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Information, Knowledge and Wisdom:The Epistemic Hierarchy andComputer-Based Information Systems

David Vance
Southern Illinois University

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David Vance, Department of Management, Southern Illinois University

Abstract

As we move further into the Information Age, and as its technology becomes more and more pervasive, it is appropriate to consider exactly what information might be and what part it should play in the formation of belief and, perhaps, even knowledge.

My goal is to contribute a little to lessening the confusion of definitions and to suggest a meter by which we can measure whether we know a thing presented by an information system, merely believe it, or simply have a piece of information and further, whether a computerized information system can be a valid tool for moving our thinking up the epistemic hierarchy.

This paper will 1.) look at some contemporary definitions of information and test their fitness against a philosophical definition, 2) define and distinguish the formal requirements for knowledge as opposed to belief, 3.) examine a definition of knowledge and epistemic warrant adaptable to Information Systems, and 4.) evaluate how this criterion might assist our decision maker of the beginning of this paper.

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Let us begin by considering the following scenario: A corporate chief executive is pondering expansion options. He has just concluded lunch with another businessman to discus the options of a new plant in Duluth, a new plant in Akron, or whether he should expand his production capacity at the existing plant. During lunch (Chinese, as it turns out) the other man recommended Duluth. Now, sitting in his office, in front of his Decision Support System he puts the same query and receives a response that an Akron plant is the best option. As he ponders, he is keenly aware that in his jacket pocket the crumpled prognostication of his fortune-cookie states "A wise man builds his fortune at home." Our decision maker has now received information regarding his decision from three sources. To which information should he give credence? Should he believe one more than another? Why? The answer, of course, is "It depends." We do not know the identity of the lunch partner, nor his credentials. He may have been a world renown expert in the field with unique insights into the problem; or he could have been a paid operative of the competition spreading disinformation. The waiter bearing the fortune cookie could have been the local Mayor in disguise. Perhaps he knows that the city is planning to unveil a broad and generous tax incentive plan for the company, but cannot formally disclose the plan until after year-end. So we could observe that there is something about the source of information that tends to give us reason to believe or disbelieve. And what of the Decision Support System? Is it credible? How do we know? Is the basic data from which the computer works accurate? Was it programmed by a disgruntled employee? Clearly, for our decision maker, the answer to the question of which source to believe can only be "it depends." But we can safely assume that the future of the company, three cities and many employees will be directly affected by the answer.

Mason provides an epistemic hierarchy to illustrate the sequence by which information, knowledge and wisdom are produced. This begins with confusion or chaos which, through the intervention of an agent, creates data. Data is interpreted into a meaningful framework called information. Knowledge is information that has been authenticated and thought to be true, and finally wisdom is said to be knowledge integrated into society, group or organization. Here we need to define another term that could be problematic: truth. While there are at least three major accounts of truth: correspondence theory, coherence theory, and pragmatic theory, I will use a pragmatic definition:

Truth is that which accords with reality. Truth is a good basis for action and actions based upon truth tend to produce good results; that is, truth tends to foster success.

"Information" has been variously and sloppily defined as anything from objective truth to subjective invention. Indeed, some even refuse to differentiate between information, data, knowledge and wisdom, lumping all such concepts into an ill-defined lump called "information". For the purposes of this paper and in order to pursue my logic, I will say that information is that which may *or may not* be believed; if believed, then a necessary pre-condition of knowledge. And knowledge, is very different from mere true belief. Since we are focusing on computer generated information as it impacts human knowledge, we are most accurately talking about Information Systems epistemology.

My goal is to suggest a meter by which we can measure whether we know a thing presented by an information system, merely believe it, or simply have a piece on information. Further, whether a computerized information system can be a valid tool for moving our thinking up the epistemic hierarchy.

I will posit as the normative definition of information that which is recorded in the Cambridge Dictionary of Philosophy and I will use this as the litmus with which to test contemporary definitions.

Information is defined as "an objective (mind independent) entity. It can be generated or carried by messages (words, sentences) or by other products of cognizers (interpreters) Information can be encoded and transmitted, but the information would exist independently of its encoding or transmission."

Information may or may not be believed. Further, we need to define and distinguish the formal requirements of knowledge as opposed to belief. The traditional definition of knowledge is justified true belief. That knowledge is justified true belief worked well until Gettier wrote his famous three page paper in 1963. which described a situation in which the three conditions of knowledge (belief, truth, and justification) are fulfilled, and yet knowledge does not result. The paper turned the world of epistemology on its head and sent philosophers great and small off to search for the missing "fourth element" that would give a concise definition of knowledge.

