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Some basic aspects of knowledge

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Abstract

Knowledge processing is one of the most significant factors contributing to socioeconomic sustainability. It is therefore important to analyse hindrances that slow or even prevent the growth, communication and use of knowledge. This treatise hypothesises that the differences in interpretations of some basic epistemological, ontological and didactic concepts significantly contribute to the ambiguities and other impediments in knowledge processing. Examples of such misconceptions are presented and a mitigation strategy discussed. Interaction between computerised media and humans such as the rise of the open sources of knowledge and the participatory Web uncover new gates for cross-disciplinary sharing and application of knowledge.

Keywords: Ambiguity; belief; definition; didactics, discipline; epistemology; intention; knowledge; ontology; sharing.Introduct

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1. Introduction

Knowledge processing is identified as one of the most significant factors impacting on social and economic sustainability. Understanding the impediments to effective communication, sharing and use of knowledge is therefore fundamental to the future of our society. Some trends in knowledge processing exhibit a proliferation of homonyms, synonyms and non-productive terms. We are witnessing an expanding industry of encyclopedias and glossaries devoted to 'special' disciplines such as 'mechatronics' (an amalgam of mechanics and electronics without chemistry?), 'nanotechnology' (should the scientists exploring the lasers, electron beams and optics announce a new discipline of picotechnology?) and 'informing sciences' (are there some sciences that are not informing?).

Principal concepts needed to define knowledge are discussed by numerous sciences such as Ontology, Gnoseology, Epistemology, Sociology, Psychology, and treated within the fields such as Philosophy, Didactics, Cybernetics, Semantics and Informatics, see Figure 2 in Abhary et al (2008). Fundamental categorizations are derived within each discipline and ideally a consensus with regard to concepts such as 'definition', 'knowledge', 'logistic', 'structure', 'element' and 'ontology' is expected to emerge on the grounds of such broad treatment.

However, no such consensus has permeated the knowledge strata in academe or beyond. Some "novel" concepts such as 'ontology' are created by truncating and distorting the original meaning established more than four centuries ago. This is not a purely an epistemological issue, because the same inconsistency can be found in interpretations of concepts such as 'technology', 'metal', 'vector', 'element' or 'structure' ─ the whole range of key terms are used by reputable sources to denote quite differing concepts. Vigorous techno-economic evolutionary and research breakthroughs and developments such as iPod, carbon nano-tubes, webcast and hybrid composites, have overtaken state-of-the-art theories even within their own home-disciplines, triggering colourful fireworks of neologisms. In this ambient, the industrious institutions impose expressions such as 'knowledge bank' or 'data mining', allocate new meanings to terms such as 'port', 'bit' or 'pipeline', and introduce new terms such as 'snippet', 'synset' and 'produsage' (Bruns, 2008), thus impeding furthermore the knowledge transparency.

Information technology (IT) presumably copes with this diversity by providing the information retrieval 'tools' and endless decoding, probabilistic text recognition, 'knowledge discovery' and 'search engines'. This opens a never-ending opportunity for further permutations of tasks and service abilities of IT disciplines. We argue, however, that the solution is to address the causes rather than indulge in multiplying the superficial remedies. Tolerance of conceptual misalignments and unruly nomenclatures increase information entropy and decrease intellectual synergy.

1. Impediments to knowledge processing

Development of information processing and artificial intelligence significantly contribute to effective knowledge management. Yet, an environment in which the information can be stored, retrieved and transferred by the speed of magnetic waves also amplifies impediments such as prolixity, ambiguity and jargon. A closer analysis suggests that the root causes for these impediments include knowledge gaps, conflict of intentions and differences in beliefs.

Livingston et al (1998) and Goldstone et al (2001) point to widespread evidence of strong susceptibility of perceptions to the previous groupings of background concepts. Reasoning modality is related to perceptions of similarity, which is in turn influenced by previously imposed criteria of more generic categorizations. It should be appreciated that ambiguities in interpretations of preceding concepts cause consecutive mismatches in subsequently derived definitions. This provides a fertile ground for growth of whole spectrum of misalignments.

