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A HISTORY OF THE PLATFORMIZATION OF OUR ECONOMY

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Abstract

The term "platforms" has gained significant prominence in the last two decades, particularly in relation to the development of the Fourth Industrial Revolution. However, it is not easy to find a unique definition of the concept of platform that would encompass the diverse socio-technical object it can refer from industrial platforms, hardware and software platforms, or even business models. This article develops the idea that the "platformization" of our economy is a direct consequence of the specific way in which technological innovation has developed since the advent of the industrial era. In this sense, this paper aims to provide a history of the evolution of this concept, from a political economy approach. Its findings have much to tell us about our modern society, its technological innovation processes and the future trajectories of technology.

Introduction

The term "platforms" has become widespread in the economic vocabulary in a massive and accelerated way in the last two decades. Within the era of a technological revolution related to Industry 4.0 (Foladori & Ortiz-Espinoza, 2022), what some also call the Fourth Industrial Revolution (Schwab, 2017), has emerged what many call the platform economy (Deloitte, 2019) or platform capitalism (Srnicsek, 2018).

However, it is not easy to find a unique definition of the concept of platform that would encompass the diverse uses to which this concept is put and the depth of it. Indeed, the concept of platforms can refer to socio-technical objects as diverse as industrial production platforms, hardware and software platforms, technological "environments" accessible through cloud technologies or even business models.

This article develops the idea that the widespread use of the concept of "platform", as well as the diversity of meanings it encompasses today, is a direct consequence of the specific way in which technological innovation has developed since the advent of the industrial era. Thus, we believe that its study has much to tell us about modern technological processes and its future trajectory. In this sense, this paper aims to provide a history of the evolution of this concept, from a political economy approach.

Indeed, we start from a critique of the dominant and "deterministic perspective of technology" (Diéguez, 2005), which places technology within an autonomous rationality that would be outside social dynamics. This perspective fosters a clear positivist and acritical vision of technological transformations. On the contrary, we propose here an analysis from a political economy approach that will allow us to understand and analyze technology in the context of the mutual determination between productive forces and social forces of production operating in our modern societies. This is particularly relevant given the fact that many of the digital platforms that have emerged in the last decade claim to be modifying the nature of contradictory capital-labor relations. This is a claim that we will try to analyze and problematize in this article.

We will begin this task with a description of the theoretical approach of political economy to technological change. Having defined this approach, we will be able

to characterize the role of technology within the main economic trends that have taken shape since the advent of the industrial era. This characterization will allow us to carry out, in a second step, an etymological analysis of the concept of "platform". This will help us to unveil certain trends and characteristics of technological innovation and adoption process in the industrial era. Based on these general considerations, we will be able to address in a third stage the current evolution of technological platforms, within the era of the technological revolution linked to Industry 4.0. Finally, in our conclusions, we will present some analytical clues as to the trends that emerge from this analysis and the possible evolutions of digital platforms in the future.

The Role of Technology in Capitalist Society: A Dialectical Approach from Political Economy

As described by David Harvey in his book "Capital and the Madness of Economic Reason" (2019), a political economy approach has the merit of allowing us to analyze science and technology from the role they occupy in relation to the process of capital valorization and commodity production. This is of particular interest to us because, again following Harvey, "only under capitalism do we find a systematic and powerful force for technological and organizational dynamism that is sustained and cumulative in its effects" (Harvey, 2019, p. 107).

Thus, what interests us here is to understand some of the trends that take shape in the industrial era, obviously in terms of technological change, but also in terms of the way in which technological adoption and diffusion develops.

In order to clarify this theoretical approach, it is first necessary to deconstruct one of the most widespread myths that has been developed by the detractors of political economy analysis of technology: the myth of an alleged technological determinism of this approach. This myth consists of reducing any study of technology, that would be developed from a political economy approach to an analysis centered solely on productive forces (natural characteristics, labor organization characteristics, demographic characteristics, means of production characteristics).

Some authors consider that such an analysis would then represent a technological determinism since, it would assume that all technological change would follow its own rationality separated from social dynamics. But, in addition, such determinism would also mean understanding the transformation of social and cultural structures as a mechanical product of the evolution of productive forces and in particular of technological change (Héder, 2021, pp. 119-130).

