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D-CENT

Decentralised Citizens ENgagement Technologies

Specific Targeted Research Project

Collective Awareness Platforms

D3.1 – Theoretical Framework on future knowledge-based economy

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Foreword: Organization of this deliverable[1]

This deliverable is part of WP3 *whose main objective is to "critically investigate the socio economic frameworks and the forms of value creation and impact measurement in the fast changing knowledge based-economy, that are shaping the evolution of future internet architectures, the forms of social interaction, and of democracy*". (DoW WP3)

This task will advance the state of the art through a critical review of different approaches on the information revolution and of the cognitive economy based on the ground-breaking work on cognitive capitalism and collective intelligence (DoW WP3)

In Section A, we present a critical review of the contemporary theories of knowledge, particularly in economics. The analysis of knowledge as an economic good shows the causes of the market's failure to perform its traditional functions and the actual risk of under-production of knowledge in market systems.

Knowledge is a complex subject that should be studied form different interrelated perspectives. Since it is strongly embedded in social relations, we explain the methodological choice in favor of an approach aimed to explain the evolution of capitalism by combining theory, history and transformations of social relations and shares a central concern with the initial research program of French Regulation School. We make clear a theoretical position vis-à-vis the Regulation School approach. Particularly, we highlight the heuristic value of new intermediate categories of the analysis of capitalist dynamics and of its "major crises" and/or phases of historical transformation. These categories will allow us to propose a periodization based upon the identification and succession of three "historical systems of accumulation": mercantile capitalism, industrial capitalism, and then cognitive capitalism.

By cognitive capitalism we mean the emergence of an "historical system of accumulation" in which the cognitive and intellectual dimensions of labor become dominant and the central stake over the valorisation of capital become directly related to the transformation of knowledge into a *fictitious commodity*, in the sense of Polanyi.

In the Section B, we propose a brief review on the recent debate about cognitive capitalism thesis, by stressing some stylized facts able to describe the role of knowledge in industrial capitalism. The following part of the analysis is dedicated to provide a historical perspective for the crisis of industrial capitalism and the transition towards cognitive capitalism. Our thesis is that the "nature" of the Fordist crisis is not simply one of a "major crisis" of *transformation* internal to industrial capitalism. The crisis of Fordism, usually characterised as a crisis of the mode of development, corresponds in fact to a higher level of crisis affecting some of the most essential aspects of industrial capitalism itself. We conclude by presenting a seminal discourse about the possible nature of currency in cognitive capitalism.

The conclusive section aims at providing a first background for building "*a framework for implementing and federating digital complementary currency experiences, and for improving their social benefits*". It will be developed in line with the second pilot about Shared Economy/Economic empowerment. The aim is to enable communities to manage exchange using alternative digital social currencies as *"new tools for growing a shared economy, including a strong role for interoperable digital social currencies. A primary objective of the second pilot will be to offer resilient exchange systems for actively engaged users of the D-CENT platform and others in the social economy and civil society, strongly linked to democratic decision making, and remains linked to local production and distribution to avoid accumulation"* (DoW, p.5).

[1] Author: Stefano Lucarelli

We also propose some hypothesis for the future discussion about the social digital currency infrastructure by taking into account three essential elements:

1. The impossibility to accumulate impeding social currency from becoming the object of speculation. Consequently, it must lose some of its value over time. It would therefore be a *currency that melts down*, a "demurrage charged money".

2. Mitigating workers' dependency on the economic restrictions that force them to sell their labor power and therefore wage relations themselves; thus reducing precarity.

3. Implementing these principles, allows for more free time and resources for developing alternative forms of cooperation based on the common pooling of knowledge, production and, in any case, on exchange networks that exclude the logic of profit. Participation in networks where a currency of the common circulates implies adhering to these principles, whether participants are individuals, businesses or institutional subjects, as in the case of certain alternative currency models experimented with on a local level.

Section A

1. Introduction. From knowledge-based economy to cognitive capitalism[2]

The expression "knowledge revolution" denotes the emergence of a new regime of growth, where the limits of knowledge as a private good become meaningful. Especially in the last two decades, knowledge has been a subject of research in many disciplines. In order to define knowledge, economists propose different approaches that lead to very different policy implications.

In this section, we will begin by characterising certain fundamental limitations of the contemporary theorisations of knowledge. Subsequently, we will show that the thesis of cognitive capitalism rests on a method of analysis that is able to perceive the meaning and stakes of the current mutation of the place of knowledge in the economy, based on the primary role played by historical transformations in the capital/laboor relation.

1.1. Economic theories of knowledge

The modern theories of production present an analytical structure that is very rigorous in the definition of assumptions and the description of results. This development has been accompanied by growing difficulty as regards assigning clear economic meaning to the mathematical propositions derived in the course of demonstrations. In the Walrasian frameworks that dominate the textbooks used in Ph.D courses (e.g. Varian or Mas Colell, Whinston, Green), knowledge is generally treated as a set of given technologies, thus limiting investigation of the changes to which production processes are subject. Models of general economic equilibrium are in fact characterised by the absence of temporal development: firms decide how much and how to produce just once at a single point in time. It is possible to consider temporal periods characterised in a different way, by assuming the completeness of markets. There are markets where goods are exchanged in the present at current prices and futures markets where they are exchanged in the future at prices different from the current ones but fixed in the present period. If such a mechanism is to work, it is necessary to assume that the producers have perfect knowledge not only of present techniques and resources but also of all those that will become available in the future. The need to equip the models with more realistic assumptions of the temporary duration typical of productive activity has led to the formulation of temporary equilibrium models, in which future markets for all the goods in all the periods do not exist. In this context, the bridge between present and future is supposedly provided by the money and financial markets, and the problem of changes in production over time is thus connected with the question of expectations as regards future prices and the values of financial investments. Equilibrium hinges on the form of these expectations. If they cannot be described by rational expectations, some markets could be characterised by imbalances, which are called excess demand functions that do not balance out in the language of mathematical analysis that dominates this literature.

These theoretical constructs appear far removed from the concrete problems of industrial policy, above all because the fast changing knowledge based-economy that is shaping the evolution of future internet architectures and the forms of social interaction, determines constant change in the productive structure.

[2] Author: Stefano Lucarelli.

The role of knowledge in the economic systems is an issue raised in very forceful terms as early as 1912 by a scholar who introduced important departures from tradition despite being enthralled by the magnificence of the Walrasian model, namely J. A. Schumpeter. While sharing the idea of the firm as a rational entity with modern neoclassical theory, the new industrial economics has been forced over the years by the studies of an important non-mainstream school of neo-Schumpeterian character – the evolutionary economists, a group of well-equipped scholars endowed above all with the ability to get politicians to listen to them[3] – to challenge most of the traditional assumptions, e.g. that the optimal form of the market to foster innovation is perfect competition.

The core of the new neoclassical industrial economics is the anaysis of the strategic behaviour of firms thatseek to influence the actions and expectations of competitors, thereby giving rise at the same time to change in market structure.[4] The firms' ultimate objective remains, however, the maximisation of a target function, generally profit. The market structure is therefore endogenous to the model and technical change comes to depend directly on the innovative activities of firms. Technology and knowledge itslef, reduced here to information, are not freely accessible. Here we have another difference with respect to the traditional theory of production, where technology is regarded as an exogenous element. Finally, a role is assigned to technological uncertainty that involves very different results in the conclusions drawn from the models. There remain substantial differences with respect to the evolutionary economists, who do not reduce technology to information, regarding it rather as multidimensional and linked to knowledge, and focus not on the strategies of firms but on skills and on the heterogeneity of behaviours, organisation and types of firm. As regards policy, while the new industrial economics argues that public intervention with respect to the market failures that accompany the innovative process must be limited to providing subsidies for research and development and regulating the granting of patents, the evolutionary economists instead maintain that the policymaker cannot stick to standard procedures and must focus great attention on the relations between the sectoral, technological and institutional contexts in which the firms operate before taking any decisions.

The case of the European Union strikes us as very significant in this connection. The indications of industrial policy that have dominated in Europe – at least since the Bangemann Report of 1990, the primary elements of which are to be found in the Treaty of Maastricht (articles 129, 130, 130F) – are derived substantially from the theoretical framework of new industrial economics. The approach that emerges is far removed from the idea that the policymaker must intervene directly in support of national industry and consists of a set of actions designed to expand the markets and accelerate organisational and technological change in firms. While it is true that indications apparently influenced by the evolutionary approach do emerge every so often in the communications of the European Commission on industrial policy and innovation, the dominant tendency remains the reduction of industrial policy to a policy for boosting the competitiveness of firms.

For example, communication no. 614 of 2010 states that it is essential *"to increase productivity in manufacturing industry and associated service to underpin the recovery of growth and jobs, restore health and sustainability to the EU economy and help sustain our social model"* (European Commission 2010, p. 3), proposing *"a fresh approach to industrial policy"* based on two pillars: *"First, it is about those policies that have an impact on the cost, price and innovative competitiveness of industry and individual sectors, such as standardisation or innovation policies, or sectoral policies targeting e.g. the innovation performance of individual sectors. Second, it is necessary to consider the competitiveness effects of all other policy initiatives such as transport, energy, environmental or social and consumer-protection policies, but also the single-market policy or trade policy."* (p. 4) In particular, the communication recommends *"improving access to finance for businesses"* (p. 7), *"developing the Single Market and enforcing intellectual property rights"* (p. 8) and *"improving use of ICT for industrial competitiveness, resource optimisation and innovation"* (p. 13) in

[3] See Nelson, Winter (1982); Winter (1984); Dosi, Freeman, Nelson, Silverberg, Soete (1988); Silverberg, Dosi, Orsenigo (1988); Malerba, Nelson, Orsenigo, Winter (2000).
[4] See Dasgupta, Stiglitz (1980). For an overview, see Sutton (1998).

the conviction that *"clusters and networks improve industrial competitiveness and innovation by bringing together resources and expertise, and promoting cooperation among businesses, public authorities and universities"* (p. 14). The goals of strengthening clusters and networks and increasing the adoption of ICT would appear to clash with the enforcement of intellectual property rights.

