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Understanding Data, Information, Knowledge And Their Inter-Relationships

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ABSTRACT:

Knowledge, Information, and Data are key words and also fundamental concepts in knowledge management, intellectual capital, and organizational learning. This paper includes the reasons for vagueness and confusion commonly associated with those key terms, proposed definitions of the key terms, and two models of their transformations and interactions.

Keywords: *Knowledge management, intellectual capital, organizational learning, knowledge, data, information*

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1. Introduction

Despite many attempts at the definition of 'Data', 'Information', and 'Knowledge', there still seems to be a lack of a clear and complete picture of what they are and the relationships between them. Although many definitions are relevant, they are far from being complete. It is not the intention of this paper to criticize those whom have paved the way to better understanding of the topic. Rather, the goal is to provide a different or new perspective in the context of business and knowledge management. Below is a table of various definitions of Data, Information, and Knowledge from different authors. The table also includes definitions from Webster's Collegiate Dictionary. Most if not all of the definitions shared a common anomaly; they are defined with each other, i.e. data in terms of information, information is defined in terms of data &/or knowledge, and knowledge is defined in terms of information. If we are just describing the inter-relationships, that is all very well. However, with regard to definitions, this is a logical fallacy i.e. circular definitions or argumentations. (It is in Philosophy 101 – Critical Thinking and Reasoning).

Table 1: Definition

Data	Information	Knowledge	Source
Data is comprised of the basic, unrefined, and generally unfiltered information	Information… is much more refined data… that has evolved to the point of being useful for some form of analysis	Knowledge resides in the user…happens only when human experience and insight is applied to data and information	Knowledge Nirvana – Achieving The Competitive Advantage Through Enterprise Content Management and Optimizing Team Collaboration; by Juris Kelley, 2002, Xulon Press
		Davenport and Prusak have come up with this definition of knowledge: it is a mixture of organized experiences, values, information and insights offering a framework to evaluate new experiences and information	An Intelligent Organization – Integrating Performance, Competence and Knowledge Management; by Pentti Sydanmaanlakka, 2002, Capstone Publishing
	Information: Processed data… formalized, capture and explicated; can easily be packaged into reusable form	Knowledge: Actionable information… often emerges in minds of people through their experiences	The Essential Guide to Knowledge Management – E - Business and CRM Applications; by Amrit Tiwana, 2001, Prentice – Hall
	Information is data put in context; it is related to other pieces of data. Information is about meaning, and it forms the basis for knowledge	Knowledge… encompasses the belief s of groups or individuals, and it is intimately tied to action	Enabling Knowledge Creation – How to Unlock the Mystery of Tacit Knowledge and Release the Power of Innovation; by Georg Von Krogh, Ichijo, and Nonaka, 2000, Oxford University Press

	Information has been defined as data that is " in formation" – that is, data that has been stored, analyzed, and displayed, and is communicated through spoken language, graphic displays, or numeric tables	Knowledge… is defined as the meaningful links people make in their minds between information and its application in action in a specific setting	Common Knowledge – How Companies Thrive by Sharing What They Know; by Nancy M. Dixon, 2000, Harvard Business School Press
		Knowledge is a body of information, technique, and experience that coalesces around a particular subject	Managing Knowledge Workers – New Skills and Attitudes to Unlock the Intellectual Capital in Your Organization; by Frances Horibe, 1999, John Wiley & Sons
Data are elements of analysis.	Information is data with context.	Knowledge is information with meaning	Innovation Strategy for the Knowledge Economy: The Ken Awakening; by Debra M. Amidon, 1997, Butterworth-Heinemann
Data must be organized to become information	Information must be put into context to become knowledge		The Art of Being Well Informed – What You Need To Know To Gain The Winning Edge In Business; by Andrew P. Garvin, 1996, Avery Publishing Group
	Information is a flow of messages	Knowledge is created by the very flow of information, anchored in the beliefs and commitment of its holder."	The Knowledge - Creating Company – How Japanese Companies create the Dynamics of Innovation, by Ikujiro Nonaka and Hirotaka Takeuchi, 1995,

