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Knowledge, IT, and the Firm

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INTRODUCTION

No company has ever existed or will ever exist without knowledge. Still, it was only recently that knowledge started being heralded as the way forward (Drucker, 1993; Itami, 1987; Toffler, 1990). This may explain why in the business world, knowledge management (KM) is still perceived in two substantially different senses: (a) as synonymous to information management (e.g., Dempsey, 1999; Vernon, 1999) and (b) as a distinct area of study and practice dealing with the management of knowledge (e.g., Newing, 1999; Zack, 2003). In contrast, the academic world sees knowledge and information as related but fundamentally distinct. Furthermore, the vast majority of both of these communities has focused on the managerial or social aspect of KM (see, for example, Birkinshaw & Sheehan, 2002; Davenport & Glaser, 2002; Davenport, Thomas, & Cantrell, 2002; Gupta & Govindarjan, 2000). The *nature* of knowledge and its implications for management have been largely ignored. The limited work considering knowledge issues falls into the four categories below.

1. Knowledge is self-explainable and, therefore, in need of no further consideration (e.g., Newing, 1999).
2. Knowledge is self-explainable and classifiable into several commonsense categories (see, e.g., Quinn, Baruch, & Zien, 1997; Savage as cited in Skyrme, 1999).
3. Knowledge is attempted to be explained or defined without taking into account the vast relevant work done in epistemology and cognitive science. Primary examples are Borghoff and Pareschi (1998) and Davenport and Prusak (1998).
4. Organisational knowledge creation is a social interaction between tacit knowledge and explicit knowledge (Nonaka, 1991; Nonaka & Takeuchi, 1995).

The first three attempt to deal with the nature of knowledge and give the impression that there are no problems in an area beset with significant issues, whereas the fourth pays serious attention to the fundamental issue of knowledge creation.

Nonaka and Takeuchi's (1995) theory consists of two interacting knowledge spirals. The epistemological one is

based on the distinction between tacit and explicit knowledge; the ontological one is based on the widely accepted distinction between the individual and the organisation. Their important contribution is an excellently written expansion of their working hypothesis called "knowledge conversion," namely, "human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge" (p. 61). This important "dichotomy" is one of seven that form the basis of their theory, specifically, (a) tacit/explicit, (b) body/mind, (c) individual/organisation, (d) top-down/bottom-up, (e) bureaucracy/task force, (f) relay/rugby, and (g) East/West. Knowledge conversion comprises four modes: socialization (from tacit to tacit), externalisation (from tacit to explicit), combination (from explicit to explicit), and internalisation (from explicit to tacit). These four modes "constitute the 'engine' of the entire knowledge-creation process" (p. 57).

There are four weaknesses in their approach. First, their working hypothesis is characterised by a coarse grain size: Tacit and explicit knowledge are left unanalysed. As a consequence, no actual mechanisms for knowledge creation are proposed. Second, despite an impressively long index on knowledge, the issue of the *nature* of knowledge is ignored. Third, their synthesis of the seven dichotomies, although a highly welcome attempt in bridging unnecessary gaps, it is still biased since their underlying "model of knowledge creation favors the Japanese view" (Nonaka & Takeuchi, 1995, p. 237). Finally, their wide-ranging literature review fails to take into account—or refute—the most widely accepted metaphysical position, namely, physicalism.

The next section presents the results of a unified theory of mind (Gelepithis, 1984, 1989, 1991, 1997, 2002, 2004, in press) that are relevant to the issues of knowledge creation and the nature of knowledge, and form the background to the future-trends section.

BACKGROUND

In accordance with contemporary physicalism (a position accepted by the majority of scientists and philosophers), individual human knowledge should, primarily, be seen as neurally realisable. When externalised, in the form of written language, individual human knowledge becomes

fossilised. It becomes a snapshot and loses its capacity to initiate near-immediate action. Furthermore, and most crucially, it may be entirely meaningless to virtually all other humans. As a matter of fact, after the passage of some time, it may become unintelligible even to the very human who first externalised it. In other words, externally represented human knowledge becomes information.

It follows that organisational knowledge (sometimes known as organisational memory) may refer to either knowledge or information. Specifically, it may refer to employed people and their individual knowledge, or it may refer to an organisation's information. The latter needs to be interpreted by a human to be useful in any way. Interpreted information becomes internalised, possibly assimilated, and subsequently may trigger, or be involved in, knowledge creation. The central mechanism responsible for human knowledge creation is the process of understanding. It is an invariant neurophysiological process with many significant contributors to its cause as the Figure 1 illustrates. This complex system of interacting processes I call the knowledge nexus.

Through successive instantiations of the process of understanding over a period of time—quite often on the same topic—humans accumulate knowledge. The end result of understanding embodies aspects of individual human knowledge. The knowledge of human H at time t is the *system of understandings* that H has reached by that time. Eventually, an overall complex system of premises and primitives is developed comprising the axiomatic base of H's knowledge-based action. To move away from the subjectivity of individual human knowledge, communication is required. It contributes the component of breadth and intersubjective agreement characterising collective human knowledge.

