

Reinforcing Decision Aid by Capitalizing on Company's Knowledge :

Future Prospects

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Company's knowledge, decision aid, decision-making, digital information system, knowledge capitalization, knowledge management, knowledge-worker desktop, mainstream-data, shared-data, source-of-knowledge-data.

Abstract

After a brief description of the role and functions of digital information systems, we examine, within the conception of these systems, the decisive breaks resulting from technological advances. Then, we clarify the problem of "Capitalizing on Company's Knowledge" in order to introduce a vision of a digital information system centered on the knowledge-worker desktop and three hypothesis on which are based our research on digital information systems design. The digital information systems is seen as a decision aid support. We present two case studies.

1. Introduction

Faced with rapid changes resulting from the globalization of markets, the economy deregulation and the impact of new information and communication technologies, many firms have become aware of the value of non-material capital, and more especially of their intellectual capital. In the new economy that is taking place, the range of autonomy of action is increasing for more and more individuals, whatever their hierarchical levels and roles : they are placed in situations that require to take decisions. They become knowledge-workers, namely people whose knowledge is the crucial factor enabling them to improve their decision-making processes.

Thus, as envisaged by [Davenport & Prusak,98]: « *What makes knowledge valuable to organizations is ultimately to make better the decisions and actions taken on the basis of knowledge.* » Beyond the implicit approach to knowledge management carried out on a daily basis, these firms need a conscious and strong-willed approach in order to present sustainable competitive advantages. This awareness, leads us to clarify the problem of “capitalizing on company’s knowledge” and to suggest an approach to digital information systems centered on the knowledge-worker desktop, in order to improve decision-making processes and enhance the value-added of business processes of the company.

In the first part of this article, we draw up a brief description of the role and functions of digital information systems and, we examine, within the conception of these systems, the decisive breaks resulting from technological advances. Next, we try to clarify the problem of “Capitalizing on Company’s Knowledge” in order to locate the Knowledge Management function. Then we introduce a reflection onto the knowledge worker and the digital information system that leads us to distinguish between three types of data processed by digital information systems: mainstream-data, shared-data, source-of-knowledge-data. Finally, we explain our researches perspective, applying our vision to a business application developed within COFINOGA - a credit institution-, and to the Esprit Knowledge Desktop Environment (KDE) project ..

2. Digital Information Systems : From Batch Processing to Enterprise Resource Planning and Knowledge Management Technologies.

2.1 The Role and Functions of The Digital Information System.

The concept of information system covers two notions : on the one hand the reality of the organization which evolves and undertakes, communicates and records information and, on the other hand, the information system as an artificial object conceived of by humans to aid, acquire, process, store, transmit and restore the information which allows the system to carry out its activities within the context of the organization [Le Moigne, 74], [Reix, 95]. In the present

article, we shall speak only of the computer system, which we designate as “*the digital information system*”. Thus, the essential role of the digital information system is to provide pertinent information to each decision-making center, at all levels of the hierarchy, so that it can verify, make decisions and undertake actions. Taken in this way, the digital information system is an indispensable tool in decision-aiding procedures, as well as in a firm’s operating and production procedures, while interacting with all these procedures. The digital information system is also a coordinating tool. We observe that it plays an important role at the individual level, by informing or more specifically furnishing representations in order to solve problems in a decision-aiding process, and at the collective level by distributing shared representations throughout the organization. “*Software is the fuel on which modern business are run, governments rule, and societies become better connected. Software has helped us create, access, and visualize information in previously inconceivable ways and forms. Globally, the breathtaking pace of the world’s economy...From all these perspectives, software is an indispensable part of our modern World. The worldwide economies are becoming increasingly dependent on software, that technology makes possible and society demands are expanding in size, complexity, distribution and importance*” [Booch, 99]

2.2 Major Breaks with Tradition Within The Conception of Digital Information Systems

Rapid changes in information technology have caused the basic way of conceptualizing digital information systems to be brought into question on several different occasions. We would like to distinguish among four major phases in this evolutionary process, beginning with the appearance of the first computers in the 1950s and extending to the current explosion of Information Technologies (IT). These stages are described in the paragraphs below. Figure 1 presents a synthesis of the four stages.

Centralized data processing (from 50s to 60s)

This stage is characterized by a constant and relatively stable linear evolution. The technology and information associated with this era allowed us to produce tools which could improve the productivity of scientific and administrative undertakings. The software applications are installed in large computer centers. This type of computer science, called “batch processing” is functional, differed in time and task-specific. This was the era of mainframes, centralized architecture. The digital information system was centralized and corresponded to structured methods of conception known as “*oriented processing*”, as seen in the Warnier method, for example, and the Structured Programming method. These methods were influenced by the technological possibilities of the period, namely files. They were based on a functional approach to organization and used top-

down approach which consisted of breaking down a problem hierarchically into sub-problems, reflecting the hierarchy of the organization.

Data decentralization (from 70s to 90s)

This phase is characterized by a less deterministic, less predictable evolution which is at the same time more complex, marked by sustained change and stronger competition. This is the period which saw the birth of the micro-computer. The ability to decentralize some of the processing capacity allowed system designers to proceed with differed manipulation of centralized data and/or manipulation of decentralized data in real time. The digital information system could handle great quantities of information. Its main functions were memorizing and calculating. It processed essentially “stable”, structured data provided by the data analyst and the digital information system’s designer [Prax, 97], This was the era of data bases and database management systems. Among the design methods which corresponded to the appearance and extension of data bases were the Merise (particularly in France) [Tardieu *et al.* , 86] and other methods such as Structured Analysis and Structure Design (SASD)[Yourdon, 79] or Real-Time Structured Design [Ward, 85]. The basic model used in the earliest days of software development was the waterfall model, which remained sequential although capable of correlating the results obtained at each stage of the development cycle. The waterfall model has become the basis for most software acquisition standards in government and industry.

Interoperability and standardization (90s)

Organizations were looking for new markets and demanded more powerful tools capable of bringing heterogeneous systems into communication with one another. With the client-server technology, object oriented technologies and reusable components, appropriate conceptual tools and new technologies emerged : the digital information system evolved from differed processing of large-scale operations, to data storage, to the object oriented approach and ERP (Enterprise Resource Planning).