A number of sources point at the disturbing presence of ambiguous, inconsistent and overlapping concepts in engineering and sciences (Abhary et al, 2008). This can be largely ascribed to insufficient communication between the branches of science that are vigorously growing adrift. Madsen and Adriansen (2006) concluded that construction of scientific knowledge can be seen as a struggle over who should define the terms and conditions of legitimate fields of research. It has to do with who sets the discourse and with "fashions" as well.

The scientific disciplines do not comprise exclusive safe routes and precise recipes that can be followed when facing each particular new problem appearing in practice. Solutions usually require combining knowledge from quite disassociated disciplines. The reality in which scientific libraries classify and label previous experiences and relevant knowledge by following the disparate classifications and inconsistent taxonomies is not helpful. For example, the concept of 'vector' has differing meanings in medicine as opposed to mathematics (Abhary et al, 2008).

Gottschalk (2007, p 11) postulates that "Knowledge cannot, as such, be stored in computers; it can only be stored in the human brain. Knowledge is what a knower knows; there is no knowledge without someone knowing it." The above statement spurs critical questions about the definition of 'knowledge'. A quite broad consensus contradicts to the above quoted statement by promoting an idea that a growing stock of verified knowledge is stored in, and it can be searched and even processed by computerised systems. For example van Bemmel et al (2006) discuss a computerised system where the validated information, which is in essence knowledge, is stored together with a thesaurus in an updated ontological database. This computerised system is even capable of formulating new hypotheses based on the programmed instructions given by human operators. New knowledge can be discovered from databases.

On a global scale, there is a well established understanding that the knowledge assets are stored within the resources such as libraries and computerised databases maintained by academic and other institutions, and grouped within the scientific disciplines. In the broadest sense, knowledge (optionally complemented by modifiers empirical, theoretical, pragmatical, tacit or heuristic) spans from an experience and education of an individual, via a spectrum of knowledge levels ranging from the group-knowledge, knowledgeable societies, public knowledge and common sense, to the comprehensive scientific disciplines classified within professional domains and stored as academic stock of knowledge treasure.

It appears that the concepts such as 'knowledge management' are used without consistent definitions and without appreciating such diversity. Publications addressing knowledge management often use the term 'knowledge' to address significantly differing aspects. This is not necessary because there is an entire spectrum of terms available for systematic characterisation of differing concepts as outlined in Table 1 published by Abhary et al (2008); the same source presents a number of examples of inconsistencies (for example those shown in Table 3).

These symptoms indicate that basic concepts of knowledge must be reviewed. Inconsistent definitions hinder correlating the achievements in established disciplines and capitalising from the potential cognitive synergy.

2. Basic concepts

Axioms necessary for the following definitions of some basic concepts are listed by Spuzic et al (2008). It is proposed that the knowledge is a construct formed by interlinking a spectrum of intellectual components, the simplest being 'information'. Information is composed of yet a simpler form, termed 'data' which are tentatively positioned at the boundary of knowledge strata. There is a broad variety of levels expanding between the information layer and the highest strata of knowledge; several convenient concepts across this span are introduced as 'assumption', 'definition', 'hypothesis', 'theory', 'canon' and 'disciplinae'. 'Disciplinae' (plural: 'disciplinas') is here defined as a subset of knowledge ─ a scientific or other knowledge encompassing a domain (an area, a field) of knowledge that is for some reason distinguishable from other knowledge. For example: medical disciplinas are distinguishable from the Earth disciplinas (knowledge about our Globe). A 'disciplinae' is a specialized structure of 'knowledge' constructed by combining pertinent 'theories' and 'hypotheses' which together constitute the informational results of a systematic endeavour to explain (some part of) the universe.

Abhary et al (2008) illustrate this structure in Figures 1 and 4 and point at the importance of the differences between the concepts of 'knowledge', 'science', 'engineering', 'phenomenon', 'noema' and 'taught'. 'Taught' is whatever can cross human's mind. Without the taught, consciousness would be unconscious. By a deliberate, premeditated process termed 'noesis' a single person arrives in her or his mind to 'noema' ─ a special case of, somewhat relative knowledge achieved at the specific point in time. 'Noema' cannot, as such, be stored in computers; it can only be stored in the human brain (Smith, 2008).