			Oxford University Press
Data is a set of discrete, objective facts about events… as structured records of transactions	Information… as message… in the (various) form of communication… to have an impact on judgment and behavior	Knowledge is a fluid mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information…	Working Knowledge: How Organizations Manage What They Know. By Thomas H. Davenport and Laurence Prusak, 2000. Harvard Business School Press.
Data: 1. factual information used as a basis for reasoning, discussion, or calculation; 2. information output by a sensing device or organ that includes both useful and irrelevant or redundant information and must be processed to be meaningful; 3. information in numerical form that can be digitally transmitted or processed.	Information: 1. the communication or reception of knowledge or intelligence; 2. knowledge obtained from investigation, study, or instruction; 3. Facts, Data; 4. quantitative measure of the content of information.	Knowledge: 1. Cognizance; 2. the fact or condition of knowing something with familiarity gained through experience or association; 3. the range of one's information or understanding; 4. the sum of what is known: the body of truth, information, and principles acquired by mankind.	Merriam Webster's Collegiate Dictionary 10th ed.

For all intents and purposes, we need definitions that are concise, definitive, and distinct in attributes or characteristics, exhibit probable purpose, and/or offer inter-relationships. This subject is not an easy one; it involves extensive conceptual thinking dealing with many abstract concepts and semantics. Nevertheless, a thorough understanding of this topic is the quintessential foundation of information and knowledge management.

Personal experience leads me to conclude that 'definitions' can never be overstated in terms of their importance. Good definitions include several essential characteristics: (1) boundaries (i.e. exclusive, nothing left out); (2) purpose (i.e. what it does), and (3) attributes or characteristics (i.e. what it is). My proposed definitions of 'Data',

‘Information’, and ‘Knowledge’ fall within the parameter of a good definition. Thereafter, we can look into the inter-relationships between the defined subjects.

2. Definitions

Data are recorded (captured and stored) symbols and signal readings.

- Symbols include words (text and/or verbal), numbers, diagrams, and images (still &/or video), which are the building blocks of communication.
- Signals include sensor and/or sensory readings of light, sound, smell, taste, and touch.

As symbols, ‘Data’ is the storage of intrinsic meaning, a mere representation. The main purpose of data is to record activities or situations, to attempt to capture the true picture or real event. Therefore, all data are historical, unless used for illustration purposes, such as forecasting. [Note: However, Rehauser and Kremar (1996, p.6; cited by Probst et al., 2000) made a distinction between symbol and data with syntax.]

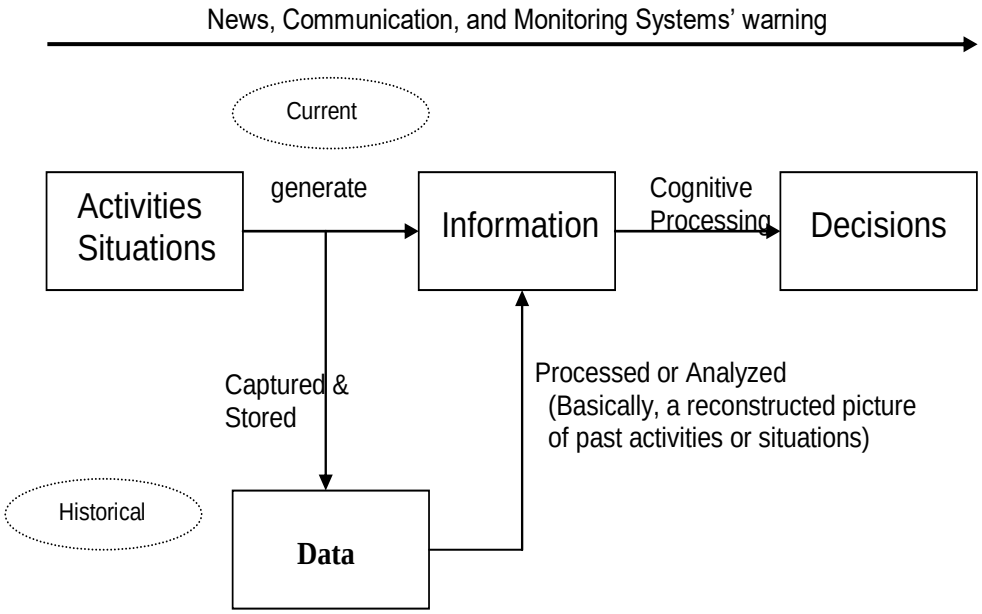
Information is a message that contains relevant meaning, implication, or input for decision and/or action. Information comes from both current (communication) and historical (processed data or ‘reconstructed picture’) sources. In essence, the purpose of information is to aid in making decisions and/or solving problems or realizing an opportunity.

