Digital and algorithmic technology: the impact on employment and the workforce

Priscila Lauande Rodrigues
PhD Student, Sapienza University of Rome

Massimo De Minicis
INAPP

The aim of this article is to answer the questions inherent to the future of work from the perspective of technological transformation, with the use of robotics, algorithmic intelligence, social media, and the evolution of business models. The study is based on a mid-2000s analysis, carried out during a second computer revolution, in which the rise of the digital economy was observed, with an increase in the outsourcing process and the contingency of contemporary patterns of work and production organization. We start by analysing platform work, on the premise that this phenomenon is distinct from that of Digital Industry 4.0 as it concerns the implementation of intense processes of production of goods and services fully outsourced from any traditional production site. Thus, the article aims to analyze this new evolution of production in the latest algorithmic digital age, by studying its functioning and impact on work, wages, and society. The theoretical perspective is to use a renewed analysis of this production dimension.

L'obiettivo di questo articolo è rispondere alle domande inerenti al futuro del lavoro dal punto di vista della trasformazione tecnologica, con l'uso della robotica, dell'intelligenza algoritmica, dei social media e dell'evoluzione dei modelli di business. Lo studio parte da un'analisi della metà degli anni 2000, durante una seconda rivoluzione informatica, in cui l'affermazione dell'economia digitale è stata osservata con l'intensificazione del processo di outsourcing e la contingenza dei modelli contemporanei di organizzazione del lavoro e della produzione. Si parte dall'analisi del lavoro mediante piattaforma, con la premessa che si tratta di un fenomeno distinto da quello dell'Industria Digitale 4.0 perché riguarda la realizzazione di intensi processi di produzione di beni e servizi che vengono completamente esternalizzati da qualsiasi luogo produttivo tradizionale. Così, l'articolo mira ad analizzare questa nuova evoluzione della produzione nell'ultima era digitale algoritmica, studiandone il funzionamento e l'impatto sul lavoro, i salari e la società. La prospettiva teorica è quella di utilizzare un'analisi rinnovata di questa dimensione produttiva.

DOI: 10.53223/Sinappsi_2021-03-7

Citation
Lauande Rodrigues P., De Minicis M. (2021), Digital and algorithmic technology: the impact on employment and the workforce, *Sinappsi*, XI, n.3, pp.112-125

Keywords
Gig Economy
Platform work
Labour market

Parole chiave
Gig economy
Piattaforme di lavoro
Mercato del lavoro

Introduction

The aim of this article is to compare the emerging assets in work and the economy beyond the traditional concepts of work and society by adhering to post-Fordist cognitive models and profiles. These models have forged representations, analyses and images in a phase significantly restricted by the economic crises of the 2000s. For more than 200 years, the same questions have been repeatedly asked: what is the future of work in a world

constantly being transformed by technological innovation? What fate does this technological change hold in store for workers and their jobs? How is this change transforming skills needs? Which skills will be obsolete tomorrow and which will become indispensable? Such questions surface again and again at each technological milestone.

With the progress seen in the field of robotics, the rapid advance of algorithmic intelligence, the omnipresence of the Internet and social media and the evolution of business models, the 'future of work' is again at the centre of debates (Daugareilh *et al.* 2019). Starting in the mid-2000s, during the second computer revolution, the assertion of the digital economy began to intensify the process of outsourcing and the contingency of contemporary patterns of work and production organization. Digital technologies and lean principles have intersected in what is commonly called digital lean production which can be a powerful combination of timeless lean principles and evolving digital technologies to decrease waste and variability in processes. Subcontracting, value chains, the coordination of subordinate companies: so many management strategies, all with the social consequence of atomization of the workplace (Weil 2017). These phenomena are redesigning the division of labour between what must be done within the boundaries of the company and what can be entrusted to the market. All operations that are not at the core of the company's profitability are outsourced. Industry 4.0 and platform work are two different dynamics of the latest phase of this technological development. But platform work is a distinct phenomenon from the digital Industry 4.0 because it concerns the realization of intense processes of production of goods and services that are completely externalized from any traditional productive place. This dynamic happens through virtual spaces[1] in which socialization, organization, coordination of production and work take place. In these so-called work platform spaces, a dual function seems to be developing. The first is the extraction of huge and constant levels of data and information about consumers and workers (data mining); the second is the outsourcing and breaking down of the process of producing goods or services into micro-tasks, pulling it back together through the action of algorithmic management. In this reproductive mechanism, the exchange does not only involve the entrepreneur and the worker, i.e., the owner of the means of production and the user worker who spends part of his working day in digital labour activities. It also involves the customer who uses the production value by adding it to the capital of his own business or consumes it in the form of goods. Generated as a space for sharing relationships, the post-capitalist sharing economy has increasingly acquired a status as a new model of automation applied to the productive forms of services and goods of contemporary capitalism, especially after the 2008-09 financial crisis. The so-called sharing economy, characterized by a platformism of social relations, has evolved into increasingly advanced spaces that reorganize the production of financial capitalism known as the gig economy. A production model capable of dilating, fragmenting, and distancing production locations and timelines, guaranteeing, by means of algorithmic infrastructures, constant control, and correspondence of each phase of work and production with an established plan by the company. So, while the first phase of automation pushed industrial mechanisation to its climax, creating industrial conglomerates and factories concentrating millions of workers, in the so-called 'industrialized' world, the arrival of platform work is triggering a profound but different transformation, this time giving industry a new perspective practically free of geographic constraints. A new business organization that moves away from the centrality and centralization of the means of production, physical and material, and employs a workforce anywhere, anytime. A production system characterized by digital platforms that, unlike the digitized industry, do not need to open new production facilities to grow, but simply lease new servers.

1 Before its arrival as an economic concept (the 'platform economy'), a 'platform' was a generic term used in the IT field in reference to an operating system, a web server or application, an execution or development environment. A software platform was "a technology (…) that can be deployed in a vast range of industries for a great multitude of purposes". Evans refers to these digital platforms as 'invisible engines' set to transform industry. In a book written before the global upsurge of Uber or Airbnb and in the infancy of the iPhone, Evans described this technology based on microprocessors and networks and, above all, how it could be used to "create value and profits" (Evans and Schmalensee 2012).

The article thus aims to analyze this new evolution of production in the last algorithmic digital era, by studying its functioning and impact on work, on wages and society. The theoretical perspective is to make use of a renewed analysis of this productive dimension.