In order to go deeper into why we consider that a political economy approach is essential to understand technological transformations and the way in which the adoption and diffusion of technology is configured, it is necessary to deconstruct this myth. Indeed, although the study of the development of productive forces is essential for an analysis of technological development, at no time can these be understood as the only or main engine of historical change. On the contrary, we can say that the interest of developing a study of technology based on political economy lies precisely in the study of the mutual and dialectical determination between the productive forces and the social relations of production.

Paradoxically, one of the first and most complete expressions of the richness of the political economy approach to the study of technology can be found precisely in one of the texts most criticized for being considered, erroneously, as determinist by its detractors: Marx's *Capital*. In the fourth note of the chapter entitled *Machinery and Modern Industry* (volume I, chapter 15), Marx writes the following:

"Technology discloses man's mode of dealing with Nature, the process of production by which he sustains his life, and thereby also lays bare the mode of formation of his social relations, and of the mental conceptions that flow from them" (Marx, 1887, pp.493-494).

It is precisely in the terms "discloses" and "lays bare" (at no point is it a question of determining) where lies what we will consider as the value of a study of technological change from the perspective of political economy, throughout this article. Indeed, these terms refer to a dialectical and mutual determination between human being's relation with nature, the mode of production, social relations and cultural conceptions when studying technology. This complexity is totally opposed to the simplistic and deterministic perspective that the detractors of political economy want to attach to this approach.

In the concrete task related to our article, a political economy approach implies that we will study technology as an essential element of the productive forces in a society. Indeed, returning to the previous quote, studying technology will imply for us to think about elements such as the relationship of human beings with nature and the characteristics of the means of production.

Something that is essential to highlight is the fact that in the modern industrial era technology has become a commodity (Harvey, 2019, p. 148). However, this has not always been the case. Indeed, at the beginning of the industrial revolution, most technological innovations came from the practical knowledge of workers and not from scientific knowledge. In fact, scientific and technological knowledge did not have a specific role within the social division of labor but functioned as a "historical legacy and property of society as a whole" (Foladori, 2014, p. 46).

Authors such as Pasquinelli (2019) posit that technological innovation refer to a process of objectification of historical knowledge into machinery. Thus, when asked who the inventor of a machine is, Pasquinelli's answer is neither the worker, nor the engineer, nor the entrepreneur nor factory owner. For Pasquinelli, the machine emerges as a synthesis of the social division of labor (Pasquinelli, 2019, p. 45). In this sense, the creation of technology does not emerge from a scientific "analysis" of nature, but from a practical "analysis" of labor.

Following this perspective, we can understand how the process of technological innovation evolves with the transition from a formal subsumption of labor under capital, which implied a coordination of the preceding labor organization through market mechanisms, to a real subsumption of labor, directly organized by the interests of capital in the form of modern industry. Indeed, as a result of this transformation, scientific labor came to occupy a space with its own identity in the social division of labor. Thus, in the mid-nineteenth century the first research and development departments emerge within large companies under the necessity to increase labor productivity (Foladori, 2014, p. 46).

It is under this historical evolution that science and technology start to be incorporated into the sphere of capital valorization. In this sense, it is also essential to note that technological innovation, developed in certain industrial branches, began to spread to other branches. Indeed, as David Harvey notes, an

autonomous industry of technological innovation gradually starts to develop. This new business seeks to sell its production to all other productive branches, as well as to consumers (Harvey, 2019, p. 148). Technology thus becomes a commodity.

Now that we have managed to situate, from a political economy perspective, the specific role and main characteristic of technology in industrial societies, we can develop the specific study of our article. Indeed, what interests us in our current research is to understand how the concept of "platform" is linked to the way in which technological innovation, adoption and diffusion takes place in our modern societies, considering that technology has become a commodity.

A Critical Etymology of the Concept of "Platform" and its Implications for Technology Adoption and Diffusion.

The Oxford English Dictionary defines a platform as "A raised level surface on which people or things can stand, usually a discrete structure intended for a particular activity or operation". If we want to be able to situate the role that the concept of "platform" plays in the modern economy, we must link it to the technol-economical characteristics and historical trends to which it refers.