Thus at the beginning of the 90s, over seventy object oriented methods or their variants had been developed. In 1997, UML (*Unified Modeling Language*) [Rumbaugh *et al*, 99], [Kettani *et al*, 98], had been adopted by the OMG (*Object Management Group*). UML is the result of a large consensus, taking into account the most recent advances in modeling and program development. The result of work by recognized experts in the field of object modeling, UML has become a standard. Currently, in order to standardize digital information system design procedures, the RUP standard (*Rational Unified Process*) has been submitted to the *OMG*. The development cycle is thus iterative and incremental. “The Rational Unified Process is a software engineering process. It provides a disciplined approach to assigning tasks and responsibilities within a development organization” [Kruchten, 99]. At the same time, professional integrated

management programs were appearing and were adopted by numerous firms starting as early as 1996. The aim of these programs is to unify different software applications within companies. Their objective is to provide an array of standard corporate procedures with modifiable parameters in order to automate management of crucial corporate activities. These programs offer an integrated view of the firm : the firm's digital information system becomes a whole, with a unique format for management applications. As its goal was using a tool, to view the firm as an integrated whole, to reduce cycles of putting products and services on the market to the utmost, the use of "integrated programs" was seen as a complete reformulation of firms' applications to obtain the most standardized digital information system possible [Lequeux, 99]. Unfortunately, and this reflects a real problem in the field, firms generally fail to integrate the organizational dimension and trade-specific procedures business process when they implement such a program.

Universality and knowledge management

More recently, a new information economy has emerged with the worldwide information network (Internet) and new digital technologies known as the information highway. The universality of standards and the ability to connect up to it, reduce the bottlenecks of information flow and allow us to accelerate researches, modifications and transactions. The appearance of e-business and the cyber-market are the most striking visible aspects of these developments. Within organizations, Intranet, a firm's own internal network, usually protected from Internet traffic and groupware tools of the IBM Lotus Notes or Microsoft Exchange variety, allows users to share different types of information. The internal electronic exchange of data is increasingly being expanded through Extranet, an extension of Intranet based on standard Internet protocols and services. Extranet allows people situated outside a firm, but belonging to a given closed network, to use Internet to have access to the same services as those on Intranet. Along with these technologies we should mention research work in Knowledge Engineering (KE) oriented towards the acquisition and representation of knowledge and reasoning. This research has provided methods used especially for developing knowledge based systems (KADS [Wielenga *et al.* 92]) (CommonKADS [Schreiber *et al.*, 00], knowledge books with MKSM methodology [Ermine, 96] and a methodology to locate the company's crucial knowledge, the "Global Analysis METHodology" (GAMETH) [Morey *et al.*, 00] which we describe below .

Over the years, design methods have been transformed with the emergence of new technologies, highlighting an organizational dimension, so that the link between the organization and the digital information system appears increasingly strong. An organization is irrigated by its digital information system. The initial phase of this transformation is characterized by a predominance of computerized services. During the second and third phases, the roles and missions of the different actors involved in digital information systems change. In particular, a new actor appears

: the prime contractor. This individual speaks on behalf of an organization’s board of directors. It is his or her responsibility to have connections with the project manager to engender a spirit of cooperation and teamwork, fundamental to the completion of any successful project. The involvement of this actor in the process of digital information systems design is witness to the ever stronger influence of organizations on systems design. Furthermore, instead of managing, processing, memorizing and sending out information, the IT position themselves as “facilitators” of communication, explanation, coordination and cooperation between actors. In addition, spurred on by the organization’s objectives and approach in terms of capitalizing on company’s knowledge, certain technologies are developed, which proliferate and overlap with the results of research carried out in Knowledge Engineering (KE). This engenders a new capacity for knowledge management within an organization. The combination of all these factors necessitates new concepts in digital information systems design.

Within this perspective, the development cycle of a digital information system can be conceived of as an iterative, incremental and constructivist process.

Stages	Design methods	Technology	Development cycle	Actors involved in the development process	Focal point of the design
Centralization of data processing from 50s to 70s	Warnier Structured method	Mainframe File	Waterfall Sequential	Computer specialists	Processing
Decentralization from 70s to 90s	Merise SASD	PC	Waterfall Spiral	Project manager Computer specialists	Data
Interoperability and standardization from 90s to 00s	Object oriented approaches : OMT; OOSE UML and RUP	Client-server ERP Internet	Incremental and iterative cycle	Prime contractor Project manager Users Computer specialists	Organization Folders Processing
Universality and knowledge management from 00s to	UML and RUP MKSM KADS GAMETH	IT KE	Iterative and incremental cycle Constructivist approach	Prime contractor Project manager Users Knowledge specialists Computer specialists Artifact	Organization Teamwork (collaboration) Knowledge management Circular, shared information Knowledge sources Work stations

Figure 1: The four stages of digital information system design

3. Capitalizing on Company’s Knowledge

During the 70s and 80s, Decision Support Systems (DSS) became a key issue in real management situations introducing a new domain of scientific research. In existing literature numerous topics concerning DSS can be found. In the 90s and 00s, the needs to enhance the potentialities of DSS with artificial intelligence tools and techniques to improve the quality of the decision-making processes arose [Rosenthal-Sabroux & Zaraté, 97]. Our experience in developing Knowledge-based systems has pointed out the potential of knowledge engineering and artificial intelligence. In particular, the opportunities inherent in work performed in the knowledge domain have been

highlighted. Thus, it is that we have seen the concept of « company's knowledge capitalization » emerge: « *Capitalizing on company's knowledge means considering certain knowledge used and produced by the company as a storehouse of riches and drawing from these riches interest that contributes to increasing the company's capital* » [Grundstein, 96].

Hereafter, we describe the two categories of company's knowledge, we attempt to characterize the problem-solving approach to capitalizing on company's knowledge, and we specify the knowledge management function.

3.1. The Company 's Knowledge

The company's knowledge consist of tangible elements (data bases, procedures, drawings, models, algorithms, documents used for analyzing and synthesizing data.) and intangible elements (people's abilities, professional knack, "trade secrets", "routines" - unwritten rules of individual and collective behavior patterns [Nelson & Winter, 82] -, knowledge of the company's history and decision-making contexts, knowledge of the company environment (clients, competitors, technologies, influential socio-economic factors). They characterize a company capability to design, produce, sell, support its products and services. They are representative of the company's experience and culture. They constitute and produce the added-value of its organizational and production business processes.

The tangible elements

Tangible elements are « explicit knowledge». Heterogeneous, incomplete or redundant, they are often marked by the circumstances under which knowledge was created. They do not express the unwritten rules of those who formalized knowledge, the « unspoken words ». They are stored and disseminated in archives, cabinets, and databases.