1. Machines, Society, Work

It has been observed that automation strategy is a historical process of capitalist production. Initially applied to industrial production with mechanical and cybernetic technology, it was later extended to the production of services with the definition of digital algorithmic structures (software, cloud computing). Algorithmic labour management, on digital platforms, is therefore not a separate concept from the automation of industrial production processes, but the latest evolutionary stage of this strategy. Automation is not simply a concept of a technical nature, but a set of ideas and theoretical frameworks that determine an advanced organization of production. The historically contingent technological applications, from mechanical to algorithmic, are effects, not causes. Thus, even the algorithmic management of production processes with the realization of sequences of digital instructions represents the effects of the ideas and theoretical structures initially generated in capitalist automated industrial production. Often the current automation strategy of production processes, from Industry 4.0 to the platform work economy (gig economy), is interpreted as a theory of processes determined to decrease the centrality of the workforce in production processes. The decrease in centrality of the workforce combined with the constant evolution of digital technology, causes a growing tension within production dynamics in which machines will replace workers in the implementation of production processes[2], this is most clearly seen in Rifkin's central argument in *The End of Work*. The author refutes those who argue that the new technological revolution such as the application of genetic engineering to agriculture, robotization to manufacturing, and the computerization of service industries will lead to new employment opportunities if there is a well-trained workforce. For Rifkin, in the past, when a technological revolution threatened massive job losses in an economic sector, a new sector emerged to absorb the surplus labour. At the turn of the century, the newly created manufacturing sector was able to absorb many of the millions of farmers and farm owners who were displaced by the rapid mechanization of agriculture. Between the mid-1950s and the early 1980s, the rapidly growing service sector was able to re-employ many of the blue-collar workers displaced by automation. Today, all sectors fall victim to rapid restructuring and digital automation; no new 'significant' sectors have developed to absorb the millions being displaced (Rifkin 1995). This theory of automation identifies an increasingly clear predominance of the share of value generated in the production by devices (machinery, technologies, robotics, artificial intelligence services, algorithmic software, and the internet of things) over that realized by the workforce. This articulated literature, which is aimed at presaging an incontrovertible replacement of the centrality of human labour by digital machines, has ancient roots that already appeared in early forms of industrial production (Bright 1958; Crossman 1960; 1966). David Noble considered the letter that in 1949 Norbert Wiener – one of the pioneers of cybernetics – wrote to Walter Reuther, then president of the UAW (the powerful U.S. auto workers union based in Detroit), one of the most relevant documents in the annals of science of the twentieth century. With this letter Wiener warned him of the possible effects of the computational machine commissioned by a corporation, which would have generated devastating effects for auto workers, for example by reducing the assembly lines. Alongside this theoretical line of overcoming the univocal centrality of labour in the production of value in production processes, a different theoretical analysis has also developed historically, aiming to identify an opposite dynamic within the technology applied to production. This analysis argues that the process of automation does not aim at replacing the centrality of human labor but instead it will lead to an increase in productivity and profitability levels also through the implementation of peripheral and less protected forms of labor. This perspective proposes a change in the concept of work in which one can dissociate

2 See Manyika and Chui 2013; Frey and Osborne 2013 and 2015; Berger and Frey 2015; World Economic Forum 2016; Manyika *et al.* 2017.

the identification of work as a stable professional status and identity for the performance of random, fragmented, and fissured work, without recognition and professional continuity.

For a long period of time, coinciding with the formulation of collective bargaining regimes in the 1930s and their crisis in the 1970s, 'work' was synonymous with 'the permanent status work', that is, formal wage labour. But since the application of lean philosophy and cybernetic technology in the production, a wide range of work types have been discovered. This multitude includes informal, random, 'off the books' work that provides wages but cannot be officially considered contractual with an employment status (Caffentzis 2013; Weil 2017). This theoretical disagreement on the different effects of automation strategy in the production of goods and services has its origin in the early stages of industrial capitalism production, during the years of the first industrial revolution, with the introduction of thermodynamic machinery in the large manufacturing industry. Indeed, during the first industrial revolution, theorists from different academic backgrounds argued about the diverse function of mechanical technology on labour and society. Unlike those theorists convinced of the constitutive power of the value of machines in production (Carnot, Joule, Carpenter, Liebig), Karl Marx identified an obvious asymmetry between human labour, a unique productive dimension capable of increasing the value of invested capital and large machines, which, isolated in the productive components, determined a mere persistence of the capital employed. Therefore, the task of automation was to intensify the added value produced by human labour by employing fewer and fewer professional statuses and increasing the length of the working day. This theoretical opposition represents the key to the theoretical debate on the effect of machines on society, work, and the state. This contrast has continued over time, which beyond the technological forms taken by the technological dimension has always represented a point of constant decline in the various analyses that seek to interpret the relationship between technology, production, and work. Even the latest phase of productive technological evolution, the one characterized by digital algorithms, does not extract itself from this dialectic. Are digital machines leading us to a post-labour society dimension or to contexts of greater intensification of the value produced by human labour? In other words, will the production of goods and services, in the large virtual productive spaces of the network, be able to free and replace humans from the times and modes of Taylorist labour organization, or, instead, will it enhance their performance in increasingly productive forms, far from the concept of labour as a consistent phenomenon capable of generating income, rights, and protection?

2. Genesis and nature of the digitized production

In this section, we will examine a fundamental shift in the relationship between technology and work, the rise of digitized technology in the early 1960s, which created a new Taylorist productive system, characterized by the advent of the Toyotist productive philosophy, and culturally recognized as lean production[3]. The 60s and 70s, represent a fundamental historical moment to analyze the impact of the first digital machines (cybernetics) on the production cycle and the industrial workforce. The contributions of cognitive analysis of production and work in those years provide us with a first theoretical framework of the ways in which digitally encoded worker information, inserted into cybernetic machines by means of magnetic cards, assumes a fundamental value in the extraction of value from the production cycle, not only in material terms but also in virtual and cognitive terms (Gallino 2003; Alquati 1975; Accornero 1975; Accornero and Magna 1986). The first form of digitization of production processes is basically a shift in the industrial cycle, from a material valorization of the relationship between man and machine to an immaterial one. Cybernetic machines exponentially increase the action of cooperation and socialization of skills, information, and workers' knowledge. So, the information to produce goods and tools historicized by the workers and shared among them, crystallized in the coded cards, represent a new form of interaction between machines and the workforce, producing an