As Antonelli and Teubal (2008) clearly argued the analysis of knowledge as an economic good immediately reveals the reasons of the market's failures to perform its traditional functions: in the light of the pioneering contributions of Richard Nelson (1959) and Kenneth Arrow (1962), any economic system would dedicate most of its resources to generate new knowledge in order to be efficient. However the private profitability of knowledge-generating actions lies well below social dsiderability. *"A radical market failure is the direct consequence of the characteristics of knowledge, as an economic, private, and unbundled good"* (Antonelli and Teubal 2008, p. 165).

1.2. Limitations of the contemporary theories of knowledge[5]

Contemporary theory perceives knowledge either as the object of a new sub-discipline (the economics of knowledge) or as the index of a shift to a new stage of economic development (the knowledge-based economy). Two series of closely associated critiques can be addressed to these theorizations.

The first critique concerns the tendency to approach the question of knowledge by starting from general theoretical models that would be valid at all times and in all places, and are founded on a separation between the economic domain and that of social relations. This tendency to reject the historicity of economies is particularly clear in Howitt's work. In his view (1996, 2004) nothing really new characterizes the place of knowledge in economic growth. The only real novelty resides in the current capacity of theory to better discern its functions and primary role that are neglected by former theories of growth. In short, the historical novelty is not to be found in a new phase of capitalism or even in the shift to a knowledge-based economy. It is to be found exclusively in the formation of an economics of knowledge, that is, of a sub-discipline of the science of economics specialized in the study of the mechanisms governing the production, distribution and appropriation of knowledge. This is the way Howitt (2004) interprets the birth and development, through gradual improvements of the theories of endogenous growth without any reference to the historical transformations in the accumulation of capital and the wage relation. In this kind of conception the theoretician seems to ignore or deny the importance of the underlying structural changes that provide the foundation for the emergence of a new field of research.

The second critique concerns the reductive vision of the place of knowledge and its new role, a vision on which most interpretations of the emergence of a knowledge-based economy are founded. These approaches have the unquestionable merit of foregrounding the idea of an historical break, and for that reason, they will receive the most attention in the rest of this sub-section. However, their conception of historical time skips over the transformation of social relations and relations of knowledge/power that structure the development of the productive forces, both material and immaterial.

The origin of a knowledge-based economy is essentially explained as a change in the magnitude of the phenomenon, a kind of Hegelian shift from quantity to quality. It is seen as the result of the encounter, or indeed the clash, between two factors: 1) A long-term trend towards a rise in so-called intangible capital (education, training, R&D, health) which from the mid-1970s onward (in 1973 in the US, for example) the percentage of "material" capital in the stock of capital and now asserted itself as the key variable in growth; 2) the sweeping change in the conditions of the reproduction and transmission of knowledge and information resulting from the "spectacular spread" of the information and communication technologies (ICT) (Foray, 2006).

[5] Author: Carlo Vercellone.

Finally, for the hard core of this vision, today broadly shared by the theorists of the knowledge-based economy and by numerous international institutions (OECD, EU), the rise of a knowledge-based economy is still essentially considered as an effect of crossing a threshold. The social determinants that are at the origin of the social crisis of the Fordist model and on the historical bifurcation towards an economy founded on distribution and the primary role of knowledge remain largely hidden.

More precisely, in our opinion two obstacles keep the theories of a knowledge-based economy from accounting for the new and contradictory place of knowledge in the "new capitalism":

1. The reductive nature of a characterization of the knowledge-based economy centred on activities devoted to the deliberate production of knowledge. Thus, for example, the research of the OECD (2003) remains essentially anchored in the "Fordist" conception that emerged from of Arrow's model (1962), where the production of knowledge is the privilege of elite R&D workers, scientific research and the knowledge industries. This interpretation obscures the most important phenomenon to have taken place since the crisis of Fordism, namely the return in force of the cognitive dimensions of labor, which are apparent at almost every level of production, material and immaterial alike. Such an evolution is accompanied by the shift from a linear/vertical paradigm of innovation to an interactive/horizontal one.
2. The technological determinism that lends information and communication technologies (ICT) a primary role in the shift to the "mass production" of knowledge and immaterial goods; adopting a mechanistic theory similar to approaches, which, according to Thompson (1963), made the steam engine into the vector of the first industrial revolution leading to the formation of the working class and the mass production of material goods.

Let us note that this tendency towards technological determinism and the under-estimation of social causalities are also found in analyses that nonetheless develop a wider vision of the knowledge-based economy, integrating the problem of non-deliberate forms of knowledge production (Foray and Lundvall, 1996). Despite the sophistication of such work, the principle explanation of the growing importance taken on by these non-deliberate forms still appears to rest in fact on the primary role of ICT. The latter is in effect understood as the major vector for the effectuation of mechanisms of horizontal coordination and networked organization at the origin of historically unprecedented modes of "collective invention".

Despite changes in detail, the shift towards a knowledge-based economy is always conceived via an interpretative grid that casts it as the product of a happy encounter between the information revolution and a long-term trend towards the increase of intangible capital.

In this way, even the most highly articulated theories of the rise of the knowledge-based economy are led to omit certain elements necessary for understanding what we see as the origin, the meaning and the stakes of the current transformation of capitalism. A few preliminary observations will allow us to measure the breadth and importance of these omissions.

No real reference is made to the social conflicts at the origin of the crisis of Fordism and the transformations of the relations of knowledge and power that structure the division of labor and the regulation of the wage-relation. The interpretation of the stylized fact relative to the primacy of the new so-called intangible capital, embodied for the most part in human beings, systematically ignores a key element: this dynamic is linked above all to the development of collective services furnished historically by the welfare state. To forget the largely non-commodified nature of these collective services and their role as a motive force in the new capitalism of knowledge is all the more astonishing when the institutions of the welfare state are now being powerfully destabilized by austerity policies and falling prey to creeping privatization.

In our view, it is not so much in ICT as the development of a diffuse intellectuality that one should seek the primordial factor of the transition towards a capitalism founded on knowledge and towards new forms of the division of labor. We will advance this thesis: the departure point of the formation

of cognitive capitalism is to be found in a process of the diffusion of knowledge, engendered particularly by the development of mass education and a formidable rise in the average level of training. What is more, this phenomenon, which has played a key role in raising the percentage of so-called intangible capital, does not only correspond to the slow deployment of a long-term trend. Instead, it is a historically accelerated process driven to a large extent by the social demand for the democratization of the access to knowledge conceived at once as a means of self-realization and of social mobility for the popular generations of the baby-boom. The constitution of the figure of a diffused intellectuality, which finds its first form of social expression in the events of 1968, not only precedes the "information revolution" from the logical and historical point of view, but is also partially at its origin. It is enough to consider the fact that some of the major innovations of the aforementioned "revolution" come out of the ideals and practices of the protest culture of the years 1960-1970.

Moreover, where ICT is concerned one must also make two other remarks: on the one hand, ICT can only function correctly on the basis of a living knowledge capable of mobilizing it, because it is knowledge that governs the treatment of information: otherwise it remains a sterile resource, like capital without labor. On the other hand, its role can be profoundly ambivalent depending on its use and on the technical support structures into which ICT is integrated, favoring either the operation of neo-Taylorist forms or a requalification and de-hierarchisation of labor relations.

Finally, the technological determinism of the theorists of the knowledge-based economy refers back to a positivist conception of science, knowledge and technological progress. This perspective leads to the abstraction of the social relations and conflicts surrounding the question of the control of the "intellectual powers of production" that have marked the entire history of capitalism. Indeed, the proof of this is the recourse to the colorless notion of the knowledge-based economy, to which one could apply the same remark made by Galbraith (2004) when, in his last work, he stigmatized the "lie" that consists in speaking of a *market economy* instead of *capitalism*, with the aim of erasing the power relations which the latter word conveys.

Ultimately, these approaches overlook the fact that the novelty of the contemporary historical conjuncture does not involve the simple creation of a knowledge-based economy. The meaning and stakes of the current transformation of capitalism are not to be found, in fact, in the simple constitution of an economy founded on knowledge, but in the formation of a knowledge-based economy framed and subsumed by the laws of capital accumulation.

The approach of cognitive capitalism vis-à-vis mainstream theorizations of the *knowledge-based economy* constitutes a double reversal at both the conceptual and methodological levels.

On the one hand, the neutral concept of the knowledge-based economy is justly replaced by that of cognitive capitalism. This concept throws into relief the historical dimension and conflictual dialectic between the two terms of which it is composed. The term 'capitalism' indicates the permanence, beyond all variation, of the *invariants* of the capitalist system; in particular the determining role of profit and the wage relation or, more precisely, the different forms of labor on which the extraction of surplus value rests. The term 'cognitive' brings to light the novel nature of labor, the sources of value and the forms of property that support the accumulation of capital and the contradictions that this engenders. These contradictions are made manifest both in the relationship between labor and capital (in the sphere of production and circulation) and in the increasingly acute antagonism between the social nature of production and the private nature of appropriation.