The intangible elements

Intangible elements are « tacit knowledge ». Acquired through practice, they are adaptable to the situations. Explicitable or non-explicitable, they are often transmitted by implicit collective apprenticeship or by a master-apprentice relationship. They are located in people's minds.

The four different modes of knowledge conversion

Here we are referring to the knowledge classification of Michael Polanyi[□]. He classifies the human knowledge into two categories : tacit knowledge and explicit knowledge. "*Tacit knowledge is personal, context-specific, and therefore hard to formalize and communicate. Explicit or 'codified' knowledge, on the other hand, refers to knowledge that is transmittable in*

[□] Born in Poland, Michael Polanyi, was a well known chemist before taking up philosophy at the age of 50. He is the brother of the economist Karl Polanyi, better known as the author of *The Great Transformation*.

formal, systematic language [Polanyi, 66].” Our point of view can be found in the work of Ikujiro Nonaka and Hirotaka Takeuchi [Nonaka & Takeuchi, 95], two Japanese authors who, with reference to Michael Polanyi consider that “*tacit knowledge and explicit knowledge are not totally separated but mutually complementary entities.*” Thus, they propose a dynamic model of knowledge creation anchored to a critical assumption that “*human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge*”. They call this interaction “*knowledge conversion.*” They insist on the fact that “*this conversion is a ‘social process’ between individuals and not confined within an individual.*” From this assumption they postulate four different modes of knowledge conversion defined as follows: “*Socialization is a process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills...Externalization is a process of articulating tacit knowledge into explicit concepts...Combination is a process of systemizing concepts into a knowledge system...Internalization is a process of embodying explicit knowledge into tacit knowledge.*” Each of these four modes of knowledge conversion are discussed in detail in their book. For Ikujiro Nonaka and Hirotaka Takeuchi, explicit knowledge can be easily expressed in written documents but is less likely to result in major innovations than tacit knowledge, which is to say that the innovation process stems from knowledge acquired through experience, albeit difficult to express in words.

These observations concerning knowledge in the company context highlights the importance of tacit knowledge. It points out the interest in creating a favorable climate for both the exchange and sharing of tacit knowledge and its transformation into explicit knowledge and in thus extending the field of knowledge which will come under the rules and regulations governing industrial property. Moreover, we should emphasize the fact that capitalizing on company’s knowledge is an ongoing issue, omnipresent in everyone’s activities, which specifically should have an increasing impact on management functions.

3.2. The multi-faceted problem-solving approach to capitalizing on company’s knowledge

The multi-faceted problem-solving approach to capitalizing on company’s knowledge is characterized by four facets, and their interactions, as shown on figure 2.

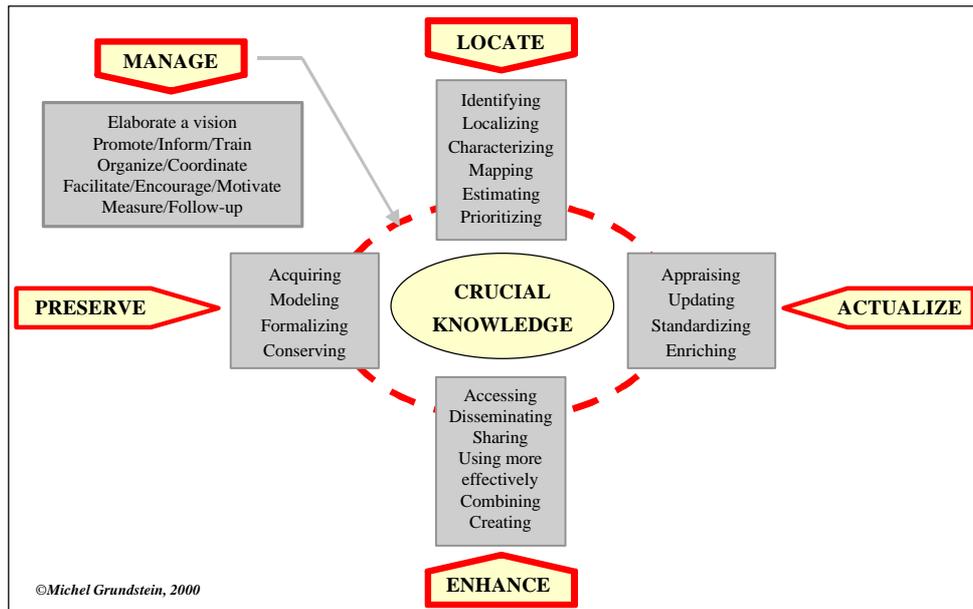


Figure 2: The Multi-Faceted Problem-Solving Approach

The first facet of the problem concerns problems bound to the location of crucial knowledge, that is knowledge (explicit knowledge) and know-how (tacit knowledge) which are necessary for decision-making processes and for the progress of the essential processes which constitute the heart of the activities of the company: it is necessary to identify them, to localize them, to characterize them, to make cartographies of them, to estimate their economic value and to organize them into a hierarchy.

The second facet of the problem concerns problems bound to the preservation of knowledge and know-how: it is necessary to acquire them with the bearers of knowledge, to model them, to formalize them and to conserve them.

The third facet of the problem concerns problems bound to the added-value of knowledge and know-how: it is necessary to enhance their value, to put them in the service of the development and of the expansion of the company, that is make them accessible according to certain rules of confidentiality and safety, to disseminate them, to share them, to use them more effectively, to combine them and to create new knowledge.

The fourth facet of the problem concerns problems bound to the actualization of knowledge and know-how: it is necessary to appraise them, to update them, to standardize them and to enrich them according to the returns of experiments, the creation of new knowledge and the contribution of external knowledge.

The fifth facet of the problem concerns the interactions between various problems mentioned first. It is there that the management of activities and processes, allowing to capitalize on knowledge in organizations, takes place. It is often called " Knowledge Management " in numerous publications. In fact, the expression "Knowledge Management" covers all the

managerial actions aiming to answer the problem of capitalization of knowledge in general: it is necessary to align the knowledge management on the strategic orientations of the organization; to make people sensitive; to form, to encourage, to motivate all the actors of the organization; to organize and to pilot activities and specific processes leading towards more mastery of knowledge; to arouse the implementation of favorable conditions to the cooperative work and to encourage the sharing of knowledge; to elaborate indicators allowing to insure the follow-up and the coordination of launched actions, to measure results and to determine relevance and impacts of these actions.

