officials suffered. Jobs that require skills, predominantly social, such as workers, for example, tend to be underpaid, as this class of workers is very large.

The European Trade Union Institute (ETUI) (2018) study estimates that less educated workers are more likely to be replaced by automation than highly skilled workers. In fact, the authors of the OECD study estimate that 44% of American workers with less than a high school diploma hold jobs with highly automated tasks, while 1% of people with a bachelor's degree or higher, hold that job. To the degree that education and wages are correlated with skills, it implies a large decline in demand for less skilled workers and little decline in demand for more skilled workers. These estimates suggest a continuation of the skill bias and technical change in the short term. This gives rise to an increasingly segregated labor market in the low-qualified / low-paid and high-qualified / high-paid segments, which in turn leads to an increase in social tensions (Ransome, 2019). Technology is one of the main reasons why incomes have stagnated or even decreased for the majority of the population in high-income countries: the demand for highly qualified workers has increased while the demand for less educated and less qualified workers has decreased (Schwab & Davis, 2018). The result is a labor market with strong demand at the high and low ends, but a hollowing out in the middle. It also helps to explain why the middle classes around the world are increasingly experiencing a widespread feeling of dissatisfaction and injustice (Matt et al., 2015). A “winner takes everything” economy that offers only limited access to the middle class is a recipe for democratic malaise and abandonment.

The survey, according to these institutional studies, consistently finds that jobs threatened by automation are highly concentrated among those with lower wages, the least qualified, and the least educated workers. This means that automation continues to put pressure on demand by group, pushing wages up and down with pressure on inequality (Colombo et al., 2017). Instead of a widespread prosperity between workers and consumers, this can lead to reduced competition and increased wealth inequality.

3 Digital Economy, Digital Work and its Ambivalences

In the light of the literature and the evidence available in the current scenario of digital work, some criticisms can be made of the institutional perspectives on working at the time of the Fourth Industrial Revolution with the main premises included in the institutional process. One issue concerns technological determinism. Institutional reports and mainstream literature make processes, organizational and product innovations and the restructuring of the business cycle, directly and immediately derive from the very nature of the technologies, as if these autonomous fossils of the social relations existing between the productive forces (Schwab & Davis, 2018). On the contrary, the effects of technologies on jobs and organizations must be considered socially shaped (Peters, 2017). According to Matt et al. (2015) it is the policy and not the immanent characteristics of the technologies that will decide how the new machines are designed. Technology is often used as an excuse or opportunity to promote industrial restructuring processes motivated mainly by financial profitability, reduced wage costs or considerations of international competition. Furthermore, technological innovations do not provide a prescribed consequence on jobs and the organization itself. Hirschi (2018) identifies three dimensions:

a) Intended or unintended effects - Some technologies are introduced for clear purposes. In other cases, effects result from the interaction between forces of production and social processes;
b) Direct or indirect effects - Many technologies have indirect effects in two ways. First, they affect workers who are not themselves subject to technology, for example, where an assembly line is accompanied by changes in the work of people in auxiliary operations. Second, the effects can contribute to a greater organization of arrangements. The more such effects, the more complex the question of how to respond. This idea embraces the scope of a technology in terms of its overall impact on the economic system. Some are specific technologies and applications, while others, such as ICT, are extremely widespread;

The degree to which a technology is reconstituted in use - It is not the technology itself, but the extent of its use that changes.

According to Ustundag and Cevikcan (2017), Investment in Technologies (ITC) registers an increase in productivity, but these investments only determine the effects of the microeconomics, because these gains cost less efficient investing companies. There is a difference between the exponential growth in technological performance, on the one hand, and the slower rate at which innovations are adopted and appropriated by companies and other organizations, on the other (West, 2018). Productivity gains are a corollary of organizational changes, facilitated by technological innovations and not by the technologies themselves, and will be achieved only by companies that adopt new forms of work organization, at the same time as new technologies (Westerman et al., 2014). With regard to work organization, an interpretation widely shared by most perspectives on new technologies and knowledge-based work, establishes a close link between the current cycles of innovation and the formation of a new type of business organization (Cherry, 2015). The most frequently used metaphor is that of the “network company” in self-managed companies, process units, project teams, temporary organizations that produce and manage innovation and problem solving processes (Bloem et al., 2014). Large corporations are even called "project-based organizations" or "multi-project environments". Projects are temporary configurations of (human) resources located within a larger “permanent” organization, where individuals have other “houses” before, during and after being involved in this temporary organization.

Employees and freelancers, due to ITC technologies, can participate in several projects simultaneously, for one or more companies, potentially assuming different roles and responsibilities in each one (Berman, 2012). This individualizes work relationships and can help workers become more autonomous about companies. Information and knowledge as inputs and results of the work process, according to these views, resisting formalized and rigid processes, while functional for its development is the presence of “communities” within the organization that creates a sense of identity and the sharing of partially self-managed values and purposes, cooperation processes, ways of circulating knowledge and sharing and intensifying internal and external communication actions (Schwab, 2017). Linguistic competences, ethics, tendencies and aspects of subjectivity become means of production and results of the process, and this “immateriality” of the actors and the means of production makes it difficult to subjugate live work to capital, because work is increasingly connected to faculties and skills that belong to the workers themselves, as well as to processes that require at least partial autonomy to perform (Colombo et al., 2017). The dualism of the world labor market has confined an increasing share of the younger generation to low-paid jobs, with poor working conditions and high levels of instability. The set of phenomena called “crowd work” implies participation in the production cycle by an increasing number of temporary employees, consumers and users who, to some extent, replace paid work (Chung & Kim, 2016). Crowdworking can be considered as extreme and possibly overrated instance of the basic subject. Employers looking for new, cheaper, more flexible, more appropriately qualified workforce and, preferably, all of this together (Morrar et al., 2017).