At the methodological level, the approach of cognitive capitalism places knowledge at the heart of the concrete historical development of conflictual relations of knowledge and power that have forged the development of the capitalist division of labor and the transformation of the wage relation.

1.3. Knowledge and the dynamics of the social relations[6]

At the beginning of the third millennium, a group of scholars coordinated by Bernard Paulré proposed to the attention of the so-called French Regulation School the notion of "cognitive capitalism" to specify the transformations that affected, after the crisis of Fordism, the regime of growth that characterizes the developed economic systems. As suggested by such group of scholars:

> The new mode of regulation must be characterised in terms of cognitive capitalism. We affirm the idea that the dynamics of transformation that dominate the waged societies is characterized by the fact that today growth is mainly based on knowledge. [...] We move beyond the research program on post-Fordism, in fact we develop the hypothesis of a new phase of capitalism that corresponds with the exhaustion of industrial capitalism and the transition to cognitive capitalism. (Corsani et alii 2002: 1. Our translation).

During the first decade of the new millennium, the cognitive capitalism hypothesis opened up new research perspectives. Following Paulré (2004), the objective of cognitive capitalism theory is to address the role of knowledge in understanding the evolution and transformation of contemporary capitalism. As Vercellone (2007: 14, note 3) stresses, i) the notion of 'capitalism' defines the enduring element in the change of the structural invariants of the capitalist mode of production; ii) the term 'cognitive' emphasises the new nature of labor on which value production in new capitalism rests.

To better understand this problem, it is important to recall that for Marx, labor as a cognitive activity – understood as the inseparable unity between thought and action – is the very essence of man (see *Capital* Book I, ch.7). It seems to us that the crucial point is the following: if the cognitive dimension of labor is the very essence of human activity, awareness of this might be understood as an impediment to the capitalist control of production and, therefore, accumulation. From this, it is clear why the relationship between knowledge and power constitutes an essential element in the class struggle resulting from the organization of production. This struggle is articulated around two central points. First, those who master and dictate the forms of labor are also masters of the intensity and the quality of labor. To the extent that the buying and selling of labor-power affects the availability of a quantity of time and not the effective labor of salaried workers, this results in structural uncertainty. Here we have an area that Taylor, for example, explicitly attacked when he analyzed the causes of the stalling or slowing down of working processes. He deduced that through scientific studies of time and movement it is necessary to bring to light and expropriate the tacit knowledge of the worker, in order to convert it into the codified knowledge possessed by management, and then return it to workers in the form of timed schedules for the labor process.

The second reason regards the fact that those who possess this knowledge might aspire to manage production, that is to say, to define the organization of labor as well as the social ends of production. In fact, a large body of work has shown that the diffusion of Fordist and Taylorist methods of organizing labor and production are not only restricted to the logic of mass production. This results in the necessity of undermining, of *destructuring* (in the sense of the Italian Wokerist term *destrutturare*), the composition of the professional working class who, most notably with the workers council movement between the wars, have struggled for the direct re-appropriation of the means of production in the face of a labor process that was not yet entirely subjected to and moulded by capital into the form of an "objective armature independent from the workers" (in Marx's terminology).

Finally, the conflictual relations connected with control over the intellectual power of production explains why the development of the capitalist division of labor, in the wake of the industrial revolution, consisted of trying, as much as possible, to empty labor of its cognitive dimension and to transform it into its opposite, a mechanical and repetitive activity. Here we have the origin of the

[6] Authors: Stefano Lucarelli and Carlo Vercellone.

tendency that Marx characterized as the passage from the formal to the real subsumption of labor by capital. However, this tendency, which finds its historical fulfilment in the model of Fordist growth, will remain imperfect and unachieved. It is always new types of knowledge that tend to reconstitute themselves at the highest levels of the technical and social division of labor, much as Marx had already envisioned in his hypotheses about the *general intellect* and the crisis of the logic of real subsumption (Vercellone, 2007).

We are referring to those passages in the *Grundrisse* in which Marx develops, after the stage of real subsumption, the hypothesis of the *General Intellect,* which anticipates the coming of an economy founded on the diffusion and centrality of knowledge, in addition to the increasing dominance of the productive value of scientific and intellectual labor (Negri, 1997). Framed in this way, the law of value founded on abstract labor time where value is expressed as a definite quantity of simple and homogeneous unskilled labor enters into crisis. This does not mean that the law of value disappears entirely, because capital continues to artificially maintain the logic of exchange value. Nor does this situation mean that labor, notably in its cognitive dimension, loses its centrality as the source of the creation of value and surplus value.

In summary, the concept of cognitive capitalism can be defined as follows: a new "historical system of accumulation" in which the cognitive of dimension of labor becomes the dominant principle of value creation, whereas the main form of capital becomes the so-called immaterial and intellectual one. Such notion, it must be noted, expresses a true oxymoron. In this framework, what is first and foremost at stake is the valorization of capital on the one hand, and in the forms of property, on the other, the control of social conditions of knowledge production and of the transformation of these latter in a fictitious capital and commodity (Vercellone, 2010). This evolution is inscribed in a context characterized by what we can call the "becoming-rent of profit" (Vercellone, 2013). Such a concept indicates the level of contradiction between contemporary capitalism and the potential of both development and emancipation which is inscribed in a knowledge-based economy. Such a developed and emancipatory knowledge-based economy may be defined as the society of *general intellect*.

A question emerges: is cognitive capitalism inherently unstable? Is it unable to mobilize a progressive struggle-development dynamics, as it was the case in the Fordist epoch? To this question some authors answer negatively. For example, André Gorz (2003) underlines that the contradictions of cognitive capitalism indicate the crisis of capitalism *tout court.* Other authors are more optimistic and emphasize the possibility of stabilizing cognitive capitalism by reconciling it with the knowledge-based economy.

1.4. The Cognitive Capitalism Thesis: an Introduction

1.4.1. Regulation Theory and Cognitive Capitalism thesis[7]

The methodological choice in favour of an approach that combines the theory, history and transformation of social relations shares a central concern with the initial program of Regulation School political economy, whose goal was to elaborate a series of intermediate tools and categories in order to make sense of the temporal and spatial variability of social and economic laws and dynamics (Lipietz 1993).

Breaking with conventional Marxism and its stress on the forms of competition, the Regulation School placed at the center of its historical analysis of growth and crises the key role of the transformations of the wage relation, in order to characterise "the mutual relations between different kinds of organization of labor, ways of living and modes of waged labor's reproduction" (Boyer [1986], p. 49).

On this basis, regulation theory has brought a fundamental contribution to the elaboration of an alternative macroeconomy, combining theory and history to understand historical change using three central concepts: regimes of accumulation and modes of regulation, whose intersection defines the mode of development (MOD) or growth regime (Boyer, 2004). MODs are particular forms in which capital organizes and expands for a period of time, exhibiting some degree of stability.

Another fundamental contribution has consisted precisely in showing how each mode of development has corresponded to a specific form of "major crisis." Thus regulation has extended to industrial capitalism one of the major lessons of the Annales School of history, by developing the hypothesis that each economy has the structural crisis of its social and institutional configuration.

Through this analytic perspective, the Regulation School has furnished an original periodization of the major structural and institutional changes, which, in the most developed countries, have lead from the industrial revolution to Fordism, placing a particular accent on the specificity of the factors at the origin of the rise, then of the crisis of each mode of development. However, in our eyes, the theoretical tools and intermediary categories forged by the Regulation School to characterise the dynamics of industrial capitalism now appear insufficient to account for the breadth of contemporary transformations of capitalism. Indeed, we are confronted with mutations concerning the dynamic of the division of labor and of the role of knowledge, which throws into doubt certain structural invariants within the very logic of industrial capitalism.

In a more general way, let us also note that the use in economics of such fuzzy categories as "post-Fordism" or "post-industrial society" seems to bear witness to this difficulty. Indeed, these terms present the great limitation of characterizing the current transformation by stressing what it no longer is, instead of defining the new nature of capitalism. The research program around cognitive capitalism emerges from the observation of a crisis that has extended over the last thirty years and that has disavowed all the scenarios of a neo- or post-Fordist recomposition of the regulation of capitalism. It also emerges from a reaction, as we have seen, to the looseness of concepts like "post-industrial society" and "knowledge-based economy," when they are used to characterize the meaning and the stakes of the current transformation of capitalism.

In the face of this challenge, the approach of cognitive capitalism has developed a theoretical reading that can offer two major contributions to the enrichment of the analytical categories of the French regulation theory.

- The first contribution concerns the periodization of capitalism through the development of intermediary categories that are able to test the hypothesis of an exit from industrial capitalism. In

[7] Authors: Jean Marie Monnier and Carlo Vercellone.

this respect, as we have mentioned, the Regulation School focused its analyses within a particular configuration of capitalism, industrial capitalism, whose transformations it characterizes by identifying the historical succession of different modes of development based on the particular association of a regime of accumulation and a mode of regulation.

In particular, two theoretical difficulties result from an approach which focuses exclusively on the internal transformations of industrial capitalism:
- First, it pays insufficient attention to what Marx called the processes of primitive accumulation and the way in which these processes are structurally produced in time and space in novel forms that today find their essential dimension in the privatization of knowledge and life itself.
- Second, it fails to produce any intermediary concept between the "mode of production", which designates the most fundamental invariants of capitalism, and the "mode of development", which designates a specific stage in the development of industrial capitalism itself.

