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EXEMPLE OF A EXPERT SYSTEM USED IN ENGINEERING DESIGN

BY

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Abstract. This paper presents the structure of a expert system. The economic activities need tools for integrate different aspect of life cycle of products. Shorter production time, shorter design time and also a shorter life time of products, bring designer in front of a problem. How they integrate all the knowledge in a system that can help them. The approach that we present, allow to different trades to bring to the main platform all the personal knowledge that any actor are able to pass to the design process.

Keywords: globalisation; information; data; knowledge; expert system.

1. Introduction

The increasing technical complexity, reducing execution time and diminishing budgets have led to fierce competition in the industry. The situation in the industry can be understood only by re-analyzing the developments in various fields, developments that have changed the company's operations.

The history of the last three decades and the developments of means to transmit the information demonstrate that the companies are often dependent on

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the economic environment. This environment dictates market expectations, customer needs, tracing the path ahead for businesses.

The markets are very versatile; with windows that lasts 12-18 months. This evolution compels companies to produce timely, but also to cope with market instability. The competitive advantage remains of those companies that can capitalize costs related to research.

2. Job Transformation from a Centralized Place into a Delocalized Environment

Increases economic activities taking place in our society, make us dependent from the material resources and energy. Thus, to increase the level of life, it has imposed a growing influence of information and communication technologies that translate into remarkable growth of information in electronic form.

Closed economies were unable to adapt to new technologies and are totally outdated. Economic environment brings forward the concept of producing well at a price as low as possible.

The world is changing. It became smaller and more competitive. Market globalisation forced to increas the interdependence of the world economies, thanks in particular loss border, and liberalization, which led to increased movement of capital and products.

Today, Internet has become an extended public network linking the world. The phone has not produced so many changes that has produced by Internet that allowed the exchange of information between various individuals in time and space. Internet produced the job transformation from a central space to a distributed environment.

In each area regarding a project, there are many programs and methods to increase productivity. The problem is: how do we integrate these modules in specific environments of designers with different skills, so that they can communicate and exchange information on the product or process in order to be done.

3. From Information to Expertise

The design consists of a body of suggested elements that allow to describe a product (shape, size, means of obtaining, etc.) and can give a global answer to a specification (functions that must be provided, operating conditions, the life product you want, environment, etc.) (Tichkiewitch *et al*., 1993).

Knowledge only occurs in an environment that is our environment that is specific to us (our profession skill) (Charlet, 2001). Even if a primary resource, it is closely related concepts of “knowing” and “competence”.

Concretely the information brings various data together to define a fact. The information therefore involves an understanding of the relationship between data. But information does not really pinpoint why those data are and

how they have evolved over time. Information is so by nature static and context dependent.

So, the information comes from putting into relation existing data between multiple databases. Behind these relationships are hiding models which can create a dynamic vision of the situation. Understanding these patterns lead to the birth of knowledge.

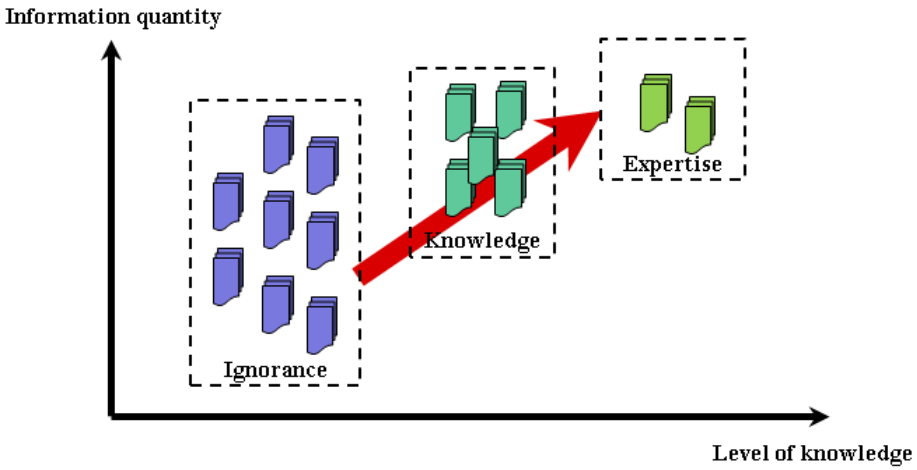

Fig. 1 – Evolution from information to knowledge.

Davenport and Prusak (1998) defined knowledge as a result of thinking: "knowledge is an amalgam of experiences, values, contextual information and insight that form a framework for evaluating and incorporating new experiences and information. They are the result of thinking. In these companies often become embedded in documents, but also in daily routine, in processes, practices and norms in specific enterprise".

