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INFORMATION AND KNOWLEDGE SOCIETY AND NETWORK ECONOMY: FROM EUPHORIA TO REALITY

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Abstract: This paper examines the future of industrial capitalism, and more precisely the rise of the new information and knowledge society (IKS) and the development of the information network economy. We propose an interdisciplinary approach connecting economic analysis and information and communication sciences. First, we describe the euphoria over the new IKS. Then, we show that information networks lead to new economic laws, but not to a new civilisation. Even if new information technology accelerates changes, we must distinguish between Utopia and reality. Beyond euphoria we show the need for new critical approaches concerning technology, information and knowledge. We can thus explain the mechanisms of various myths of the IKS.

Key words: Information, Knowledge, Network, Information and Communication Technology.

This paper examines the future of industrial capitalism: we live in a period of important technological changes and the new information and knowledge "paradigm" has become the fundamental reference. We propose an interdisciplinary approach connecting economic analysis and information and communication sciences to analyse this new paradigm. The euphoria over the new Information and Knowledge Society (IKS) will be described (1). The analysis of the information network economy (2) will show that the logic of the decentralised and externalised information networks is spreading to the whole industrial organisation. But we shall argue that beyond the existence of new economic laws concerning networks and information, we are not entering a new civilisation. We are entering a new phase of capitalism that justifies the development of new critical approaches (3). Even if new information technology accelerates changes, we need to distinguish between Utopia and reality.

1. Euphoria: the information society...

"Rupture or continuity ?" some members of the Théry committee (in charge of preparing the information highways in France; Théry, 1994) put this question to M. Cartier (1997). His answer was in favour of a rupture and even a change of civilisation. According to various contemporary authors, the paradigm of the IKS characterises the present period. The

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technological innovations are indisputable (digitalisation, development of information storage and processing capacities...). These technological aspects are the base of the euphoria in favour of the IKS.

Towards a new civilisation?

Premises: the emergence of a "post-industrial" society

Contrary to generally accepted ideas, the information society is not the result of a brutal swing and a sudden acceleration. The infrastructures of the information networks (telecommunications, in particular) were developed thanks to considerable investments in the 1960s, 1970s and 1980s. Moreover, the "global information society for all" (Bangemann, 1994) has been prepared by futurologies and analyses initiated as early as the 1960s. Indeed, while the tertiary sector became dominant in the industrialised economies - in the United States, services already represented 58,1% of the civilian labour force in 1960 (75,3 % in 2000 - source: US Department of Labor) - reflexions appeared on the economic and social changes accompanying the growth of services. Many terms described the same phenomenon : for Z. Brzezinski, it is the "technetronic" age, for R. Dharendorff the "post-capitalist" age, for A. Etzioni the "post-modern" age. D. Bell was the first to introduce the term of "post-industrialist" society in the sixties. According to M.U. Porat (1978), the essential difference between an agricultural or an industrial society and an information society is that the central point of the economic activity moves from the production of physical objects to the processing of data and symbols. Thus, the importance of information and knowledge began to be emphasised very early. In 1962, F. Machlup published his famous book on *The Production and Distribution of Knowledge in the United States*; in 1969, P. Drucker analysed the *knowledge workers*.

From the electric age to the Third Wave and the symbiotic man

"In our time, the sudden shift from the mechanical technology of the wheel to the technology of electric circuitry represents one of the major shifts of all historical time" (McLuhan, 1962, introduction). One of the main original theses of McLuhan was to consider that technology acts on the modes by which the brain processes information which affects the senses and finally the whole of society; the electric age is thus upsetting the mode of linear treatment related to the visual world of the typographical and mechanical age.

For Alvin Toffler, "The Third Wave" or "the knowledge-based economy" rests on the communication and the dissemination of data, ideas, symbols. "Power will increasingly hinge on knowledge - and the most powerful of all will be software about software, knowledge about knowledge" (Toffler, 1999, p. 28). The whole economy is changed: goods and services become modular; the control of standards becomes crucial; in companies, the hierarchy "is flattened" or eliminated; the organisational units multiply, diversify and the volume of information to be created and communicated increases.

J. de Rosnay (1995) describes the emergence of a new form of life, a biologic and data-processing supra-organisation, called "cybionte" (from *cyb*, cybernetics and *bios*, biology); "the symbiotic man" will, one day, be able to communicate in real time with the networks of the cybionte. A futuristic panorama is proposed, with optimism: "Sharing, solidarity and harmonisation of time in the respect of differences will be the new rules, the new way of life of the symbiotic man" (de Rosnay, 1995, p. 381, our translation). Among the golden rules of the symbiotic man, we can notice the insistence on collective intelligence, on co-evolution, on regulation by a double control going down (hierarchical or *top-down*) and up (democratic or *bottom-up*), on the "fractalisation" of knowledge (to produce and transmit knowledge, one does not need a linear and encyclopaedic knowledge, but a fractal and hypertextual approach).