In this sense, it is useful to highlight how, since the beginning of industrialization, the process of automation of productive processes has tended to mechanize specific human processes, but in such a way that they can be generically generalized to other branches of activity. We can see this from the first processes of mechanization of work at the beginning of the 19th century. Indeed, machines such as the Jacquard loom, patented in 1801, were not limited to mechanizing the production of a single weaving pattern but, through a system of punched cards, could be adapted to an infinite number of different woven patterns. It was a machine that in our days we would call "programmable".

Such a system not only allowed the objectification in the machine of the knowledge of the workers, but it allowed the operation of the machine with ever decreasing knowledge. This is a perfect example of how, through mechanization, knowledge is extracted from the working class and objectified into machines, becoming then private property. In this way the knowledge of society becomes part of the sphere of capital valorization. Thus, the capacity of these machines to

increase productivity, their adaptability and ease of use allowed them to spread massively in only 3 decades. By 1836, between 7000 and 8000 machines of this type were in use in England (Manchester Guardian, 1836).

We can then continue tracing the historical trend towards the universalization and adaptability of mechanization processes through a new technological leap: the calculating and programming capacity of machines. Indeed, the creation of Babbage's analytical machine in the mid-19th century was inspired by Jacquard's loom, seeking to mechanize the generic processes of mathematical calculation, through punched cards. This aimed to create a generic machine capable of mechanizing infinitely diverse calculations. This universalization trend would finally allow Ada Lovelace, in 1843, to produce the first theorization about the creation of algorithms, capable of programming machines like Babbage's (Awat, 2021).

We can see then the emergence of the first meaning of the notion of "platform" in the context of the industrial era. Indeed, with the commoditization of technology, technological innovation emerges with a specific tendency to create generic and adaptable technologies that can be sold to different sectors of industry. This is what the concept of platform will refer to: a set of generic and adaptable technological tools that can be structured in diverse ways in order to answer to diverse needs.

If we try then to summarize what we have unveiled, we can see two essential tendencies of technological innovation. First, starting from its function within the process of capital valorization, we observe its historical tendency to replace human labor and reduce the social times of production and circulation. Secondly, understanding technology as a commodity, we also see the historical need to sell the technological commodity to the widest possible spectrum of buyers. Thus, production-oriented scientific and technological innovation tends to produce sets of elementary and generic technological tools whose different combinations can respond to the needs of various branches of production and to different moments in the cycle of capital valorization.

But this is not the only characteristic we can unveil from the political economy study of technological change. The study of the evolution of the platformization

process in the XXth and XXIst century will allow us to understand new perspectives on the meaning and scope of this concept.

The Role of Platforms in the Modern Technological Innovation and Technological Adoption Processes

A historic technological leap forward occurred with the emergence of the era of information and communication technologies (ICTs). Although the legacy of Babbage and Lovelace continued to gain ground throughout the 19th and early 20th centuries, it was not until the huge investment made during the World War II period that these technologies came reached their maturity.

However, the war logic that had driven the emergence of these technologies had, for this very reason, distanced them from the possibility of mass commercialization. Those technologies were not thought for been commercialized but they were built for winning a war, no matter the cost and human skills needed to run them. Indeed, the cost of infrastructure and the need for highly skilled labor to use them constituted two major barriers to their commercialization.

This is how emerged a process of innovation focused on adapting this technological leap to the needs and capabilities of private companies. Thus, the concept of platform rises again, but this time in the form of a specific industrial organization. Indeed, “industrial platforms” capable of absorbing the high infrastructure and labor costs required by information technologies emerged. The sense of “platform” in this context refers to a critical mass of production that needs to be reached and located in a same place, in order to make profit from the extremely high costs of technological transformation of their production processes. An example of such platforms would be the industrial platforms for automotive production.

From this first productive iteration, new productive configurations began to emerge. Those new socio-technical structures allowed large companies to recreate adaptability from some of these new technologies, without fully resolving the cost and labor barriers. This is how the logic of “product platforms” arose, allowing different products to be generated from the same production infrastructure and from the same technologies. In fact, product platforms are based on production

of modular and generic technology that can be assembled in different ways to meet the needs of different consumer segments. We can think of this product platforms as a kind of technological Lego production capable of selling different products to different consumers but based on the same modular and generic pieces. A successful example of this strategy is the family of Nokia 3310/1200/1100 phones (Seppälä et al., 2015). This logic has continued to evolve and disseminate. One of the most visible examples of this dynamic is the modularity built around the iPhone ecosystem, where this principle embeds the hardware and accessories production, the software implementation and the manufacturing process (Baldwin & Clark, 2000; Langlois, 2002; Wang, 2016).

