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KNOWLEDGE MANAGEMENT: A NEW IDEA OR A RECYCLED CONCEPT?

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KNOWLEDGE MANAGEMENT

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ABSTRACT

Reading recent knowledge management (KM) articles, one cannot escape the impression of a recycled concept. Definitions of the new field look remarkably like those of information systems, decision support systems, and even data management of the past. Since we believe KM is essentially new, a refined articulation of KM is desirable. Our point of departure is the observation that yesterday's *data* are today's *information*, which will become tomorrow's *knowledge*, and knowledge, in turn, recycles down the value chain back into information and into data. We outline a framework of KM that articulates the basic terms of this perpetual process. The proposed model defines operations and transformations of data-to-information, information-to-knowledge, and their reverse order. Such transformations correspond to a time dimension of past-present-future and resemble the process of abstraction. Based on our analysis, we conclude that knowledge management is truly a new idea, not a recycled concept.

Keywords: data, information, knowledge, knowing-that, knowing-how, information systems, decision support systems, knowledge management.

We are being drowned in Information while being starved for Knowledge and distracted from Wisdom

Norman Myers [as quoted in Feldman,1999]

I. INTRODUCTION

Yesterday's data are today's *information*, and tomorrow's *knowledge*, which in turn recycles back through the value chain into information and then into data. This statement perhaps sums up the interchange and upward/downward migration of terms of knowledge management (KM). Indeed, information systems and information technology, as well as other scientific terms, suffer from overuse when disseminated into public use. Concepts like byte, network, email, even end-user, once the prerogative of the few are now common property. Adding a natural human weariness with old terms, and the perpetual striving for renewal, concepts tend to become buzzwords and labels.

The need for buzzwords in our fast moving society is a double-edged sword. Kanter [1999] remarks that buzzwords make a positive contribution as they draw attention to the subject at hand. At the same time buzzwords tend to create a shallow image of ideas and a notion that their introduction is more for marketing and sales consumption than to denote innovation. For example, for many people business process reengineering (BPR) is just another name for quality system analysis, and executive information systems (EIS) are a form of decision support software for executives. Even data warehousing did not escape scrutiny as to its newness. It can be regarded a recycled concept as a database "view" of a given domain, despite its merits in terms of performance and efficiency.

Other cases in point are terms like *data*, *information*, and recently *knowledge*. Knowledge is often not distinguishable from information or data [Alavi

and Leidner, 1999]. In the beginning there were data and information, with data processing turning the former into the latter. Then, data management and information management appeared. And now we have knowledge management (KM) and "the coming of knowledge based business" [Davis and Botkin, 1994]. Serious attempts to clearly distinguish these concepts are being published [Alavi and Leidner, 1999; Davenport and Prusak, 1998; and Nonaka et. al, 1996] but still definitions of KM are conspicuously similar to those given in the past for MIS, DSS, EIS and related systems.

For example, the definition "the derivation of knowledge management emanated from its earlier definition of capturing, storing, and analytically processing the data that resides in the various company databases for decision making" [Kanter, 1999], is indistinguishable from good old MIS defined two decades ago. MIS may be an "integrated, user-machine system for providing information to support operations, management, analysis and decision-making functions in an organization" [Davis and Olson, 1985]. But, as Kanter points out, broadening the definition of *knowledge* to include the tacit or implicit knowledge carried in an individual's mind and not presented in company databases suggests something of a new direction [Kanter, 1999].

Peculiarly, many KM and data mining [Chen et. al., 1999] studies that make generous use of the term knowledge shy away from a definition of that concept, and give something that qualifies as information. Some writers prefer to concentrate on KM, leaving *knowledge* as a black box or a commodity of sorts, and referencing it with managerial terms like "markets", "buying" and "renting" [Davenport and Prusak, 1998]. The authors of *Working Knowledge* are quick to state that: "since epistemologists spend their lives trying to understand what it means to know something, we will not pretend to provide a definitive account ourselves… we offer … a pragmatic description that helps us communicate what we mean when we talk about knowledge in organizations" [Davenport and Prusak, 1998].

In "knowledge management**",** the focus and accent are on management. KM alludes to a function like *management(x),* where *x* can be anything, i.e., {*x* = *data, information, resource, project*,...}. Once the accent of KM is on management, the discussion is well-structured, dealing with the capture, storage, sharing and so on of that *x.* This approach is indeed a black box. A similar fate doomed words like "system" as in decision support systems, where the focus is more on system than on the decision making process.