Because the knowledge nexus is neurally realisable, it is opaque and most likely never fully presentable. Nevertheless, through language, the axiomatic base is externally representable and potentially formalisable. This interdependence and foregoing analysis should have made clear the inseparable link between biology and

human language, that is, the inseparability of the subjective and the objective.

The next section draws upon the background already presented to outline two major directions concerning (a) information and communication technologies (ICT) and (b) the economy.

FUTURE TRENDS

Before embarking on a sketch of the two major future trends, it is worth emphasising that it is the development of the appropriate environment that would nurture employees' knowledge nexus, which is important for business innovation. Successful management will be that which can realise both the near-unlimited scope and the fundamental limits of that nexus. It is in this respect the management of a company that is significant rather than futile attempts to manage knowledge.

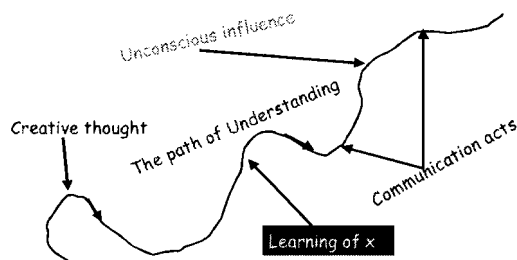
ICT and, increasingly, artificial intelligence (AI) are at the forefront of developments providing aids for addressing problems associated with the knowledge nexus. The majority of such problems include the identification, acquisition, and sharing of information, as well as the creation of knowledge. Books and edited collections addressing aspects of information-related or knowledge nexus problems abound (e.g., Borghoff & Pareschi, 1998; Hlupic, 2003; Quinn et al., 1997; Skyrme, 1999). What is much less widely available is discussion of the scope and limits of technology.

The scope of AI and ICT technology is enormous. The following three types of problems cover an extremely large space with far-reaching potential consequences for our society.

- Overall integration of information sources and tools.
- Identification of appropriately specified information through the use of search engines.
- Formalisation of certain aspects of human knowledge through R&D in knowledge representation and reasoning.

In all these cases, advanced technology can be a very significant help. It has to be realised, though, that AI and ICT systems cannot, on their own, either create or share knowledge. This is a point that is very often overlooked with serious negative consequences. Several people have noted that despite the increasing use of artificial aids, the human remains in the loop (see, for instance, Cross & Baird, 2000; Senge & Carstedt, 2001). Actually, no future technology can possibly take the human(s) out of the loop of human knowledge creation. Let us briefly see the reason for this intrinsic limit.

Figure 1. Aspects of the proces of understanding



AI and ICT systems may be distinguished into two possible categories: human based and machine based primitives (Gelepithis, 2001). The latter is not yet available. The former type of AI and ICT systems, whether creative or not, are automated axiomatic systems with inbuilt procedures for drawing consequences from their human premises. At worst, they are ad hoc systems capable of providing a cost-effective and, quite often, enhanced solution with respect to their human counterparts. A better solution, nevertheless, does not constitute creation of new knowledge. In the best-case scenario, they are capable of producing all possible consequences, some of which are bound to be new. In other words, “creative” AI systems can produce *new consequences* of existing knowledge. They are incapable, though, of producing *novel* human knowledge. Such knowledge involves *evaluation* of human premises and that, in turn, requires the full spectrum of human primitives, a task shown to be technologically impossible (Gelepithis, 1991). Finally, the highly desirable and potentially fruitful capability of current AI and ICT systems to produce new consequences of existing knowledge has to be ultimately evaluated by humans.

It should be noted that although humans are the only creators of novel human knowledge, ICT and, in particular, AI can facilitate the creation of such knowledge through the development of tools enabling (a) increased connectivity within the semantic system of humans and (b) increased and enhanced human-human communication. The latter should be what Skyrme (1999) calls knowledge networking. It is along these lines that a brighter future for business innovation lies.

As with technology, the intrinsic limit of economy is derived from the nature of knowledge and its associated mechanisms of creation, as sketched in the previous section. In the case of the economy, the limit concerns the scope of the notion of market. Specifically, the notion of a knowledge market is not realisable.

Claims for or against the possibility of a knowledge market are few and far between. They also vary in how convincing they are. At one extreme, reasoning is reduced to blind faith: “Given time, market forces will undoubtedly take care of the situation” (Burton-Jones, 1999, p. 221). At another extreme, Gamble and Blackwell (2001, p. 185) remark, “It is almost axiomatic in management that what you cannot measure you cannot manage.” Unfortunately, the next step they go to is to create a metric for a “knowledge management initiative.” It is unclear whether a “shifting the goalposts” approach is being practiced or whether an implicit belief against the possibility of a knowledge market is being held.