In noting these problems, we are drawing upon one of the major lessons of the work of Fernand Braudel (1979), according to which. the history of capitalism both precedes and goes beyond the industrial revolution and can also be linked to different forms of surplus-value extraction and capital accumulation. Therefore, we believe that the periodization of capitalism (and of the major crises that characterize its transformations) must take into account the historical succession of different dominant configurations of capital accumulation.

We have chosen to describe this intermediary level between the "mode of production" and the "mode of development" using the concept of the "historical system of accumulation" (Lebert and Vercellone 2004; Paulré 2004). In the history of the capitalist mode of production, this concept designates a dominant logic of accumulation that orients, over the long term, the tendencies inherent in the valorization of capital, the division of labor and the reproduction of the most fundamental aspects of social relations. According to this perspective, mercantile capitalism was succeeded by industrial capitalism, which has itself now entered a new transitional phase towards the historical system of accumulation called cognitive capitalism.

We note that the concept of the "historical system of accumulation" also introduces the possibility of a crisis at a higher level to that recognized by the regulationist concept of the major crisis of the mode of development. According to the thesis of cognitive capitalism, the significance of the crisis in the Fordist mode of development is not simply one of a crisis of transformation internal to industrial capitalism. Rather, the crisis of Fordism has affected some of the most essential aspects of industrial capitalism itself. To summarize, the thesis of cognitive capitalism would signal the exhaustion not only of a mode of development specific to industrial capitalism, but the tendential crisis of some of the more structural invariants in the dynamics of the long period opened by the first industrial revolution.

We want to be clear that this hypothesis does not suggest that history is a linear process. Rather, it proceeds by means of overlapping and hybridization; moreover, in the same manner that a mode of production is never present in an absolutely 'pure' state but is articulated with and subsumes other modes of production, likewise a new historical system of accumulation, such as cognitive capitalism, does not completely supplant its predecessor, but reassembles and rearticulates it within the framework of a new logic.

➢ The second contribution concerns the attempt to forge a few analytical categories aiming specifically to circumscribe the historical transformations of the place of knowledge in relation to that of the wage relation and of other institutional forms of capitalism.

To do this, we began with an observation: knowledge has always played a primary role in the development of capitalism. The roles and forms of knowledge, however, have varied across both time and space. It is important, therefore, to specify the nature of the transformation that is today affecting the relationship between knowledge and capitalism, and which allows us to speak of the

crisis of industrial capitalism and the transition towards a new historical system of accumulation. With the goal of gaining a greater insight into the historicity of the phenomenon of "knowledge" it seems useful from a heuristic point of view to emphasize three complementary dimensions from which the place of knowledge in the development of capitalism can be understood.

- The first dimension concerns the capital-labor relation, and is related to the often conflictual relationship between two inseparable aspects of the knowledge economy: 1. knowledge incorporated and mobilized by labor, the description of which is reliant on the forms of the technical and social division of labor and the socio-institutional mechanisms that regulate access to knowledge and determine the general level of education of the working class; 2. knowledge incorporated into capital in the form of fixed physical capital or immaterial assets. The relation between these two aspects is at the heart of the historical characterization of the different configurations of the capital-labor relation. This relation plays a central role in the production of knowledge and innovation, as well as in the determination of value and the competiveness of firms and territories. This fact is primary since it orients and overlaps with the two other dimensions of the problem.

- The second dimension relates to the question of the regulation of the forms of access, diffusion, and appropriation of knowledge. To simplify somewhat, this is the way in which knowledge is guaranteed as a common good, exempt from the logic of the market,or, at the other end of the spectrum, constituted as a scarce resource allowing for its private appropriation and its transformation into what Polanyi would call a fictitious commodity. The study of this dimension raises crucial questions that are today at the center of unresolved debates and conflicts, in particular those regarding intellectual property and the institutional regulation of relations between the open and closed models of scientific research.
- The third dimension concerns knowledge as a central factor in the determination of competitiveness at the micro-, meso- and macroeconomic levels. As a result, knowledge plays an essential role in the historical analysis of forms of competition and modalities of entry into the international division of labor.

The interrelation of these dimensions gives us a relatively coherent logic to describe the regulation and the forms of production in the knowledge economy that is dominant in a particular historical system of accumulation. On this basis, the task T3.1 will investigate the models of organization of collective resources and awareness platforms, for achieving sustainability in experiences of new forms of production in the knowledge economy, such as networked social production.

1.5. The transition towards cognitive capitalism: elements for an historical perspective

We are now going to develop the thesis of cognitive capitalism by placing it in the context of the long-term history of capitalism. According to this periodization, we will give an important place to the forms of the division of labor and the regulation of the relations between knowledge and power, at the expense of other dimensions that might equally deserve to be considered. In the following section B, we will focus exclusively on the transition between industrial and cognitive capitalism, noting that we have considered mercantile capitalism in other articles found in the bibliography.

Section B

2.1. Knowledge economy: some stylized facts[8]

The emergence of industrial capitalism corresponds to the opening of a particular path in the regulation of the knowledge economy. This regime is based on three main tendencies: the social polarisation of knowledge, the separation of intellectual labor from manual labor, and the incorporation of knowledge as fixed capital. These processes are supported by a logic of accumulation based first on the centrality of the large Mancunian firm, and second on the Fordist model for the mass production of standardized durable goods. This model makes the development of fixed capital the fundamental object of property and the principal form of technical progress. In industrial capitalism, the centrality of material labor goes hand in hand with the establishment of norms for value-creation inherent to economies based on homogenous time and bulk-productivity.

The wage relation and the knowledge economy in industrial capitalism

In the dynamics of technical progress driven by the first industrial revolution, the search for increased productivity is inseparable from and subordinated to the lessening dependence of capital on the know-how of workers compared to its importance in the pre-industrial organization of production (Dockès and Rosier 1983; Marglin 1974.) The development of industrial capitalism rests on a process of progressive expropriation of the knowledge of workers and their incorporation into an increasingly complex system of tools and machines. This tendency towards the real subsumption of labor to capital is made concrete in the separation and opposition of knowledge and collective labor.

According to this logic, the principal criterion for economic effectiveness in industrial capitalism is the search for homogenous temporal economies. This criterion, which is also one of the fundamental aspects of the relation between value and labor time, is made manifest in the organization of the labor process in terms of prescribed tasks and operating times. This logic is likewise at the origin of a rupture in the social representation of time. This rupture opposes directly paid labor time, which is considered as the only productive time, to other "non-productive" social times dedicated to the formation and reproduction of labor power.

In many ways, the polarising logic of knowledge in industrial capitalism reaches its pinnacle in the Fordist model. In terms of knowledge economies, this model is based on the hierarchy between two starkly divided levels in the division of labour. At the level of the workshop, the scientific organization of labour seeks to remove all intellectual elements from the act of production; labour, in the sense used by Marx, becomes more and more "abstract", not only in its form, but also in its content, as management centralises the knowledge that was previously in the possession of labourers. This separation of labour from the subjectivity of the worker results in the objectification of labour itself within the ensemble of describable, measurable, and timed tasks. Innovation is chased out of the workshop and the work of conceptualisation becomes the exclusive domain of small groups of workers restricted to the offices of industrial engineers and R&D centres. Let us also note that all the elements in this logic of the specifically capitalist development of the division of labor rest on the fact that the greatest part of value-creation is found in the sphere of direct material production where the activity of the worker's labour consists principally in acting on inanimate material by means of tools and machines, according to a paradigm of energy expenditure.

This centrality of material labor encourages the respect of two central conditions of the canonical

[8] Authors: Jean Marie Monnier and Carlo Vercellone.

definition of the wage relation, which are: 1. the renunciation, in exchange for the wage, of the workers' share of any claim on the ownership of the product of their labor, to the extent that this product is physically separated from the workers' labor and appropriated by the employer; and 2. the fact that in industrial capitalism, the wage is effectively exchanged for the purchase by capital of a determinate fraction of human time, placed at the disposal of the corporation. The productive time of labor in the paradigm of energy expenditure corresponded to the time executed and remunerated inside the factory according to the dispositions established by the work contract. On the contrary, the respect of these conditions, as we will see, is often destabilised today by the rise of the immaterial and cognitive dimension of labor.

Knowledge, innovation and the determinants of competitiveness

In industrial capitalism, the competitive capacity of an economic system is determined by the degree of development of a sector of material equipment goods. The specialisation of countries in this sector is the primary means for mastering the evolution of the norms of production that are incorporated in fixed capital and that dictate the hierarchy of the international division of labor (Mistral 1986.) In particular, during the golden age of Fordism, it was thought that the large corporation could plan space with the same efficiency as the time and motion engineers applied the "scientific organization of labor" on the shop floors. The regional and international division of labor thus appeared as a variable that the large firms could, to a large, submit to their strategy of valorization. This vision of the international division of labor, responding to a dynamic logic of comparative advantages, was expressed very well by the theory of the product cycle (Vernon 1979) and in a more sophisticated way by the theory of the Fordist branch circuit (Lipietz 1983). The latter stressed the hierarchical organization of spaces according to the more or less strategic nature of the productive activities that they hosted, with a fracturing of production ranging from engineering and design to the most routinized activities of fabrication.[9]

The driving force of tangible capital and the cycle of innovation native to industrial capitalism (which is marked by short periods of radical innovation followed by longer periods of incremental innovation) help to explain the mode of regulation for research and industrial property during this period of development.

