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From Information System to Information and Knowledge System

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Abstract. In this paper we notice that all definitions of information system never make a clear distinction between the notion of information and the notion of knowledge. We propose to clarify differences between data, information and knowledge by suggesting a model of an Enterprise's Information and Knowledge System (EIKS) supported by a Digital Information System. Then, based on our knowledge management research, we propose to transpose the Enterprise's Knowledge Management System implemented from our Model for General Knowledge Management within the Enterprise (MGKME) to the Enterprise's Information and Knowledge System. This leads us to describe the EIKS's components, highlighting two categories of components: underlying components and operating components. Moreover, we consider the perspectives offered by EIKS's evolution.

Keywords: Knowledge · Enterprise's Information and Knowledge System (EIKS) · Digital Information System (DIS) · Model for General Knowledge Management within the Enterprise (MGKME) · EIKS's components

1 Introduction

The enterprise increasingly develops its activities in a planetary space with three dimensions (Grundstein, 2007):

- A global space: this space covers the set of the enterprise that are the geographic places of localization.
- A local space: this space corresponds to the subset of the enterprise located in a given geographic zone.
- A space of influence: this space is the field of interactions of the enterprise with the others organizations.

The hierarchical enterprise locked up on its local borders is transformed into an Extended Enterprise, without borders, opened and adaptable. Furthermore, this Extended Enterprise is placed under the ascendancy of the unforeseeable environment

that leads towards uncertainty and doubt. One can remark that, depending on the geographic place of the local space (e.g. US, South America, Europe, and Asia), the vision of the global space is dependent of local members' culture. Behaviors may be different, and understandings of things can cause a hierarchical antinomy in the importance of the decisions and choices that are made.

The Extended Enterprise meets fundamental problems of information exchange and knowledge sharing among, on the one hand, its formal entities distributed in the world (offices, core competencies, business units, projects), and, on the other hand, the enterprise's employees (nomadic or sedentary), bearers of diversified values and cultures according to the places of their localization.

Two kinds of digital information networks overlap (Figure 1):

- A formal information network between the internal or external entities in which circulate data and codified knowledge. This network is implemented by using intranet and extranet technologies.
- An informal information network between members, nomadic or sedentary employees, in which information exchanges and tacit knowledge sharing take place. This network is implemented by using communication technologies, social networks, collaborative systems, and specific applications of Web 2.0.

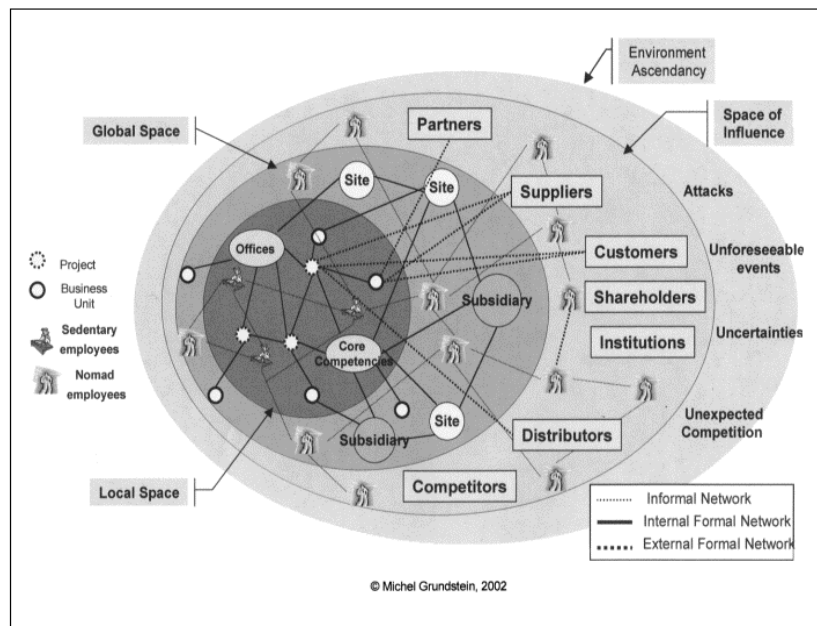


Fig. 1. The Formal and Informal Digital Information Networks within the Extended Enterprise

In the Extended Enterprise, initiatives and responsibilities are increasing, whatever the individuals' hierarchical levels and roles are. Employees are placed in situations in which they need to take decisions. They become decision-makers who use and create more and more knowledge as a basis for their efficiency. On this basis, Davenport and

Prusak (1998), state that “What makes knowledge valuable to organizations is ultimately to make better the decisions and actions taken on the basis of knowledge.” Therefore, knowledge is the crucial factor enabling employees to improve their decision-making processes and to enhance their competencies.