The new economy

The concept of new economy is convergent with the idea of a new civilisation: "When we talk about the new economy, we're talking about a world in which people work with their brains instead of their hands. A world in which communications technology creates global competition (…). A world so different its emergence can only be described as a revolution." (Browning and Reiss, 2002). The emergence of the new economy is often dated 1992-1993. In September 1997, K. Kelly, *Wired* executive editor, defined the *New rules for the New Economy* which he considers to be a Network Economy: the laws of connection, of "plentitude", of exponential value, of Tipping Points, of increasing returns, of Inverse Pricing (the best product gets cheaper each year), of generosity (the most valuable things are free), of allegiance (a man is no longer inside an organisation with clear boundaries, but on a network), of devolution (the network economy behaves ecologically: organisations must devolve and new activities must appear), of displacement (of materials by information and knowledge), of "churn", of inefficiencies (the productivity paradox is not a problem because to measure productivity is significant only in the old industries, not in services).

D. Tapscott (1996) points out that the new economy is a "knowledge economy", a "digital economy" where everything becomes "virtual", a "molecular" and "networked" economy, an economy which tends to be "disintermediated". Most authors insist on the globalisation of business and revolution in Information and Communication Technology (ICT).

Main characteristics of euphoria

The technological push leads to optimism and euphoria: ICT and globalisation become synonymous with freedom and/or co-operation, networks transform the whole economic and social organisation, knowledge is the core value of the new society.

Technological push: Being digital or "Bits are Bits"

For the founder of the Media Lab., everything rests on the passage from a world based on the atoms ("GATT is about atoms", Negroponte, 1995, p. 11) to a world of "bits", and digitalisation leads to exponential changes. An enthusiastic vision of a new world follows: "Like a force of nature, the digital age cannot be denied or stopped. It has four very powerful qualities that will result in its ultimate triumph: decentralizing, globalizing, harmonizing, and empowering." (Negroponte, 1995, p. 229).

Globalisation, co-operation: anything, anytime, anywhere for everybody

The global village announced by M. McLuhan (1962) becomes a reality. Capital is increasingly global, companies are organised in networks, researchers communicate by Internet and the media broadcast by satellite… The famous expression "anything, anytime, anywhere", the slogan of Sun microsystems, is no longer a dream. Moreover, globalisation, supported by the networks, can be regarded as a condition of co-operation on a planetary scale. Cyber-democracy (Lévy, 2002) is linked to globalisation.

"The Network is the Message" (Castells, 2001)

Even if M. Castells cannot be regarded as a utopian, he emphasises the emergence of "global informational capitalism" (Castells, 1996): capitalists do not exist any more as a class but are replaced by a collective capitalist, a "meta-network" of capital goods. The concept of "network society" is one of the major aspects of the "informational society": according to M. Castells, a social structure based on networks is a very dynamic and open system and networks favour innovation and globalisation in informational capitalism.

From interactivity to collective intelligence

According to Derrick de Kerkhove (1997, p. 20), the new ecology of the networks is founded on three principal conditions: interactivity, hypertextuality and connectivity, also called "webitude"; it is "the mental link between people, or network industries (industries of the intelligence)". The idea of "knowledge networking" (C. Savage) is found in many publications on knowledge management and in various official reports. Al Gore (1999) proposed a "Digital Declaration of Interdependence" which must include the creation of a Global Knowledge Network. Ideas, knowledge and Collective Intelligence constitute from now on "the wealth of nations" (Lévy). The euphoria over the information society leads to the euphoria over the knowledge society.

The emergent information and knowledge society: American, European and Japanese programs

ICT "are generating a new industrial revolution already as significant and far-reaching as those of the past. It is a revolution based on information, itself the expression of human knowledge." (Bangemann, 1994, p. 3)

France was very advanced in the field of the official texts if one considers the report of Simon Nora and Alain Minc "L'informatisation de la Société" (1978). However, the true launching of the information society issue from the political point of view took place at the beginning of the nineties with the metaphor of "information superhighways" developed by Al Gore. In September 1993, Al Gore and Ron Brown announced the National Information Infrastructure (NII) initiative. In Europe, the Bangemann report recommended the liberalisation of telecommunications and proposed pilot applications. This report and other documents of the European Commission avoided the metaphor of "information superhighways" and chose the notion of "the information society - new ways of living and working together" (Bangemann, 1994, p. 3) in order to insist on the consequences on society of using ICT.

