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Control of the Machining Systems

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***Abstract* — Today, information has become more important. Even data, information and knowledge are often used as if they have same meaning. This problem raises difficulties in engineering. It is necessary to exist a knowledge management system to avoid increased costs, waste of time and increased errors. Knowledge management is a comprehensive process of knowledge creation, knowledge validation, knowledge presentation, knowledge distribution and knowledge application. In this paper, knowledge management has been explained in general. Then as an example for this study, machining system has been considered, and an application of Knowledge Management in engineering has been attempted to explain. The paper proposes a knowledge management to achieve a competitive control of the machining systems. The model can be used by the manager for the choosing of competitive orders.**

***Index Terms*— competitive control, information technology, knowledge management, machining system, marketing knowledge**

I. Introduction

The recognition of the Knowledge Management (KM) imperative will provide an impetus for enterprise to understand and nurture their knowledge resources and activities.

KM has assumed a broad range of meanings from its inception; however, most of the published material remains ambiguous and provides little empirical evidence to support a specific definition for the knowledge management concept. KM has been acknowledged as being important to competitive advantage and organizational progress.

Thus, a clear understanding and agreement about KM should prove to be of great value for enterprises. As enterprises strive to create a competitive advantage with their products and services, they continue to contemplate the KM concept and the impact on organizational success.

In a effort to define KM, enterprises must determine which

A general definition has been 'getting the right information to the right people at the right time' in order for them to make better decisions.

Knowledge management implementation is an advantage for the enterprise from viewpoint of the competitiveness. The new knowledge will be used both in the enterprise management and to develop new products and new services or make important changes in the business decisions.

By means of learning, the enterprise which uses the knowledge able to adapt and respond continuously to the changes of the business environment.

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An important goal of KM is seen to be the sharing of best practice. So, by the improving the flow of knowledge through the enterprise can be obtained the following benefits:

- the sharing of the best practice around business processes;
- the ability to respond more effectively to customer demands.

Due to technology facilitates the rapid exchange of information, the pace of acquisition is growing exponentially in both large and small enterprises. The vast amounts of knowledge possessed by the enterprises are spread across countless structured and unstructured sources.

To improve processes and bring new products to the market faster and more cheaply, the enterprises have to identify, make available and apply this knowledge.

It is necessary to exist a knowledge management system and coordination between disciplines to avoid increased costs, waste of time and increased errors. Thus, information must be understood, organized and transformed for problems solving. Consequently, information transformed in product is knowledge and coordination of this kind of knowledge is made by means of knowledge management.

The manufacturing industry faces the challenge of responding quickly to the ever-changing requirements of customers. It is necessary that in these high competitive environments, enterprises to control production system dynamics of such as:

- change in the product types and variants;
- change in the production quantities.

Enterprises have to develop and implement more responsive and flexible manufacturing systems based on knowledge. By this way, they can respond to outgoing and difficult to predict change in production requirements and make products with high quality, low cost and fast delivery.

The market dynamics is further passed to the mode of operation and management. In a knowledge-based society and economy, operations such as determining the relevant information and aggregating them into pieces of knowledge must be automated, because in such a complex and unpredictable environment, they are indispensable tools for creating, searching and structuring knowledge. The interaction between the economic environment and the manufacturing system is a major source of knowledge about the economic environment and the manufacturing system themselves [3].Paper has the following structure: section II explains data, information and knowledge terms, section III presents knowledge management in engineering, section IV illustrates knowledge management of machining system, section V contains a case study and section VI summarizes the main conclusions achieved.

II. Defining Data, Information and Knowledge

Defining data, information and knowledge is difficult. It is possible to distinguish between data, information and knowledge on base of external means or from the perspectives of the user.

In [2] it is shown that, data are considered as raw facts, information is regarded as an organized set of data, and knowledge is perceived as meaningful information.
Data consists of symbols that represent objects, events, and their properties. Information is data that has been made useful. Information answers who, what, where, when, and how many questions. Information is helpful in deciding what to do, not how to do it.
Knowledge consists of instructions and know-how. Knowledge answers how questions. Knowledge is more than information. Information is data organized into meaningful patterns. Information is transformed into knowledge when a person or an intelligence system reads, understands, interprets and applies the information to a specific work function.
One person's or one intelligence system's knowledge can be another person's or intelligence system's information. If the information can not be applied to anything, it remains just information.
However, a person can take that same information, understand it and interpret it in the context of previous experience, and apply to anything, it is transformed to knowledge [2].

III. Knowledge Management in Engineering

Information is becoming ever more important in engineering. It is not suitable to use data, information and knowledge conventionally. That is there is conceptual confusion. Also, today's technological products need interaction between different disciplines. So the confusion increases more. At the multidisciplinary engineering system, any discipline contains some information peculiar to system. However, most of the information mean essentially same even if they are expressed in different terms in different disciplines. Therefore, the available information must be evaluated, simplified and transformed into usable form that is knowledge.
Next, the knowledge is coordinated and connected with the system. So, a kind of know-how is acquired for the technological product. This case is generally based on a model, while it has special characteristics. An example of machining system has been analyzed in the following section. The model produced by technical knowledge which is

