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The role of the Enterprise's Information and Knowledge System within the Digital Enterprise

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ABSTRACT. *Since the last decades our world, completely transformed by the digital invasion, is becoming a digital world. Notably, enterprises, social lives, and even health care, subjected to the immediacy of this invasion, are confronted with drastic change challenges. Enterprises become digital enterprises. Whereas digital is an adjective related to digit, there is no unanimous definition of what this concept actually means in the scientific literature. Digital devices such as computers, tablets, and smartphones, give individuals the means to interact regardless where they are, and to share more than just information. The Enterprise's Information and Knowledge System (EIKS) considers individuals not only as users of the digital information system, but also as components, i.e. processors of information and holders of knowledge. Within enterprises we observe the emergence of digital departments differing from the information system department. Such digital departments are not under the supervision of a Chief Information Officer. In this paper, relying on three postulates and on the characteristics of the digital enterprise, we propose to present what the EIKS is, its role within the digital enterprise and what it is becoming, through the use of the General System Theory.*

KEYWORDS: *Knowledge, Enterprise's Information and Knowledge System (EIKS), Digital Information System (DIS), Digital World, Digital Human Beings, Digital Enterprise.*

1. Introduction

The process of digitalizing is the basis of all electronic technologies. Enterprises rely nowadays more than ever on electronic artifacts processing information that has been codified in binary code. Such process of digitalizing creates huge quantities of information to process, to store, and to share within and/or between enterprises.

We consider “digital invasion” as an expression reflecting something we observe not only within enterprises, but also in daily life: everything is or may be digitalized. Whereas “digital” is an adjective related to digit, there is no unanimous definition of what this concept actually means in the scientific literature, even if it is studied by authors such as [CAN 15].

Digital devices such as computers, tablets, and smartphones are strongly integrated in our lives and lead enterprises to become digital enterprises. Since the emergence of the Web, digital technologies are also transforming the structure of social relationships ([SUS 12]). Today, enterprises are beginning to see the power of digital resources to create new products and services ([RAI 12], [SAM 03]), and are also transforming their own processes.

The aim of this paper is to focus on the Enterprise’s Information and Knowledge System (EIKS) and to clarify its role within the digital enterprise. We began introducing background theories and assumptions, particularly: (1) three fundamental postulates on which our vision of knowledge in the organization relies ([GRU 09]), (2) specifications on the way of understanding digital world, digital human beings, and the digital enterprise ([BER 12]), and (3) the General System Theory ([LEM 77]), through which the EIKS has been studied and defined. Then we present what the EIKS is, its role within the digital enterprise, and what it is becoming, through the use of the General System Theory. The work presented in this paper aims at defining the role of the EIKS within the digital enterprise.

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 [TSU 93].

The way of creating individual's knowledge is introduced in the first part of this section, whereas ways of defining and understanding digital world, digital human beings, and the digital enterprise are explained in the second part of this section. The General System Theory ([LEM 77]) is presented in the third part of this section.

2.1. Information and Knowledge

Our approach is built upon the assumption emphasized by [TSU 93] concerning knowledge creation ability. Drawing from the concepts of "sense-giving" and "sense-reading" studied by [POL 67], [TSU 93] 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" ([TSU 93], 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 [POL 67] 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." ([POL 67], p. 301). [TSU 93] added the concept of "interpretative framework", which can be seen as a "mental model" as defined by [JON 11]: "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, [WII 92], 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." ([WII 92], p. 73). Authors as [GRU 08], [GRU 09] 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 is independent from individual, is not more than information, which may lead to different interpretations, as notably studied by [ARD 14a]. Furthermore, as emphasized by [HAE 00] we must discern “the knowledge of knower and the codification of that knowledge.” ([HAE 00], p. 295).

[TSU 93] 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). [TSU 93] 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.” ([TSU 93], p. 89).

Our three fundamental postulates are:

1. Knowledge is not an object – it results of the interpretation by someone of information ([TSU 93]),
2. Knowledge is linked to the action – it is necessary to realize processes, which in turn create knowledge ([GRU 09]),
3. Company’s knowledge includes two main categories of knowledge – tacit and explicit knowledge ([POL 58], [ARD 14b]).

