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THE KNOWLEDGE-BASED SOCIETY AND THE REVERSE TRANSITION FROM KNOWLEDGE TO INFORMATION

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Abstract:

The knowledge-based society developed technologies of information in order to make better use all the data it had acquired and to manage it efficiently. Computers have replaced human memory and improved other human capacities. However, these changes have had some hidden effects. Some information is processed by computers, and the epistemic subject is replaced by them. From an epistemological point of view, we cannot speak about the bits of knowledge that are stored, but only the semantic information or data which is attached. Secondly, in the case of an epistemic subject, the so-called tacit knowledge which is incorporated into skills and practical capacities becomes more important, and is externalized in new forms. Therefore, my claim is that we can speak of a paradoxical reverse transition from knowledge to information in the knowledge-based society.

Key words: information, knowledge, knowledge based society, the new mode of knowledge production, tacit knowledge, organizational knowledge.

Some preliminary remarks

In a paper published at the inception of a new mathematical approach to language and immediately following Claude Shannon's paper "A Mathematical Theory of Communication," Warren Weaver made a distinction between three levels of analysis which has since become classical.

The first level is the technical level, which refers to "the accuracy of transference of information from sender to receiver," the second is the semantical level, which describes "the interpretation of meaning by the receiver, as compared with the intended meaning of the sender," and the third is the "influential" level, which concerns "the success with which the meaning conveyed to the receiver leads to the desired conduct on his part."[1]

Although the first level implies only technical problems that can be increasingly alleviated by the further development of technology, the other two levels contain in themselves premises for a philosophical approach. I consider first and foremost the concept of meaning. But here I will follow an epistemological path which is focused on the dynamics of knowledge and information in a knowledge-based society. Some preliminary remarks are necessary in order to clarify some concepts.

I will use in the following considerations the so-called general definitions of data, information, and knowledge based on an erotetic approach.[2]

An item is a piece of information if it has semantic content. This means that it is a piece of information if and only if:

1. It consists of one or more pieces of data;
2. These data are well-formed;
3. These well-formed data are meaningful.

[1] Weaver, 1949, p. 11.
[2] Floridi, 1999, pp. 106–107.

Sentence 1 says that without any data, we do not have any information. So, what is data? I think that the most elementary definition is also philosophically acceptable. If the world was characterized by absolute uniformity, then we would not have any data. Therefore, a datum is the effect of a difference in the world. A homogenous world, with identical parts, would not be able to produce data, or at least would only be able to produce a single datum—the fact that it exists (recall Parmenides' theory of being!). Fortunately, the world is full of difference and change.

Sentence 2 says that the data have to be ordered according to some rules and are structured in a syntax.

Sentence 3 says that the data are related to meanings, and that they become semantical items which should be understood and interpreted correctly, and even imply "truth."

For example,[3] "12" is a sign that makes a difference, but is not yet informative, because we have to attach a meaning to it in order to transform it from an empty sign to an informative one. "12" can become an astrological sign, a number of chairs, or a bus route. Therefore, a datum becomes information if and only if it becomes meaningful.

In conclusion, according to the general theory of information, information is described as data plus meaning. I will use this idea of semantic informational content in an epistemological context as an acceptable *definiens* for the concept of knowledge.

If we want to offer an approach regarding the cognitive process by which knowledge is created, transmitted, and stored as semantic informational content, then we must focus our attention on an epistemic subject which is able to have some beliefs.[4] Moreover, I agree with the thesis that knowledge involves understanding, an insight, and an intentional process or structure. I agree also that semantic content is not necessarily packed in a linguistic shell if the condition of semantic functioning is fulfilled differently. For example, we can use a picture in order to offer information about something.

Next I will follow the causal analysis of information, beliefs, and knowledge proposed by Dretske.[5] Therefore, I will define beliefs as semantic structures with an executive function, namely the shaping of the system's output. If this condition is fulfilled, then the semantic structures work as cognitive structures in that system. This means that a belief will be stored in memory—which is a part of the cognitive system—in an accessible way, and it will be used when it is necessary for a cognitive process. Therefore, the semantic structure is a cause of the output in the system. This means that a semantic structure is qualified as a cognitive structure and as a belief if and only if its semantic content causally determines the output in the system in which it appears. As a result of these assumptions, we have to differentiate between semantic structures and cognitive structures. The concept of information helps us to understand this difference.