3 For a detailed description of the advent of lean manufacturing, and the Lean manufacturing philosophy, see De Minicis (2018).

unprecedented amount of information. This process of immaterial valorization of the workforce through cybernetic digital machines is initially identified in the works of Alquati, Gallino, Accornero, in the great industrial production of the first personal computers such as in the production cycle of Olivetti in Ivrea. In cognitive terms this process is conceptualized as Operative Worker Information. Information becomes an essential element of the cooperative action of the workforce. In the cybernetic production the worker transfers assessments, measurements, elaborations to the produced goods. This process transforms the good produced in a container of worker knowledge and technical expertise. The reflections of Alquati, Gallino, and Accornero on the industrial production of the first calculating machines in the 1960s-70s allow us to isolate for the first time in the relationship between automation, production and work a primordial function of information isolated from the material productive action. Thus, the acquisition of data becomes for the first time a productive objective. From the isolation of this first form of valorization of the productive process through the acquisition of the data, the operative worker information, inherent to the cycle and to the post-Fordist Taylorist industrial productive structures and the continuous evolution of the digital machines will lead to an progressing need to acquire information and data increasingly external to the process and to the company structures. This will involve, on the one hand, the end of the centralization of the productive processes (Srnicek 2016; Accornero and Magna 1986; Womack *et al.* 2007), on the other, an inexhaustible necessity to acquire and to elaborate information from part of the productive capitalism inspired by lean production. From the information increasingly acquired at diversified times and spaces of production, algorithmic machines make it possible to match every single phase of the reproductive cycle, apparently dispersed and fragmented, to the established business plan, making Taylorism flexible and adaptable to the composition and trend of the demand. Thus, the constant evolution of algorithmic digital technology applied to an increasingly outsourced and contingent production will lead us towards the concept of big data: a type of production of goods and services that extracts value from operational information (data) directly in the relationships and spaces of exchange and social cooperation, often outside the traditional boundaries of production and work. Such places lay outside the industrial cycle, where the workforce and the extraction of information are scientifically organized in virtual spaces governed by algorithmic tools. In this sense, the process of evolution of productive automation, in the decomposition, division and organization of work relative to the machinery employed, seems to reconfigure Taylorism, not as a historically contingent element of the industrial cycle, but as a tendential process that reproduces itself in new forms in every phase of capitalist creation (productivity and profit of the workforce with machines). Therefore, operational information, such as current big data, constitutes a collective asset from which to extract value and recompose gestures and cognitive information of the scalable workforce systematized algorithmically in the Taylorist sense and moves away from an industrial onto a social cycle of extraction. After all, there is not much of a leap between the island manufacturing industrial cycle of Olivetti and the sharing economy organizational tasks of the Amazon Mechanical Turks (De Minicis 2018). The crucial question, on which a wide literature of analysis of the digitized evolution of production has questioned itself, is to understand if this change represents an evolutionary phase of Taylorism, a contemporary post-Fordism, or a complete caesura with the productive and extractive dimensions of industrial capitalism. An immaterial and cognitive capitalism marking the downward trend in the centrality of material human labour (Boutang 2011; Rifkin 1995). This understanding of the application of technology to production leads us to an intensification rather than a replacement of human productive value. But in what terms does this intensification take place? To answer this cognitive question, it is necessary to study the latest evolution of digitized production which is represented by platform work.

3. Immaterial or material value in the production of platform work

With the evolution of algorithmic technology, an economy of goods and services sharing has developed and has made it possible to extract value from information, data, knowledge, and activities provided by users of the digital network. This new dimension of the valorization of human sociability

has taken place through the development and affirmation of digital platforms able to guarantee, using mathematical and algorithmic formulas, order of production and valorization amidst such an enormous flow of information and knowledge. Platforms are placed in the digital space as subjects that not only generate but also govern the rules of exchanges, having direct access to the data produced by online interactions. Moreover, platforms can be considered an organizational model, a true production philosophy. This second meaning has far-reaching implications in terms of the transformation of traditional companies and productive forms of post-Fordist capitalism. This dimension of production organization comes in different forms. An interesting classification is offered by Srnicek 2016, who categorizes digital platforms according to five main types: 'advertising platforms' (Google, Facebook) that extract information about users, analyze it and then use the product to sell advertising space; 'cloud platforms' (AWS, Salesforce) that own the hardware and software needed by digital businesses and make it available on demand (cloud computing); 'industrial platforms' (Predix by GE, MindSphere by Siemens) that build the hardware and software needed to transform traditional manufacturing companies into digital production processes based on the Internet of Things (for these processes and their supporting policies, Germany coined the term Industry 4.0, later adopted in Italy as well); 'product platforms' (Rolls Royce, Spotify, Zipcar) used to transform goods into services (good-as-a-service model), for example with the shift from the purchase of a car to the access to the most suitable means of transport at the moment of need; and, finally, those of primary interest for our analysis , the 'lean platforms or platform work' (Uber, Airbnb, Deliveroo, Amazon mechanical Turk...) that acquire, organize and sell work services in the digital space. They can also be defined as labour platforms (LPs) that most clearly represent the ultimate evolution of digital technology processes applied to the organization of work. In fact, platform work tends to be divided into two macro-typologies, 1) Online *web based platforms:* completely online, whose productive phases are not locally organized, with a totally cognitive productive process finalized to the production of digital products, realized only in the virtual world. Its work performance essentially belongs to the digital business (design, translation, image recognition) and it is outsourced in micro-components in any area of the world. The main platforms belonging to this type are AMT, Upwork, Speaklike, and Addlance. There are then the so-called 2) *On location-based platforms,* in which work performance is realized partially online and offline, in virtual or real-world settings with highly localized performances, in both definable and identifiable times and places, essentially represented by traditional work performances (delivery, transport, home care and care). The main ones are Deliveroo, Uber, Justeat, Glovo. However, what is a digitized work platform really? What kind of action determines the creation and extraction of value from the material and cognitive performances of the workforce digitally collected by the network in the forms of social cooperation? The term 'platform' is, indeed, everywhere, but it is unclear whether it is a mere reference or an actual structure, a new condition in the digital age or the *semantic camouflage* of a natural evolution of capitalism. When software platforms were contained behind personal computer screens and locked into physical infrastructure, the structure seemed harmless. But now that the production and distribution of goods and services of platform work (meatspace and cyberspace) have merged, the analysis certainly becomes more complex. If platform work is to be considered as an evolutionary stage of the highly digitalized post fordist Taylorism, the genesis of which we have seen, it can hardly be considered as an alternative paradigm to capitalism. Therefore, in analyzing platform work , we again see that ideal opposition: on the one hand, a narrative that sees it as a step towards a radically 'destructive' form of innovation of all organizational structures of work and production, a creative action of entrepreneurial subjects (Schumpeter 1994), capable of defining a new post-Taylorist economy; on the other hand, it is seen as a step towards progress through incremental innovations that aims to preserve the current post-Fordist system by radicalizing some of its characteristic forms, thus interpreting it as a super-Taylorist process. For Boutang (2011), the digital revolution determines the end of material and Taylorist capitalism, as the essential point is no longer the consumption of human labour power, but that of inventive power. For these authors, a new cognitive capitalism is determined