In our point of view, knowledge can be considered as an object, and so managed as information when it has been made explicit, stable, well defined, and recognized by a given specific and homogenous population.

2.2. Digital World, Digital Human Beings, and the Digital Enterprise

The word “digital” directly refers to the Latin term *digitalis* that means “of or belonging to a finger”, from which comes the first definition given by the *Oxford English Dictionary*. The word “digital” is initially used to characterize the recording mode of sounds, images or videos as opposed to “analog”. The example of the sounds can help us to better understand the meaning of this notion - particularly in relation to the introduction of the compact disc (CD) in the 1980s as popular goods and the gradual replacement of vinyl. The analog recording is based on sound reproduction in a way very close to reality *i.e.* by reproducing on a medium - for

example, a vinyl. In contrast, the digital principle is to discretize the continuous sound - or image or any other information. This process of digitizing is the basis of all electronic technologies that work with discrete numbers in base 2, *i.e.* from a series of 0 and 1. In practice, 0 and 1 are represented by an electrical circuit where passes the electric power (digit 1) or where it does not pass (digit 0). This technical description is clearly not sufficient to understand the pervasive use of digital devices. Especially it does not emphasize the value they have acquired in these recent years through concepts such as “digital world”, “digital human beings”, and “the digital enterprise”.

2.2.1. Digital world: How is the world transformed by using digital devices?

It is reasonable to say that the development of Internet and of Web technologies in the 1990s primarily induced a transformation of the world and of its social and cultural values. The Web is more than the interconnection of computers; it has determined a major change in our practices and our relationships with the surrounding world, as it has created new models of production, distribution and reception of information in general.

As a result of the ubiquity of the Web in our lives, what is digital is everywhere. A few decades, we expected the information technology to be mainly a powerful tool with multiple functions capable of helping human in many fields. Today, this view is obviously reductionist, if not completely false: The digital is becoming a full environment in which we are immersed, it determines and shapes our world representations and action modes. The digital is not just a set of tools: Not just a set of technical devices to better do what we did before. It can't be considered as a car that allows us to do the same road more rapidly than on foot. The digital changes our practices and enables new possibilities.

Let us try to illustrate this statement with two simple examples. The first one can be the use of Twitter ([BIF 10]) during a conference, seminar or a university course. This tool profoundly changes the way to participate to this event, because: not only (1) it allows people who are not in the room to be informed on or to comment what is said there, but also (2) it induces a different way to understand the conference, seminar or course. While the speaker is talking, someone from the audience reacts to what he says. This reaction is read by the others – physically present or not - and this often creates multiple layers of discussion. Someone is following what the speaker says, someone is to deepen what he has just said - for example by seeking references on the Internet or by requesting clarification from another participant who knows more. In short, Twitter changes the form and content of the debate, but also the form of intelligence itself. As a second example, let us examine the impact of a popular device, Global Position System (GPS) on our daily life: Using a GPS alters our relationship to space and we perceive space differently. We always know where we are and how to reach our place without being lost creating a sense of confidence.

Besides, it is no longer necessary to remember the road and to know how to read a map, even if it may be a problem in the case of hardware or network failure.

These two examples show that we no longer understand the same things in the same way; our relationships in knowledge transfer ([DAV 00]) and acquisition is dramatically changing. The digital devices generate practices and also new implications of these practices, it changes our way of being in the world and also our cognitive approaches how we manage our attention considered as a scarce resource and consequently our way of thinking and perceiving time and space. These important facts force us to question a naive conception of the nature of human and his place in this digital world.

2.2.2. Digital human beings: Are “digital human beings” going towards a whole dependency of digital devices?

According to [STI 14], “the tools change our physiology and therefore our way of inhabiting the world”. Individual is not simply a human being who uses digital tools, but a human being who works differently, who has a different relationship with his surrounding: space, time, memory and information source of knowledge, etc. He is becoming a “digital human being”.

The individual in everyday life is paired up with digital devices. He lives surrounded with technical devices: computers, mobile phones, connected objects, etc. These digital devices have the main particularity to be the core of his activities. They stand between individual and the world. They slip between people, to the core of their practices, they help them and more radically, they transform their way of being.