Dretske's definition for information as a causal process is this:

"Information (in signal or structure *S*) causes *E* insofar as the properties of *S* that carry this information are those the possession of which (by *S*) makes it the cause of *E*."[6]

Let us consider a perceptual belief. All the information about angles, lines, and gradients will be used causally as ingredients, but they will not all be immediately structured as cognitive content even if they are related to semantic content. The cognitive status as belief is given, but the capacity to exercise control over the final output is acquired.

Therefore, following Dretske, "information is that commodity capable of yielding knowledge, and what information a signal carries is what we can learn from it... Knowledge is identified with information-produced (or sustained) belief."[7] This being said, if we preserve a definition of knowledge as justified true belief, we could claim that knowledge as a "dynamic human process of justifying personal beliefs toward the truth" is similar to and different from information: "First, knowledge, unlike information, is about *beliefs* and *commitment*. Knowledge

[3] See Floridi, 1999, p. 108.

[4] I mean only that in the new framework of informational society, we must take account of the old philosophical dilemma regarding the process of an epistemic subject acquiring knowledge, and how knowledge grows if the epistemic subject does not have any knowledge at the beginning, and he or she does not know what he or she is looking for (See Floridi, 1999, the paragraph "The paradox of the growth of knowledge: from the chicken and the egg to the needle in a haystack," pp. 88–96).

[5] Dretske, 1981, part III.

[6] Dretske, 1981, p. 198.

[7] Dretske, 1981, p. 44, 86.

is a function of a particular stance, perspective, or intention. Second, knowledge, unlike information, is about action. It is always knowledge 'to some end.' And third, knowledge, like information, is about meaning. It is context-specific and relational."[8]

Finally, these considerations may also help us in our aim of understanding the differences between the human mind and the epistemic subject on the one hand, and artificial intelligence and computers on the other hand. Computers handle data and may store or process it, and in this sense they can "understand" it in their own way, without any subjective commitment. But I think that it is highly controversial to say that computers "understand" information, and absurd to say that they have beliefs and knowledge.

I will return to these topics below.

The knowledge-based society and the new mode of knowledge production

The concept of the knowledge-based society became a common one in the public sphere.[9] I will use it in this paper in a broad, neutral philosophical sense that remains opened to different approaches.

Generally speaking, human action is based on knowledge, and a society in which knowledge is used as a resource will be more efficient than other socities that make a minimal use of knowledge. On the other hand, power within the society may be based on knowledge. For example, in ancient Egypt knowledge was the primary organizational principle and the basis of authority, because social processes depended upon knowledge of religious doctrines on the one hand, and on astronomical and agrarian knowledge on the other. The modern industrial and scientific revolution generated changes which led gradually to the knowledge-based society.

In the industrial society, the constitutive mechanisms and forces are labor and the property. Social relations and the membership of individuals in social groups revolve around property and labor.

In the knowledge-based society, a new factor was added to labor and property, namely knowledge. Scientific knowledge provided new principles for social hierarchies and stratification, for the distribution of social status and the quality of personal life. Moreover, knowledge became a normative principle of social cohesion and integration.

As a result of these social changes, science itself changed, especially in the way in which it is produced. Some philosophers proposed a distinction between two modes of knowledge production.[10]

Mode 1 of knowledge production is "characterized by the hegemony of theoretical or, at any rate, experimental science; by an internally driven taxonomy of disciplines; and by the autonomy of scientists and their host institutions, the universities."[11] This mode of knowledge production is traditional, initiated by the researchers and based on the academic framework of scientific disciplines.

As opposed to Mode 1, Mode 2 is context-driven, problem-focused, and interdisciplinary. First, research is generated and carried out in its own context of application based on the interests expressed by different parts of society, and as a result of a negotiation process which is based on communication between interested social actors. In this mode, organizational structures and hierarchies are opened to social and economic context and to social needs. Therefore, research begins only after social agreement about problem is achieved, and defined with a critical eye toward its applications.