Table 1. Economic and organizational structure of the platform work of Food delivery (on-location-based platforms) in Italy (year 2017)

	Financial balance 2017	Capital raised	Year of establishment	Order quantity	Office	Employees	Riders	Restaurants	Number of cities
Deliveroo	20 mln +	0	2015	n.d.	Milano	70+	2000+	1900+	11
Moovenda	2.5 mln +	2 mln	2015	108 k	Roma	25	150	800	5
Foodracers	2.5 mln +	n.d.	2015	98 k	Treviso	n.d.	n.d.	600+	n.d.
Bacchette Forchette	2 mln	0	2015	n.d.	Milano	4	n.d.	135+	2
PrestoFood.it	1 mln +	165 k	2013	54 k	Catania	11	90+	290	5
Just Eat	n.d		2011	n.d.	Milano	105	External partners	7600+	18+
Foodora	n.d		2015	n.d.	Milano	n.d.	n.d.	1000+	4
UberEATS	n.d		2016	n.d.	Milano	n.d.	n.d.	n.d.	n.d.
Glovo	n.d		2015	n.d.	Barcellona	100 +	2500+	1000+	10
Cosaordino	n.d	n.d	2015	n.d.	Lecco	5	30	100+	6
Sgam	n.d	450 k	2015	n.d.	Bologna	n.d.	120	100	1
MyMenu	n.d		2013	n.d.	Padova	n.d.	n.d.	n.d.	n.d.

Source: Inapp and Guarascio (2018)

by algorithms and cybernetics. On the entire social spectrum, the new technology increases the power of the immaterial production. Hence, with the algorithmic digitized evolution there is a further step in the concept of automation: technological change is no longer an exogenous resource that accelerates the extraction of value from production, but the main objective of accumulation. Value production depends on social cooperation and tacit knowledge. *The entrepreneur is a surfer who does not create the wave*. It seems clear that understanding this process is a real challenge. The real theoretical question is the understanding of the relationship between algorithmic automation, production and work and if this is to be interpreted as a revolutionary and destructive innovation with diversified purposes, or an incremental innovation capable of radicalizing the Taylorist phenomenon.

4. Crowd work in the platform work

To answer this question, it seems essential to study the production cycle of digital labour platform, analyzing the organization of the production and of the work in location-based platforms and in web-based platforms. To understand how this form of profitability is achieved, we try to observe how the production process of the economic collaborative PW (platform work) is structured. For this analysis, in reference to the on-location platform work, we examine the financial flow and organizational structure of the main work platforms within the food delivery industry in Italy by using the information in the Inapp report (2018) (Table 1).

As shown in Table 1, platforms that are characterized by an important aggregate turnover – *Deliveroo, Glovo, Just Eat* – seem to use the algorithmic formula to substitute a specialized, informative, managerial workforce. However, if we consider more carefully the complexity of actions that make up the production process, then the situation appears radically different. In this case, the algorithmic machine uses a much higher human workforce. For instance, Deliveroo involves, in addition to employees, more than 2000 riders and 1900 restaurants, Glovo 2500 riders and 1000 restaurants. Apart from the widely debated issue of the contractual nature of subordination or autonomy of riders involved in the production process, it is important to underline that behind different forms of informalization, outsourcing, fragmentation, relocation, collaboration in the production process, there is a large amount of human labour force coordinated and organized, but not replaced, by the

Table 2. Labour Platform of Crowd work only online. Economic and organizational characteristics

Name	Employees	Volume of Investments in Millions of Dollars	Crowdworkers logged	Minimun Hourly wages / Maximum in Dollars / Avarage	Activites carried out per year
Amazon Mechanical Turk	10	10-150	500,000	3.77/29.43 10.65	100,000-600,000
Clickworker	10		800,000	0.50 /17.68 3.84	
Crowd Guru	15		50,000		
Crowdflower	65	10		0.51/15 2.93	
Javoto	36		80,000		
Prolific	3		70,000	0.47/16.44 6.60	
Mylittlejob	25		216,450	0.40/56.25 9.97	115,700
Testbirds	100		250,000		
Content.de	15		7,000		

Source: Inapp and Guarascio (2018)