It was in this environment that Alvin Plantinga wrote his two volume opus on epistemology: Warrant: The Current Debate and Warrant and Proper Function. Per Plantinga, warrant is that quality which, combined with truth and belief creates knowledge. But warrant is more than justification; as indeed it must be, due to the questions raised by Gettier. In Warrant and Proper Function, Plantinga addresses epistemic problems dating from the dawn of Western reasoning to the present and argues for a better definition of knowledge based upon warrant. A belief has warrant if it has been (1) produced by cognitive faculties that are working properly (functioning as they ought to, subject to no cognitive dysfunction) in a cognitive environment that is appropriate for those cognitive faculties (2) the segment of the design plan governing the production of that belief is aimed at the production of true beliefs and (3) there is a high statistical probability that the belief produced under those conditions will be true. Note that knowledge defined as warranted true belief.

It is this definition of knowledge and epistemic warrant that I propose to adapt to Information Systems. What must be the process by which information becomes knowledge? Recall that wisdom is the state when knowledge dissipates into or becomes the incorporated fabric of the individual or organization (as a collective of individuals.) In any regards, before there can be dissipation of knowledge, there must exist the conditions and processes of transformation whereby information becomes knowledge in the mind of the receiver. The question remains, where is truth guaranteed or preserved in the process? The answer, sadly, is that there is usually only a presumption that data is accurately processed, the epistemic equivalent of the blind leap of faith. What is needed is a rigorous test similar to Plantinga's that looks critically at the hardware and software of a system to see if it indeed is providing warrantable information. I suggest the following:

Computer based information can be a source of warrant for the user if and only if:

1) It has been produced by computational faculties that are working properly (functioning as they ought to, subject to no dysfunction) in a computational environment that is appropriate for their kind of computational faculties.

2) The segment of the systems design plan governing the production of that information is aimed at the production of true information and

3) There is a high statistical probability that the information produced under these conditions will be true.

Criterion one addresses proper function and environment. Proper function is almost too obvious to mention, except that we have Pentium processors in machines across the nation and we know that these are defective. Yet we use them daily. Proper function is testable. A sensor that sends inaccurate data cannot be a basis for warrant. A program that intermittently drops or garbles bits of data cannot provide a basis for understanding the objective reality it is designed to monitor. But functional testing must be done in the real world environment in which the system will operate. This is addressed with "congenial environment." A system which performs well on "dummy data" cannot be assumed to be warrantable when applied to live data. A sensor designed to measure atmospheric phenomena on Earth may or may not give valid data when sent to Venus. In either case, its data could not be a basis for warranted belief without some additional test that demonstrates proper function in a Venusian atmosphere. It is conceivable that a device that functions erratically on Earth may function perfectly on Mars, and so forth: If a system has something less than perfect accuracy, then error rates must be incorporated into the processing scheme, and accounted for. Proper function does not say "perfect"; it means that there is an objective criteria against which to measure performance and note dysfunction. Proper function in the "designed for" environment is a necessary requirement for warrant.

Criterion two goes a step further, because even if functioning properly, a component must be aimed at providing true information. A software virus may be functioning exactly as designed, and in a congenial environment, but is obviously not aimed at providing true information. A program could be designed to inflate certain performance parameters to the benefit of a given worker or manager, and function properly, but the outcome is obviously untrue. We have recent news that Lockheed has been fined millions of dollars because an engineer reprogrammed a test parameter so that defective products would measure as acceptable. Our initial example of the disgruntled programmer was an example of an increasingly common phenomena: the logic bomb or software time bomb. If the system is not aimed at truth, it is trivially true that it cannot provide a basis for warrant. How can this be avoided? Rigorous testing with expected results checked against real outputs, limiting software write access as much as possible, systems design parameters that are scrupulous in their focus on getting relevant data accurately; these are a beginning.

The last condition brings the notion of statistical probability. As I mentioned earlier, this is problematic, for it brings the requirement that certain epistemic probabilities be known a priori, to become part of the Bayesian reference class. And while statistical or logical probability is a factor in cognitive warrant, it omits (as it must) certain areas of conditional epistemic probability. But this intriguing problem I will have to leave for another paper.

If these conditions are met then there will be warrant for believing the output of an IS process. As can be seen, these vital pre-conditions are at best only assumed in the works cited. Mason gives it passing notice by stating that "an implied covenant exists between the information givers, takers, orchestrators and stakeholders in a information society." This implied covenant addresses accuracy, validity, fidelity, privacy and concerns about ethical use. However, can we base the development of a society on an implied agreement? I think we do so at our peril. It is imperative that information generation and processing, leading to user knowledge, be based upon as close to truth as possible. The above offered criterion, applied to systems design, development, implementation and use would move us closer to that goal.

Problems in this scheme are manifold. Costs are higher, both initially and during system life. Verifications take additional time, which affects information timeliness. Limitation, control or at least monitoring of

systems design and development personnel is expensive and potentially invasive. Yet as we evaluate how this criterion might assist our decision maker of the beginning of this paper we can also see that, faced with a Decision Support System of largely unknown origin and accuracy, working from unverifiable data sources, using inscrutable logic, the fortune cookie doesn't look so outrageous!

References available upon request to David Vance at Southern Illinois University