To handle their tasks, these individuals, who are commonly pointed out as knowledge workers, have to access information, knowledge, and skills widely distributed in the global and influence spaces of their enterprise. They must rely on the formal and the informal information networks of the enterprise through their sedentary or mobile computerized workstation.

In this paper we put down background theory and assumptions; notably, we introduce the concept of “commensurability of interpretative frameworks”. Then, highlighting that all definitions of Information System never make a clear distinction between information and knowledge, we clarify our approach introducing the concept of the Enterprise’s Information and Knowledge System (EIKS), which makes the difference between data, information and knowledge. Besides, based on our knowledge management research, we propose to transpose the Enterprise’s Knowledge Management System implemented from our Model for General Knowledge Management within the Enterprise (MGKME) to the Enterprise’s Information and Knowledge System. This leads us to describe the EIKS’s components, highlighting two categories of components: underlying components and operating components. Moreover, we consider the problem of the EIKS’s evolution.

2 Background Theory and Assumptions

Relying on the assumption that individuals may interpret differently the same information, this work focuses on knowledge as being the result of the interpretation of information by someone according to Tsuchiya (1993). The way of creating individual’s tacit knowledge is introduced in the first part of this section, whereas conditions for considering information as knowledge are then presented in the second part of this section.

2.1 Creation of Individual’s Tacit Knowledge

Our approach is built upon the assumption emphasized by Tsuchiya concerning knowledge creation ability. Drawing from the concepts of “sense-giving” and “sense-reading” studied by Polanyi (1967), he states, “Although terms ‘datum’, ‘information’, and ‘knowledge’ are often used interchangeably, there exists a clear distinction among them. When datum is sense-given through interpretative framework, it becomes information, and when information is sense-read through interpretative framework, it becomes knowledge” (Tsuchiya, 1993, p. 88). In other words, we can say that tacit knowledge in our brain results from the sense given, through our interpretative frameworks, to data that we perceive among the information transmitted to us. Or rather, knowledge exists in the interaction between an interpretative framework

(incorporated within the head of an individual, or embedded into an artifact), and data.

Here, “sense-giving” and “sense-reading” are defined by Polanyi as follows: “Both the way we endow own utterance with meaning and our attribution of meaning to the utterances of others are acts of tacit knowing. They represent sense-giving and sense-reading within the structure of tacit knowing.” (Polanyi, 1967, p. 301). Tsuchiya (1993) added the concept of “interpretative framework”, which can be seen as a “mental model” as defined by Jones et al. (2011): “Mental models are personal, internal representations of external reality that people use to interact with the world around them. They are constructed by individuals based on their unique life experiences, perceptions and understandings of world. Mental models are used to reason and make decisions and can be the basis of individual behaviors. They provide the mechanism through which new information is filtered and stored.”

In a different way, Wiig (2004), who highlights a discontinuity between information and knowledge, describes this process clearly. He states “The process, by which we develop new knowledge, uses prior knowledge to make sense of the new information and, once accepted for inclusion, internalizes the new insights by linking with prior knowledge. Hence, the new knowledge is as much a function of prior knowledge as it is of received inputs. A discontinuity is thus created between the received information inputs and the resulting new knowledge.” (p. 73). Authors as Grundstein (2008, 2009) elaborated a model that attempts to describe the transformation process from data to information, and from information to tacit and explicit knowledge.

Consequently, we postulate that knowledge is not an object processed independently of the person who is acting. So, we can say that formalized and codified knowledge that are independent from individual, are not more than information, which may lead to different interpretations, as notably studied by Arduin (2014). Furthermore, as emphasized by Haeckel (2000) we must discern “the knowledge of knower and the codification of that knowledge.” (p. 295).