On the other hand, 'knowledge' is an established system of relations, which survives by being shared with more than one person, usually a significant number of humans. 'Knowledge' can continue to exist over a significant time-span with considerable reliability. At a higher level, 'knowledge' is stored systematically as an asset within the scientific disciplines and it is accessed and used for multiple purposes by an individual or by the broadest society.

'Knowledge' is composed of 'theories' and 'hypotheses'. The motivation for grouping theories and hypotheses into the scientific or academic disciplines is to facilitate storing, growth, communication and application of specific category of knowledge. 'Theory' can be regarded as a composition of 'definitions'. Abhary et al (2008) and Spuzic et al (2008) propose the following definition of 'definition' as a norm that must be observed when defining scientific knowledge. As they argue, 'definition' is a fixed (posited) set of relations that significantly increase the probability of an intended (premeditated) realisation (actualisation). Such actualisation is to be achieved by a system that can be organised to utilise a definition for such a specified purpose. When this realisation affects some phenomenon, its probability can be estimated quantitatively, and relevant entropy can be associated with the corresponding definition. A definition cannot be created without the existence of a manned system organized above a certain level of chaos. However, once it is generated and recorded, a definition can continue to exist (to be recorded, stored) without the existence of the initial manned system. When conceived by a relevant system, a definition becomes autonomous from its own representation (record); definition can be distinguished from any substance of which its record is made. Therefore, an identical definition can be replicated endlessly; it is infinitely shareable.

Definition is composed of inter-related components: informations and data. The attribute 'fixed' ('posited') in the above context emphasizes the difference between the restless process and the permanent information. In other words, although our ambient is in the state of perpetual motion, a definition—a model—can be generated, not to imply that the defined phenomenon is at a standstill, but to create a specific unchanging metric. One way of comprehending these concepts is to visualize through the use of analogy: information is an 'intellectual photograph' of a phenomenon, while a definition can be depicted as a whole album of photographs.

Any given theory and definition are limited by the assumptions and the scope of their applicability. However, new hypotheses can be derived from a well established theory, and there is always possible to extend the explorations and make further contributions to knowledge. In this process, many hypotheses have been proven erroneous, and numerous theories and definitions had to be modified or abandoned over the history of sciences. Evolution of knowledge would be impossible without having established an incremental evidence of the concepts with fixed definitions that serve as the reference points and signposts for further development.

3. Some aspects of mitigating strategy

The significance of the above concepts is in defining knowledge in terms of its application and sharing. Groups of (few or many) people who work together to pursue common goals and use collective assets can perform quite differently depending on how they communicate knowledge. An appropriate understanding of a 'common goal' requires acknowledging a variety of aspects within an interactive structure that includes detailed and individual perceptions, intentions and beliefs. The released synergy is proportional to the completeness and concordance of all three above aspects. For example, an academic institution which rejects collaboration with peer institutions in order to protect its market can instead experience a loss of market opportunity due to the reduced versatility of the available academic services. Another example might be a large industrial system that suffers significant financial losses due to the lack of dialogue between two antipode expert teams protecting their territory of knowledge. Such examples of intellectual protection and confidentiality safeguards result in the loss of the expertise due to the lack of knowledge sharing and stifling of creative endeavour. There are known cases of world-leaders in industrial engineering that employ quite aged experts because they are the only sources of relevant knowledge. Technology can be forgotten. The critical moment, when the experts leave, can cause a significant disturbance in the functioning the overall system. On a larger socio-economic scale so-called 'brain-drain' is well recognised problem affecting entire geo-political regions. Within the institutional fences, the team work and complemental modes of collaboration are officially strongly promoted with a growing emphasis. Yet in the practice, the achieved synergy is too often below the claimed, not to mention the desired levels. A common institutional approach is to train individual members, groups and leaders for 'team skills', and variety of factors including 'emotional intelligence' and 'cultural tolerance' are examined. However, the declarative commitments, emotional intelligence and cultural tolerance are still only the superficial remedies when compared to addressing the core issues such as the underlying beliefs and the resulting intentions.