Second, if in Mode 1 research is initiated by an autonomous investigator, a scientist searching for truth, devoted to the values of universalism and objectivity, and free from any social, ideological, or economic constraints, in Mode 2 the research is centered on the problem selected, so that the problem is more important than the scientist who works to solve it. In Mode 2, science becomes an interactive process in which the actors and their interests and capacity for reflexivity are brought together.

Third, if in Mode 1 the sources of theoretical and experimental scientific challenges are located into the scientific disciplines, in Mode 2 science is conceived as a process based on exchanges and imports between disciplines and between science and society—researchers are able to cross disciplines and use their knowledge anywhere.

Other differences between the two modes are related to the differences between societies based on the modern scientific revolution and those based on

[8] Nonaka, Takeuchi, 1995, p. 142.
[9] For a detailed analysis, see Stoenescu, 2012.
[10] Nowotny, Scott, Gibbons, 2001a, 2001b.
[11] Nowotny, Scott, Gibbons, 2001b, p. 179.

knowledge. If in Mode 1 the interaction between researchers was limited by physical and technical constraints, in Mode 2 the researchers use new information technologies that assure instantaneous communication. At the level of social institutions, there is a convergence between their development and knowledge production. Modernity built institutions separately, and science was conceived as an independent social institution. In Mode 2, decisions are made through an interactive institutional network characterized by the actions of many stakeholders and the operations of many levels of connection between interested actors.

The relation between science and society is patterned according to some new trends.

The first trend consists of an increasing desire to settle priorities. These are established at three levels: the supranational level, the national level, and the system level. The European Community is the best example for a supranational level in which research priorities are established according to social and economic needs. At the national level, governmental institutions develop research programmes in agreement with the political agenda and their research capacities. At the system level, we have a mixture between top-down policies that promote systemic priorities and down-up attempts to promote the individual interests of scientists for other research topics.

The second trend is the commercialization of research. The two sides of this problem are public funds and intellectual property. On the one hand, researchers attempt to find financial backing for their research, or to sell the fruits of their labors. On the other hand, research organizations and individual researchers try to increase the value of their intellectual property rights. As a result, the idea of science as a public good and the principle of open access are revised.

The third trend is the accountability of science, "the growing emphasis placed upon the management of research—and, in particular, upon efforts to evaluate its effectiveness and assess its quality."[12]

Knowledge—which was traditionally conceived as a public good—become an intellectual property that is produced, deposited, accumulated, transported, managed, protected, and traded like any other good or service. Gibbons wrote that the old unwritten contract between science and society assured only the diffusion of scientific discoveries into society, while the "new contract must now ensure that scientific knowledge is 'socially robust,' and that its production is seen by society to be both transparent and participative." [13]

The modern social contract between science and society was built on trust, and has included some reciprocal expectations and sanctions. The new contract reflects the disappearance of traditional boundaries and the reciprocal "invasion" of science and society. The relations between universities and science, between fundamental research and applied research, and between science and technology have been reconfigured. In the terms of the previous contract, science was engaged in making discoveries and offering them to society, but in the new contract, knowledge is produced jointly by science and society.

Technology was traditionally conceived as a set of empirical applications of the universal laws of nature discovered by "pure science." In the knowledge-based society, science was industrialized and technology was "scientized". Therefore, science and technology are designed as cognitive systems which are different in their goals, but which share a common theoretical core. This new relation between science and technology cased other changes in the relationship between science and society, technology and society, and the trilateral interaction between science, industry, and education.

Another feature of the knowledge-based society is the amplification of the social dimensions connected with different stages of knowledge in the so-called context of discovery. Therefore, in the knowledge-based society, the condition of reliable knowledge is not sufficient for a society which is really based on knowledge. Knowledge itself becomes a pure public good, different from labor and property. This means that knowledge is open for use by anyone, provided that some rules are respected. This is also a strong reason to impose another condition which has a social character. Following Gibbons, I will use the expression "socially robust knowledge" for the systems of beliefs which are not

[12] Nowotny, Scott, Gibbons, 2001b, p. 183.

[13] Gibbons, 1999, C, p. 81.

only reliable, but also socially used as a public good according to some rules. This public space is like an "agora" where science and the public talk to each other, one that is more comprehensive than any other public space. Universities, industry, and government are parts of this public space "where today's societal and scientific problems are framed and defined, and their solutions are negotiated" (Gibbons, 1999, p. 84). Socially robust science is tested not only methodologically, but also socially in different contexts. While reliable knowledge is open to negotiation and theoretically closed in its principles, socially robust knowledge is open to negotiation as a social product.