We will try to focus on the knowledge element, and give it a more appropriate explication. This focus on knowledge follows Spender's [1996] idea that knowledge is the basis of a dynamic theory of the firm. We believe knowledge is the essence of KM without which this new endeavor is a mere recycling of management topics. And, if such explication leads us to philosophy and epistemology, areas which have dwelt on the subject for centuries, so be it. We intend to employ some basic terms from those and related fields to clarify and distinguish *knowledge* from allied concepts and thus help to establish the emerging field of knowledge management on solid foundations. Without articulating the K word, the whole KM area may turn out to be yet another fad that will fade away in time.

Our paper, then, aims to zoom into the black box of knowledge within the realm of information systems and knowledge management. We review the basic operations and processes of inquiry, and propose a model of the transformations of data-to-information-to-knowledge, and the reverse, which are the foundations of information retrieval, decision making, data mining, and knowledge management.

II. FOUNDATIONS

Struggling with the concept of knowledge is as old as the history of human thought. From Plato to Descartes and to Kant, initial attempts were made to define knowledge as a symbolic representation built of basic primitives that can be manipulated by rules. This idea was later used as the basic premise of artificial intelligence (AI) which aimed to endow machines with knowledge. Symbolic and rule oriented representations of knowledge are not accepted by all thinkers, and other models have been proposed in a wide area of epistemology [Dreyfus, 1997; Wittgenstein, 1960]. Philosophers demarcate two types of knowledge: *knowing-that* and *knowing-how* [Ryle, 1949]. These types basically correspond to the factual knowledge we call data or information and to skill and know-how, which normally reside in the person's mind.

Before we move on to the elaborate on the subject, we describe the foundations of Knowledge Management.

KNOWLEDGE MANAGEMENT

Knowledge Management (KM) can be viewed as turning data (raw material) into information (finished goods) and from there into knowledge (actionable finished goods) [Kanter, 1999]. This basic input-to-output idea is scarcely a departure from the classical definitions of MIS, DSS, EIS and related systems.

Davenport and Prusak define knowledge as a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experience and information. Knowledge originates and is applied in the mind of knowers [Alavi and Leidner 1999]. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms

[Davenport and Prusak, 1998, p.5]. This definition is a pragmatic description of the meaning of knowledge in organizations.

Alavi and Leidner [1999] give a more elaborate definition of KM as a systemic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that others may make use of it to be more effective and productive. They go on to define a knowledge management system (KMS) as "an information system designed to facilitate codifying, collecting, integrating, and disseminating organization knowledge".

SO WHAT IS NEW?

We have already noted the resemblance of these definitions to the classical definitions of MIS, DSS, EIS, and Expert Systems. The reader is invited to replace the word *information* or *data* with the word *knowledge* in the following definitions to realize the problematic effect. For example,

- "A management information system (MIS) is a computer-based organizational information systems which provides information to support management activities and functions" [Ralston and Reilly, 1993].
- Closely related are the definitions of a DSS, which is "intended to support decision makers by providing access to a variety of data and by facilitating the use of analytical procedures, operations and models in a fast and flexible way" [Peppard and Henry, 1988], and
- an expert system (ES), which "generally consists of a knowledge base and an inference engine. It may also include a natural language interface…and explanation facility, and a knowledge acquisition subsystem that is used to enhance the knowledge base" [Hunt, 1986].

We note that knowledge already appears in the last definition. Hunt [1986] states that an ES is a "computer program that contains both declarative knowledge (facts about objects, events, and situations) and procedural knowledge (information about courses of action) to emulate the reasoning processes of human experts in a particular domain". Are we then applying a new word to the same concepts simply because the old ones were overused? Is KM no more then good old MIS, DSS, or ES?

As in the past with information, the business world is now discovering and recognizing that knowledge is an asset. So, we are still in pursuit of what is new with KM, claiming it is the concept of knowledge.

DATA AND INFORMATION

Any definition of knowledge must start from data and information. Information is "data endowed with relevance and purpose" [Drucker, 1995], or data that make a difference [King, 1993]. Clearly, the value of information is determined by the receiver not by the sender [Churchman, 1972]. If data becomes information when they add value in some way, then information becomes knowledge when it adds insight, abstractive value, better understanding.

Information is normally associated with meaning. For example, Bourdreau and Couillard see information as result of analyzing and interpreting data – phrases or images that carry meaning [Bourdreau and Couillard, 1999]. Such assigning of meaning to information is another example of an upgrading of a term that in due course becomes the norm.