Crowd work, therefore, fits the continuum of reallocation, virtualization and implementation of domestic markets and bidding systems that have been observed in recent years and are likely to continue. Under conditions of intensified work and increased competition between locals and workers, it can be an inherently contradictory effort. The risk would be transferred even more to workers, and companies would escape legal regulations, social partnership, relationships and collective agreements (Bloem et al., 2014).

It was found that, even companies that intend to cultivate employee commitment for the same reasons, have limited success with these efforts, as they are increasingly driven by financialization, short-term performance and shareholder value or real intervention by the shareholder (Willcocks & Lacity, 2016). These dynamics put pressure on employment and working conditions, the reduction in the level of personnel, the intensification of work, the reduction of costs and the reduction of job security, particularly in countries with higher wages (West, 2018). HR efforts to cultivate commitment and strong organizational cultures in these contexts are perceived as hypocritical, at least in insults. Companies are able to integrate practices, social networks and forms of free cooperation in the production process by building "extended production" networks that involve freelancers, users and consumers (Chung & Kim, 2016).

Big Data modeling solutions are facilitating the qualitative or quantitative use of performance standards as a basis for benchmarking and performance profiles. It is to this set of processes and mechanisms that the Schwab (2017) definition of digital Taylorism can be applied. When discussing the cognitive skills required of the new workforce, Schwab (2017) referred to digital Taylorism: digital work is rarely truly more autonomous, self-organized, varied and creative than Fordist work. The decisive question of technological unemployment must be added to these problems. Robotics, digitalization and the development of Artificial Intelligence, added to mechanization, can lead to unemployment rates that, according to Ransome (2019), can reach 50% of the workforce by 2040. Computerization is still in its youth and computerization of middle class work is taking place at a much faster rate than the mechanization of the manual labor force. In training, technology does not generate paid jobs to the same extent that it eliminates them (Hirschi, 2018). If the predictions of Schwab and Davis (2018) are confirmed, the effects on knowledge workers will be those of extreme radicalization of the current negative trends that highlight and highlight, in relation to salary levels, employment, opportunities and working conditions, and also that of a significant disappearance of cognitive work. Ransome (2019) argues that these processes can also lead to wider consequences. As the working class has shrunk by mechanization, capitalism has been saved by the rise of the middle class. Now capitalism cannot compensate for the digitization of middle class labor with a corresponding creation of new jobs. According to West (2018), these processes that will lead to a systemic crisis of capitalism before the 21st century are over, as capitalism cannot support unemployment rates of 50% or more and systems in which wage labor is a minority of the labor force, active work.

According to ETUI's study on digital work (2018), a substantial proportion of current jobs will be made obsolete by the latest generation of robots, due to their ability to print objects in 3D, translate documents, develop insurance policies, care for the elderly in their homes and tell doctors what can be wrong with patients. The very concept of "work" may be out of date and replaced by an ever-growing portfolio of commissions and projects awarded through online platforms. The current innovation cycle also involves an individualization of the relationship between workers and machines. The set of these processes affect the bargaining power of the unions and the collective action capacity of workers (Kane et al., 2015).

For workers to allow disruptive change processes, it means dealing with losses related to objective facts (risk of unemployment, health risks, inverted change in the content of work, etc.) and / or a feeling of powerlessness in providing processes beyond any possibility of control by the individual. Both elements, if present, are crucial to hinder participation in unions and collective mobilizations (Willcocks & Lacity, 2016).

4 Conclusions

The current wave of technological innovation and its relationships with work and production are composed of expressions such as Industry 4.0 and digital capitalism. The rhetorical narratives and expectations that accompany these definitions of current changes in capitalism are not new. They confirm and expand the rhetoric and expectations that, in recent decades, have been linked to concepts such as post-Fordism and the knowledge-based economy. In this article, the choice was to focus, mainly, on the implications that the current transformations can have at work, in view of what happened in recent years and the current scenario. In particular, the rhetoric about digital and knowledge work has been confronted with the literature and the evidence on this subject. What has emerged is that all the transformations, often called the digital revolution, have so far failed to achieve any of the promises it has raised. The organization of work does not have to become more horizontal, if not partial and formal. Workers have not increased their decision-making power or autonomy. Work has become more creative only for a fraction of highly skilled workers. On the other hand, work has become more precarious and less paid, and the distinction between working time and life span has decreased. Contrary to what is stated by the institutional readings of Industry 4.0, until now technological innovation has not replaced predominantly less qualified jobs.

The creation of new jobs refers mainly to the delay in services. Until now, digital innovation has produced results that companies have always pursued in the history of capitalism: reducing the workforce, wages, guarantees and rights related to work and the bargaining power of workers; an increase in the ability to monitor and evaluate work performance; dispersion of the workforce and concentration of capital (monopolies, “the winner takes everything”), ownership and management of functions; an increase in the efficiency of production, process and value chain management, due to increased production and data dissemination.

Currently, companies are managing to make the second pole of these dichotomies (digital Taylorism, verticalization, commodification, individualization) dominating the first (autonomy, participation, cooperation between peers and socialization of production). As has always been the case in the history of the relationship between capital and labor, the possibility that the production process will change in a favorable direction to work depends mainly on the capacity for coalition and conflict and on the negotiation of power of the latter. These elements develop within the work also thanks to the support of the dynamics (political, cultural, organizational) and the actors that are external to the production process, as the history of the workers' movement demonstrates. Therefore, positive results of Industry 4.0 for workers will depend on social and political conflicts.

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