2.2 Conditions for considering information as knowledge

Tsuchiya emphasizes how organizational knowledge is created through dialogue and highlights how “commensurability” of the interpretative frameworks of the organization’s members is indispensable for an organization to create organizational knowledge for decision and action. Here, commensurability is the common space of the set of interpretative frameworks of each member (e.g. cognitive models or mental models directly forged by education, experience, beliefs, and value systems). Tsuchiya states that “It is important to clearly distinguish between sharing information and sharing knowledge. Information becomes knowledge only when it is sense-read through the interpretative framework of the receiver. Any information inconsistent with his interpretative framework is not perceived in most cases. Therefore, commensurability of interpretative frameworks of members is indispensable for individual knowledge to be shared.” (Tsuchiya, 1993, p. 89).

In our point of view, information can be considered as knowledge when it is stable, well defined, and recognized by a given specific and homogenous population.

3 The Enterprise's Information and Knowledge System (EIKS)

Through the Enterprise's Information and Knowledge System (EIKS), we want to point out the importance to integrate individuals as users and as components of the system, so that not only a Digital Information System (DIS) is processing information, but also individuals (Hornung, 2009, p.9), who are notably creating knowledge from information processed.

The switch from Information System to EIKS is explained in the first part of this section. EIKS's components are then presented in the second part of this section. The Enterprise Portal illustrates an EIKS's visible component in the third part of this section, whereas the evolution of EIKS is finally discussed at the end of this section.

3.1 Information System and Enterprise's Information and Knowledge System

Many authors have already defined the concept of Information System, for example let us quote the following definitions: "An Information System is an organized set of resources: material, software, employees, data, procedures, in order to acquire, to process, to store, to disseminate information (data, documents, image, sound, etc.) in organization" (Reix, 2000) ; "An Information System is the set of all elements that contribute to the process and the circulation of information in an organization (data base, software, procedures, documents) including Information Technology" (Educnet, 2006) ; "Technically, we can define an Information System as a set of elements interconnected which collect (or recover), process, store and disseminate information in order to support decision and process control in organization" (Laudon and Laudon, 2006).

All these definitions do not explicitly distinguish the notions of information from the notion of knowledge. Thus, we introduced the concept of "Enterprise's Information and Knowledge System" (EIKS).

The Enterprise's Information and Knowledge System (EIKS) consists mainly in a set of individuals and Digital Information Systems. EIKS rests on a sociotechnical fabric, which consists of individuals in interaction among them, with machines, and with the very EIKS. EIKS includes (Figure 2):

- a Digital Information System (DIS) that is an artificial system, the artifacts designed from Information and Communication Technologies (ICT),
- an Information System (IS) that is constituted by individuals who, in a given context, are processors of data to which they give a sense under the shape of information. This information, depending on the case, is passed on, remembered, treated, and diffused by them or by the DIS,
- a Knowledge System (KS) that consists of tacit knowledge embodied by the individuals, and of explicit knowledge formalized and codified on any shape of supports (documents, video, photo, digitized or not). Under certain conditions, digit-

ized knowledge is susceptible to be memorized, processed and spread within the DIS. In that case, knowledge is no more than information.

We insist on the importance to integrate the individual as a user and as a component of the system as Chua and Brennan (2004) highlighted in their study on Collaborative Knowledge Management System (CKMS) design. They emphasized that “One of the most important components of CKMS is the knowledge workers, who are also the users of the system, and the workspaces they are associated with” (p. 172).