This "product platform" perspective later evolved into hardware and software platforms that made it possible to lower the production costs of ICTs so that they could be mass marketed. Additionally, this platform strategy occurred at the same time as much of the innovation in ICTs was directed towards lowering the cost and increasing the efficiency of its components (Mitchel, 2023). Indeed, the production of computer generic hardware components, and the development of highly polyvalent software platforms allowed the emergence of personal computers that were characterized for an accessible cost and for being able to adapt to a great diversity of needs at the same time that being easy to use. This allowed to overcome the cost and labor qualification barriers mentioned above and unleashed the massification of access to these technologies.

However, a fundamental point in this massification of access to ICTs is that it configured a new scenario of global interconnectivity between "diverse technologies, whose main elements are cyber-physical systems, artificial intelligence and global connectivity" (Foladori & Ortiz-Espinoza, 2022, p. 161). This qualitative leap is precisely what many call the Fourth Industrial Revolution or the technological revolution linked to Industry 4.0.

A first point that it is essential to highlight here is that the massification of digital ICTs, mainly in terms of hardware and software for personal computers and smartphones, created a scenario of network effect that produced a process of global monopolization of these technologies (Cortés, 2004). In fact, the intellectual property of the software and hardware components of the "pioneering" companies in the sector is what allowed a concentration in a few

global companies of the mass production of ICTs. One of the most emblematic examples of this effect is Microsoft (Cortés, 2004).

Once we have done this historical reconstruction of the evolution of the platform concept and its historical importance, what matters most to us here, however, is to be able to characterize the dialectical relationship that exists, in the context of the ongoing fourth industrial revolution, between the technical relations of production, i.e. the specific relations that workers establish with the means of production, and the social relations of production, i.e. the relations that workers establish among themselves in the productive process. We believe that it is precisely the understanding of this mutual determination that will allow us to elucidate some of the structural tendencies of present-day capitalism.

Unpacking Platform Capitalism

The concept of platform capitalism has been used in many different ways and commonly refers to the transformations of contradictory capital-labor relations in the context of the fourth industrial revolution, and more precisely in the context of those relations being mediated by "platform technologies". Some political economy approaches have centered their focus on the way in which the digital and platform economy emerged from the contradictions that the neoliberalism model exacerbated since the 80s (Srnicek, 2018). Other approaches have focused their efforts on a prospective analysis of the transformation of the labour-capital relationship in the age of Artificial Intelligence (Martyntenko, 2021). Based on these contributions we will try to connect our historical analysis to the present contradictions of technological innovation under capitalism and the possible tendencies for the near future.

After this historical analysis of the platform concept, the term of "platform technologies" may seem contradictory to what we have developed till now, since the logic of platformization has appeared to us as being intrinsic to technological innovation in the industrial era and not a set of specific technologies. However, in order to contribute to a better understanding of modern technological innovation and economical processes, we will try to clarify what this concept of "platform technologies" refers to. For this it is necessary to develop a further analysis of the dialectical relationship that exists between the modern technical and social relations of production.

Indeed, as a result of the global connectivity generated by the technological revolution linked to ICTs and the scope it has developed in relation to the fourth industrial revolution, the emerging technical relations of production have developed a whole new set of possibilities when thinking the articulation of social and economic processes. This has had a great influence on the way our societies have faced the deep economic crisis that exploded in 2008 (Srnicek, 2018). Thus, in the face of the massive unemployment that was triggered by that crisis, new forms of relationship between workers and companies have emerged, thanks to the new possibilities of technological mediation unleashed by the development of Industry 4.0.