Ascribing meaning to information is hardly the original notion of information set forth by Claude E. Shannon, founder of Information Theory. He claimed that information has little to do with meaning in the ordinary sense. Information theory is a non-semantic mathematical theory of a communication

channel's capacity to transmit data. "Information, in this theory must not be confused with meaning" [Shannon, 1962 p. 99].

WHAT IS KNOWLEDGE

Knowledge is that slippery and fragile thing or process we have a hard time defining. It has the curious characteristic of changing into something else when we talk about it. As Dewire [1999] put it, "knowledge – we know it when we use it". This hide-and-seek notion of knowledge may partially explain why when we attempt to capture, record or store knowledge – it turns back into information or data.

A wide range of characteristics is attributed to knowledge. Consider the following sample of definitions of knowledge (not of knowledge management).

- Knowledge is the power to act and to make value-producing decisions [Kanter, 1999, Polanyi, 1962].
- Knowledge is information made actionable in a way that adds value to the enterprise [Vail, 1999];
- it is a mission specific professional expertise [King, in Bourdreau and Couillard, 1999]; and,
- knowledge is things that are held to be true in a given context and that drive people to action [Bourdreau and Couillard, 1999].

The difficulty of defining knowledge is also due to the contradiction that "knowledge resides in a person's mind" [Alavi and Leidner, 1999] and at the same time has to be captured, stored, and reported.

The dimensions of knowledge range from a mere recalling of facts, and hence can be stored, to action and expertise, to a potential and ability. We can carry it a step further and propose that knowledge is the production of new facts, or even more engaging, the production of new knowledge, a recursive or reflexive process that is indeed infinite.

As a basic starting point – we try to represent *knowing-how* in terms of *knowing-that*. Such representation is not always achieved by or related to the volume of facts. One would even make an inverse observation: the more facts the lower the information and knowledge value, a topic that merits a separate inquiry.

Personal Knowledge

Polanyi [1962], in his pioneering work on personal knowledge, provides a comprehensive model of knowledge, defining three levels of knowing:

- Skill – acting according to rules,
- Know-how – skill plus acting in a social context, and
- Expertise – know-how plus the ability to influence the rules and domain of knowledge.

The expertise level is recursive or reflexive – it acts on itself. Indeed, Polanyi defines knowledge as "an activity which would be better described as a process of knowing".

Based on Polanyi, two types of knowledge are generally identified:

- Tacit or implicit Knowledge - mental models and experiences of individuals [Bourdreau and Couillrd, 1999]
- Explicit Knowledge - formal models, rules, and procedures.

Components of Knowledge

Although knowledge at the organizational level is hard to define, Wittgenstein [1960], Dreyfus [1997] , and others provide the list of components shown in Table 1.

Table 1. The Components of Knowledge

Context	Rules of thumb
Experience	Values and beliefs
Basic truths	Needs
Best practices	Emotions
Common sense	Desires
Judgment	Socializing into a culture

In summary, knowledge is the process of knowing, a reflexive process that takes data and information, in a social context, together with the factors listed in Table 1, and generates new data, information, and/or knowledge. Thus, knowledge constantly evolves, or else reverts to its raw material. This phenomenon brings forth such novel aspects as human capital, the importance of organizational learning, and knowledge mapping.

INTELLECTUAL CAPITAL, LEARNING, AND KNOWLEDGE MAPS

One new aspect is the treatment of knowledge as human capital. Unlike material capital, "knowledge walks out the door at the end of the day". Or, as studies are beginning to reveal about concepts of organizational memory and intellectual capital, that knowledge never leaves [Stewart, 1997]. Ames [2000] contends that knowledge is the "understood/comprehended result of analyzing information". To her, since knowledge is equal to comprehension, the construct "comprehension management" is not possible.

Another important concept that appears with KM is the learning organization [Huber, 1991, Senge, 1990]. This concept focuses on the idea that knowledge is not a deliverable "end product", as information or data may be, but rather a means, an ongoing process that keeps evolving. As a recursive and reflexive process, it is most appropriately part of KM, and as such, it certainly is a

new idea. Organizational learning is a fresh idea for management, with long-range strategic benefits that can draw on many aspects of related fields of the social sciences.

A third idea is the knowledge map. These maps are the links, yellow pages, and pointers between and among tacit and explicit knowledge available in an organization that are managed for common benefit [Vail, 1999]. Realizing that it is hard to capture and store knowledge itself, the next best thing to do is map it in an organized way. Such maps are perhaps what knowledge management is all about.