A more substantial argument is put forward by Davenport and Prusak (1998). Their starting point is that knowledge markets exist not as “pure” markets (i.e., markets that operate solely in economic terms). They claim that a price

system for a knowledge market revolves around the notions of money, reciprocity, reputation, altruism, and trust. In a nutshell, they recognise that money is far from adequate and believe that reciprocity, reputation, and altruism (these three in diminishing degree), as well as their combinations, constitute the substitute for money. Since transactions involving reciprocity, reputation, and altruism do not constitute payment in the traditional, monetary sense of the term, they are forced to introduce the notion of trust as the necessary factor for the workings of such a market. But trust is one of the goods (the other two are loyalty and truth telling), which “cannot, in principle, be taken as commodities in the market sense” (Arrow, 1974, p. 22).

One may take Arrow’s principle as a basis for an argument against the possibility of a knowledge market. It is nevertheless an argument based on extrapolation and henceforth not fully convincing. Our knowledge-based argument for the impossibility of a knowledge market is summarised below.

Markets require two elements for their existence: (a) an object to be transacted among their players and (b) a price system as its mechanism for the transactions.

Some may argue that knowledge markets have existed at least since humans started exchanging goods they produced themselves. For, any good produced—or procedure for making goods—was bound to involve the use or description of some knowledge. Nevertheless, what was traded was the good or procedure, not the knowledge involved.

What about information such as a piece of advice, a report, or an academic paper? Could such information not be transacted? No; since the meaning of some information depends on the receiver, its price cannot be fixed. Put differently, since the interpretation of information depends on the individual, its value depends on the potential client. Therefore, no common price can be assigned, no metric can be designed. The following two examples should clarify our point. First, what should be the value of the 21st-century equivalent of Newton’s laws? Second, how much should one pay for that imperceptible, yet consciously made, grimace that reveals a no-purchase of company X?

True, for thousands of years now, people have been able to sell information to someone able to use it. Nevertheless, the circle of potential buyers and sellers was and will continue to be extremely limited because information is only subjectively evaluative. Expert advice is valuable only to a small number of people, quite often to a single individual only. A knowledge market is not viable because individual human knowledge is neurally realisable, and collective human knowledge is only individually interpretable and assessable (see the background section). It follows that our resources will be better spent in



creating a knowledge environment rather than the chimera of a knowledge market. Sustainable business innovation requires near-continuous knowledge creation, and that requires in turn a knowledge environment. This is a difficult but necessary objective. It is difficult because knowledge has no airtight compartments.

CONCLUSIONS

Knowledge management is both mistaken and indispensable. It is mistaken because no one can manage something that takes place inside another one's mind. It is indispensable because it brought to managers' consciousness what they always relied upon: human knowledge.

Innovations (both minor and major) will come with improvements of search engines and further formalisation of the formalisable part of collective human knowledge. Breakthroughs are more likely to come from innovative hybrid designs (i.e., novel human-AI systems interactions). Both require humans in an environment that can nurture their knowledge nexus. Managers should act accordingly.

Finally, because of the strong push for economic, political, and cultural globalisation, one issue becomes of paramount importance. How could the particular cultures of all the peoples be synthesised into an Earthian culture rather than be obliterated and replaced by the monolithic pursuit of profit? Companies should understand the key cybernetic principle: variety requires variety. Innovation requires variety, too.

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KEY TERMS

Artificial Intelligence: The study of the principles of intelligence (scientific objective), and the design and build of intelligent machines like robots (engineering objective).

Cognitive Science: The multidisciplinary study of intelligent systems (natural, artificial, and hybrid). The disciplines that currently comprise cognitive science are (in alphabetical order) anthropology, artificial intelligence, education, linguistics, neuroscience, philosophy, and psychology.

Collective Human Knowledge: Shared human knowledge that has been linguistically represented.

Communication: H1 communicates with H2 on a topic T if, and only if, (a) H1 understands T (symbol: U(H1 T)), (b) H2 understands T (symbol: U(H2 T)), (c) U(H1 T) is presentable to and understood by H2, and (d) U(H2 T) is presentable to and understood by H1.

Epistemology: The study of knowledge. It is a vast area that has been studied for more than 2,500 years by the greatest minds in philosophy and, increasingly, by scientists in disciplines like psychology, neuroscience, and cognitive science.

End Result of Understanding: An entity E has understood something, S, if, and only if, E can present S in terms of a system of its own primitives (i.e., self-explainable notions).

Information: Potentially meaningful (material) patterns. For a summary presentation of the major views on information along with a rudimentary theory of information and some of its consequences (see Gelepathis, 1997).

Physicalism: The thesis that everything in the universe is physical. Applied to the mind, physicalism asserts that (a) all entities in the universe are physical entities and their combinations (ontological physicalism) and (b) all properties of any entity in the universe are physical properties (property physicalism).

Shared Human Knowledge on a Topic T at a Particular Time t: The end result of all communication processes among the members of a community on the topic T by the time t.