From the middle of the nineties various programs were developed and reports written: the Digital Economy reports in the United States, the report of the Digital Opportunities Task Force of the G-8 in 2001, the initiative *e*Europe since 1999, the Japan "IT Basic Law" and "*e*-Japan strategy" and many other reports by major institutions (World Bank, Department of Trade and Industry in the United Kingdom, OECD...). The World Summit on the Information Society in Geneva in 2003 and in Tunis in 2005 is significant of the interest in the IKS issue shown by the political world at the international level.

In conclusion of this first part, euphoria seems pertinent and many important official programs confirm the exponential development of the information society. Moreover, the new information network economy emerges, with new economic laws…

2. ... and the information network economy

The concept of information appears in the 1930s-1940s with two main approaches: the economists' approach dominated by the work of Hayek and the engineers' approach with the "mechanics of information" based on Shannon's theory. The engineers' approach has been decisive for the technological development of the telecommunications industry. Permanent exponential progress in telecommunications and computing industries is leading to the information network economy. Generally, economic analyses are focused on new economic rules correlated with the development of information networks, but it is important to go further by studying the types of networks: since the 1980s, a new model of telecommunications network architecture has been developed. This new architecture favours a new industrial organisation model which is shaping the IKS.

From Hayek to Shannon's mechanics of information

Information is often conceived as data which are transmitted and knowledge appears as the prolongation of information with a multiplicative factor. This approach, that we call the "mechanics of information", can be found in different economic works, but is more precisely introduced by E. C. Shannon.

Hayek: knowledge, information and economic efficiency

From the point of view of the economic theory, the first works where information (knowledge) appears are those of Hayek and Lange (market economy versus planning). Hayek (1936) considered that the economic theory of his time did not explain the process of acquisition and communication of knowledge which permits economic equilibrium to be reached. He showed that, since a person cannot know everything, the problem to be analysed concerns the division of knowledge, "which is quite analogous to, and at least as important as, the problem of the division of labor. But, while the latter has been one of the main subjects of investigation ever since the beginning of our science, the former has been as completely neglected, although it seems to me to be the really central problem of economics as a social science." (Hayek, 1936).

If Hayek introduced an interesting approach concerning the division of knowledge, most economists have essentially developed the ideas of price-information and efficiency: the concept of informational efficiency associated to the assumption of rational anticipations is the reference (of course, various writers have shown that prices cannot perfectly reflect all available information and the efficient market hypothesis has been re-examined). So the dominant economic paradigm has focused attention on information, price and efficiency, and from this point of view is convergent with the idea of the "mechanics of information": information is, above all, data that can be coded through a series of bits.

Shannon's information theory

According to C.E. Shannon (1948, p. 380), a communication system essentially consists of five parts: an information source, a transmitter, the channel, the receiver, the destination. Following Shannon, telecommunications engineers have used the term of transmission. "The transmission function corresponds to the remote transport of the transmission signals. The signals to be transmitted, coming from the local area networks, are initially treated, if an adaptation of the support appears necessary. They are then transmitted, in an electric or optical form, by using guided or radiated transmission, from a transmitter towards one or more receivers" (Ducastel, 1993, p. 213, our translation). In this context, the problem of the information theory is a typical engineering problem since it consists in transmitting a series of bits and improving transmission performance. This question has found more and more efficient solutions with the exponential rise of telecommunications and computing technologies.

"Telecommunications" transmission and the exponential rise of telecommunications and computing industries: toward knowledge and intelligence

In the last decades, the double revolution of data processing and telecommunications occurred: Moore's law underlines the doubling of the capacity of computers every 18 months, and optical fibre is becoming essential in telecommunications: an optical fibre, today, makes it possible to convey between 2,5 Giga Bits/second (Gbps) and 10 Gbps, equal to 100,000 simultaneous telephone ways. The DWDM (dense wavelength division multiplexing) allows the optical fibre systems to transmit the equivalent of 90,000 volumes of encyclopaedia in one second… and progress is permanent and continues everyday…

"Telecommunications transmission" refers to this permanent technological progress which permits the transmission of more and more bits (anything, anytime, anywhere…).

Obviously, the IKS is a reality from a technological point of view, in the "telecommunications transmission" efficiency perspective… The pyramid below indicates a constant progression. We would pass from data to information and

knowledge. At the top of the hierarchy, we would find intelligence or even wisdom which is "knowledge with insight" (Skyrme, 1999, p. 47).

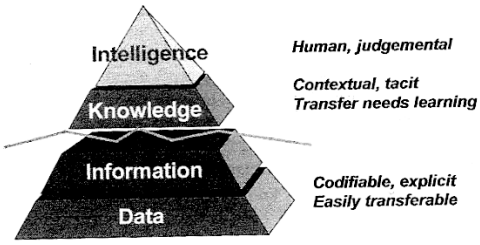

Diagram: A "knowledge hierarchy", from D. J. Skyrme (1999).