III. TECHNOLOGY

Technology is not a substitute for knowledge. While knowledge is an ongoing process, technology is a pipeline, a means, more of a vehicle for delivering data and information. Information technology, does not in itself create knowledge or guarantee knowledge generation. The medium here is *not* the message. The assumption that technology can replace human knowledge or create its equivalent has been proven false time and again [Davenport and Prusak, 1998].

Attributing knowledge to humans rather than to machines is a frequent discussion in AI, in dealing with the difference between humans and machines. Humans deal with and possess knowledge whereas machines handle the representations of knowledge, at least one step lower in the abstraction of reality. This level is really data or information.

The relative independence of knowledge from technology is evident in a case study of Lotus Notes, often quoted as software to promote knowledge. Davenport and Prusak [1998] describe the results of a study which showed that

the introduction of Lotus Notes into an organization did not, by itself, produce a change of information sharing and communication patterns

Computers are called data processors, information processors, and even knowledge generators. But, as already pointed out, they can help store and access lots of facts – *knowing-that,* they cannot replace expert know-how simply by adding more facts [Dreyfus, 1997].

Note the correspondence between *knowing-that* and *knowing-how* and data and data mining. Data, stored in databases, are facts that can be recalled, processed and the like. Once given relevance and purpose, data are turned into information and then into knowledge, which is *knowing-how* to do something. This is the stated goal of data mining - finding and discovering new insights and knowledge from large databases [Chen et. al. 2000].

The limiting aspect of technology as a strategic asset of an organization is due to what Webber calls a "self canceling advantage" since the same technology is quickly available to everyone [Webber, 1993]. Thus, knowledge is the strategic advantage of an enterprise in the long run, not necessarily its IT.

IV. MODEL

Given the range and dimensions of knowledge, and its unique place in KM, which make it a distinct field, we now outline a model that relates and distinguishes the various terms and concepts of knowledge so that a clear picture results. We also tie in wisdom, insight and related concepts.

As shown in Figure 1, reality is related to entities whereas data are the attributes of those entities.

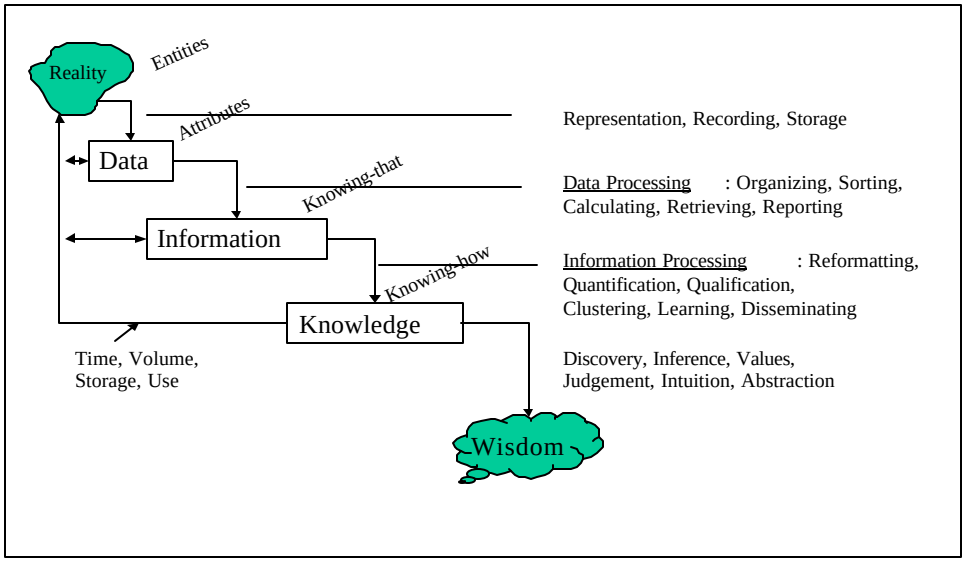

Figure 1. Knowledge Terms and Transformations

- Data (bases) represent, record, store, and maintain those attributes.
- Information is *knowing-that* and is the result of data processing operations such as organizing, sorting, etc.
- Knowledge is defined as *knowing-how* and is a consequence of information processing operations.
- Wisdom is knowing "when" and/or "if". Knowledge contributes to wisdom through activities such as discovery, inference, value, experience and more.

All these quantities are transformations in the process of knowing.

TRANSFORMATIONS

Information systems are processes of transformation [Spiegler, 1995]. Spiegler defined the transformations that take place from data to information and on to action. In defining such transformations, certain operations are required: data processing, information processing, and knowledge processing. These operations follow a path from data (D) to information (I) and to knowledge (K).