The question of the place of human in the digital world has been addressed for the first time by [NEG 95]. He knew already that many people will be afraid of technology and would refuse to understand it. For him, technological advances will be inevitable: “*One day, computers, bytes, and bits will be a part of almost everything we do*” ([NEG 95], p. 43).

2.2.3. The “digital enterprise”: How is the enterprise transformed by the digital world?

As we mentioned in the previous section, the digital world driven by new technologies is changing the habits of humans and thus changing also business: Organizations, processes, researches and innovation, governance, communications, customer relationships, skills and career management.

The great transformations are well known: the Cloud Computing, which allows businesses to overcome infrastructure constraints, adapts their Information and Communication Technologies (ICT) tools to their activity; the high speed networks and mobility, which break the limitations of the physical boundaries of the organization. The enterprise was a pyramid structure of resources management. It becomes a network of competencies and means, which adapts according to the objectives and the environment. Further changes are also beginning to emerge. We will mention three; First the spread of social networks as a tool in the enterprise and a main channel of the customer relationship. The aim is to make the enterprise a collaborative organization. Social networks create a direct relationship between the enterprise and its clients, by giving them the power. As soon as the most customers form a community to follow a trademark or complain, the enterprise can no longer ignore it. It must listen, propose and adapt. Then, this marketing transformation is also commercial: mobile applications and web services. They become a mandatory channel of distributing for the enterprise's products. We must not underestimate the magnitude of this transformation: The ability to provide the best possible customer experience is at least as important as the quality or price of the products. Finally, the connected objects are one of the most important growth drivers for our economy. It is the ability to equip all objects which surround us daily with simple and automatic functions to simplify our lives. The scope of application is endless. Our cars are already able to report problems to a service center or guide us as a function of traffic, our homes monitor themselves, etc. The production and logistics cycles are also beginning to be completely redesigned to take advantage of digital world. We are only at the beginning of what will become as common as to have a phone in the pocket today.

2.3. The General System Theory

System theory was proposed in the 1940's by [VON 68] and furthered by [ASH 56]. [VON 68] emphasized that real systems are open to, and interact with, their environments. Through emergence, they can acquire qualitatively new properties resulting in continual evolution. Rather than reducing an entity to the properties of its parts or elements, system theory focuses on the arrangement and relations between the parts which connect them into a whole. This particular organization determines the system which is independent of the concrete substance of its elements.

In the field of knowledge management, [LEM 77] defined a system as an object within an environment, with goals and performs an activity. It sees its internal structure evolve over time, yet without losing its unique identity ([LEM 77], p. 60).

[LEM 77] reproaches the Cartesian revolution for having focused on an ontological pole when defining entities ([LEM 77], p. 63). Things were defined by their attributes, by what they are, neglecting their relationships with each other

([WIL 72]). The General System Theory considers that such formal description (the ontological pole) has to be filled in by the point of view of what entities do when they are interacting with their environment, their *role* in their environment (the functional pole).

Through the analysis of what an entity is (the ontological pole) and what an entity do (the functional pole); it becomes possible to define it, even if such definition lacks an analysis of what the entity will become (the genetic pole). Indeed for [PIA 70], defining an object needs to define its history (past) and to define its project (future). So that [LEM 77] introduced the General System Theory as a way to define entities by defining what they are (the ontological pole), what they do (the functional pole), and what they will become (the genetic pole).

Figure 1 illustrates the General System Theory. Such definition of entities will notably allow us to describe what the EIKS is, its role within the digital enterprise, and what it is becoming.

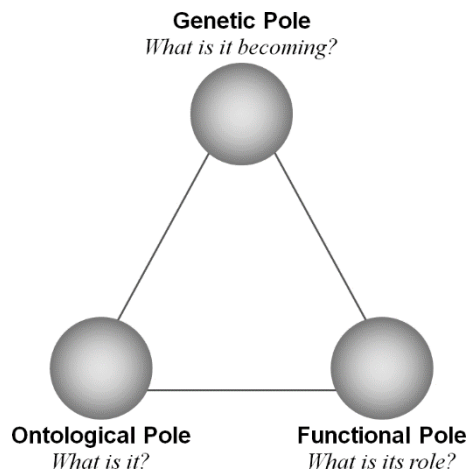


Figure 1. Definition of an entity through the General System Theory ([LEM 77])

When looking at Figure 1:

- The *ontological pole* considers the system in its structure, as it is perceived as a set of arranged objects, such as “something”: it is the point of view of the system being.
- The *functional pole* considers the system within its function, as it is perceived as acting as "doing something": the point of view of the doing of the system.