We shall show the necessity of a critical analysis of this presentation, but, before that, we have to consider another reality: the new IKS is based on a new specific "economic good", i.e. information, and on a new infrastructure which is changing many economic rules: information networks.

The information network economy: new economic rules, new economic laws

Information networks are the fundamental element of the IKS. We define an information network as follows: an information network treats, transforms or transports information; it includes telecommunications, computing and audio-visual services. Information is "a particular kind of economic good, different from a piece of coal or a working hour" (Jonscher, 1984, p. 14, our translation). It is infinitely renewable and not even depreciated with use (Porat, 1978). According to C. Shapiro and H. R. Varian (1999, p. 3), "essentially, anything that can be digitized – encoded as a stream of bits – is information". Information has very specific economic characteristics: in particular, it is costly to produce but cheap to reproduce (high fixed costs but low marginal costs); most costs are sunk; information is a experience good every time it's consumed.

"The old industrial economy was driven by *economies of scale; the new information economy is driven by the economics of networks"* (Shapiro and Varian, 1999, p. 173). So networks have a fundamental characteristic, called "network effects" or "network externalities" or "demand-side economies of scale". When the size of a network grows, the utility of the consumers also grows. Metcalfe's law stipulates that the value of a network rises up in proportion to the square of the number of users. Katz and Shapiro (1986) emphasised that the dynamics of industries subject to network externalities is basically different from that of conventional industries.

In preceding works (Badillo, 1987, 1998), we also underlined various paradoxes of the network economy: as the network extends, the unit cost decreases exponentially; moreover, by studying the cost function, we showed that, as the network develops, the use ratio decreases (the capacity progresses geometrically while the use progresses arithmetically). The economic logic is thus completely reversed. Usual logic, in particular, founded since Ricardo on the concept of diminishing returns, rests on the idea that the development of the economic activity meets an asymptote very quickly. The information networks apparently escape this usual logic. We have also to note that with the rise of the network and information economy the network architecture has radically evolved in the last twenty years.

Architecture and control of networks: the new industrial organisation model

The information networks not only allow the transportation of information but also correspond to a new model of industrial organisation. A revolution has, of course, occurred in technology but, above all, in the conception of network architecture (Badillo, 1998). This new conception has major economic consequences.

Information network architecture: from the hierarchical model to the decentralised model

Two main types of networks can be schematically opposed: on the one hand, "hierarchical" or "integrated" networks and on the other hand, "decentralised" or "externalised" networks. To clarify this assertion, let us propose some elements of analysis of the communication network architecture. Let us distinguish the costs which characterise the most significant functions of a network. The cost of a network C is equal to the sum of the costs related to the function of emission and control of the network C_E , to the function of distribution, C_D (which includes, for us, the functions of transport and distribution), and to the function of reception, C_R , where the role of the reception terminals is an essential strategic stake ($C = C_E + C_D + C_R$).

- Hierarchical network: Grosch's Law

"Hierarchical" or "integrated" networks integrate the greatest number of functions while the reception terminals at the subscriber's end have very reduced functionalities. The strategic role deals with the function of control which is preeminent (C_E reaches a high level). The logic of these networks corresponds to Grosch's law, which justified the big computers in the computing field: "the bigger the machine, the less expensive it was to call upon its services. Because if a computer is four times more powerful than another, its price is not four times higher, but once and a half only: there is a law, Grosch's law, which permits us to calculate the economies of scale realised each time one passes to a higher dimension. The application of this law thus leads to the construction of increasingly powerful computers" (Lussato, 1981, p. 64, our translation). The logic of the "integrated" networks is similar to that of the big size computers.

- Decentralised network: Bouhot's Law

In "decentralised" or "externalised" networks, the essential function of these networks is no longer basically the control of the network. Most of the management of signals is realised at the level of the terminal equipment located at the subscribers' end; one can also refer here to the decoders of television channels, to the satellite reception antennas or to the future computers which will combine traditional functions and audio-visual reception functions or telecommunications functions (C_E is lower and C_R more and more important). The logic of these networks corresponds to Bouhot's law which "contrary to Grosch's law, shows that the most powerful result is obtained when a computer of the smallest possible dimension is able to treat the smallest possible operation. A new logic (...) leads to the greatest decentralisation of the machines: as opposed to what was believed up to now, the true economy of scale is not due to increasingly gigantic machines, but to very small machines manufactured in great number" (Lussato, ibid., p. 74).

- From monopoly (Grosch's Law) to market (Bouhot's Law)

The "integrated" traditional network, associated to natural monopoly, is questioned, more especially as the technological evolution and the supply of a variety of services make possible the rise of "externalised" networks. The control of the network can then be shared between different actors intervening on the market segments which "encircle" the network: the equipment market, the software market, and the terminals market. The central infrastructure, the network itself, allows economies of scale from which many actors can profit in managing the distribution and reception functionalities of the network.