The tacit dimension of knowledge and organizational knowledge

My thesis is that in the knowledge-based society, the development of new technologies also changes communication practices and the way in which knowledge is transferred and conveyed. As a result of these practical changes, the concept of knowledge itself must be reconsidered, especially with regard to its objectivity. The idea of objective knowledge that is free of context and values has changed. Michael Polanyi[14] criticized the idea of objective knowledge that is free from any subjective influence, and argued that—at least in the context of discovery—the subjective dimension of knowledge is very important. It is obvious that scientific discoveries are related to feelings and beliefs. In Polanyi's view there is a tension between reason and explicit critical interrogation on the one hand, and the tacit dimension of knowledge on the other. Polanyi argues that personal choices and imagination are inherent parts of the research process which are always significantly motivated by passions. Therefore, discovery of truth is not independent from personal elements. Moreover, scientific research requires the passions of its researchers.

In order to grasp this difference and conceptualize it, Polanyi proposed a distinction between personal knowledge and propositional knowledge, understood in terms of the difference between tacit knowledge and explicit knowledge. This means that we are able to know more than we can say with the help of our language. We can convert tacit knowledge into propositional knowledge, for example, and we can transform some tacit procedures associated with a practice into explicit rules, but something will always remain implicit and unstated. The dynamic of these two forms of knowledge is based on the possibility of reciprocal transformations between tacit and explicit knowledge, but if we take into account the historical process of knowledge development, then we have to accept in principle, following Polanyi, that all knowledge is ultimately either tacit knowledge or rooted in tacit knowledge.

Another crucial feature of the knowledge-based society—a feature which is also related to the tacit dimension of knowledge—is the new role of various organizations in the production of knowledge. If we think in the light of the traditional Cartesian distinction between subject and object—or between the knower/subject and the object which is known—and try to rethink it, then we can see an organization as a mechanism which has not only the capacity to process information received from outside in order to adapt to the environment, but also the capacity to create knowledge and new information with the help of its own inner mechanisms, to send them out into the environment, and to modify this environment.

Nonaka and Takeuchi[15] proposed a theory of organizational knowledge (or knowledge-creating organization) which is based both on the distinction between explicit and tacit knowledge and on the supposition that knowledge is socially created and transformed through the interactions between individuals who work in an organization. Their paradigm can be better understood with the help of a case study. The two Japanese philosophers discuss the case of a bread-making machine. They describe the way in which the tacit knowledge of the bread-maker can be extracted and worded in such a manner that it becomes possible to incorporate it into a bread-making machine.[16] Nonaka and Takeuchi make a distinction between four modes in which knowledge is transformed in an organization:

[14] See Polanyi, 1956, 1964, 1967.

[15] Nonaka, Takeuchi, 1995.

[16] In terms of Collins' distinctions between kinds of tacit knowledge, it is obvious that this approach starts from one case of relational tacit knowledge, but the case can be redefined if desired, something that Collins himself did. See Collins, 2010, Appendix 1.

- from tacit knowledge to tacit knowledge, a conversion which is called "socialization,"
- from tacit knowledge to explicit knowledge, a conversion which is called "externalization,"
- from explicit knowledge to explicit knowledge, a conversion which is called "combination," and
- from explicit knowledge to tacit knowledge, a conversion which is called "internalization."[17]

Socialization is an interactive process in which an individual learns and acquires knowledge, mental models, and skills from others without using language, but only by observation, imitation, and practice, with all of these understood as forms of sharing experience. The information is extracted from a mixture composed sensations, feelings, thoughts embedded in a context.

Externalization is a process of converting tacit knowledge into explicit concepts and judgments with the help of language. Tacit knowledge may become explicit not only if the informational content is constrained in order to take the shape of an assertion, a theory, or a hypothesis, but also if it takes the shape of a metaphor, an analogy, or a model. Through externalization, new explicit concepts are created from tacit knowledge.