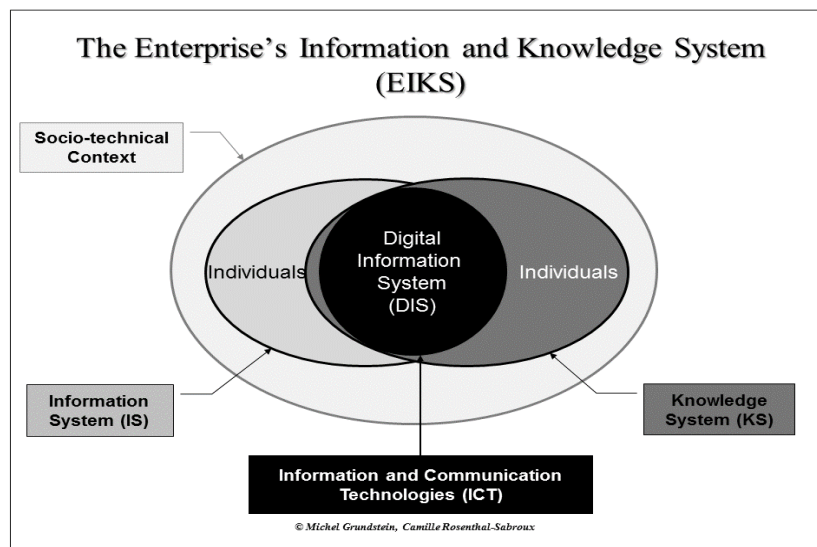


Fig. 2 The Enterprise's Information and Knowledge System (EIKS)

3.2 The EIKS's Components

To implement EIKS's components, enterprises need models of reference. In our research group, we conceived a General Model of Knowledge Management within the Enterprise (MGKME). The MGKME supports our full meaning of KM, that is: KM is the management of the activities and the processes that enhance the utilization and the creation of knowledge within an organization, according to two strongly interlinked goals, and their underlying economic and strategic dimensions, organizational dimensions, socio-cultural dimensions, and technological dimensions: (i) a patrimony goal, and (ii) a sustainable innovation goal.

MGKME should be seen as an empirical model (Figure 3). It materializes a synthetic vision of our researches standing against more than twenty years of experiences in the KM field. It suggests a sociotechnical approach defined as “the study of the relationships and interrelationships between the social and technical parts of any system” (Coaks, 2002, p. 5).

MGKME is composed of two main categories of elements: (I) the underlying elements consist of sociotechnical environment and value-adding processes (Porter,

1985); (II) the operating elements focus on the underlying elements. They consist of managerial guiding principles, ad hoc infrastructures, generic KM processes, organizational learning processes, and methods and supporting tools.

In this paper, we distinguish the notion of model of reference from the notion of system, which depends on the context and takes shape in the implementation of the model of reference in the actual field. The model is defined by its elements; the system that materialized the model is characterized by its components. For example, the Enterprise's Knowledge Management System (EKMS), which is implemented in the actual field, materializes the partial or total elements of MGKME.

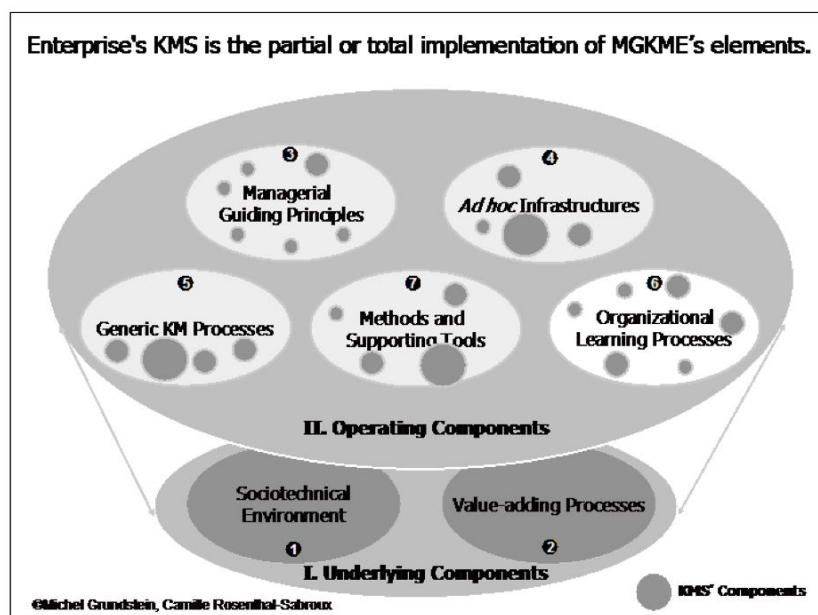


Fig. 3 Model for Global Knowledge Management Within the Enterprise (MGKME)

Furthermore, when considering the implementation of MGKME into an Enterprise's Knowledge Management System (EKMS), we observe that this implementation can be generalized to the Enterprise's Information and Knowledge System (EIKS).

According to these hypotheses, the components of the EIKS should be as follows (Figure 4).