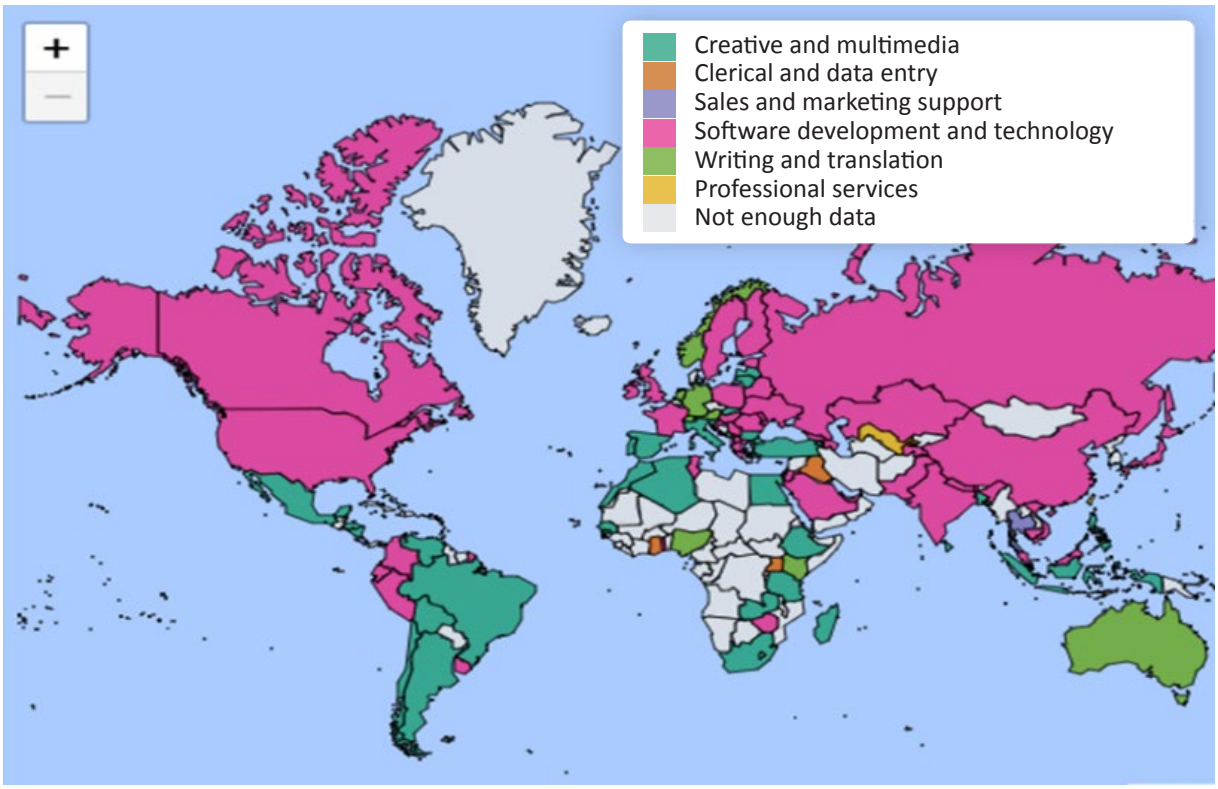
algorithm and in many cases employed without any contractual relationship (De Minicis *et al.* 2019).

This informal labour force allows the algorithmic machinery to act for as long as possible and to match the individual and informal work performance to the established central employer plan. Therefore, increased profitability corresponds to an intensified human labor performance provided by a highly scalable workforce at almost-absent wage costs that are not directly linked to the organization that carries out the good or the service. This phenomenon produces a high intensity of underemployment. A Marxian idea on the technological evolution applied to production states that: if the cost of one hour of work were calculated by dividing the weekly survival wage by the number of weekly working hours, once the obligation to stipulate a contract of at least weekly duration were eliminated, there would be a real possibility that the level of impoverishment of workers fell below the survival threshold (Marx 1980). This dynamic is evident in the functioning of the web-based work platforms (Table 2).

In this type of production organization, formally hired employees with regular fixed income are usually in the tens of units, while the entire human labour force involved in the production process can reach a maximum of 800,000 potentially active units as in the case of Clickworker. In this case, the materialist and Taylorist perspective that considers the evolution of automation not as a replacement of labor force but as a way to use paid piecework with lower cost and with the sole task of running the machine for as long as possible, appears reinforced. To measure the incidence of work completed on online platforms, it is necessary to use systems using algorithmic softwares to intercept the outsourced work tasks, that are able to capture activities taking place on platforms, the internet activities users and the enterprises involved such as *The online Labour Index* (Ilabour Project, Oxford Internet Institute). The data recorded by this indicator, which monitors 162 *web-based online work* platforms in the world, shows that in 2020 there were 163 million registered Internet users globally, of which 19 million were active, earning at least 1000 dollars in a month, and 5 million were considered full-time workers (Figure 1).

The countries with the largest presence of crowdworkers are India, Bangladesh, Pakistan, UK, USA, mainly engaged in software development, building multimedia tools, transcription, surveys, and translation. India's data is impressive, with 40% of the workforce engaged in the creation of software and algorithms for companies located mainly in

Figure 1. Top work activities in each country of the online web-based platforms



Source: Oxford Internet Institute iLabour Project, 2020

Anglo-Saxon countries (USA, Canada, UK). This raises questions about the precariousness of the global workforce (detachment of employee working conditions) and the outsourcing of professional tasks, which are also characterized by high skills (software engineers, statisticians, programmers). The three major work activities carried out by crowd workers on web-based platforms in Italy are: 1. creation of creative and multimedia products; 2. software and technology development; 3. text writing and translations. The system of algorithmic platforms, therefore, does not transform the logic of technology applied to capitalist Taylorist production, but simply decentralizes and relocates the workforce to minimize the interruption in the continuous extraction of information and data (ILO 2021). In this context, State intervention is necessary to regulate the phenomenon, limit the working day, and give an equitable qualification to workers employed by platforms. Therefore, even in automated production processes of the economy of Platform work, the problem lies in the recognition of the wage or non-wage nature of the workers employed. Hence, the low labour cost is often the most profitable element of the whole complex algorithmic evolution process. Thus, with digitization processes, the workforce does not undergo intensive replacement processes by algorithmic machines. But algorithmic technology instead places work in a situation of peripheral underemployment of the production process. Algorithmic production in Platform work weakens wage bargaining, which is fundamental in the relationship between capital and labour. Digital automation seems to produce a downward compensation effect for the jobs lost with technological evolution. The work recovered in new sectors is characterized by a low quality in terms of wage and contracts. Automation does not expel the human workforce from production processes but from contractual guarantees. Thus, in the most advanced forms of digitization of goods and services production processes, the technological restructuring of work leads to the destruction of permanent employment. Work is not replaced but underemployed. With the rapid digitized technological evolution, mass unemployment is no longer only a cyclical aspect of the capitalist

cycle, which can subsequently be absorbed into new sectors of production but becomes permanent. The organization of platform work seems to integrate two different economic theories on the impact of technology on work and society. According to classical economists unemployment caused by automation was only temporary since expelled workers were soon reemployed in a new sector linked to technological innovation. For the neoclassical (Brems 1977), the cause of unemployment was, on the other hand, attributable to wage rigidity, which did not allow the transition of workers to the new technological sectors. For these scholars, wage rigidity did not allow productive sectors to reabsorb the labour force in excess. The contract between classical and neoclassical economists seems to be perfectly synthesized in the organizational processes of the digital platform workforce. In Western countries Algorithmic automation reduces work, but lost work is reoccupied on platform work albeit under worse contractual and wage conditions.