So the externalised and decentralised networks offer the possibility, in accordance with Bouhot's law, to obtain considerable economies of scale. In fact, with a new architecture, new networks lead to more and more competition in and around networks. We enter a new stage of capitalism with a new model of industrial organisation.

Information networks as a model of industrial organisation

The information networks favour a new model of industrial organisation. The externalised and decentralised networks became the referent of the industrial organisation of modern companies and upset the value chain. In recent books on management, e-Business is conceived in the broad sense as including relationships of the company with other companies, with the consumers, and internal relationships (with the employees) which are based on ICT, mainly on Web-based technology. The sources of value of the company would no longer be related to the production of physical products from rare resources, but rather founded on services depending on the creation, circulation, treatment of information. According to Grady E. Means and David Schneider (2000), the e-Business model becomes the reference: ineluctably MetaCapitalism is developing… every major company in every sector will, by necessity, transform from a conventional to an e-business model.

So we have emphasised the new laws of information network economy. Euphoria is almost justified... but, in fact, we are far from a new civilisation. Behind the technological revolution, the result of the transformation is clear: in less than twenty years a paradigm shift has occurred from the natural monopoly network, dominant since the XIXth century, symbolised by a strong hierarchy, to the decentralised network directly associated to market economy. We agree with the importance of the technological revolution, with the existence of new economic laws concerning networks and information, but we are not entering a new civilisation. We are entering a new phase of capitalism that justifies developing, beyond utopia and euphoria, new critical approaches.

3. The need for new critical approaches: from Utopia to reality

"Utopias are often only premature truths": Lamartine.

In the field which interests us, the information society, networks and knowledge, it is not sure that Utopias are only premature truths. There is a mythical dimension. While bathing in euphoria, talk about the information and network society has created a set of myths resting on the sacred role of technology. The critical presentation of these myths will be organised

around four groups of themes: economic reality or reversed Utopia, technological Utopia, knowledge Utopia and the diffusion of myths.

Economic reality or reversed Utopia?

Authors like W.J. Baumol or R. Solow wondered about the effective development of the information society. The cost-disease model (Baumol, 1967) shows "that the expansion in the share of GNP constituted by services is not composed of services generally, but is accounted for largely by the *stagnant* services – those that have experienced relatively little productivity growth" (Baumol et al., 1992, p. 124). Thus the entry into the post-industrial society does not constitute a new golden age but is accompanied by considerable productivity problems, particularly in the sectors where human work is fundamental and where productivity increases are limited. As H. and W.J. Baumol (1985, p. 40, our translation) emphasise, "the execution of a Purcell's or Scarlatti's piece of music takes neither more nor less time and people today than in 1684". The analysis of the information society is concerned with this approach: "If the cost disease, rather than a growing demand for information, does account for the bulk of the growth of the information sector, then the "information economy" view apparently must be deflated considerably by the results of our study of the pertinent statistics. This is, in fact, what the data suggests" (Baumol et al., 1992, p. 144). Even if more recent studies indicate that "Baumol's disease has been cured" (Triplett and Bosworth, 2002), they also show that "the industry and aggregate evidence, taken together, suggest that much of what happened in the U.S. after 1995 was a continuation of processes that were as old as Industrial Revolution itself" (Triplett and Bosworth, 2002, p. 6). The interrogations have also concerned the famous paradox of R. Solow: the impact of computers and ICT remains difficult to appreciate. The time of adaptation of ICT is particularly long from the point of view of organisations. Throughout the years 1970-80, the companies seem to undergo excessive costs in the equipment and network use fields. In a recent interview, R. Solow (2002) says: "the outcome is still unresolved (...) the paradox has dissipated in part. I still don't think we fully understand the answer yet. But we're learning more all the time".

The new laws of the network economy can also be interpreted in the opposite way: the returns decrease in an exponential way if the network is blocked or saturated; the security questions involve increasingly significant costs as the network develops: the potential number of pirates increases and the security level must become increasingly reliable. The cost of protection of the network increases quickly. In addition, the more information has value and is expensive to produce, the more it is likely to be pirated; then the argument in favour of the network, namely that information is diffusable and reproducible at a cost close to zero, is turned against the network. The economic actors will protect, even dissimulate information… but that involves new costs… The externalities can become negative with the protection of information or the diffusion of false information: the mechanism of rumour on Internet constitutes an example of this type of negative externality. Destroying network effects can follow. The topics of the network economy can thus be interpreted in a symmetrical way and according to an opposite logic with negative effects being able to intervene in sequence.
Such economic mechanisms refer to the first law of thermodynamics; the positive network effects announced as new laws liberating from a number of constraints, are rebalanced by mechanisms quite as powerful but negative. Negative network effects can be very important and economic reality may be far from Utopia and even close to a reversed Utopia.