Intellectual property and the regulation of research in industrial capitalism

Since the beginning of the twentieth century, the mechanisms for the deliberate production of knowledge have rested on two specific systems of regulation:

1) A public system of research and higher education whose essential function is to produce and transmit free basic knowledge according to the model of so-called "open science". In this system, research is financed by subsidies on the condition that the results are shared freely and without cost, and that the primary motivation of the research is not profit, but recognition by one's peers;

[9] Thus in a typical large Fordist firm, the division of labor into three major hierarchical levels – level 1: planning department, engineering and design; level 2: skilled manufacturing; level 3: routinized manufacturing, particularly for the final phases of assembly – is so sharp that these different phases of the production cycle can, from a technical point of view, be easily be subjected to territorial "disintegration" into independent segments and productive units. In particular for level III, the constraints of localization linked to the skills of labor and the characteristics of the external economies were greatly attenuated. The large firm could therefore employ criteria based on the simple reduction of production costs, particularly through the exploitation of differential levels of development in each region.

2) A system of R&D centers managed by large firms, in which scientific knowledge, specifically related to technology, is internally produced. It is characterized by goals that are clearly specified by the firm and controlled in a vertical manner.

The rules of intellectual property are in accordance with a logic of capital accumulation and private appropriation of knowledge that are ultimately reliant on active materials. The patenting of inventions must be justified by their incorporation into a technical industrial apparatus, that is to say they are connected to creative human labor and not nature. These norms trace a clear border between true innovation and discovery.

Furthermore, in industrial capitalism the patent system is inscribed in regimes of accumulation that are essentially national in nature. Therefore, the patent is not only limited in time, but also in the territorial domain of its application, namely the nation-state. The pillars of this system today are called into question with the displacement and internationalization of the borders of traditional intellectual property rights according to the model used in the United States.

2.2. Crisis and the transition towards cognitive capitalism: its origin and meaning[10]

The origin of the transformation of contemporary capitalism can be found most clearly by calling into question the long-term trend towards the polarization of knowledge characteristic of industrial capitalism. This reversal corresponds to a crisis in the logic of real subsumption, at least from the viewpoint of production. It translates into the recognition of a great number of new kinds of living knowledge, which are incorporated and mobilized by labor, as compared to formalized knowledge, which is incorporated into fixed capital and the organization of firms. It is in the recognition of this new hegemony of the knowledge of living labor in relation to the dead knowledge of capital that we can find the central framework for the hypothesis of cognitive capitalism. In sum, knowledge and intellectual labor are no longer, as Smith (1970 [1776], p. 14) suggested, "like every other employment, the principal or sole trade and occupation of a particular class of citizens". Knowledge begins to be dispersed across society, a diffusion that will become progressively more apparent at the very heart of organizations and the relation between firms.

This evolution has its roots in three processes at the heart of the social crisis of the Fordist wage relation:

- *The refusal of automised labor and the rise of demands for autonomy among waged workers.* This has caused a crisis in the scientific organization of labor, even if this evolution did not signify the end of neo-Taylorist research programs for the rationalization of labor (including intellectual labor.) This process of social transformation has moved beyond the limits of the factory and destabilized, in a more general manner, the ensemble of institutions of the disciplinary society, in Michel Foucault's sense, upon which industrial capitalism was founded.
- *The constitution of a diffuse intellectuality developing from the "democratisation of education" and a rise in the general level of training.* It is this new quality of labour power that has led to the rise of immaterial and intellectual labor and the calling into question of the kinds of division of labor and technical progress that characterized industrial capitalism.
- *The expansion of the collective services and insurances of welfare.* This process has long been interpreted as a single factor in the crisis of Fordism that reverses "the long-term tendency for the reduction of the social cost of the social reproduction of labor power" (Aglietta 1976, 326). In contrast to this position, we believe that the expansion of welfare also offered two essential conditions for the emergence of an economy based on knowledge and characterized by a logic that in many respects could constitute an alternative to the contemporary regulation of cognitive capitalism.

Two main considerations support this third claim:

First, the social conditions and the real driving force of an economy founded on knowledge are not found in the private laboratories of R&D centers, but in the institutions and collective productions of the welfare state (health, education, public research institutions, etc.) that result in the production of man by man (Boyer 2002, Monnier and Vercellone 2007). These are activities in which the cognitive and relational dimension of labor is dominant and could be the vector of an alternative model of development founded on the primacy of collective services provided outside the logic of the market.

Second, during the 1970s, the expansion of social wages (pensions, unemployment insurance) allowed for an attenuation of the constraints on the wage relation, and promoted independent mobility between different kinds of labor and activities (in contrast to current forms of précarisation). This corresponded to a freeing-up of time (subtracted from capital) that, from the point of view of the development of the knowledge economy, presented itself as an immediately productive force (to borrow Marx's description of the General Intellect). In this respect, it is

[10] Author: Carlo Vercellone.

necessary to highlight an essential argument concerning the genesis of the new capitalism. The installation of the conditions for an economy based on knowledge and the centrality of immaterial and intellectual labor precedes, both historically and logically, the genesis of cognitive capitalism. The transition towards cognitive capitalism is the result of a process of restructuring through which capital attempts to frame and control the collective conditions of knowledge production and stifle the emancipatory potential inscribed in the emergence of a diffuse intellectuality.

It is this context that explains much of how cognitive capitalism (under the aegis of finance capital and neo-liberal policies) has pushed towards a new process of desocialization of the economy, one that aims for two objectives (which also work against the development of institutions and social conditions that might have allowed for the efficient management of the knowledge economy): 1. the goal of enlarging the space of the market by progressively colonizing the institutions of the welfare state and the common goods represented by knowledge and life; and 2. the accentuation of precarity and individualization in the wage relation through a return to competition. This is because the reinforcement of economic constraints on salaried workers is an essential condition for controlling and putting back to work labor power that is increasingly autonomous within the production process.

In sum, we recognize that the contemporary regulation of cognitive capitalism depends on a logic that is capable of drawing from the collective sources of knowledge production. In order to better grasp the meaning and contradictions of the passage to cognitive capitalism we will now examine its relationship to the three levels of knowledge suggested above.

Changes in the division of labor and the wage relation

The principle source of value now lies with the knowledge mobilized by living labor and not in the resources of material labor. In fact, in the new capitalism, the labor of a growing part of the population increasingly consists in working with information, producing knowledge, and engaging in service relations based on the exchange of knowledge, communication, and the production of man by man. The importance of routine productive activity and manual labor, consisting in the transformation of material with the help of tools and machines, has given way to a new paradigm in which labor is at once more immaterial, intellectual and communicational. From this position, we can affirm that information and codified knowledge now constitute the principle material being transformed in production, and that tacit knowledge, which resides in the brain, stands as the principle tool allowing for the processing of this material, that is to say its transformation into new products and new knowledge.

The rise of the cognitive and immaterial dimensions of labor are at the origin of two major mutations in the organization of production and the wage relation, both of which break with the tendencies of industrial capitalism.

The first concern is the movement from a Taylorian to a cognitive division of labor. In other words, the structuring principle of the division of labor in the workplace moves from a technical logic based on the decomposition of tasks, to a logic of apprenticeship and specialization across a field of competencies (Mouhoud 2003). The efficiency in this form of labor division no longer rests on the labor time linked to different tasks, but on the cumulative nature of knowledge that assures the maximization of the capacity for learning and innovation. This evolution tends to break down the once strict borders between conception and execution, and allows the power of innovation to return to the workshop from which industrial capitalism had hoped to banish it. In sum, as Philippe Lorino suggests, "productive science is no longer 'encapsulated' in the form fixed by machines." It increasingly resides in the responsive nature of labor power, capable of sharing generic and decontextualized knowledge and open to multiple uses in different fields (Veltz 2000). This change in the wage relation brings new tensions to the surface. In particular, the new importance of knowledge incorporated in labor poses the unforeseen problem of measurement, since the productive cooperation of waged workers can develop autonomously in relation to the management of the enterprise. In this movement, the Taylorist control of labor tends to be replaced by the "control of

subjectivity" (Clot 2002). This demands that workers apply themselves to their labor by putting their creativity at the service of the enterprise as though it were a species of free and independent activity. This attempt to respond to the crisis of the real subsumption of labor, at the level of the labor process, with the subsumption of the subjectivity of labourers itself runs into two major contradictions. In reality, the control of subjectivity corresponds to a "double bind" which consists in demanding something and its opposite at the same time. It results in a "crack in the self" which threatens to affect the capacity for workers to learn and, as a result, the ability of enterprises to change. Moreover, the control of subjectivity is most often carried out by means of individual incentives that work against the collective cohesion of labor upon which the accumulation of knowledge depends.

The second change concerns the crisis of the Fordist-industrial model regarding bulk-productivity and the organization of time based on the clear division between labor and non-labor, the productive sphere and the sphere of reproduction (Vercellone 2007). The industrial criteria for evaluation of efficiency are also called into question: references to homogenous time are no longer able to either describe or organize labor, nor are they reliable measures of the value or costs of production. In particular, in the knowledge-intensive sectors of the economy, labor time directly devoted to productive activity during the official working day constitutes merely a fraction, and frequently not the most important part of the social time of production. Cognitive labor, due to its very nature, stands as a complex combination of the intellectual activities of reflection, communication, sharing, and elaboration of knowledge that are carried out as much outside as within the framework of immediately productive labor.