5. The organization of production in the platform work

How does underemployment occur during the production cycle of labour platform? This question will be answered in this section of the study. Platforms, through the action of the algorithm, have altered the classic cycle of industrial production, radicalizing a dynamic already partially experimented with the advent of the '*just in time workforce*' of '*lean production*'. This system, although different from platform work, changes the industrial production scheme: production, distribution, exchange, consumption. In the logic of *lean production*, the exchange becomes the first phase. This innovation determines a fundamental change, the Birth of the Just-in-Time manufacturing. This production system is characterized by a just-in-time workforce and technological automation. Platform work applies this important innovation of the production cycle to the virtual market, with a further and essential innovation: the good exchanged is no longer a product, service, or labour, but the share of productivity obtained from each work task. This exchange occurs in the virtual market before. When conducting work on platforms, the workforce increases the value of invested capital, however, the platform does not use this productive value to increase its capital but instead sells it in the virtual market. Thus, the historical determinations of the Marxian and Ricardian theory of value embedded in the digital capitalist model of production change:

- the workforce is under the control of the platform;
- the goods, however, are purchased by the customer;
- the workforce creates value only for the client's capital;
- the production machinery belongs to the platform.

This organization of production determines two conditions for the labour force employed. First, the difficulty of determining who the employer and employees are. Second, a condition of deep underemployment due to the work not being linked to the interests of the company but rather sold in the virtual market.

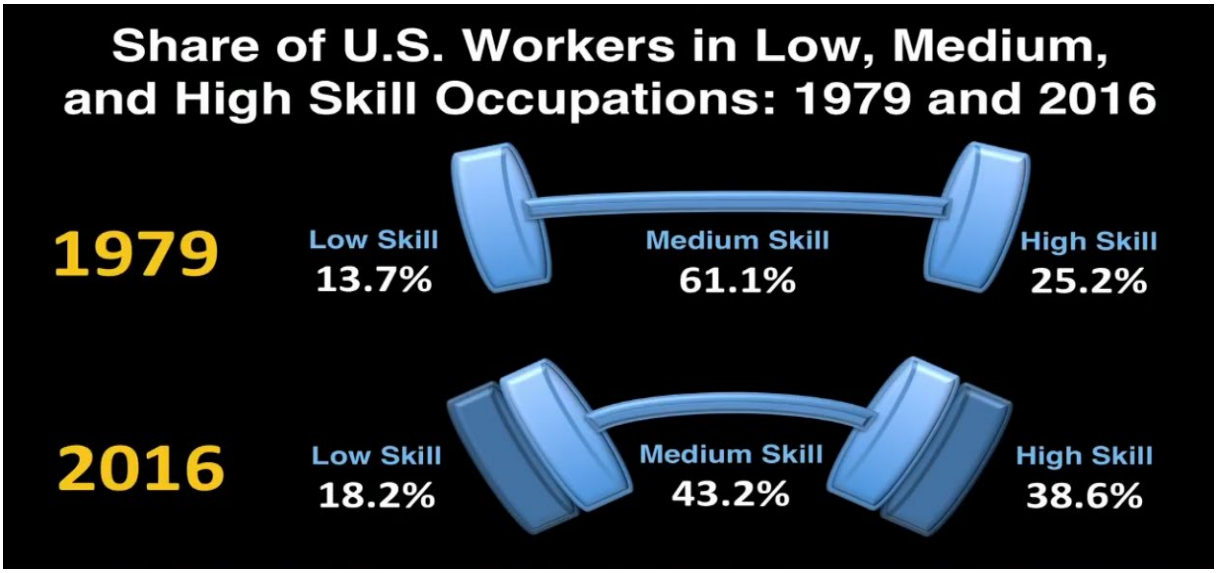
6. The fragmentation of job in platform work

According to classicists, within each commodity there is an exchange value given by the labour force employed; this dimension takes on a more articulated dynamic in Ricardo's analysis, which divides the productive work, present in goods, from the work applied to the production of machinery. Marxian theory takes up and profoundly innovates this analysis. The value given by the workforce and objectified in the product is greater than the labour needed to produce the means of livelihood of the worker (necessary labour), the so-called surplus labour. The surplus labour produces the value of the production of goods and services and leads to an increase in productivity (surplus - value). Consequently, surplus - value = W (work) - W (wage). In the platform's productive cycle of work, surplus - value, traded in the digital market, results from a breakdown of surplus labour into many micro-work tasks. The unit of the production cycle is then recomposed thanks to the algorithmic action. This way, the fragmentation of labour activities leads to a fragmentation of wage quotas. The wage becomes a micro-payment for every single task realized (piecework payment). Another discontinuity element in the production cycle of PW is the division of capital employed in production between different entities (platforms, customers).

7. Underemployment and technological polarization in the digital era of production

It was previously stated that automation does not replace the workforce in production processes, but instead increases its productivity. This theory can be reinforced by combining the hypothesis of

Figure 2. Percentage of workers in low, medium and high occupational skills in the United States 1979 – 2016



Source: image elaborated by Autor (Ted Talk conference 2017)

technologically negative compensation in working platforms, as seen above, with the reconstruction made by Autor *et al.* (2003), on the effect of digitalization in terms of polarization of professional figures. For Autor (2010; 2015), the impact of digitized technology on the production cycle does not result in an expulsion of low skilled workers, with a decrease in the number of jobs, but into a long-term polarization of the workforce with an overall increase in low and high-skilled workers. The percentage of employment replaced by digital technology is the one with a high rate of routinization, with work tasks expressed in detailed procedures, easily replicable by algorithmic machines. These professional figures are identified in professions mainly related to the industrial sector. Over time, these professionals would decrease, while the digital technological impact would not affect highly and low-skilled workers, who are not subject to the concept of the routinization of work tasks for opposite reasons (Figure 2).