Technological Utopia

Ideology and "technological" Utopia: the techniques of communication do not make communication

P. Breton and S. Proulx (2002) show that ideology is central in the informational paradigm, and writings favourable to new technologies are actually founded on ideological positions. Opposed to the "technical tropism" (Wolton, 2000, p. 196, see also Varii Auctores, 2000), D. Wolton, asserts that "technical progress *in* communication is not enough to create progress *of* human and social communication" (Wolton, 2000, p. IV). He considers that new media (Internet) do not bring progress from the communication point of view. This position is very interesting because it is totally opposed to a number of flattering texts on Internet, viewed as an open network, a tool of freedom, as we pointed out previously. In this heterodoxy compared to the currents of euphoria, the stress is laid on the media, and on communication: "the shift remains ontological between the performance of machines and the complexity of human communication. It is the reason why today *the topic of the communication society* is an illusion. The more communication there is, the less we understand each other, even if our societies are packed with techniques, from the top to the bottom of society, from private to public life, from the cradle to old age" (op. cit., p. 208, our translation).

Technology as an ultimate finality: "technology for technology's sake"

Faced with any economic, social problem… in the context of the IKS, politicians, decision makers and finally the whole society are inclined to search for a technological solution. But there is a progressive slip: in the end, the "technological solution" is an obsession. Then Utopia emerges: when there is a problem, new technology appears as the instantaneous and definitive solution… Technology becomes an ultimate finality.

The assertion of McLuhan: "The medium is the message" explains to a certain extent such a position. The medium, and thus technology, replaces any other finality, even a human finality. The formula of T. Gauthier "art for art's sake" can be transposed: "technology for technology's sake". A certain number of myths or Utopias of the IKS are explained by such a displacement of finality.

Knowledge Utopia: the rupture between information and knowledge

With the progress of telecommunications and computing industries, the multiplication of the storage and line capacities causes the Utopia: we would be able to reach knowledge, even wisdom, with the assistance of information technologies. But knowledge is in no case a multiplication of information and we have to distinguish clearly between what we have called "telecommunications transmission" and "knowledge transmission".

Knowledge is not a multiplication of information

We are circumspect on the exponential possibilities of knowledge development on the almost exclusive basis of technology. To clarify this point, the distinction of M. Polanyi, developed by Nonaka and Takeuci, between two types of knowledge is very useful. Explicit knowledge "can be expressed in words and numbers and can be easily communicated and shared in the form of hard data, scientific formulae, codified procedures or universal principles", whereas tacit knowledge is "highly personal and hard to formalize. Subjective insights, intuitions and hunches fall into this category of knowledge" (Nonaka and Takeuci, 1995, p. 8). All the difficulty lies in this gap between easily quantifiable knowledge and tacit knowledge. It is not easy to pass from information to knowledge and even less so, to tacit knowledge. In short, there is no homothety between information and knowledge. Of course, the contemporary communications networks permit us to store, seek, copy, filter, treat, visualise, transmit and receive information on a scale never reached until now, and this will continue to rise exponentially. However, "Now that information is available so quickly, so ubiquitously, and so inexpensively, it is not surprising that everyone is complaining of information overload. Nobel prize-winning economist, Herbert Simon, spoke for us all when he said that "a wealth of information creates a poverty of attention"" (Shapiro and Varian, 1999, p. 6). Thus, the information society and its networks produce and disseminate information without limit: not hierarchised, not checked, not structured… information… which is however the base of knowledge, while knowledge constitutes the main added value of our societies. Information "is a set of data, structured and formatted, but so inert and inactive as long as they are not used by those who have knowledge to interpret them and to handle them"… On the other hand, "knowledge is basically a cognitive capacity" (David and Foray, 2002, p. 17, our translation) whose reproduction is much more expensive than information…

There is no homothety between information and knowledge because in no case knowledge can be regarded as an addition, or a multiplication of information. First, all information cannot lead to knowledge. Actually, if on the one hand the networks make information available, on the other hand they cause entropy and diffuse noises. Knowledge can be based only on structured, hierarchised and relevant information, on a pyramid of knowledge. In addition, while data and information are codified, explicit, easily transferable, the knowledge and intelligence field is more complex: it is strongly tacit, it depends on human judgement and very largely on context. As Plato (our translation from French, Platon, p. 92) says, "it would be a windfall (…) if knowledge was likely to run from the fullest to the emptiest" and could run like the water of a cup: from the full cup to the empty cup… from the brain of the scientist to that of the ignoramus… an obviously illusory windfall which would allow the instantaneous transmission of knowledge from an individual towards others. Y. Quéré stresses that the acquisition of knowledge cannot be made without effort: "no knowledge nor culture without effort" (2002, p. 73). To believe that technology can permit freedom from the effort related to training is a Utopia. Knowledge needs information, but it transcends information by the effort, the setting in memory and the control of the concepts and their relationships. The temptation to substitute technology as a finality is strong (technology as a major tool of multiplication and dissemination of knowledge) whereas human effort, intellectual curiosity, education… remain determinant.