3.3. The Knowledge Management Function

The knowledge management function consists in carrying out different activities taking place at three levels whether they concern the strategic orientations and plans, the operational monitoring and control or the application and technological implementation and deployment.

The level of strategic orientations and planning activities

Some questions are dealing with knowledge management strategy and orientations : How should we link knowledge management to corporate strategy ? What activities should be developed and promoted ? What organizational structures should be put in place ? How should we go about creating them ? How can we implement enabling conditions for knowledge management initiatives ? What impact and benefit evaluation methods should be installed ? How can we go about provoking cultural change towards more knowledge sharing attitude ?

The level of operational monitoring and control

Other questions are dealing with operational monitoring and control of knowledge management activities: Which processes should be implemented to respond to the four facets of the problem-solving approach ? How can we facilitate these processes ? How should we proceed, what should our approach be ? With what methods and what tools ?

The level of applications and technological implementation and deployment

Other questions are dealing with the development and implementation of knowledge management applications: Which applications should be developed ? How can we legitimate the value of the knowledge ? How do we justify the necessary investment ? How should we define the profitability threshold ? How should applications be designed ? How should we choose those technologies best suited to the task ? How can chosen solutions be deployed ?

Within this perspective, we must keep in mind that organizations need to evolve through their own efforts, by intensifying diversity and creating new foundations for thought and behavior.

4. The Knowledge-Worker and the Digital Information System

When considering the multi-faceted problem-solving approach to capitalizing on company's knowledge we can envisage the digital information system as an essential instrument to support decision-making processes and provide these knowledge-worker with crucial knowledge that is required to accelerate and improve the reliability and quality of their decisions. The following discussion emphasizes new prospects on digital information systems centered on the knowledge-worker desktop. This vision focuses on knowledge-worker at his desktop using and producing a broad variety of data that enable him to solve problems, make choices and act in his daily activities [Grundstein & Rosenthal-Sabroux, 99]. That lead us to map out a vision of a Digital Information System centered on the Knowledge-Worker desktop and to propose three hypothesis:

- Hypothesis 1: Information are of different types. We propose an information typology based on the status regards to the treatment system they require : "*mainstream-data*", "*source-of-knowledge-data*", "*shared-data*".
- Hypothesis 2 : The information system design taking into account this typology must integrate specific modules: the "*source-of-knowledge-data system*" and the "*shared-data system*". These two specific modules require for their design and for their implementation the results of research carried out in Knowledge Engineering (KE) and Information Technologies (IT).
- Hypothesis 3 : The identification of two types of information "*source-of-knowledge-data*", "*shared data*", complementary with information usually treated the "*mainstream-data*" require to integrate GAMETH methodological framework designed by Michel Grundstein, in the first phase of a digital information system design process.

4.1. The vision of a Digital Information System centered on the Knowledge-Worker Desktop

Within the corporate framework, knowledge-worker find themselves confronted with situations that go beyond daily routine, situations in which they must evaluate all possible choices in terms of criteria relevant to a given set of goals. Taking into consideration all available information ("*mainstream-data*", "*shared-data*", "*source-of-knowledge-data*"), their own intentions, any restrictions which bear on the decision and their knowledge and know-how, they must analyze and process information in order to make these choices.

Finally, it is their capacity to analyze and process all information available to them and their ability to evaluate potential courses of action – in other words, their capacity to implement knowledge appropriate to the given constraints of the situation – which enables them to choose the most satisfying course of action, as defined by H. Simon [Simon, 69].

This vision places strong emphasis on the ultimate goal of the digital information system which would be to provide knowledge-worker, engaged in a work-related decision-making process at

their computerized work-stations, with all the information needed to understand situations they will encounter to make choices - which is to say, to make decisions – to carry out their work, capitalizing the knowledge produced in the course of performing these tasks.

In the approach we have just described, the digital information system, beyond its functions of acquiring, processing, storing and reconstructing information processed or stored, will become an indispensable strategic tool. Thus, from their computerized work-stations, within a given situation, knowledge-worker should be able simultaneously to receive “*mainstream-data*” specific to their jobs, to access “*shared-data systems*” in order to transfer their own tacit knowledge, and to gain “*source-of-knowledge-data*” which are necessary to understand and resolve daily problems encountered in their work, to do their own work and to capitalize on the knowledge produced while that work is being carried out. This vision is represented on the figure 3.

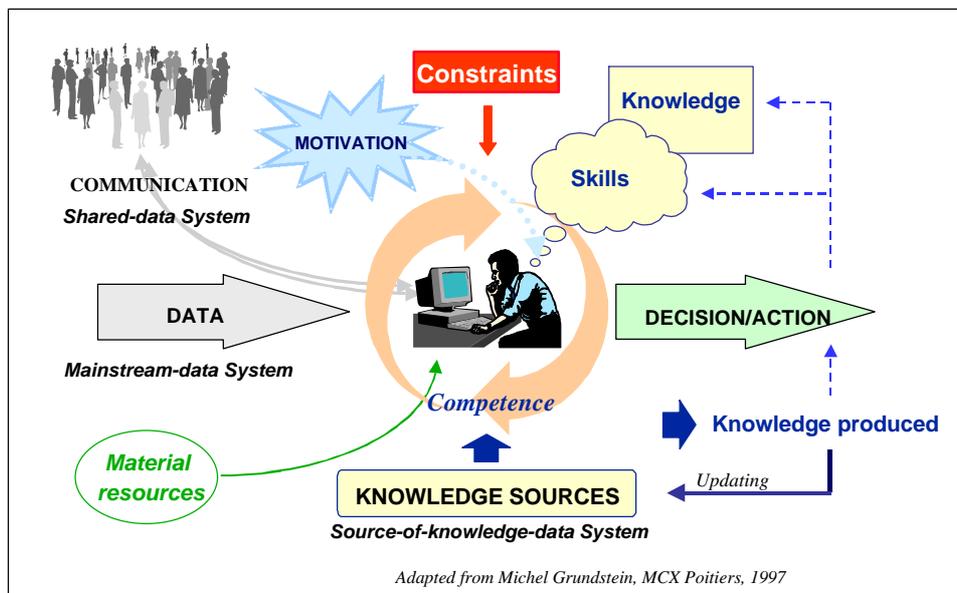


Figure 3: The Knowledge-Worker and the Digital Information System

4.2. The hypothesis

4.2.1 Hypothesis 1 : The different types of information

When we consider the processes involved in a company’s production and overall operation, we see that the information circulating in the digital information system constitutes the data which have meaning within a given context. For example, in the context of a bank, in addition to information on the current balance in a client’s account (positive or negative balance), the account manager may need information concerning the current state of the account : is the negative balance of client X’s account at a given moment a first-time occurrence, or has this