Evidence linking the digital economy to the polarization of employment has considered two broad categories of tasks: 'routine' tasks (codable and therefore susceptible to computerization) and 'non-routine' tasks (unpredictable and often involving creativity or problem-solving). The main prediction of this literature is that jobs involving non-routine activities are more difficult to automate, even if they are low-skilled. This framework offers an explanation of why the US employment structure has emptied in recent decades, with the growth of non-routine, low-paid jobs (e.g., carers, riders) and non-routine, high-paying jobs (e.g., executives), but with severe drops in mid-level routine jobs (e.g., clerical and production workers) (Levy and Murnane 2013). By combining the proposed theory of technological underemployment previously described with Autor's scientific hypothesis on the polarization of professional figures, we could represent an overall dynamic regarding the impact of digital technology on work. Consequently, the algorithmic digitization of the industrial sector would lead to a loss of jobs or job shares in medium-level professions (production workers, technicians). The share of jobs lost would pass onto the service sector, also using the spaces offered by the platform economy. With jobs requiring both high and low skills. Digital technology applied to the industrial sector replaces average workers, the algorithmic digitization of work platforms initiates a compensation process, reabsorbing a part of these workers. Platforms reoccupy them, however, with contingent and often informal relationships whether they are high-skilled (programmers, software designers) or low-skilled (turkers, riders, drivers): a digital reinstatement effect (Acemoglu and Restrepo 2019) that increases the contingent labour share as well as labour demand. Although software and computers replace work in some white-collar businesses, they have simultaneously created many new businesses that platform work can enable. The

employment condition of platform workers in Italy supports this hypothesis, as most already have a job, in the real world, with insufficient income[4], or are looking for it. Among platform workers with a job in the real world, the majority are technicians or workers. They come from sectors that require medium skills and are often linked to the industrial sector (De Minicis *et al.* 2019). Therefore, the digital technological polarization can also be interpreted as a generalized movement of the workforce from the industrial sector subject to permanent contractual conditions to informal employment situations of platform work. At first glance it may seem that technology replaces the workforce while in fact it actually triggers a rise in the number of workers and productivity levels in other non-standard forms of work. Caffentzis (2013) in his critical essay on Rifkin's analysis concerning the disappearance of productive labour deriving from the digital technological impact, argues that automation does not determine the disappearance of productive human labour, but of the status historically associated with it. Since machines are not able to produce value autonomously, according to the Marxian theory of Value, if machine replaces all or part of the workforce, the degree of valorization of production that the workforce guarantees must be sought in a different sector more or less contiguous to ensure a systemic equilibrium of the capitalist model.

8. Proposals

In this context, public regulation, and various forms of collective bargaining (agreements, contracts, charters of rights) often appear to be insufficient solutions. First, because the platforms that sign these agreements are few, second because it is often difficult to demonstrate their applicability. Furthermore, public investment in mandatory training is another area of intervention that requires serious reflection. In a context where many middle-income-occupations are dying out and high or low-level occupations lean towards underemployment, the problem needs to be re-discussed. The theory of the polarization of underemployment emphasizes this. In this context, it would be useful not only to focus on sectoral regulatory policies, or on huge investments in public financial resources towards activation plans based on mandatory specialized training, but also to hypothesize a general rethinking of welfare and an appropriate classification of platform workers.

Conclusions

Technology is currently having significant effects on labour markets. From automation to artificial intelligence and new technology-based business models, these effects are difficult to track and quantify. In this article we have tried to provide an overview of the technological changes that have driven these developments and have considered the consequences for wage, employment, and labour markets. The fragmentation of stable work is the most worrying aspect of new technology. The society of the future seems to be oriented not towards a post-work society, but towards a post-status work society, where the function of production and enhancement of the workforce do not end but grow. In this scenario we ask some questions. Could existing regulations be applied effectively? Do these developments suggest new regulatory challenges or are these market and system failures that require regulatory responses? And finally, do the basic principles used to classify the different types of employment relationships provide an adequate basis on which to distinguish between the various types of workers and the rights and obligations associated with them? Harris and Krueger (2015) advocated a new legal category for platform's workers: 'independent workers'. They argue that the existing categories of employees and independent contractors are not suited to the new employment contracts resulting from the digital gig economy. 'Independent workers' to whom they refer can choose when to work or whether to work at all; they can work on multiple platforms at the same time; and they can carry out private activities pending the execution of new paid jobs[5]. For Harris and Krueger, it is difficult to assess the number of hours worked and the company on which these workers

4 For almost 50% of the platforms, income is essential or an important component of the overall budget (De Minicis *et al.* 2020).

5 The new legal category of workers that these Authors propose to create occupies a middle ground between the existing categories of employee and independent contractor; the latter typically are workers who provide goods and services to multiple businesses without the expectation of a lasting work relationship. Based on a set of governing principles to guide the assignment of benefits and protections to independent workers, the proposal would enable businesses to provide benefits and protections that employees currently receive without fully assuming the legal costs and risks of becoming an employer (The Hamilton Project 2015).

depend. For these reasons, Harris and Krueger propose that independent workers be exempt from some of the benefits available to employees, including overtime and the minimum wage. Other authors have objected to the proposals and reasoning of Harris and Krueger. Eisenbrey and Lawrence (2016) reject the case for a new category of workers and the rationale for denying them certain employee entitlements. These authors note that major gig economy platforms exert substantial control over the work, making them, to some extent, like conventional employers. For instance, Uber sets service fees and performance standards. Its drivers can be disciplined for not accepting jobs while they are logged into the app. Uber also offers a guaranteed wage, based on the data it already collects about the time that drivers are logged in and available for work. Eisenbrey and Lawrence see no reason why these mechanisms cannot be used to extend employee entitlements to Uber drivers and other gig-based workers. Now this ideal contrast, present for years in the institutional and regulatory debate on platform workers, appears difficult, contrasted and almost impossible to resolve. But beyond the forms of classification of platform work (self-employed or employees), this new context of digitized Taylorist production should determine a new theoretical conceptualization of the dimensions of welfare and work. Restoring income consistency to the wage dimension. The debate and implementation of the different forms of basic income, minimum income and the legal minimum wage are only the first signs of this awareness (Van Parijs and Vanderborght 2019). The first forms of minimum income or basic income are already starting to be tested and implemented, some of which are directly inserted to integrate and complete the pre-existing welfare model. The production of universal forms of income support together with the fair classification of platform workers and the definition of minimum wages by law should therefore be complementary and not opposing interventions. In contexts where platform workers are classified as independent workers, there would be an intensification of universal income support, while in contexts, where platform work is recognized as employee, there would be greater use of tools such as unemployment insurance. The last Commission proposals, of the 9th of December 2021, to improve the working conditions of people working through digital labour platforms, move towards this direction. The proposed Directive seeks to ensure that people working on digital labour platforms are granted the legal employment status that corresponds to their actual work arrangements. It provides a list of control criteria to determine whether the platform is an employer. If the platform meets at least two of those criteria, it is legally presumed to be an employer. In these instances, workers would therefore enjoy labour and social rights that come with the status of worker. For those being reclassified as employees, this means the right to a minimum wage (where it exists), collective bargaining, working time and health protection, the right to paid leave or improved access to protection against work accidents, unemployment, and sickness benefits, as well as contributory old-age pensions (European Commission 2021).