We use the notation of *K* → *I* → *D* and vice versa. Excluded from this discussion are database operations such as capture, verify, classify, index, store, and others. Table 2 describes these transformations.

Reversing the Process

Knowledge turns into information (*K* → *I*) with elapsed time, volume, repetitive use, training, storage, computerization, and more.

Knowledge and Information turn into data (*I* →*D* or *K* → *D*) with time, updates, reuse, application, and more.

Indeed, as mentioned in previous sections, "knowing" too much, may be counter-productive and turns such knowledge back into information or data.

Table 2. Transformations

Data Processing Operations: *D* → *I*	Information Processing Operations: *I* → *K*	Knowledge Processing Operations: *K* → *W*
• Organize	• Reformat	• Discovery
• Sort	• Quantify (Statistics)	• Inference
• Calculate	• Qualify	• Values
• Retrieve	• Associate, Cluster, Compare	• Judgment
• Report, Present	• Aggregate, Summarize	• Intuition and Insight
	• Apply, Connect	• Creativity
	• Learning (Heuristics)	• Abstraction
	• Communicate	
	• Disseminate	

Figure 1 (and the transformations it depicts) is also a model of abstraction, or stepping away from reality, but abstraction is beyond the scope of the current paper.

TIME DIMENSION

Another observation from the transformation analysis is the time horizon of data, information, and knowledge. Data deal with the past, information works in the present, while knowledge usually has to do with aspects of the future. Thus, the transformations (*D* → *I* → *K*) and (*K* → *I* → *D*) differentiate these terms, and suggest time direction as to their management.

ARCS AND NODES

Among the operations for generating knowledge is association. The ability to associate, link, and apply require intelligence and knowledge. Association suggests another observation that distinguishes data and information from knowledge. As in neural nets, data are stored in the nodes and the rules – knowledge – can be thought of as the arcs. Hence, the ability to perform associations is not only related to the data of a net, but also to its logic, learning, experience, and indeed knowledge.

KM IN CONTEXT

We are now ready to place KM in context with the other related systems. Figure 2 depicts key components related to our discussion so far: environment, data, information, database, and action.

Two black boxes are shown in Figure 2: F1 and F2. F1 is the basic transformation of data into information. F2 portrays the turning of information into action upon the environment, and can easily represent the decision making function performed by managers. We can also identify the three types of systems that appear (chronologically) in such a setup. Data processing is really associated with turning data into information. Information systems encompass a wider range – data processing, but also decision support and databases. And the emerging knowledge management systems are even wider in scope, taking in

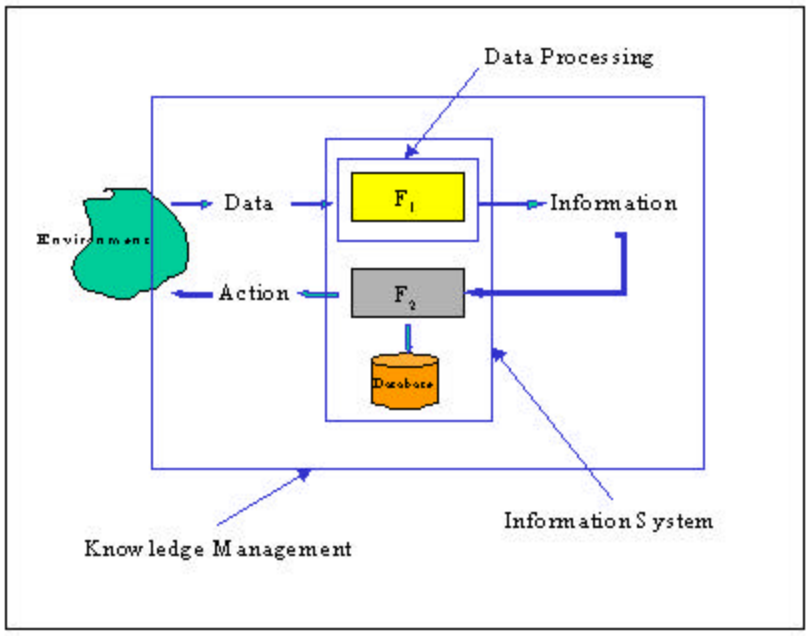

Figure 2. Knowledge Management in Perspective

part of the environment, external to the organization, as well as the other human-oriented aspect of knowledge.