Knowledge is the (1) cognition or recognition (know-what), (2) capacity to act (know-how), and (3) understanding (know-why) that resides or is contained within the mind or in the brain. The purpose of knowledge is to better our lives. In the context of business, the purpose of knowledge is to create or increase value for the enterprise and all its stakeholders. In short, the ultimate purpose of knowledge is for value creation.

Given the definitions for data, information, and knowledge, the relationships between data and information, information and knowledge, why they are most often regarded as interchangeable and when they are not, the processes and their relevance to our intended application can be explored. The key to understanding the intricate relationship between data, information, and knowledge lies at the source of data and information. The source of both is twofold: (1) activities, and (2) situations. Both activities and situations generate information (i.e. ‘relevant meaning’ to someone) that either is captured thus becoming Data, or becomes oblivious (lost).

Examples of activities where information is generated and data can be collected include business activities like production, sales transactions, or advertising campaigns. Situations pertain to changes in the environment that may or may not be related to human activities, such as changes in the climate. Changes in the climate would affect such human activities as agriculture, or other economic activities such as cargo shipping. A situation is a context that affects decisions. For example, the deterioration of a factory building may impact production. In short, activities and situations generate information that feed into the decision-making process. The following diagram illustrates the relationships between data and information.

Figure 1: Formation of Information and Data



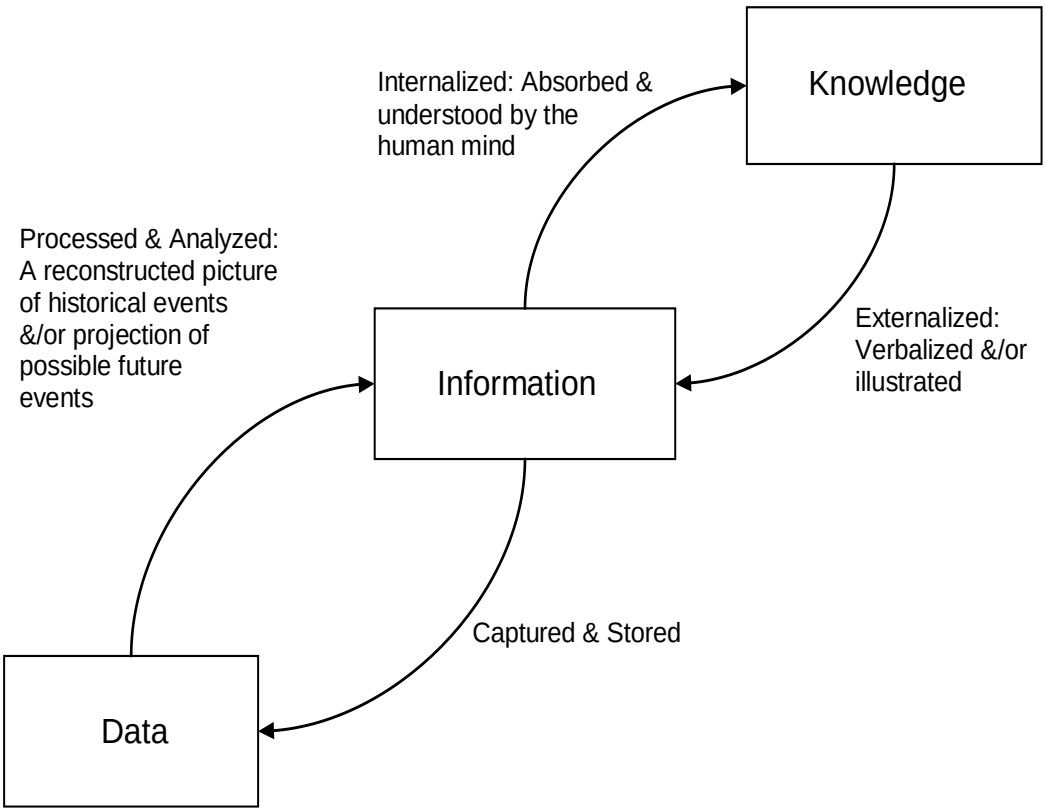
Once they are captured and stored, data can be processed back into information through compilation and analysis. The picture of past activities and situations can thus be reconstructed. There are two fundamental aspects of data processing, compilation, and/or analysis:

- Data to data
- Data to context

For example, 'Anthony' represents a person, and '555-2345' represents a phone number. Both pieces of data may have a relationship, such as ownership, that means

‘555-2345 is Anthony’s phone number’, which in turn implies a message or decision where there is a likelihood of reaching Anthony via phone call. Further compilation of names of customers and their contact numbers may lead to information of how many customers one can reach and possible times needed to complete the task, i.e. 100 customers vs. 10,000 customers. An example of data to context data processing is ‘Anthony’ located in a current phone book vs. ‘Anthony’ located on a tombstone. Both the same data in different context would yield different meaning, implications or information that may necessitate a different decision or consequence.

Diagram 2: Relationships Amongst Knowledge, Information, And Data



The key to understanding the relationship between information and knowledge is to know where the information resides. Recall that information is at its essence a message that is generated from activities and situations. However, information resides in storage media (database, print, video tapes, etc.) in the form of data, or in the human mind as knowledge (in its simplest form of know-what or the higher forms of know-how and know-why). If this is the case, then the overlap between data and information vis-à-vis information and knowledge becomes obvious, i.e. they occupy different space at the same time. This also explains why many perceive data and information, as well as

information and knowledge as interchangeable. "…one man's data can be another man's knowledge, and vice versa, depending on context" (Stewart, 2002, p.6 footnote). However, they are not interchangeable in terms of their accepted distinct definitions. So, what is a book: knowledge, information or data? It is all the above in various context. A book is knowledge from the author's perspective, information for the potential reader, and data as well which is contained in a storage media (called 'book').

These distinctions can help us crystallize our understanding in terms of managing data, information, and knowledge within the business model or organization. The importance or usefulness of definitions cannot be overstated when it comes to execution of management activities and business programs that involve millions upon millions of dollars.

Data management is the capture, storage, structure, compilation, retrieval, and analysis of records. It is the reconstruction of recent or historical events as inputs for decision-making and/or problem solving.

Information management includes reconstructing a picture of historical events, collecting current or recent market intelligence, as well as projecting possible future events (forecasting and scenario planning), and of course analysis for decision making and/or problem solving. Thereafter, action can be taken and then reviewed.

Knowledge management, on the other hand, is, in essence, the management of human capital (tacit knowledge that resides in the human mind) relationship capital such as customer, supplier, strategic alliance, social capital (tacit and explicit), and structural capital (explicit knowledge a.k.a. data and information), the source and stock of knowledge; and the flow of knowledge as in knowledge creation, sharing, and application to create and/or sustain organizational value and competitive advantage.

3. Conclusion

Knowledge management is not an isolated concept. Topics such as individual and organizational learning, creativity and innovation, leadership and teamwork, community networking, technology, corporate culture, and strategy contribute to the process of creating, capturing, and applying knowledge for value creation. Knowledge management is neither a fleeting concept nor a fad. It is just elusive because of its multi-disciplinary characteristics. In time, as more research and understanding is applied it will be better understood.

Final words on the definition of data, information, and knowledge may not and should not come from this document. Nevertheless, this paper has hopefully clarified certain issues for future applications.

4. References

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