Knowledge is manifested in the form of representations of spirit which it can manipulate and build to reach the whole of cognitive tasks required to achieve the desired purpose. This notion of representation is fundamental. After Richard (1990), cognitive activities (the specific human spirit) "respond to a representation of situation".

We can consider the information included, assimilated to knowledge, which allows to achieve the projected purpose. The information provides a new perspective for interpretation of an event or object. It acts on knowledge by adding new parameters or the existing structure (Fig. 1).

For Skyrme (1994), the difference between information and knowledge is dependent on the human perception. Even if the knowledge is simplified and submitted as information, they cannot be exploited unless they are filtered through the mind.

4. Extracting Knowledge

Increased economic and scientific activities can be translated into remarkable growth of available information in electronic form, which led to the creation of new tools necessary for analyzing and structuring of documents that allows users to browse them and/or evaluate.

Extracting knowledge consists in extracting the necessary knowledge of a document and represents the structured form. This form can then allow storing information into a database or to be used as a basis for the automatic generation of summaries.

The process of extracting knowledge regardless of the field, involves a number of steps: selection, analysis, processing, data mining and interpretation.

This process is incremental, and the central role is offered for the concepts of information and data.

5. Formulating the Knowledge

The machines are computers that treat information, and they cannot reason alone but only on the basis of knowledge that has already been made.

Different formulations that can be made starting from the same knowledge are not identical. The linking between explicit knowledge and their formulation shows important interest:

– Keep following the provenance information modeling components that enabled a database;

– To maintain the coherence of global resources heterogeneous;

– Exploiting knowledge to better manage an enterprise documents.

Thus formulating knowledge and knowledge are two different things.

Formulating knowledge consists of collections of symbols used to express some knowledge in natural language. The documents are the type of items used to formulate knowledge.

Knowledge modeling expressed in a document in electronic form, requires working with their formulation.

6. Structuring Knowledge

Structuring knowledge consists to identify, document and preserve memory in all activities and all explicit knowledge relative to these activities.

The objective is not to improve, to bring up to date or to enrich, but to identify and preserve knowledge (to identify, locate, model, formula and archive).

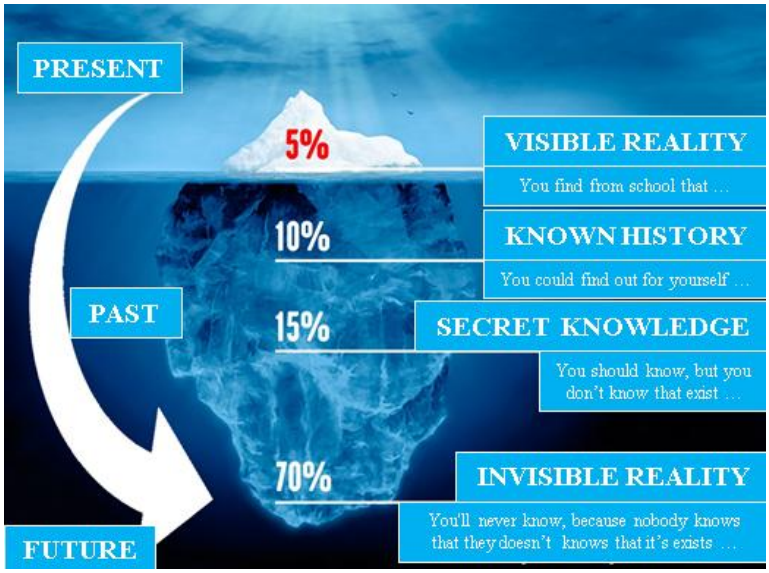

Fig. 2 – Evolution from information to knowledge.

To limit the loss of knowledge, there are companies such as Dassault wishing to formalize gestures transmitted orally until now so they can show new employees (Helderle, 1996).

A temporary rupture is a potential loss factor of knowledge (Duizabo and Guillaume, 1996).

From our point of view, (Tichkiewitch *et al*., 2004), structuring knowledge is now considered a framework in which all its processes as knowledge processes. In this idea, all processes involve: creating, disseminating, and applying knowledge to renew the company's survival.

Two Japanese experts in (Nonaka and Takeuchi, 1997), distinguishes two kinds of knowledge:

– Tacit knowledge;

– Explicit knowledge.

Tacit knowledge is possesses by individual. They are difficult to convey and not formalized. They are competencies and personal experiences, intuition, trade secrets, etc. After Nonaka this type of knowledge are important to initiate a process of creating new knowledge. Explicit knowledge are formalized and submitted as reusable documents like information regarding processes, projects, customers, suppliers, etc. In other words are documents that can be add and/or scanned using a shared information system.

Vinck in (Vinck, 1997) proposes a grouping of knowledge and nonknowledge into two groups: implicit knowledge, explicit knowledge using the iceberg model (Fig. 2).