Let us note that the rise of the cognitive and immaterial dimension of labor is, potentially, at the origin of a double destabilization of the terms of the canonical wage relation on which the work contract rested in industrial capitalism:

- First, in the activities in which the cognitive and immaterial dimension of labor is dominant, the renunciation by the workers, in compensation for the wage, to any claim on the property of the product of their labor is no longer guaranteed. In cognitive labor, which is productive of knowledge, the result of the labor remains incorporated in the brain of the worker and thus inseparable from his person. Together with other factors this helps to explain the pressure exercised by enterprises in order to attain a strengthening of the rights of intellectual property and to re-enclose the social mechanisms at the basis of the circulation of knowledge, in a new phase of the primitive accumulation of capital.
- Second, in industrial capitalism's paradigm of energy expenditure, the wage was exchanged for the purchase by capital of a clearly determined and limited fraction of human time, inside the enterprise. Within this temporal framework the employer then had to find the most efficient ways to make use of this paid time in order, as Marx would say, to extract from the used value of labor power the largest possible quantity of surplus labor. Thanks to the expropriation of workers' knowledge and to the strict prescription of operational times and modes, Taylorism was in its day a response to this decisive question. In the Fordist factory, effective labor time, productivity and the value and volume of production appeared to be perfectly predetermined in a scientific way, even if in reality the assembly line could never have functioned without an important gap between prescribed and real labor.

But everything changes when work, as it becomes increasingly immaterial and cognitive, can no longer be reduced to a simple expenditure of energy carried out during a given time period. By its nature it implies both a qualitative dimension and an involvement of the workers, mobilizing their subjectivity and all their knowledge. Thus the effective time during which labor power is placed at the disposal of the employer exceeds and overflows the strict and official framework of the labor time foreseen by the contract, to the point where it encompasses all of social time. The result is a

rise of unmeasured labor, which is very hard to quantify according to the traditional criteria for its measurement.

Finally, in cognitive capitalism, the increasingly social and intellectual character of the labor determines, in our view, a displacement of the concept of productive labor as well as that of exploitation. Precisely due to the crumbling of the traditional frontiers between the sphere of reproduction and that of direct production, the exploitation of the use value of labor power is expanded to the totality of social time. [11]

The move towards a regime of permanent innovation and an international division of labor based on cognitive principles

The acceleration of the rhythm of innovation is another distinguishing trait of the transition towards cognitive capitalism. We are witnessing the installation of a "regime of permanent innovation" (Paulré 2000) in which the principal source of competition is no longer found in the incorporated knowledge technologies of fixed capital but in the abilities of a labor force capable of mastering the dynamics of continuous change and the ceaseless renewal of knowledge that quickly becomes obsolete.

Within this framework, a break occurs with the linear model of programmed innovation and the rigid hierarchy of the Fordist division of labor theorized by the model of the branch circuit. Indeed, the shift to a regime of permanent innovation goes hand in hand with a socialisation and decompartementalization of the production of knowledge. This development reinforces the hypothesis which holds that the essential trait of the shift from industrial to cognitive capitalism is linked to a radical change in the mode of knowledge production, the latter being more and more collectively distributed. This socialisation of knowledge production and innovation is manifest at several levels: within firms, through the decompartmentalization of R&D and production activities; at the level of inter-firm relations, where the network becomes the dominant model of organization and where knowledge production is characterized by an intensification of cooperative relations between enterprises, but also between enterprises and different research institutions; and finally, in the proliferation of "knowledge-intensive communities" outside the logic of the market, which constitute one of the most powerful expressions of a dynamic of distribution and production of knowledge that overflows the framework of the corporations, even to the point where it appears as an alternative form of organization with respect to both hierarchy and market as forms of coordination.

This evolution has a crucial impact of the location of firms and the genesis of international specialization. Also, the hegemony of intellectual labor and the primacy of cognitive labour in the new international division of labor are attested by the mobility of capital. The places currently in the most difficulty are often neo-Taylorist, since they are the most vulnerable to the extreme volatility of capital. In contradiction to this, knowledge-intensive activities are more territorially rooted since, in this case, it is capital that depends on a pool of intellectual and immaterial labor that pre-exists the activity of corporations and is most notably concentrated in cities. In sum, in the new international division of labor, itself based on cognitive principles, the long-term competitiveness of a territory depends increasingly on the "stock" of intellectual labor that can be mobilized in a cooperative manner. In this way, "the logic of the exploitation of comparative advantages in replaced by the

[11] In this context, the proposal of a social income or wage, to be guaranteed independently of employment and conceived as remuneration for the totality of social time contributed to the creation of wealth and value, assumes its full significance. From the standpoint of the development of an economy founded upon knowledge itself, the guaranteed social income or wage should be understood both as a collective social investment in knowledge and as a primary income for individuals. That is, as a social salary that stems directly from a productive contribution and not as a mere social security flowing from a redistribution of income (Monnier and Vercellone 2006). See also Lucarelli and Fumagalli (2008).

retention in a territory of monopolistic elements or absolute advantages over specific areas of competence" (Mouhoud 2003, 128). The emergence of cognitive capitalism goes along with a strong tendency towards the polarization of the geography of development between regions and nations. It threatens to condemn a certain number of developing countries that are least able to provide qualified labor, to a veritable "forced disconnection".

This tendency is growing stronger as the ability to patent living material and the biotech revolution now allow corporations in the North to appropriate freely the genetic resources and traditional knowledge of the South, replacing with "new commodities" the number of products traditionally imported by developing countries. Certainly, we are not faced with an irrevocable process. In the same way that certain phases of production can be relocated to developing regions, certain functions of control and conception have been relocated to the countries of the global South or the former Socialist bloc, such as India and China, taking advantage of an important reservoir of intellectual manpower. In this way a logic of delocalization based on the reduction of labor costs combines with the new logic of the cognitive division of labor (Lebert and Vercellone 2004).12

The foundation of intellectual property rights and the innovation and accumulation of knowledge: a contradictory logic?

The emergence of cognitive capitalism turns on its head the foundation of the intellectual property rights system and the regulation of research inherited from industrial capitalism. This development is favored by two major trends:

- The first relates to the erasure of the line between pure and applied research, which is most prevalent in the software and biotech industries. This development makes previously unthought-of forms of privatized knowledge and life a condition for the general expansion of criteria for what can be patented, most notably allowing for a blurring of the boundary between discovery and invention (Coriat 2002).
- The second relates to the way that, in an economy based on diffuse intellectuality, the usage of communications technologies destabilizes the system of intellectual property rights in numerous domains. At the same time, it favors the emergence of horizontal forms of cooperation and knowledge exchange based on non-market logic, such as the example of Libre / Open Source software.

The question of the reinforcement and extension of the system of intellectual property rights into the domains of pure research and even life itself are the decisive aspects of the contemporary regulation of cognitive capitalism.

The reformulation of intellectual property rights is justified by the argument that in knowledge-intensive sectors of the economy, costs are fixed and centered on investment in R&D. In reality, however, these policies often correspond to the creation of *positional rents* and a strategy focused on the exploitation of public-sector research by the private sector and the logic of the market. This is much more important than the claim that patents are the best way to stimulate the production of knowledge since this claim has never been verified. In fact, it is more often the case that the enforcement of intellectual property rights acts as a brake on innovation and the cumulative aspects of the knowledge-based economy.

[12] One can even ask whether, contrary to a widespread belief, the case of China as the new industrial workshop of the world is not a successful strategy of development allowing for the deep destabilization or even the reversal to its advantage of the logic of absolute advantages structuring the new international division of labour.

Three main arguments confirm our interpretation:

- The majority of fixed costs for research are related to R&D centers. In fact, the conditions of research and innovation are increasingly collective and ultimately depend on the quality and the density of labor power produced by the public education system. Moreover, a large number of patents held by corporations are not the immediate result of their research efforts, but are developed from research done at public institutions or, in other cases, come from preying on the knowledge of traditional communities (Shiva 1997).
- It is erroneous to act as though the inventions and patented "discoveries" would not have seen the light of day without the protection of patents (Mansfield 1986). Moreover, many patents have no other function than to impede rival research and innovation in certain areas of activity. This strategy, called "saturation" or "flooding," relies on the multiplication of patents, which sometimes cover basic forms of knowledge. It results in "situations of excessive privatization, in the sense that it affects even the most minor uses of knowledge, slowing the rhythms for creating new knowledge and the creation of dominant positions that have anti-competitive effects" (CGP 2002, 155).
- There exists no proven correlation between the existence (and breadth) of intellectual property rights and the stimulation of innovation. In fact, the decisions to re-enforce intellectual property regulations in the United States during the 1980s reduced innovation (Clement 2003) and translated into a decline in R&D in the industries and corporations that were most active in patenting their work (Bessen and Maskin 2000.) At the same time, in the pharmaceutical industry, the principle reason leading to demands for increased production was the need to increase profits in a context marked by a declining rhythm of innovation since the mid-seventies.

The reinforcement of the system of intellectual property, even as the race to patent is seen as a question of survival for some corporations, in many ways constitutes a blockage of circulatory movement for the production of knowledge.