Over the last four decades, technologies have gone through four successive phases in an unseen accelerated pace:

1. A support role phase: through standardized services such as the mechanization of accounting processes, for example.
2. A collaborative role phase: through customized technological infrastructures and services built as specific solutions to the needs of each company.
3. A phase of technological differentiation: where the ability to integrate new technological advances related to Industry 4.0. became a determining factor in defining competition among capitalists.
4. A technological business model phase: in which a company's entire business model is based on Industry 4.0 technologies. Companies such as Uber or Airbnb are iconic examples of the latter phase.

It is precisely this last phase, where technological change, linked to Industry 4.0, ended up transforming business models, to which the terms "platform technologies" and "platform capitalism" refer. They refer to the term platforms because emergent technological business models are characterized by putting at the service of workers and consumers, a series of digital tools that allow the mutual organization of their relationship. This set of tools works precisely as a digital platform, in the sense that we have been developing so far, meaning that it puts at the service of thousands of people standardized digital tools, which can

be used in different ways. Indeed, taking the same example of Uber, the same servers, programs, but also programmers and technical or administrative support staff are put at the service of millions of users, as a large platform of services based on digital technologies that allow such massification. While we cannot go into the details of this new relationships, we can just mention that from technical and social relations perspective, this technological mediation creates many challenges when defining the capital-labor relationship, since the economic retributions for services become distributed and not centralized. This contributes to blur the employee-employer-customer relations and has produced terrible consequences in the precarization of labor.

One area that needs a special attention from an international political economy perspective is the platformization of financial services through the development of blockchain technologies and the massification of cryptocurrencies. The global impact of these technologies has opened an important debate around the traditional functions of money that can be covered by those nonpublic currencies and the economic impact of the decentralization that they encompass (Chey, 2023).

However, in the other hand, it is also essential to observe how this new structuring of social relations has at the same time a dialectical effect on the technical relations of production. Indeed, it is precisely through the massification of the use of these digital platforms that the last two decades we have seen the production of unprecedented amounts of data stored in digital components. It is precisely based on this use of digital technologies and the resultant production of millions of data that artificial intelligence technologies have emerged, which has been absolutely decisive for the future of Industry 4.0. We can see operating the magic of a dialectical relationship: The transformation of social relations, driven by the mediation of digital technologies, have in return totally reshaped the future of technological innovation.

Conclusion

We see increasingly clearly how the specific need of technological diffusion in the industrial era, has shaped a historical trend of platformization of technological innovation, which is generating massive and extremely accelerated changes in

modern societies, which in return has a profound impact on the trajectory of Industry 4.0 technologies.

Regarding the future of these dialectical relationships in the context of the fourth industrial revolution, the study of the evolution of artificial intelligence (AI) is essential. Indeed, we are already seeing a trend of platformization of AI technologies, which does not simply consist of massifying the use of their functionalities, with services such as chat GPT for example. In fact, programs such as Google's Vertex AI are making accessible to any users a whole technological environment that gives access to hardware and software that can allow the creation of their own artificial intelligence technologies. Those technological solutions can be adapted to an infinite number of needs. The platformization of AI will allow to drastically reduce the cost of access to these technologies, massifying their access, which will have a profound impact on the adoption of these technologies and the corresponding social transformations at rates never seen before.

We can say as the main conclusion of this study of the history, etymology and evolution of the concept of platform that we can understand this concept as an embodiment of historical trends and structural contradictions of technological diffusion in the industrial era. Indeed, technology has become a merchandise since the beginning of the modern industry and its diffusion is essentially mediated by market mechanisms inside the general process of valorization of capital.

Additionally, we have also unveiled how the platform concept can also be understood as an embodiment of the dialectical relationship between technical and social relations of production in the fourth industrial revolution. Indeed, the globalized connectivity exacerbates the social relations changes induced by technologies that can be diffused quicker than any time in history. In return, the global scale of this social changes has an unseen ability to shape the future of technology innovation, not only from a political and cultural perspective, but from the very material basis upon which these technologies, more and more interconnected to their social use, are built.

For this reason, we believe that further study of the phenomenon of platformization of technologies and social relations, in all the complexity that we

have been able to describe here, can contribute significantly to the understanding of the socio-technical trajectories of our modern societies. But more deeply than helping us to understand the future of current technologies, these reflections allow us also to understand that there is a whole alternative set of possible technologies, not merchandised and not being subject to the resultant platformization imperative, that has been historically relegated. And alternative technological future can and need to be explored.

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