One of the most detrimental impedances to effective team work and collaboration is a belief that the knowledge is a property that should be kept confidential and 'intellectually protected'. This isolationism blocks the exchange, exposure and verification of important concepts, theories and hypotheses. A diametrically opposite belief, namely that the knowledge is a basic agent affecting the chances of survival, is one of the principal factors affecting the success of team work. For example an understanding that our fate does not depend on the outcome of a competition with other teams or groups of individuals as much as it will be affected by the outcome of the competition with a much wider spectrum of processes in our ambient (such as for example global climate change), will affect our beliefs and trigger quite momentous motives, which in turn can dramatically change our intentions.

Another fundamentally constructive belief is that the overall efficiency, growth and verifiability of knowledge increase dramatically with the sheer quantity of informed participants. Furthermore, a belief that the open and rapid sharing of existing knowledge across the trans-disciplinary boundaries incubates nucleation of new ideas, increases the probability of making viable hypotheses and speeds up the testing procedures, leads to significantly better utilisation of resources and to more rapid progress. An example of this can be found in the rapid increase in collaborative knowledge sharing exemplified within the ethos of platforms such as Wikipedia and the 'participatory Web' (also referred to as Web 2.0), which has given rise to new models for business (Tapscott 2006).

This treatise takes the position that constructive competition is most effectively achieved by: (1) investing resources and energy through the cross-disciplinary sharing of knowledge; and (2) publishing new knowledge or providing improved evidence for validation of existing knowledge through its applications. Use of jargon and nomenclature that contravene to the concepts defined by other disciplines are symptomatic of a lack of inter-disciplinary communication and reflect an absence of belief and intention that the knowledge in one disciplinae will be and should be used in other disciplinas.

The leaders in the academe and industry promote open (free) source via the Internet. The strategy of open source is proposed as the catalyst for breaking through the barriers that impede communication and knowledge transfer within and between academic teams in industrial productive organisations. The model of open source can be efficiently scaled and applied within the structure of any institutional system. Team reliability and efficiency are directly proportional to the capability to share and activate knowledge stored within the formally structured subsystems. It appears that the barriers such as information divergence, intent disparity, knowledge imbalance and conflict of beliefs can be mitigated by means of proactive use of artificial intelligence aids (computers, internet and other software).

Information systems are omnipresent in all human endeavours and today human-computer interaction lies at the crossroads of many disciplinas. In this new ambient the leading sources reflect informed beliefs and constructive intentions thus increasing the probability of growth, sharing and application of knowledge. Knowledge sharing, however, must not be confused with sharing the decision-making roles and with the responsibility sharing hierarchy.

4. Conclusions

In this age of knowledge, enhanced by artificial intelligence systems, both communication speed and misinformation waste multiply at critical rates. Particularly obstructive is the increase in information entropy due to causes such as the differences in interpretations of basic epistemological and ontological concepts. It is hypothesised that the whole spectrum of ambiguities and knowledge ownership barriers are symptoms of the underlying issues such as the motive mismatch, intent disparity and discord in beliefs. Improving knowledge transparency in science and engineering is of crucial importance. Defining the basic scientific concepts is a task that demands gathering together of appropriate institutions. Missions of the academe include sustaining the knowledge shareability and applicability. Successful application of knowledge is equal to its validation.

The perspective of interaction between artificial intelligence and manned systems, and the rise of the open networks of cross-disciplinary knowledge, uncover new gates and dimensions for communication and application of intellectual treasures at the unprecedented rates. However, the actual purpose of knowledge treasures should not be lost out of the sight; more attention to disaccord in beliefs and intentions is needed to take better advantage of available knowledge. Sustainability of life forms is proportional to the efficiency of knowledge sharing and it is encouraging to realize that knowledge is infinitely shareable. Appropriate definitions are probability intensifiers.

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