customer had repeated overdraft problems ? Has he been reported to - or is he in litigation with - the National French Bank ? Information concerning the current state of an account at a given moment and information revealing whether or not the current overdraft is an unusual occurrence is not of the same type. In the first case, the information is called “*mainstream-data*” : it informs the account manager on the state of a given account. In the second case, the information furnished is called “*source-of-knowledge-data*”. The type of the information is different: it is the result of a reasoning process encapsulated in a decision-support system; it responds to a specific request, providing the account manager with knowledge which will allow him to have a better understanding of the situation and to reach a decision concerning what action to take towards this particular client.

The mainstream-data

The “*mainstream-data*” makes up the flow of information which informs us on the state of a company’s business process. If the digital system information is itself a company’s production system, (for example, a bank’s digital information system), the “*mainstream-data*” informs us on the state of the information-related material to be transformed and on the state of the digital information system which carries out this transformation. If the company’s production system involves physical materials, the “*mainstream-data*” will provide information on the state of that material before and after the transformation and will furnish information on the whole environment which makes this transformation possible.

The source-of-knowledge-data

The “*source-of-knowledge-data*” is the result of a knowledge-engineering approach which offers techniques and tools for acquiring and representing knowledge. This knowledge, encapsulated in computer programs capable of reconstructing it as information immediately intelligible to human beings, thus becomes accessible and can be handle. This leads us to integrate into the digital information system specific modules called “*source-of-knowledge-data systems*”, which both in their conception and in the techniques used to implement them draw upon the results produced through new orientations in knowledge engineering research [Charlet *et al*, 00].

The shared-data

Moreover, the new information and communication technologies have caused a break with older technologies, a rupture linked to the relationship of humans to space, to time and to the capacity to be ubiquitous which take us from the real to a virtual world, from the manipulation of concrete to abstract objects. The instantaneous transfer of digitalized multimedia documents which include text, images and sound, the possibility of asynchrony of information exchanges which transform our relationship with time and space, electronic conferences which 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, speed up the transmission and sharing of tacit knowledge which, up to now, operated from person to person on a master-apprentice basis. In short, they generate processes of information exchange that were unimaginable with previous technologies. Information processed by these new technologies is called “*shared data*”.

4.2.2 Hypothesis 2 : Specific modules integration in the digital information system design .

The digital information system design taking into account the typology of data described above must integrate specific modules : the "*source-of-knowledge-data system*" and the "*shared-data system*". These two specific modules require for their design and for their implementation the results of research carried out in Knowledge Engineering (KE) and Information Technologies (IT).

From a functional point of view, the "*source-of-knowledge-data system*" allow the user to have direct access on the one hand to information on knowledge carrier, on the other hand to support on which are memorized “*source-of-knowledge-data*”. The "*shared-data system*" allow the user to communicate and to interact with person holding knowledge who interest him. These two specific modules require for their design and for their implementation the results of research carried out in Knowledge Engineering (KE) and network technologies.

4.2.3 Hypothesis 3 : GAMETH Framework integration into the design process

The identification of two types of information "*source-of-knowledge-data*", "*shared data*", complementary with information usually treated the "*mainstream-data*" require to integrate GAMETH methodological framework designed by Michel Grundstein, in the first phase of a digital information system design process. Using GAMETH in the first phase of a digital information system allow to locate the important knowledge on the one hand to incorporate in the specific module "*source-of-knowledge-data system*" and on the other hand to put on circulation in the specific module "*shared-data system*". That broaden the information usually limited to "*mainstream-data*". This methodological framework suggest to analyze sensitive processes which conduct to identify determining problems for the enterprise actors in their activities, to identify company's crucial knowledge necessary to solve this problems. The digital information system designed with the integration of GAMETH framework in digital information design process lead to conceive digital information system that provide to knowledge worker at their computerized work-stations the knowledge necessary to solve problems in the execution of his duties.

5 GAMETH : A methodological framework

GAMETH is a methodological framework designed by Michel Grundstein [Morey *et al*, 00] which aims at locating the company's crucial knowledge, that is to say knowledge (explicit knowledge) and know-how (tacit knowledge) which are necessary for decision-making processes

and for the progress of the essential processes which constitute the heart of the activities of the company. This methodological framework is based upon three assumptions, proposes three guiding principles and infers a methodological approach, as shown on figure 3 :

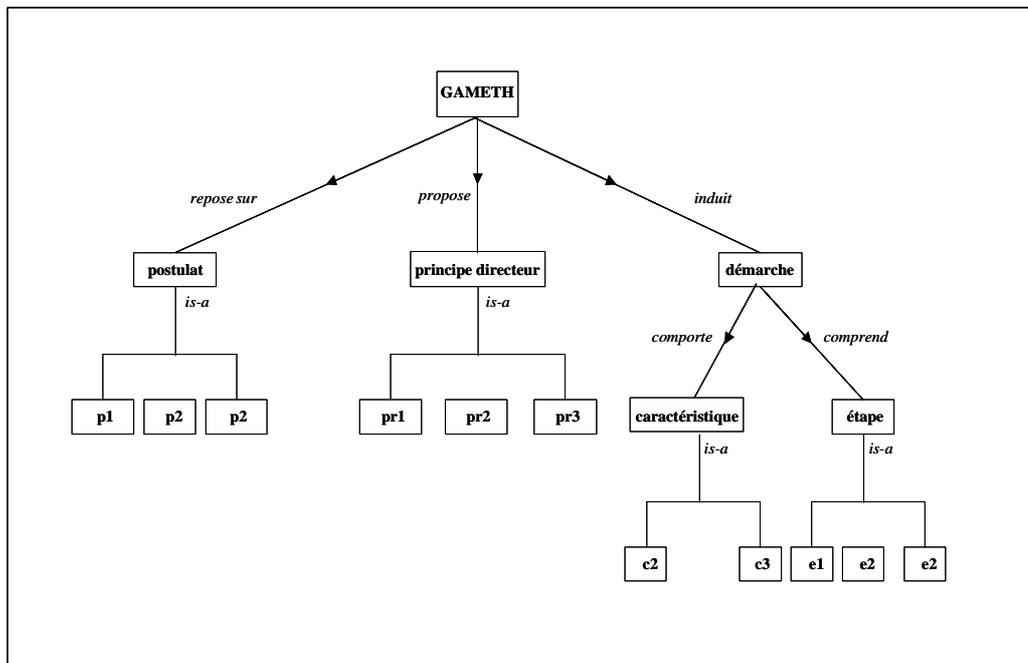


Figure 3 : GAMETH's representation

5.1. GAMETH's assumptions

Assumption 1 :