- The *genetic pole* considers the system in its evolution as it is perceived as being modified over time in line with the project: it is the point of view of the becoming of the system.

In the next section, we will describe what the EIKS is, the role it plays in the digital enterprise, and what it is becoming.

3. The Enterprise's Information and Knowledge System in the Digital Enterprise

The work presented in this paper relies not only on the scientific literature, but also on observations we did and we are doing within enterprises. Through the General System theory ([LEM 77]), we propose to refine the definition of the EIKS by understanding and by explaining its role within digital enterprises.

The ontological pole of the EIKS is introduced in the first part of this section, *i.e.* according to the General System Theory, what the EIKS is. Then the functional pole of the EIKS is presented in the second part of this section, *i.e.* what is the role of the EIKS. Finally the genetic pole of the EIKS is explained in the third part of this section, *i.e.* what the EIKS is becoming.

3.1. The ontological pole – what is the EIKS?

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, ...) in organization” ([REI 00]) ;
- “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” ([EDU 06]) ;
- “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” ([LAU 06]).

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) ([GRU 14]).

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, digitized 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 [CHU 04] 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” ([CHU 04], p. 172).

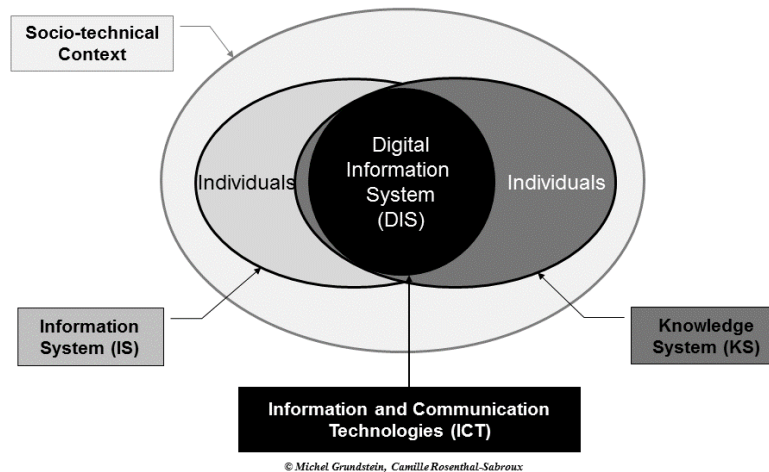


Figure 2. *The Enterprise's Information and Knowledge System (EIKS) ([GRU 14])*

3.2. The functional pole – what is the role of the EIKS?

The role of the EIKS is strongly related to the role of the concept itself. Indeed it is the concept of EIKS that leads to point out the existence of tacit knowledge resulting from the interpretation by someone of information. Nevertheless, instantiating an EIKS within a digital enterprise also leads to point out the existence of tacit knowledge inherent to individuals. So that the EIKS leads to consider individuals not only as users of a digital information system through digital artifacts, but also as processors of information in an information system, and holders of knowledge in a knowledge system. Individuals are components of the EIKS, even if it remains a concept and is not formalized within a digital enterprise.

Regarding individuals as components induces another role of the EIKS. Digital enterprises are organized around digital artifacts which may – or may not – operate under the supervision of a Chief Information Officer. Information technology is becoming more and more central for digital enterprises, and at the same time, individuals are becoming less and less central for such enterprises. Individuals are realizing processes, they are using digital artifacts that are central for the digital enterprise, but they are no longer central for such enterprises. The EIKS has the role of focusing on individuals and on the ways they process information and they hold knowledge. We consider that such focus may give the means to fill the gap between the digital enterprise and the enterprise itself, notably by focusing on individuals as stakeholders and by identifying their role in the digital enterprise.