The illusion: "telecommunications transmission" is not "knowledge transmission"

Lastly, it is necessary to distinguish between "telecommunications transmission" (which increases with the progress of information technologies, in agreement with Shannon's model) and "knowledge transmission". First, knowledge transmission is based on the communication between people. Indeed, it is not only a question of transmitting signals corresponding to contents; the relationship between individuals is of primary importance. In communication, there exist power links, co-operation links between individuals (see the School of Palo Alto). In addition, knowledge transmission goes beyond communication. "To communicate is the act of transporting information in space, and transmitting, transporting information in time" (Debray, 2002, pp. 12-13, our translation). If the prowess of the technology which allows ubiquity is undeniable - to share information at the same time in different places -, it should not occult the much larger importance of the transmission, the heritage of information and knowledge in time. From the knowledge point of view, what do thousands of institutional Web sites and individual pages of researchers represent compared to only one work of Plato ?

So, knowledge Utopia consists in believing that technology *in fine* is likely to directly replace the human brain, human communication and training, whereas, in our opinion, there is a discontinuity and a rupture between information and knowledge. This confusion, which makes the technology pass from the status of tool to a finality in itself, is characteristic of various myths of the IKS. We will briefly illustrate some myths falling under this logic.

The diffusion of myths

The myth of democracy

To see in the Web the tool of freedom is tempting: freedom of the press, right of association with virtual communities, freedom of creation… However, the question is obviously not at the level of the tool but at the level of the institutions which support and guarantee freedom.

The myth of education

ICT for education and e-Learning allow very interesting new developments of the tools for education. Nevertheless, it remains that, as Luc Ferry (2003, p. 44, our translation) indicates, within the framework of the republican school "the child was called a "pupil", i.e. somebody who was invited to rise to the realisation of higher ideals." The pupil must thus make efforts to adapt knowledge, which integrates ideals; the ICT can help the learner, but in no case will substitute for him.

The myth of co-operation-collaboration

The concepts of knowledge management, intelligent agents, collaboration, co-operation or collective intelligence imply that information will be shared effectively within the company or in the educational field. However, if collaborative work is considered, technology is only one more marginal element; to realise collaborative work, information must be shared; a photocopier, a pencil and a sheet of paper are already excellent tools. Since the concept of slack (R.M. Cyert et J.G. March created the concept of organisational slack; we introduced the concepts of technological slack and regulation slack (Badillo, 1987, 1996)) the company has always functioned far from pure effectiveness schemes; technologies certainly allow the transmission and remote storage of information, but do not change anything with regard to human relations. Collaboration, information sharing…remain human problems and concern infinitely more ethics, moral education, than technologies. The following assertion of A. Sen (1999, p. 262), "Successful markets operate the way they do not just on the basis of exchanges being "allowed", but also on the solid foundation of institutions (…) and behavioral ethics (…). The development and use of trust in one another's words and promises can be a very important ingredient of market success", puts in the foreground this concept of ethics which is much more essential than technology for developing any collaborative work.

The myth of knowledge as a global public good?

The question of knowledge as an economic good is the object of debate: "The seminal contributions of Kenneth Arrow and Richard Nelson had long shaped the debate about the economic organization for the supply of knowledge (…) technological knowledge was seen as a public good for the high levels of indivisibility, non-excludability, non-appropriability and hence non tradability. In this context, markets fail to provide the necessary coordination" (Antonelli, 2003, p. 3). "The new growth theory has elaborated the assumption that technological knowledge is appropriable to such an extent that individual firms have the necessary incentives to fund research and development expenditures" (ibid, p. 26).

So the debate is clear: is knowledge a public good, even "a global public good" (Stiglitz, 1999) or, through intellectual property, can it be part of market economy? The public good argument would be justified by the fact that knowledge is at the base of any human activity. This good must then become free and shared by everybody. According to us, there is here a Utopia; indeed, in this case why not consider first subsistence foods, heating, electricity, or telephone as particular public goods which ought to be free? This is another important economic question to be developed.