Knowledge is not an object but does exist in the interaction between a person and data, and is stored through an interpretative framework in individual memory. This assumption is based on a constructivist set of axioms and shared by [Piaget, 67], [Le Moigne, 94], [Nonaka & Takeuchi, 95] ;

Assumption 2 :

Knowledge is linked up to action. This assumption is related with the concepts of “embodied cognition” [Suchman, 87] or “actionable knowledge” [Schön, 83] ;

Assumption 3 :

Company's knowledge is divided into two categories : explicit knowledge embedded in documents, artifacts, etc., and tacit knowledge (or know-how) owned by individuals [Grundstein, 96], categories that are also stressed out in [Collins, 93], [Wiig, 99].

5.2. GAMETH's guiding principles

GAMETH proposes the three following guiding principles :

Guiding principle 1 :

A “*principle of representation*” which contends that organization, perceived from the angle of the knowledge it uses and produces, can be represented as a set of activities that contribute to processes whose end purposes are to produce goods and services for a customer (internal or external to the company) under the most favorable conditions of cost, adherence to schedule and quality. This principle is shared with Jean-Claude Moisdon [Moisdon, 97] ;

Guiding principle 2 :

A guiding principle dealing with the analysis of processes, which contends that processes have to be studied from the point of view of the knowledge they use. Then, starting from one or several sensitive processes leads to the company's crucial knowledge ;

Guiding principle 3 :

A “*principle of action*” which infers an approach based on a collaborative modeling work [Grundstein, 95]. It means that we use the partial knowledge of the actors about a process to build its representation instead of using documents. This collaborative work allows us to identify informal connections between the company's actors which are usually not described in documents. This kind of constructivist approach allows to get a collective involvement, which is a necessary condition to succeed in knowledge capitalization operations. This notion of “involvement” has been studied in detail by Mayo [Mayo, 33], Roy and Bouyssou [Roy & Bouyssou, 93] and Rosenthal-Sabroux [Rosenthal-Sabroux, 96].

5.3. The GAMETH's methodological approach

GAMETH infers an approach which comprises two features and three steps.

GAMETH's methodological approach features

The features of this approach are the following ones :

Feature 1:

It is a problem-oriented and not a solution-oriented approach. The underlying idea is that to make a capitalization operation really effective, we have to find the most appropriate solutions (technical or organizational) to the company's problem and not being driven by the services we sell, even if we have to take into account the environment we live in;

Feature 2 :

It is an approach focusing on processes that connects knowledge to action. Since we consider that knowledge is not an object, it is natural to study the way knowledge is used within processes rather than studying knowledge from a theoretic point of view.

The steps of the GAMETH's methodological approach

The approach comprises the three following steps :

Step 1 : Identify the sensitive process(es)

The first step of the GAMETH approach consists in determining the sensitive process. A sensitive process presents stakes collectively recognized by the actors : that is why they choose it among the other ones. It exists several kinds of stake :

- weakness of the process which risks not attaining its objectives ;
- obstacles to overcome ;
- difficult challenge to take in charge ;
- produced goods or services which are strategic in regard to the organization's orientations.

This step allows to define the project's context, the field and the perimeter of intervention, but also to identify the processes which have to be studied in further details because they really matter.

Step 2 : Identify the determining problems

This step allows to identify the problems which weaken the critical activities belonging to the sensitive process(es), that is to say the activities that could endanger this process(es).

Step 3 : Identify company's crucial knowledge

This step aims at identifying, locating and characterizing the company's crucial knowledge. We try during this step to answer to the following question : Who uses Which Knowledge in What Phase of the Sensitive Process Cycle ?

6. Applications

Our research on knowledge management led us to delineate three types of information and to develop a vision of digital information systems centered on knowledge-worker at their computerized work-stations and to integrate GAMETH framework in the first phase of a digital information system design process. We describe, below two examples. The first one shows on the one hand the interest to distinguish different types of information (hypothesis 1 and hypothesis 2) and on the other hand the application of our vision on the decision support system "THOT" developed at Cofinoga. The second example describe an Esprit project : "the Knowledge Desktop Environment" (KDE) in which GAMETH is used as a methodological framework.

6.1 The Cofinoga Application : THOT

Cofinoga [Ariès, 99], is a credit institution, Thot is an evaluation mockup developed at Cofinoga concerning the granting of credit study. It results from a specific methodology, the Methodology for Knowledge System Management (MKSM) developed in the French nuclear industry, Atomic Energy Commission (CEA) by J. L. Ermine [Ermine, 96]. MKSM is a global analysis of knowledge to be managed. This is performed by a succession of elicitation and modeling of knowledge to make corporate knowledge intelligible. MKSM obtain models for the design of a knowledge management system, in this case it is THOT.

The context

This project began in 1995, and was prolonged by the development of a source-of-knowledge-data generic system destined to be deployed in different company business units.

The needs

The needs were defined as follows :

- to control the granting of credit activity with reference to previous files,
- to be able to trace and especially to exploit previous experience, as well as the decision processes attached thereto.

The problem

Cofinoga grants credits, this activity must be reactive, flexible and productive. This organization with concurrences, is destined for a large clientele. Each contract brings its lot of new knowledge and experience, which must be available for reuse during future consultations. The loss of know-how is often difficult to avoid, when several persons separate treat similar cases in a different way, or when a particular skill is lost.

The solution

The Thot system makes possible to store all the acquired experience as it is built up, including the approach followed leading to a credit request. It relies on advanced information technology solutions built around "case-based reasoning" (a case being defined by a context, a decision, a justification, and a choice). It enables loading and consultation of knowledge bases as a function of each person's habits.