Combination is a process of fitting and incorporating concepts into systems. In this process, the epistemic subject uses different technical equipment, facilities, and networks. The previous information and knowledge is reconfigured, sorted, and combined with new information. In the knowledge-based society, new technical means have been developed for storing information in databases process it according to previously established cognitive aims.

Internalization is a process of learning by doing, transforming explicit knowledge into tacit knowledge in the form of mental models, or so-called "know-how." Explicit knowledge is expressed linguistically in theories, documents, books, manuals, databases, and is spread by universities, or with the help of mass media or other means. In this way, knowledge is re-experienced and interiorized by epistemic subjects, individuals, and organizations.

[17] See Nonaka, Takeuchi, 1995, pp. 146-156.

Nonaka and Takeuchi's theory, following Polanyi, gives a definition of tacit knowledge based on the presupposition that it can be made explicit in some conditions. Therefore, in their view tacit knowledge is the same as implicit knowledge, and is opposed to explicit knowledge. This means that tacit knowledge is reduced to being a relational property. Harry Collins developed this analysis of tacit knowledge, and has made a distinction between three types of tacit knowledge: [18]

- somatic tacit knowledge, which is embodied in the human body and brain;
- relational tacit knowledge, which may or may not be able to be made explicit in some circumstances;
- collective tacit knowledge, which is embedded in society.

The approach proposed by Collins enlarges the traditional meaning of tacit knowledge, and provides a new perspective on its role in the knowledge-based society.

I think that in light of this distinction proposed by Collins, we can identify two other components of organizational knowledge which have a tacit dimension:

1. Knowledge embedded in organizational technologies, rules, and procedures. Any organization tends to regulate itself with the aim to efficiently use its own knowledge. A person outside the organization will not have any knowledge of these rules.

2. Knowledge culturally embedded as an aggregate of perceptions, values, beliefs, faiths, and visions. This kind of knowledge contains a diversity of elements, from neural software that has a cognitive interface, to the so-called anonymous collective thinking in which an individual is kept. Some philosophers mentioned the importance of a biological knowledge or a historical *a priori* knowledge that grounds and establishes the conditions for the possibility of knowledge.[19]

Conclusion: the reverse transition from knowledge to information

It is time to put together all the pieces of the theoretical puzzle developed above. My thesis is that

[18] See Collins, 2010.

[19] See, for example, Konrad Lorenz, 1978, or Michel Foucault, 1989.

in the knowledge-based society, knowledge itself becomes more important than it was in other types of societies, but even as the role of knowledge grows, we must also recognize the growing role of information. Moreover, information becomes a decisive factor in society, and it tends to work solely as an independent variable. I will explain how and why.

The development of information technologies in the knowledge-based society—especially the use of computers in all human activities—transformed society's inner structure and gave it new properties. The knowledge-based society is also an informational society. Therefore, the tacit knowledge which is embedded in society has changed in structure, volume, and properties. On the other hand, at the level of individuals, the users of computers have acquired new skills, and a new kind of tacit knowledge has been internalized. I think that we can even speak of changes at the level of somatic tacit knowledge in the human body and brain. Moreover, the interaction between humans and artificial intelligence has become a factor in new changes and developments.

The ways in which information is stored and processed by computers or with the help of artificial intelligence has become a key factor in human development and the social integration of individuals, and also in the cohesion of society at large, in its communication and decision-making process. And all these activities depend on the information which is stored and processed by machines without any human intervention, because the human mind is unable to work with such large quantities of information. This Humans are the only epistemic subjects who are able to gain knowledge, and yet the knowledge-based society has commissioned much of its activity to computers, which are not epistemic subjects and which process information automatically.

The use of computers changes the entire discussion of tacit knowledge, from somatic to relational to collective. The individuals have to learn and to acquire new skills, and these generate new uses of the mind and body, and, as a result, new elements of somatic tacit knowledge are internalized. New rules are produced and new irreducible tacit items are located at the relational and collective level.

Therefore, to the reciprocal epistemological conversions from tacit knowledge to explicit knowledge, I add the reverse transition from knowledge to information which occurs at a somatic and collective level. The conditions in which an epistemic subject might gain and produce knowledge are materially and formally modified and restructured at all levels of tacit knowledge, but also through the conversion of knowledge into information with the support of new information technologies. I will discuss the details of these changes in a future paper.

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