Nowadays, digital enterprises (especially service companies) create value by processing information, and the information has value even greater as it helps to the achievement of the objectives of the organization. Collecting, sharing, and managing information is predominantly the work of Talentsoft¹ for example, through its human resources management software (a digital information system). Such software helps clients to manage their human resources. The interactions between different stakeholders are made and highlighted in this tool. To give a simple example: In the recruitment process, the manager may make an application for recruiting a new member in his/her team on the tool. The request is validated by the director and the offer is broadcasted by the recruiter on the Web. Candidates respond to an advertisement and finally, the treatment of separate applications is still done on the tool. This underlines how much the digital enterprise is an “extended digital enterprise”. The concept of EIKS has then a clear role for enterprises such as Talentsoft: It can serve as a reference to highlight the gaps related to the digital environment and thus identify and position human beings in the system. They are both users and components of the system. Indeed, the Human Resources Information System (HRIS) is a digital environment where actors provide and exchange information that is source of knowledge in the recruitment process. Then, decisions induced by this exchange change the way of designing the digital product and the business model of Talentsoft. Such examples show that EIKSs may exist within digital enterprises, even if we are not clearly aware of. By using the concept of EIKS as a reference framework, we have achieved its usefulness in the examples above.

3.3. The genetic pole – what is the EIKS becoming?

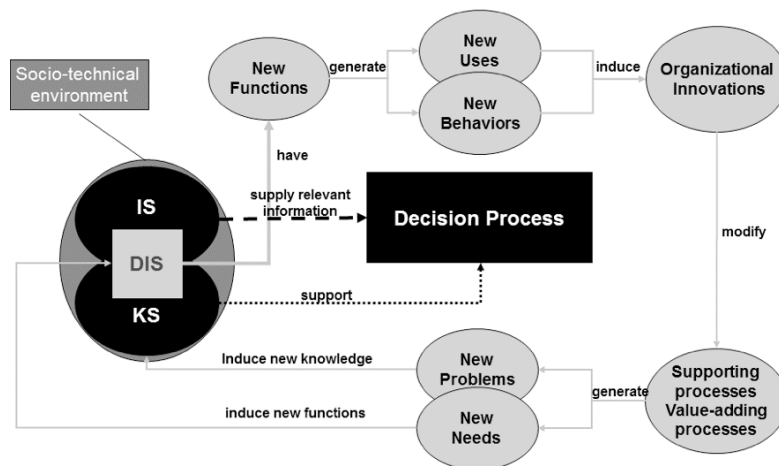
The Enterprise’s Information and Knowledge System (EIKS) is the nervous system of the enterprise: it feeds the processes of governing, piloting, deciding, and acting (Figure 3).

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

¹ Talentsoft is a leading developer of cloud-based talent-management software. Since its creation in 2007, it has evolved into one of Europe’s leading software-as-a-service companies with over 4 million users in 100 countries.

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.



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Figure 3. *EIKS's Evolution*

4. Conclusion and Perspectives

Individuals are not simply human beings using digital artifacts. Human beings become digital human beings, with different relationships to space, time, memory, and information source of knowledge within the digital enterprise. Indeed, enterprises are becoming digital enterprises and the world itself is becoming a digital world. The word “digital” is initially used to characterize the recording mode of sounds, images or videos as opposed to analog. The process of digitalizing requires discretizing information, all electronic technologies working with discrete numbers codified in binary code.

In this paper, we propose to focus on the Enterprise's Information and Knowledge System (EIKS) and to clarify its role within the digital enterprise. We began introducing background theories and assumptions, particularly: (1) three fundamental postulates on which our vision of knowledge in the organization relies [GRU 09], (2) specifications on the way of understanding digital world, digital

human beings, and the digital enterprise [BER 12], and (3) the General System Theory [LEM 06], through which the EIKS has been studied and defined. Then we presented what the EIKS is, its role within the digital enterprise, and what it is becoming, through the use of the General System Theory.

The EIKS considers individuals not only as users of the digital information system, but also as components, *i.e.* processors of information and holders of knowledge. By refining the EIKS and by clarifying its role within the digital enterprise, we may now regard the world, which is becoming a digital world, such as an instantiation of EIKS.

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