2.3. The recent debate on cognitive capitalism[13]

Following this line of thought Lucarelli and Vercellone (2013) proposed to different scholars the following set of research questions: in what sense can we say there has been a shift from industrial capitalism to a capitalism grounded on knowledge and the immaterial? How is the evolution of the relationship between knowledge and power transforming the production system? What kind of transformation is taking place in the logics of consumption? Are the industrial innovations tendentially based on the appropriation of the digital revolution sustained by *open science*?

One of the essential elements in the growth of the cognitive dimension of labor is linked to what has been defined as the "feminization of labor" (Morini, 2007). What are the meanings and the stakes of this mutation and, in particular, what is its impact on the new segmentation of cognitive labor? And which new and unique articulations are today assumed by racialization and congnitization of work?

Some theorists of cognitive capitalism highlight the deep contradictions which oppose its basic logics to the development of an economy based on knowledge. What are the case studies that may shed light on the contradictory relationship between knowledge-based economy and cognitive capitalism? Under what conditions can knowledge represent a fundamental valorization element in contemporary capitalism? What is the role of universities in cognitive capitalism, especially in newly established global forms that involve multi-campus transnationalism and forms of open science and education? And what are the consequences of the neo-liberal reforms of the higher education?

[13] Author: Stefano Lucarelli.

Miguez and Sztulwark (2013) defend the idea of a rupture in the long-term dynamics of capitalism, linked to the passage of industrial capitalism to a new historical system of accumulation. They propose a historical reading of this dynamics around two main aspects of the accumulation of capital: 1. the creation of value (the relationship between work and means of production) and 2. the appropriation of value. A knowledge-based economy presents a paradoxical element: on the one hand, the appropriation of innovation rents requires an institutional frame leading to the collective learning to capital accumulation. On the other hand, the development of social learning may depend of a public re-appropriation of this rent.

We find the same conclusions in Atsushi Naito's contribution (2013), where the author offers an examination of the macroeconomic defect of cognitive capitalism from a post-Keynesian perspective. Starting from the seminal work proposed by Fumagalli and Lucarelli (2007) - that shows how the increasing polarization of income distribution risks penalizing not only aggregate demand, but also the knowledge-learning process - Naito investigates both the weakness in demand as primary cause of macroeconomic instability and the role of financialization. Finally, he focuses on affective labor and examines its function in the macroeconomy. In cognitive capitalism, affective skills are becoming more and more important, but affective labor is connected with non-regular employment and a low level of wages.

Following a Foucauldian approach, Antonella Corsani (2013) describes the figure of *salaried-rentier* in the "subjectivity factory". From a neoliberal perspective, as Foucault (2004 : 149) wrote, "social policy will have to aim not at the redistribution of income, but at the increasingly generalized capitalization of all social classes". The global finance transforms both the nature of wage and the subjectivity of waged workers. Individual capitalization has replaced solidarity systems and produced a new form of alienation. In a certain sense, Yann Moulier-Boutang (2013) continues Corsani's discourse. He does so by deepening one of the most interesting examples of social forces which resist on the micro-political level, i.e. the open source, open data, open culture movements. This contribution aims at showing that no bottom up innovation is possible without the creation of new institutions and new rights. Open source is similar to the *terra nullius* principle. In human history, every time the *terra nullius* principle was revocated, the members of traditional communities have been harmed and deprived of their rights to use land, natural resources, crafts, language, and culture. For the future, Moulier-Boutang sustains the necessity of new struggles that may affirm a *scientia nullius* principle against the new enclosures. In his discourse, the notion of cognitive capitalism seems to lose its capitalist features and begins to assume the forms of a new society based on the socialization of knowledge(s).

In this context an important debate emerges: according to Moulier-Boutang (2011: 58), a stable regime of cognitive capitalism may be established. The spread of positive externalities in the globalization serves to balance out the negative externalities, in the hopes of eliminating the sources of lasting imbalance in the growth of knowledge production. Positive externalities may be captured and then put to value in the creation of private profit.

However, a different conclusion may be reached: the negative effects produced by capitalist command on knowledge with regard to cognitive labor-force, in fact, reduce the diffusion of knowledge itself. This process may be defined as the tragedy of the anti-commons as produced by knowledge privatization. Moreover, this privatization occurs within a financilized monetary economy of production (Fumagalli and Lucarelli, 2011). As a consequence, the system's instability increases. On the other hand, if the capitalist command on knowledge decreases – in so doing favoring the production of collective goods – then the specifically capitalist character of contemporary production and consumption would be destabilized (Vercellone, 2010, Monnier and Vercellone, 2011, Lucarelli and Vercellone, 2011).

Moreover, after the Great Recession, also American scholars discover the relevance of placing the concept of cognitive labor under examination. Prominent scholars in the fields of digital labor, humanities, and education have been involved in the discussion (see for example the contributions collected in Peters and Bulut, 2011).

George Tsogas (2013) original and attractive analysis deals with the social movements that show their opposition to contemporary capitalism. He considers that the London (commodity) riots of August 2011 represent a warning: consumption and cognitive capitalism are asphyxiating in the structures and norms of industrial capitalism that are still in place. We would also propose the following notes: during the London riots people expressed a demand of collective consumption goods that are at the same time collective investments (i.e. personal computers, mobile phones, smart phones etc...). It was the revolution of consumers without purchasing power to obtain the possibility to control the collective production inputs that populate shop-windows. This case shows that new "subjectivity factory" – where neoliberalism imposes the replacement of consuming subjects with "self-entrepreneurial" subjects – is not necessarily the unique alternative. It also demonstrates that the role of consumption in cognitive capitalism is not always easy to understand.

In their paper, Fumagalli and Morini (2013) aim at analyzing the link between "productive" social reproduction and the central role played by precarity as a generalized, structural and living condition. Social (re)production is at the same time a collective and individual activity, since it simultaneously deals with individual learning and social relations.

The way through which social reproduction is valorized is the rising of the "precarity trap" that the authors define as "the result of the absence of policies promoting social security and of the pressure to keep brains under control".

Anna Curcio (2013) takes into account the processes of racialization of cognitive labor. In her contribution, race and knowledge are assumed as specific, if different, devices of contemporary capitalist valorization, as tools of organization and regulation of the labor market. Curcio tells the vicissitudes of a young Dominican nurse in the Italian job market, where the *racialized gender* is articulated with knowledge as simultaneously agent of inclusion, although subordinated, and terrain of marginalization and discrimination. Knowledge, just as race, is turned into a machine of segmentation and subordination: it ceases to describe talent, skills, and abilities and becomes instead the measure of exploitation. Emphasizing the articulation of race and knowledge within cognitive capitalistic production allows us to sharpen the analytical tools through which labor transformations can be read to break the silence of new possible social relations.

The new generation of overworked, in-debt an unpaid cognitive workers, without whom cognitive capitalism cannot survive, is also at the core of Francesca Coin's contribution. Coin (2013) discusses the neoliberal reform of higher education within the theoretical framework of Marx's Grundrisse. She highlights the relationship between the economic crisis and the neoliberal reform in education by considering assessment as its distinctive feature, and its root to be the law of value itself.

2.4. Conclusion[14]

The emergence of cognitive capitalism corresponds to a rupture in a number of tendencies that formerly characterised the regime of the production and regulation of the *knowledge economy* that issued from the first industrial revolution. This transformation could be characterised by an almost term-by-term opposition of the pillars of the "new capitalism" and those of industrial capitalism:

- Knowledge and the immaterial become the principle source of value, replacing the criteria of output productivity and of direct labor time proper to industrial capitalism;
- The varieties of knowledge incorporated in labor take a preponderant place with respect to those incorporated in fixed capital, pushing for a recomposition of the tasks of design and execution, the activities of manufacture and innovation;

[14] Authors: Jean Marie Monnier and Carlo Vercellone.

- A regime of permanent innovation replaces the sequential regime of industrial capitalism, a development going hand in hand with the installation of a new international division of labor founded on cognitive principles;
- An increasingly close intertwining of basic and applied research, which occurs particularly in the software and biotech industries, gives rise to a new paradigm of innovation. Its social output depends closely on the system of intellectual property rights associated with it.

These major changes in the wage relation and in the regime of knowledge production are associated with new mechanisms of regulation, which in many domains block the circulation of knowledge and the collective dimension of knowledge accumulation. In particular, precarious labor conditions and the individualization of the wage relation, the destabilization of the collective services of the welfare state and the excess privatization of knowledge linked to the reinforcement of intellectual property rights tend to make the current regulation of cognitive capitalism into a potential obstacle to the development of a knowledge-based economy. Yet cognitive capitalism, as was formerly the case for industrial capitalism, can be articulated to quite different modes of regulation in time and space. This is one of the central questions, which will be at the heart of future developments in the research program around the thesis of cognitive capitalism.

3. Hypothesis on commons and alternative currency for the Task T3.4[15]

A critical analysis of the knowledge economy, and of the increasingly central role played by cognitive labor in contemporary capitalism,is developed in this first deliverable as a theoretical as well as empirical necessary premise for the research project which will brought to the foreground in the next deliverable, concerning respectively commons and alternative currencies.