There exist two categories of components: underlying components and operating components.

- Underlying components
The Sociotechnical Environment and the Value-Added Processes give a concrete expression of the enterprise that evolves and undertakes, using and creating knowledge, disseminating and recording information.
- Operating components

The operating components represent the digital Information System, the artificial object conceived by humans to support employees to collect, store, process and disseminate information, in order to carry out their activities within the context of the enterprise.

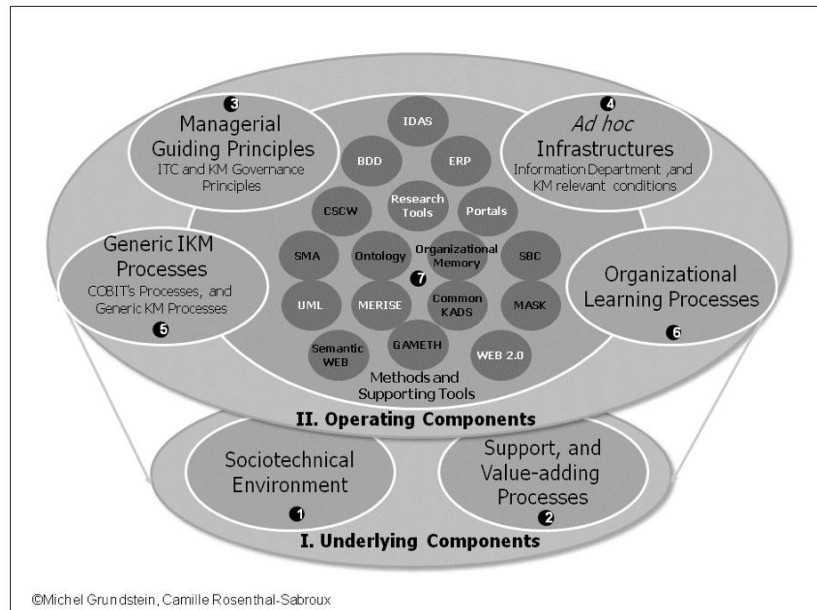


Fig. 4 EIKS's Components

Thus, the Managerial Guiding principles and Generic Information and Knowledge Management Processes are directly issued from IT Governance Principle, and Processes described in the COBIT® (2005), and Generic KM processes described in MGKME. The infrastructures are implemented as Information Management System Department and ad hoc infrastructures for KM. Methods and Supporting Tools complement one another: notably, on the one hand, we consider Data Management, ERP, IDAS, Portals, Research Tools, Web 2.0, UML, MERISE, coming from IS, and, on the other hand, we consider CSCW, SMA, KBS, Semantic Web, Ontology, Organizational Memory, Common KADS, MASK, GAMETH®, coming from KM. Organizational learning processes apply both to information and knowledge management.

So that EIKS's components rely on Information and Communication Technology artefacts. Nevertheless, the individual being not only a user, but also a component of the EIKS, sense-giving and sense-reading processes are taken into consideration, as well as the differences between data, information, tacit and explicit knowledge.

3.3 The Enterprise's Portal, an EIKS's visible component

The aim of this work is not to identify the technology used to implement an EIKS, but to point out the importance of individual tacit knowledge, and of his/her sense-giving and sense-reading processes. The Enterprise's Portal is one of the EIKS's visible components. It must enable users to access three types of data to be processed by the Digital Information System (DIS): the *mainstream* data, the *source-of-knowledge* data, and the *shared* data (Rosenthal-Sabroux and Grundstein, 2008).

The *main-stream* data makes up the flow of information that informs us on the state of an enterprise's business process or working information needed by each individual to act.

The *source-of-knowledge* data is the result of a knowledge-engineering approach that offers techniques and tools for acquiring and representing knowledge.

The *shared* data are information linked to inter relationship between people, processed by information and communication technology. These technologies have caused a rupture with older technologies, a rupture linked to the relationship of human beings to space, to time and to the capacity to be ubiquitous which takes us from the real world to a virtual one, from the manipulation of concrete objects to abstract ones. The instantaneous transfer of digitalized multimedia documents that include texts, images and sounds, the possibility of asynchrony of information exchanges that transforms our relationship with time and space, electronic conferences that allow us to be in different places at the same time, engender a transformation in our behavior at work. They accelerate the publication and dissemination of documents, they facilitate working in groups, they modify our means of communication, and above all, they speed up the transmission and sharing of tacit knowledge that, until now, operated from person to person on a master-apprentice basis. In short, they generate processes of information exchange that were unbelievable with previous technologies.