Of course, there is a difference between the information and knowledge-based society and the society corresponding to the oil and car paradigm, but we are still in the same capitalist system. The objective is to introduce a new division of labour which includes information and knowledge. Utopia is to believe that civilisation is changing and that we are becoming free from the rules of market economy. With ICT the market is larger, the information exchanges are faster. Technology is the support of this acceleration. Technology is also a powerful multiplier. The differences between the information-rich people (information "haves") and the information-poor people (information "have-nots") are growing. This explains the expression of "digital divide" and its worrying reality. New technologies are powerful multipliers of wealth or enlargers of the gap between the poor and the rich. The reality of the market mechanisms and their laws will be more and more relentless. Under the influence of ICT and their mechanisms of acceleration, competition will develop which, on a world-wide scale, will reallocate resources in a brutal way for the countries fallen under the charm of euphoria and the sirens of Utopia…

Please let us distinguish between our present analysis and our moral position: of course, we would agree to promote the free diffusion of knowledge as well as food, and so on… but we affirm that in our "IKS" it is only a mythology… To believe that gratuitousness will solve the problems is a Utopia *(if the implicit assumption which we have retained throughout this*

text is made: market economy remains the reference; to question this framework would constitute another work…). We can even add that this Utopia is perverse because exemption from payment prevents the remuneration of information and knowledge production and thus their development.

The myth of information and the media

The media are supposed to disseminate information, even knowledge. However, on the one hand, produced information is very standardised and often judged insufficient because coming from very limited original channels through the rewriting of the news provided by only a few news services/agencies; on the other hand, while knowledge could extremely well h ave developed with educational television, such was not the case. The problem is more a question of "literacy" than technology: to be able to read, understand and use the media and the new media. We are again faced with the same problem: the illusion is to believe that the development of the media provokes the development of information and knowledge for the whole of humanity. But more technology and more media permit only to diffuse more bits… and often, the same information produced by a restricted number of information sources or, and that's worse, by uncontrolled sources which diffuse all kinds of information without "hierarchisation", "checking"… From this point of view, the work of the professional journalist is essential; it is also fundamental that the public can be able to understand, criticize and analyse the information produced by the media. In other terms, the more important is not to diffuse more and more information but to be able to produce pertinent information for "intelligent" people… and the intelligence is not a question of technology but a question of media literacy which includes, in particular, cognitive, ethical and moral dimensions.

Conclusion: capitalism and knowledge: from Utopia to reality, from technology to ethics and trust…

Concerning the question of the future of economics, we believe that our text, which proposes an interdisciplinary approach connecting economic analysis and information and communication sciences, throws light on three aspects:

1. There is a euphoria about the emergence of the digital man or the collective intelligence. This euphoria leads to the diffusion of several myths concerning cyber democracy, education, media… The belief that we are entering a new civilisation is an error of analysis.
2. In fact, we are faced with the emergence of a new stage of capitalism. Information networks, and the specific architecture of these networks, are shaping a new model of industrial organisation; information is a particular good with specific characteristics and networks introduce new rules, new economic laws… Knowledge is also a particular good; from the economic point of view, there is a very important debate concerning the question of knowledge as a global public good. For the future it is essential to develop new economic analyses in this field to distinguish between the mythical dimension and the reality.
3. It is indispensable to develop new critical approaches about the new information network economy:
   If we can admit the existence of new rules and new economic laws concerning information and networks which partly justify euphoria, we have also shown that "reversed Utopia" exists. The positive network effects are rebalanced by mechanisms quite as powerful but negative (Internet is powerful to diffuse useful information as well as rumour, to develop knowledge as well as propaganda…). To a certain extent, there is a thermodynamic law of information and network. It would be interesting to develop research in this field.
   Another important error is made with the confusion between information and knowledge. Indeed, ICT allows impressive technological progress. Utopia is to believe that in a mechanical way ICT has a driving effect on knowledge. In fact, communication with the meaning of human relations and knowledge transmission in the long term are essential; ethics, effort, are central and could not be replaced by technology as a finality in itself. Utopia consists in believing that only with the "telecommunications" dimension (exponential progress in computing - Moore's law - and telecommunications transmission) knowledge is better and better produced and diffused. Utopia concerns the questions of education, even of democracy, collaboration, or the relevance of the information disseminated by the media. We show that there is not a continuity, but a rupture between information and knowledge. Knowledge is not the information processing capability multiplied by factor X. Knowledge transmission implies multiple dimensions relating to individual effort, human relations, institutional environment, ethics… Moreover, as recent works in biology show, the human brain is in no way comparable with computers: "the brain functions (…) at the same time like an electric machine *and* a chemical machine" (Changeux, 2002, p. 29, our translation). The human being and the training and knowledge mechanisms of his brain will remain irreplaceable for a long time to come… another reason more to be fascinated by the new society known as the information and knowledge society…

Beyond technology, beyond telecommunications transmission, we have finally insisted on "knowledge transmission" with its human dimension. We have to reconsider technology as a tool and not as a finality. Let us refer again to A. Sen who

underlines the importance of "behavioral ethics (… and) development and use of trust". Only, and only if we succeed in reintroducing these dimensions, will the IKS be synonymous with the diffusion of true information, knowledge and wealth.

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