7. Dissemination of Knowledge

Disseminating knowledge is the most advanced form of management. It is not only a matter of creating initial conditions, encouraging the emergence and local exchange of knowledge, nor of formalizing this knowledge in such a way as to preserve them in a certain activity, but to allow their dissemination and application to different contexts.

The cost of dissemination is also visible in the sense that the corresponding actions and their related costs are identified. On the other hand, the potential gain appears much less identified. The potential benefits and gains that can be expected from knowledge dissemination:

– reduction of errors;
– reduction of redundancies;
– faster problem resolution;
– improved decision-making;
– reduced research and development costs;
– increasing the autonomy of workers;
– improved relationships with clients.

8. Expert System Used in Design

Expert systems are one of the applications of artificial intelligence that have left research labs for use in the corporate world. Many expert systems have been successfully implemented to solve practical problems.

An expert system is proposed in (Fig. 3) and reproduces the behavior of a human expert performing an intellectual task in a specific field. This software capable of performing an expert task (classification, diagnosis, design, planning, etc.) with performances equal to those of the best specialists has some fundamental characteristics:

– expert systems are generally designed to solve classification or decision-making problems;

– expert systems are tools of artificial intelligence, they are used only when no exact algorithmic method is available or practicable;

– an expert system is only conceivable for areas where human experts exist. An expert is someone who knows an area and is more or less capable of transmitting what he knows: for example, a child is not related to his mother tongue.

The structure of an expert system is organized around three main elements: the knowledge base, the fact base, the inference engine.

The knowledge base contains all the information that a human expert would need to carry out his work in a given field. It is the only component of the system that contains knowledge specific to the domain that the system is supposed to cover.

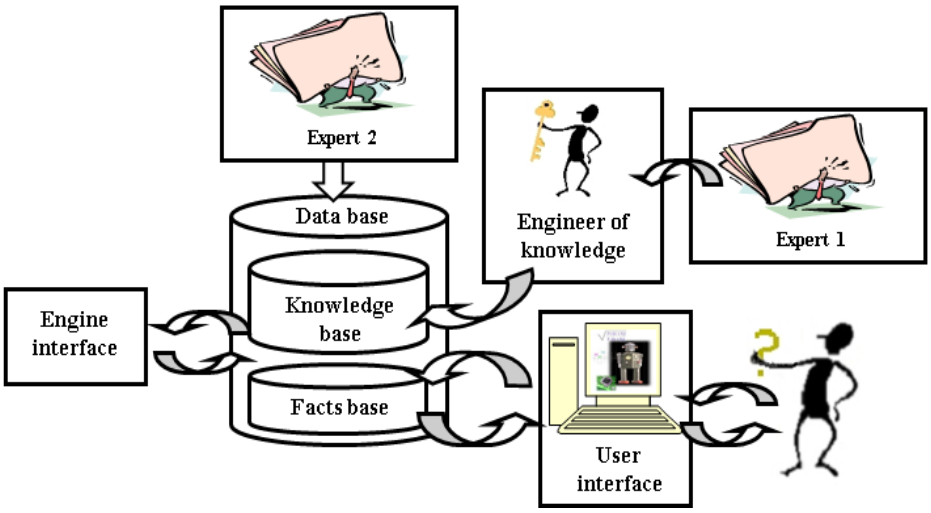

Fig. 3 – Expert system structure.

Secondly, the basis of facts, that is, the state of the current problem, may be more or less complex. It contains mainly the initial data, a particular context, the different processes already executed on these data, the data acquired by the processes. It will therefore be represented in multiple ways: by files, property lists, objects.

The third component is used to exploit this knowledge. An inference engine is required to relate the description of a problem to the analytical capabilities of a given situation.

9. Conclusions

In general, and thanks to the structuring of the knowledge base, the inference engine will be able to answer questions, reason and draw the consequences implied by the knowledge included in the system.

A major peculiarity in the architecture of expert systems lies in the clear separation between the knowledge base and the inference engine, the mechanism by which this knowledge is exploited.

The tools developed for the help of engineers are tools that allow to the actors, through computer models, to manipulate the knowledge available on the project. The objective is not to realize an automatic design, but to allow external actors (designers) to reflect on their main problems.

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EXEMPLU DE SISTEM EXPERT UTILIZAT ÎN PROIECTARE

(Rezumat)

Instrumentele dezvoltate pentru ajutorul inginerilor sunt instrumente care permit actorilor, prin modele computerizate, de a manipula cunoștințele disponibile cu privire la proiect. Obiectivul nu este de a realiza o proiectare automată, ci pentru a permite actorilor externi (proiectanți), de a reflecta asupra principalelor probleme.