Beyond help in preparing files, the system makes it possible to minimize the development expenses in similar future cases, and to enhance the reliability of the choices made, both from the quality and budgetary forecast standpoints. The system allows storing all the acquired experience as the project goes along. It therefore permits capitalizing previous experience, whether it led to success or failure. Thus, beyond a system that helps in preparing files, the solution implements the functionalities necessary for knowledge traceability. While realizing a decision support system, these complementary functionalities respond to the problem of capitalizing on company's knowledge defined above.

The results acquired during this work are used in the "source-of-knowledge-data system". This system, destined for use by business units, makes it possible to capitalize the knowledge resulting from past experience or from projects under way, for application to new files. Hence it is a means to improve decision making during the granting credit process.

The instantiation of our vision on the Cofinoga application is represented on figure 4.

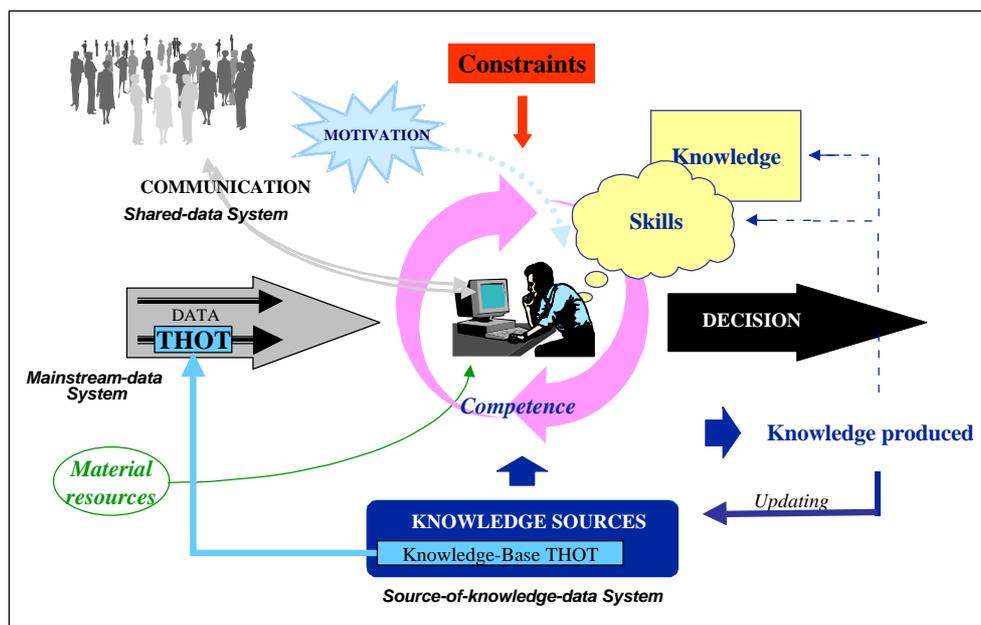


Figure 4 : THOT and the Digital Information System

6.2. The Esprit Knowledge Desktop Environment (KDE) project

At the present time, we take part with Salustro-Reydel Management (SRM) into an ESPRIT project, named KDE[□], which aims at increasing the competitiveness of European industry by a better management of company's knowledge assets and by simplifying the selection and accessibility of these assets, at any level of the company. The objectives of the project are the following ones :

- to develop easy to use methods supporting the specification of KM application software ;
- to develop a set of generic tools supporting the implementation of KM application software previously specified ;
- to develop the Knowledge Worker Desktop (KWD) favoring the use of KM application software and promoting their use at any organizational level by people who are not familiar with technology.

In the framework of our collaboration with SRM, we use GAMETH within the methodological part of the project and within the part dealing with the specification of the KWD, in order to validate its relevance and its practical validity. The KWD is in fact an information system which distinguishes the “*mainstream-data*”, “*the shared-data*” and the “*source-of-knowledge-data*” and which comprises the “*shared-data system*” and the “*source-of-knowledge-data system*”. This system presents among other things to the end-user the chaining of tasks that he has to perform, as shown on figure 5 :

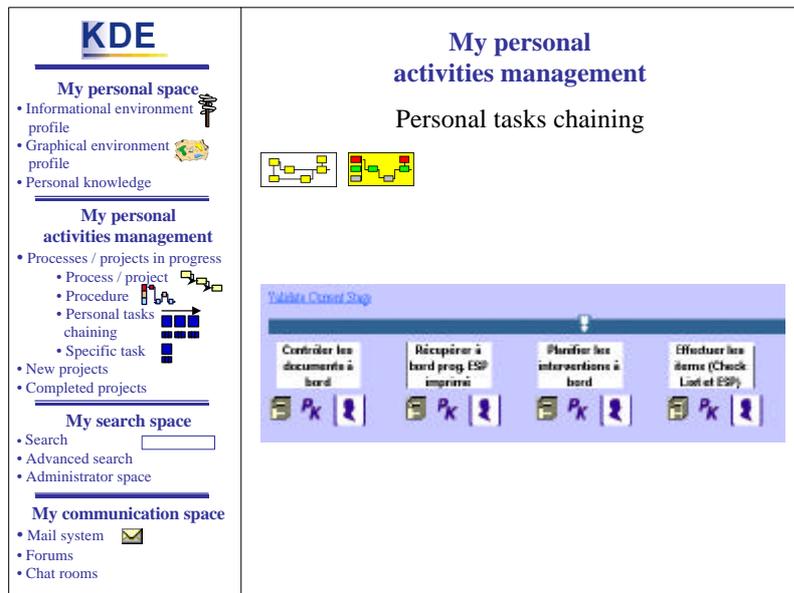


Figure 5 : Source-of-knowledge-data system

[□]Esprit-IV Project 28678. Participants are Bureau Veritas, Eutech, Intrasoft, Salustro-Reydel Management, TXT and the university of Amsterdam

Each task is linked up with three types of “*source-of-knowledge-data*”. The left button, symbolized by a yellow document, allows to access to any document dealing with the above task. These documents carry formalized and stored knowledge, which constitute “*source-of-knowledge-data*”. Indeed, from a cognitive point of view, the individual will interpret the contained data to create for himself new knowledge according to his interpretative framework. Of course, knowledge created from a document can be very different from the knowledge the author of the given document wanted to convey, since the two interpretative frameworks are not necessary consistent with one another [Pachulski *et al.*, 00].