References

Acemoglu D., Restrepo P. (2019), Automation and New Tasks: How Technology Displaces and Reinstates Labor, *Journal of Economic Perspectives*, 33, n.2, pp.3-30

Accornero A. (1975), Dove cercare le origini del taylorismo e del fordismo, Bologna, il Mulino, XXVI, n.241, pp.673-693

Accornero A., Magna N. (1986), Il lavoro dopo la classe, *Stato e mercato,* 2, n.17, pp.253-270, Bologna, il Mulino

Alquati R. (1975), *Sulla Fiat e altri scritti*, Milano, Feltrinelli

Autor D.H. (2015), *W*hy are there still so many jobs? The history and future of workplace automation*, Journal of Economic Perspectives,* 29, n.3, pp.3-30

Autor D.H. (2010), *The Polarization of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings*, Center for American Progress and The Hamilton Project

Autor D.H., Levy F., Murnane R.J. (2003), The skill content of recent technological change: An empirical exploration, *The Quarterly Journal of Economics*, 118, n.4, pp.1279-1333

Berger T., Frey C.B. (2015), *Future Shocks and Shifts: Challenges for the Global Workforce and Skills Development*, OECD, Directorate for Education and Skills, Education Policy Committee, Parigi, OECD

Boutang Y.M. (2011*), Cognitive Capitalism*, Cambridge, Polity Press

Brems H. (1977), Reality and Neoclassical Theory, *Journal of Economic Literature,* 15, n.1, American Economic Association, pp.72-83 <https://bit.ly/334kWkd >

Bright J.R. (1958), *Automation and Management*, Boston, Division of Research, Graduate School of Business Administration, Harvard University

Caffentzis G. (2013), *In Letters of blood and fire, work, machines and the crisis of capitalism*, PM press/Common Notions/Autonomedia

Crossman E.R. (1966), *Taxonomy of automation*, Parigi, OECD

Crossman E.R. (1960), *Automation and skill*, London, H.M. Stationery Office

Daugareilh I., Degryse C., Pochet P. (2019), *The platform economy and social law: Key issues in comparative perspective*, Working paper n.10, Brussels, ETUI

De Minicis M. (2018), Precari e capitale, socializzazione e contingenza della forza lavoro, *Economia e lavoro,* LII, n.1, pp.121-130

De Minicis M., Donà S., Marocco M. (2020), *Il lavoro online in Italia: Gig o Sharing economy? Prime evidenze empiriche da un'indagine Inapp*, Sinappsi, X, n.3, pp.125-145 <https://bit.ly/3EWXuD6>

De Minicis M., Esposito P., Marsiglia S., Marocco M., Scicchitano S. (2019), *Gli internauti e i lavoratori on line: prime evidenze da INAPP-PLUS 2018*, Policy Brief, n.15, Roma, Inapp <https://bit.ly/3DZnTP4>

Eisenbrey R., Lawrence M. (2016), *Uber business model does not justify a new 'independent worker' category,* Washington, Economic Policy Institute

European Commission, *Directive of the European Parliament and of the Council on improving working conditions in platform work,* Brussels, 9.12.2021, COM (2021), 762 final

Evans D., Schmalensee R. (2012), *The Antitrust Analysis of Multi-Sided Platform Businesses,* University of Chicago, Working Paper n.623, Coase-Sandor Institute for Law & Economics

Frey C.B., Osborne M. (2015), *Technology at Work: The Future of Innovation and Employment,* University of Oxford, Citi GPS Series

Frey C.B, Osborne M. (2013), *The Future of Employment: How Susceptible are Jobs to Computerisation?* Working Paper, Oxford Martin School

Gallino L. (2003), *La scomparsa dell'Italia industriale*, Torino, Einaudi

Harris S., Krueger A. (2015), *A Proposal for Modernizing Labor Laws for the Twenty-Century Work: The "Independent Worker"*, Discussion paper 2015-10, Washington, The Hamilton Project

ILO (2021), *World Employment and social Outlook. The role of digital labour platforms in transforming the world of work*, Geneva, ILO

Inapp, Guarascio D. (a cura di) (2018), *Report sull'economia delle piattaforme digitali in Europa e in Italia*, Inapp report n.7, Roma

Levy F., Murnane R. (2013), *Dancing with Robots: Human Skills for Computerized Work*, Washington, Third Way

Manyika J., Chui M. (2013), *Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey Global Institute

Manyika J., Chui M., Miremadi M., Bughin J., George K., Willmott P., Dewhurst M. (2017), *A Future that Works: Automation, Employment and Productivity*, San Francisco, McKinsey Global Institute

Marx K. (1980), *Il capitale*, Libro I, Roma, Editori Riuniti

Rifkin J. (1995), *The End of Work*, New York, Putnam's Sons

Schumpeter J. A. (1994), *History of Economic Analysis*, London, Routledge

Srnicek N. (2016), *Platform Capitalism*, Cambridge, Polity Press

Van Parijs P., Vanderborght Y. (2019), *Basic Income, A Radical Proposal for a Free Society and a Sane Economy*, Paperback

Weil D. (2017), *The Fissured Workplace: Why Work Became So Bad for So Many and What Can Be Done to Improve It,* Harvard, University Press

Womack J., Jones D.T., Roos D. (2007), *The Machine That Changed the World. The Story of Lean Production-Toyota's Secret Weapon in the Global Car Wars that is Revolutionizing World Industry*, New York, Free Press

World Economic Forum (2016), *The future of jobs*: *Employment, skills, and workforce strategy for the fourth Industrial Revolution*, Global Challenge Insight Report, Geneva, World Economic Forum

Priscila Lauande Rodrigues
priscila.lauanderodrigues@uniroma1.it

Lawyer, doctoral canditate in Private Autonomy, Enterprise, Labour and Protection of Rights in the European and International Prospective at the Sapienza University of Rome and member of the Scientific Committee of the Italian - Brazilian Institute of Labour Law.

Massimo De Minicis
m.deminicis@inapp.org

Researcher at Inapp, working on the labour market, unemployment benefits, the work in the digital economy, the social safety nets (basic income, minimum income) and the phenomenon of working poor.