Thus, such an analysis allows us to sketch an answer to a crucial question: "*What are the social and monetary conditions that are able to foster the development of alternative productive forms both with regard to the public and the private sector?*"

In this perspective, the investigation of the complex relationship which links money and commons needs to be situated against the background of a critique of Hess and Ostrom's theories of the commons (Ostrom, 1990, Hess e Ostrom, 2007). In such theories, in fact, the analysis of labor as well as money transformations are – curiously – completely absent. This lacking can largely be explained by the fact that the dominant conception of the commons is grounded on two main postulates. On the one hand, it rests on a naturalist and a-historic vision of the commons.in continuity with the Samuelsonian theory of collective goods and markets' failures, this vision characterizes the nature of different goods only by referring to criteria such as rivalry and exclusivity (Laval, 2011). The novelty lies in the introduction – beside public goods (non-rival and non-exclusive) and pure private goods (rival and exclusive) – of a new category, which associates rivalry to non-exclusivity, as in the case of commons. On the other hand, these theories implicitly accept one of the foundational postulates of classical economic theory, namely the social and economic neutrality of money conceived of in terms of a simple technical tool whose function is to facilitate exchanges.

Such unresolved theoretical problems require – as we will see – the introduction in the theory of the commons of the structuring role of money and of the evolution of the organizational forms of production in the age of knowledge-based economy and informational revolution. In particular, we will need to start from an endogenous and active conception of money – as proposed by the theory of monetary circuit – as the crystallization of a complex social and economic relation, which is grounded in the profound asymmetries marking both the access to money and its circulation.

On this basis, we will be able to characterize a dynamic approach of the *common*, an approach in which the issue of money and the transformation of the division of labor plays a central role.

The analysis of the role of money and cognitive labor in the knowledge economy will allow us to show that there is no good such that, given the natural traits linked to its use-value, it is not *ipso facto* classifiable by the conventional economic theory into only one of the economic spheres (the public, the private or the common) and into a corresponding form of cooperation and appropriation of the labor's product.

The common can concern every kind of good even if this does not absolutely mean that regulatory particular problems, which emerge in the management of a certain good, should be overlooked.

[15] Author: Carlo Vercellone.

3.1 Algorithms and cryptocurrencies[16]

The use of technology is the fundamental axis of the metamorphosis caused by the fusion of life and labor in the knowledge economy.

The case of today's cryptocurrencies, whose creation is based on software, algorithms and network technologies that, at first glance, seem autonomous from global financial institutions and national and private banks, highlights certain ambiguities and the mixing of genres. Without going into a detailed analysis,[17] the Bitcoin project (BTC) is based on an anonymous peer to peer production of money and is made relatively safe through a cryptography based on specific public algorithms[18]; its code is under an open source license and it uses the principle of network computing. These aspects put it into the same category as great cooperative projects and collective socio-technological innovations that come from the hacker community, just like Linux.

Due to its open source characteristics, BTC gives way to forks, derivations that allow the implementation of other digital currencies; there are around 40 now. Probably, the goal at the origins of BTC were to prosper as a tool of exchange outside the control of financial institutions and to free transactions from commissions, exactions and market limits.

This isn't exactly what is happening. In this phase, instead, this cryptocurrency is above all used as an instrument of speculation and accumulation. The convertibility with classic currencies (starting with the Yuan and US Dollar) and a production that is algorithmically limited[19] in quantity and time reproduce, in some ways, the role of gold as reserve currency. The metaphor also extends to the terminology used and to a certain gold rush mythology that is based on that of videogames. Like the extraction of gold, the today production of BTC style cryptocurrencies (not by chance defined as "mining") requires a great quantity of electrical energy and computational power, which are then respectively consumed and produced by powerful PCs, derived from those dedicated to gaming, to work at maximum regime.

The key criteria of BTC is found in the principle of an extraction of currency proportional to computational power but without having any of the characteristics that would be inscribed in the social code of an algorithm for a currency of the common. This is precisely why the experiment can't break free from an innate capitalist immutability based on the guiding role of profit in the distribution of labor and social organization. BTC merely shifts the register. Leveraging technology, it is gaining support within the hacker and P2P movements. For the moment, it rather seems to be drawing them into the sancta sanctorum of finance, massively training hackers for trading, proposing a speculative race through an algorithmic production of "autonomous" money. Today, the technical abilities of hackers constitute an advantage but the computational power, and therefore hardware investment, becomes more and more preponderant. This is already the case of BTC, which is now only minable with special, dedicated computers that cost (tens of) thousands of dollars. This is without taking into account digital corporations, new or old, that are "inspired" by this process to probably launch their own currencies in the future.

Despite this, the experience of BTC has the merit of having opened the way and the debate over the possibility of creating truly autonomous digital money with the scope of creating a currency of the common.

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[16] Authors: Giorgio Griziotti and Carlo Vercellone.

[17] See: http://www.dyndy.net/2013/04/bitcoin-ends-the-taboo-on-money/

[18] For example, SHA256 is a cryptographic hash function conceived by the American NSA and used in Bitcoin. Other digital currencies like Litecoin and Feathercoin use the Scrypt algorithm.

[19] Bitcoin's algorithm is conceived for a maximal and decreasing production of 21 million units of which 75% will be emitted by 2017. Instead, Litecoin foresees the production of 84 million units.

We assist to the first attempts to conceive a cryptomoney discouraging the speculation or, more ambitiously, to implement a money of the common. Projects like the Freicoin including a demurrage fee that, in theory should ensure the circulation and support the sustainable investment. Other attempts, like the openUDC or ucoin in France, try to link the cryptomoney generation to the implementation of a universal basic income.

An alternative digital social currency (that sometimes European social movements called *money of the common* or *commoncoin*) should take into account three essential elements, hardwired into its algorithms and its implementation:

- The impossibility to accumulate and thus impeding it from becoming the object of speculation. Consequently, it must lose some of its value over time. It would therefore be a *currency that melts down*, a "demurrage charged money".
- Mitigating workers' dependency on the economic restrictions that force them to sell their labor power and therefore wage relations themselves; thus reducing precarity.
- Allowing, on these premises, for more free time and resources for developing alternative forms of cooperation based on the common pooling of knowledge, production and, in any case, on exchange networks that exclude the logic of profit. Participation in networks where a currency of the common circulates implies adhering to these principles, whether participants are individuals, businesses or institutional subjects, as in the case of certain alternative currency models experimented with on a local level.

Task 3.4 "reviewing the most significant experiences of alternative complementary and social currencies" will investigate how such principles could be enforced within the framework for implementing and federating digital complementary currency.

3.2. Hackers and makers and the *cryptomoney* space of confidence

Even if a perfect algorithm could be found in order to prevent speculation and fiat money convertibility, a *commoncoin* should be practical to use and conceived to obtain a large confidence.

Today they are on the different and extended cooperative production environments. Often these activities are managed following the capitalist rules, e.g. the well-known eBay or Airbnb applications, in some other cases they are more autonomous and less oriented to capture profit and income, e.g. the free and open software implemented in the hackers' communities or the Wikipedia site. However, both these categories are based on immaterial goods as knowledge and immaterial services, exchanges and shares.

Since the first years of the new century the new "Makers" movement, an engineering-oriented networked cooperative community, announce a geolocalised tecno-social transformation of the material production and manufacture. A perhaps more "physical" cooperation in the makerspaces like the fab-labs, where "makers" conceive and use "open hardware" electronics, robotics, 3-D printing and Computer Numerical Control (CNC) tools.

In 2005 the RepRap (short for replicating rapid prototyper) project was born in Bath by dr. Adrian Bowyer to develop a 3D printer that can print most of its own components.

Even if Adrian Bowyer is far from being a convinced Marxist he wrote in the Reprap presentation paper titled "Wealth without money" :
"Karl Marx and Frederick Engels wrote in the Communist Manifesto that, 'By proletariat is meant the class of modern wage labourers who, having no means of production of their own, are reduced to selling their labour power in order to live.' This diagnosis is essentially correct;… So the replicating rapid prototyping machine will allow the revolutionary ownership, by the proletariat, of the means of production. But it will do so without

all that messy and dangerous revolution stuff, and even without all that messy and dangerous industrial stuff. Therefore I have decided to call this process Darwinian Marxism..."

Arduino, a 10$ single-board micro-controller, conceived in Ivrea[20], is the most popular brick of "open hardware" allowing, with many other low cost components, the General Intellect to reappropriate emerging socio-technological sectors as "Internet of things" or RepRap replications of machines and also a new revolutionary auto- production of the "The long tails of things[21]" .

The current transformation of electronic money from an autonomous tool into financial speculation explicitly demonstrates the importance and political centrality of algorithms in exploiting the overall cooperation.

The OpenUdc [22] is a non-speculative cryptocurrency project based on a universal digital income principle. UDC will not be convertible however will "enables to buy digital goods only, not real goods". This could be an interesting experiment but today we need to find out the environment where a non-speculative *commoncoin* could obtain a confidence and be massively adopted.

Hakers & Makerspaces are not the natural background to introduce the *commoncoin*? Once this process is set in motion will other sectors not join the movement and create a real exodus from capitalistic finance?

In any case, the *money of the common* experiment should be not only limited to searching the best algorithm and rules but also politically trying to connect andto integrate these procedures with the digital or material peer2peer production on the net and worldwide.

[20] For those who know the historical and political role of the Olivetti Company in Ivrea as a leader of innovation and progressive capitalism in the "thirty glorious" post WW2 could be interesting to know that Arduino has been conceived by a group belonging to the Interaction Design Institute, founded by Olivetti (and Telecom Italia) in Ivrea (and is the name of an Ivrea bar where members of the project was used to meeting each other).

[21] http://en.wikipedia.org/wiki/The_Long_Tail_(book)

[22] http://udcproject.wordpress.com/presentation-of-udc-in-english/

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