The middle button, symbolized by the “PK” icon (meaning Personal Knowledge), which also belongs to the section named “My personal space”, allows him to access to a personal space, as shown on figure 6 :

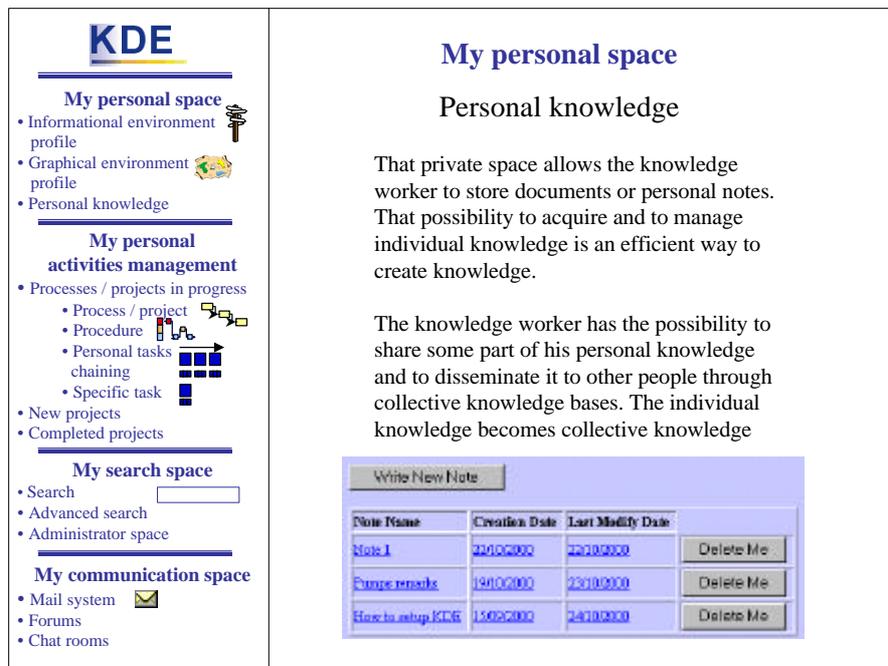


Figure 6 : Presentation of the end-user personal space

This space provides to the end-user on the one hand the ability to store documents or notes that he needs to perform the given task and on the other hand the ability to access to these documents, which become then “*source-of-knowledge-data*”. Indeed, the final documents accessible with the left button are written by individuals for another people and deal with a specific task. They do not necessarily carry the same information than personal notes which only exist to help an individual to perform his job.

In the first case, information deal with a specific task, whereas in the other case, information deals with anything which could be useful to the author to create new knowledge, necessary to get his work done. He can decide to share the documents stored in his personal space if he wants to, and then these documents will be accessible thanks to the left button.

And finally, the right button, symbolized by the head of an individual, allows to access to the people having the knowledge useful to perform the given task. Knowing who are these people constitutes a third kind of “*source-of-knowledge-data*”. Even if in this case the information does not convey in itself some knowledge, it promotes the knowledge creation in favoring interaction between an expert and a knowledge worker.

From a functional point of view, this interaction is promoted by the “*shared-data system*”, as shown on figure 7 :

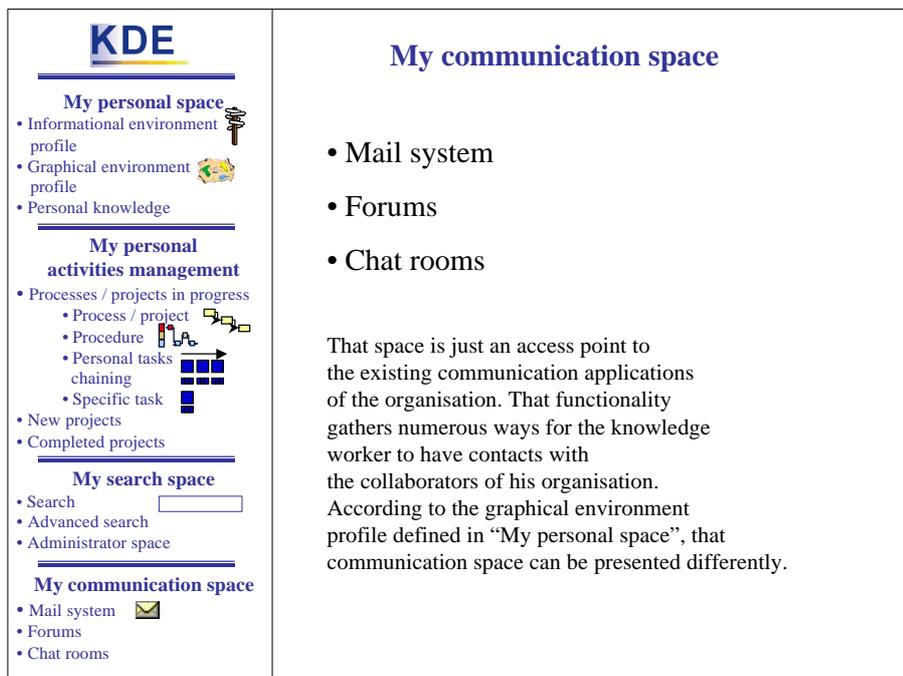


Figure 7 : Shared-data system

This system allows the end-user to access to any type of communication technology, as electronic mail service, forums, chat rooms, etc., used within the enterprise.

7. Perspectives

In today’s new economy, firms are increasingly aware of the value of non-material capital, and especially of knowledge capital. Beyond an implicit everyday approach, firms need a conscious

and deliberate approach which should, above all, be closely tied to the organization's strategic orientation. Thus each organization should be examined with reference to its own specific features. Within this context, an increasing number of agents, regardless of position and/or hierarchical rank, are experiencing progressively expanding areas of responsibility : they are faced with the need to make decisions which, until recently, they were not responsible for. They have become actor/decision-makers. This implies that a digital information system should be set up which is both open and adaptable, one which gives each actor at his/her work-station the means to provide, receive, gain access to and share "the largest possible variety of information deemed necessary, in the fastest possible way":

- the decision-making process should be accelerated and its bases improved;
- agents carrying out their work should become more efficient, allowing them to acquire new know-how and to maintain and/or increase their level of competency;
- agents should be given increased autonomy and mobility in their work, enabling them to deal more effectively with fluctuations engendered by economic constraints.

The digital information system designed with the actor/decision-maker at his/her work-station in mind and the integration of GAMETH framework in digital information design process would lead to conceive digital information system that provide to knowledge worker at their computerized work-stations "*mainstream-data*" specific to their work, "*source-of-knowledge-data*" crucial to achieve decision making and, allow them to share continuously their tacit knowledge.

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