The portal becomes a window opened on the Enterprise's planetary space of activities. Thus, beyond the technical infrastructures that are implemented, the essential role of the Digital Information System (DIS) is to provide relevant information to each employee at all levels of the hierarchy, so that he/she can control his/her situation, make decisions and carry out his/her tasks.

3.4 EIKS's Evolution

The Enterprise's Information and Knowledge System (EIKS) is the nervous system of the enterprise: it feeds the processes of governing, piloting, deciding, and acting (Figure 5).

The Information Systems (IS) and the Knowledge Systems (KS) rest on Digital Information Systems (DIS). They constitute, on the one hand, the source and the support of piloting and deciding processes of the enterprise, and, on the other hand, the enterprise's structuring basis. These systems bring features that generate practices and behaviors different from those envisaged at the time of the requirements analysis. According to the conception of DIS, the underlying models, and the technological platforms used for their implementation, this phenomenon becomes more and more a factor that induces organizational innovations. In that case, there is modification and/or creation of new supporting processes and value adding processes. This

evolution of processes generates new problems and new needs: on the one hand, understanding and resolution of problems induce the construction of new knowledge; and, on the other hand, new needs induce the conception of new functionalities.

The management of the EIKS has to take into account these evolutions. These last ones must be integrated during the conception of the DIS.

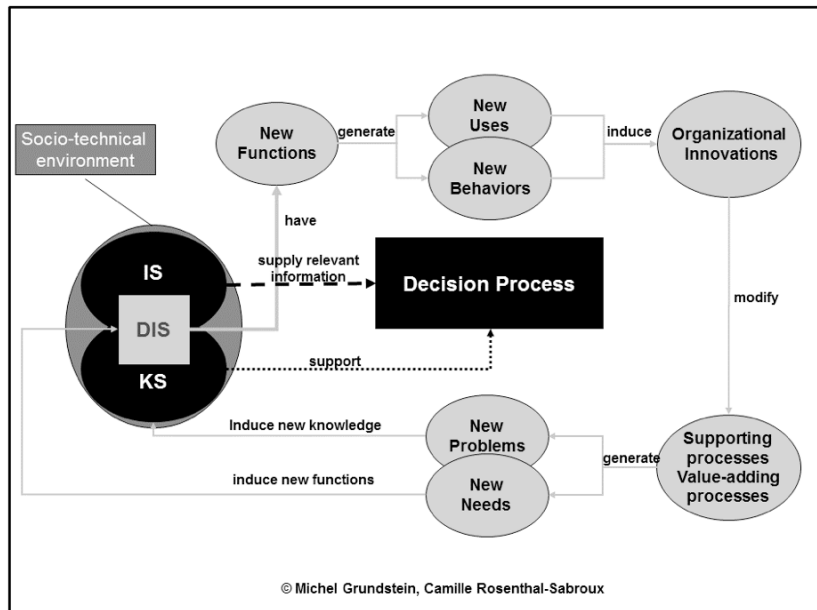


Fig. 5 EIKS's Evolution

Conclusions and perspectives

Many authors have already defined the concept of Information System. These definitions do not explicitly distinguish the notion of information from the notion of knowledge. In this paper we introduced the concept of Enterprise's Information and Knowledge System (EIKS). Based on our knowledge management research we proposed to transpose the Enterprise's Knowledge Management System implemented from our Model for General Knowledge Management within the Enterprise (MGKME) to the Enterprise's Information and Knowledge System. This led us to describe the EIKS's components, highlighting two categories of components: underlying components and operating components. Moreover, we considered the problem of the EIKS's evolution.

In this paper we adopt a given perspective founded on an empirical vision coming from experiences on the field and from academic researches.

We think that on the one hand, the distinction between data, information and knowledge, and on the other hand, the distinction between underlying and operating elements, brings to a better understanding of Digital Information System engineering.

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