V. SUMMARY AND CONCLUSIONS

SUMMARY

The major points made in this article are:

1. The paper discusses the nature of the knowledge management problem in light of a range of definitions that look quite similar to those of older concepts such as MIS, DSS, EIS, and even data management. The idea pursued in the paper is that without accenting and elaborating on the meaning of *knowledge* and

related terms, the emerging KM area may end up as yet another buzzword. We believe, as Spender [1996] suggests, that knowledge is the basis of a dynamic theory of the firm.

2. Our point of departure is the observation that yesterday's *data* are today's *information*, which will become tomorrow's *knowledge*, and knowledge, in turn, will recycle down the value chain back into information and into data.

3. A brief review of the foundations of knowledge and epistemology shows the range of explanations given to knowledge throughout the ages from a symbolic representation of primitives and rules, to the classification of knowledge into *knowing-that* and *knowing-how,* a suggested distinction among data, information, and knowledge.

4. The many topics, operations and transformations associated with knowledge management are summarized in Table 3 and discussed below.

5. The dimensions of knowledge show it to be a slippery concept that to some is a "thing", to others an expertise, still to others an ability to act, up to a process of knowing. We observe that knowledge is recursive and reflexive in nature, a process that generates new data and information, as well as new knowledge.

6. The classification of knowledge as tacit vs. explicit is now common and appears in most KM literature. An important notion is the organizational aspect of knowledge, and its related factors of human capital, learning organization, and knowledge maps, which are the basis for dynamic theory of the firm.

7. The roles of technology and knowledge have shifted. The previous idea that technology may replace knowledge was replaced by the idea that knowledge has a life of its own.

Table 3. Knowledge Management and Related Concepts

Topic	Explanations and Examples
Dimension of Knowledge	- Data and Information - Power to act - Information made actionable - Expertise - Things held to be true in given context - Best practices
Classification	Tacit vs. Explicit
Organizational Factors	Human capital Learning Organization Knowledge maps
Technology vs. Knowledge	Previously: Technology assumed to replace knowledge Now: Knowledge has life of its own?
Transformations: Data → Information Information → Knowledge Knowledge → Wisdom	 Organize, sort, calculate, retrieve, report Reformat, quantify, qualify, associate, cluster, aggregate, … Discovery, inference, value, judgment,
Time Dimensions:	Data – past; Information – present; Knowledge – future
KM Context:	Data processing – narrow, data into information Information system - wider, information to action Knowledge management – includes environment

8. We outlined the basic transformations of data-to-information and, information-to-knowledge and their inverse to articulate the terms *data*, *information*, and *knowledge.* A proposed knowledge-to-wisdom transformation includes operations such as discovery, inference, value, and judgement.

9. The time horizon of data, information, and knowledge correspond to past, present, and future. These relations are an important aspect for the design of knowledge management systems.

10. Placing KM in context helps designate its scope. While Data Processing dealt with narrow input/output transformation, and IS took a wider scope encompassed database management and decision support, KM is much wider because it includes implicit and external aspects of the enterprise environment.

CONCLUSIONS

Although knowledge management is, indeed, a separate branch of inquiry within information systems, it is not yet mature. It suffers from a lack of agreement on the definition of knowledge, confusing knowledge with data or information, leaving it as a black box, or having KM and MIS indistinguishable. As such it leave a taste of buzz.

The characteristics of knowledge discussed in the paper, together with ideas in organizational learning, intellectual capital, and knowledge maps, will establish and solidify KM as a new and promising field within the wider domain of information systems.

Overall, KM is a new concept not a recycled one. It is now our job to think and develop it further in terms of its own vocabulary and its own meaning. Our IS field and its deficiency of theoretical and philosophical roots may at last found a safe harbor in the sea of knowledge. Knowledge may be the right concept to help establish not only KM as a new endeavor but also put the entire IS discipline on firmer foundations.

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LIST OF ACRONYMS

AI	Artificial Intelligence
DP	Data Processing
DSS	Decision Support System
EIS	Executive Information System
IS	Information System
IT	Information Technology
KM	Knowledge Management
KMS	Knowledge Management System
MIS	Management Information System

ABOUT THE AUTHOR

Israel Spiegler is an associate professor and past chair of the Information Systems program at Tel Aviv University, Graduate School of Management. He holds an M.Sc and Ph.D degrees in Computers and Information Systems from UCLA. He was on faculty of Boston University, and is currently a visiting professor at the School of Information Science Claremont Graduate University. His areas of research are databases, artificial intelligence, and system analysis.

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