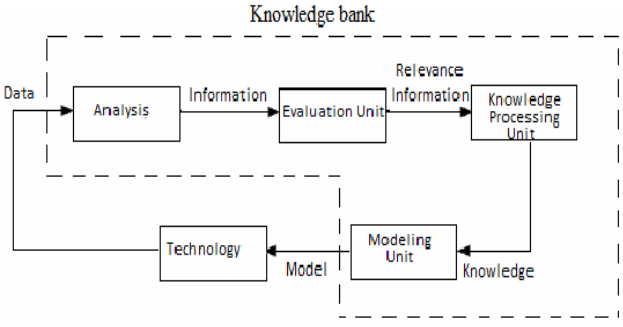

Fig. 1 KM model

acquired by the interaction of data, information and knowledge, by the coordination and the application of them on engineering system. KM model is presented in Fig. 1.
KM is a comprehensive process of knowledge creation, knowledge validation, knowledge presentation, knowledge distribution and knowledge application [2]. When KM model is applied by the enterprise into its production process it is obtained increasing competitiveness of the product in the market. That is KM model can be used for every stage of the engineering works such us design, manufacture, maintenance and repair.

IV. Application of the Knowledge Management on Machining System

By manufacturing system we understand all the technological systems that are used to produce a specific product.
Each of these technological systems is composed of machine-tool, tools, devices, parts, operator and carries out one of the operations of the technological process of making that product.
The machining system performance depends on how it is run. In more specialized papers [1] reference is made to the relationships between the parameters of the processing regimes and the technical performance of the machining system (purely technical aspects), while in others, equally numerous [4], [5] references are made to the relationship between the product made by the machining system and the market (economic relations).
In the literature no attempt to approach the whole machining system – market assembly is reported; therefore, there are significant resources to improve performance which are not used because the technical and economic aspects are dealt with separately.
Also, it is not known an algorithm for the management of the machining system – market assembly, but only algorithms for the technical control of the technological systems [6] and tools of economic management of the relationship between the technological system as a whole and the market [7].
Nowadays, the machining systems are controlled by means of numerically programmed machine tools which are part of the system [8]. The control is exclusively technical because there is no economic variable, although this is actually the ultimate goal of any processing process.

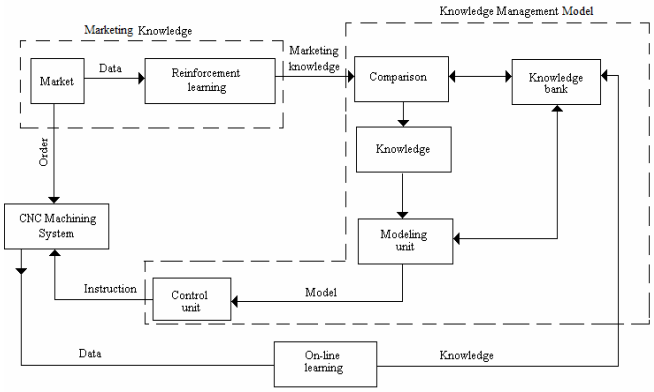

Figure 2 Knowledge management arhitecture of the machining system

The dynamic changes and the overall progress of society are reflected at company level by many orders in number, small in volume, very diverse, obtained through frequent auctions with short- term response, which leaves no time for a relevant analysis of said orders.
As a result, a long-term management is no longer possible. A sort of fluctuating (just like the market) on-line, fast responsive, prompt and rapid, however, ephemeral management is called for [4]. For these goals we propose knowledge management model of machining system.

The architecture of KM model of machining system is presented in Fig. 2. The system showed in Fig. 2 consists of KM model, CNC Machining System, Marketing Knowledge. KM model contains very important features of the system.

KM model consists of knowledge bank, compare, modeling and control units. The knowledge bank is formed according to the characteristics of the system.

It is very important that information which concerns with subject, correct, update, concordant must be converted knowledge and they must be stored in this unit. It is necessary that this unit becomes a flexible structure because it can be updated depending on the market dynamics and technical characteristics of the new manufacturing products.

The information coming from the Marketing Knowledge-unit are diagnosed by the comparison unit. Also the comparison unit has information-receive ability from knowledge bank. The essential function of the comparison unit is to compare the information and knowledge with each other. The output information from the comparison units is a new knowledge. This new knowledge has been sent to modeling unit.

Not only does the modeling unit receive information from the comparison unit, it also interacts with the knowledge bank. The output of the modeling unit is the model which is analyzed in control unit. This unit sends the manufacturing instruction for to the CNC Machining System. Through on-line learning, the output information from CNC Machining System unit becomes the new knowledge and has been sent to knowledge bank.

The machining system receives contracts after the tenders (competitions) generated by the market offer quatations.

The competitive control means competitiveness assessment, and based on it, an intervention on the machining system through instructions regarding the progress of the machining process in order to obtain maximum competitiveness.

On the other hand, after assessing competitiveness, the management system should enable to develop competitive offer for the tenders. To achieve these two objectives, the competitive control uses the reinforcement learning to get to know the market and the non supervised on-line learning technique to get to know the machining system.

V. Case Study

Let us assume that in market there are more offers quotations for a certain product. Using reinforcement learning, the information from market becomes marketing knowledge and they are compared with the ones from knowledge bank.

After the comparison, knowledge unit send the technical-economic parameters to the modeling unit. Also, modeling unit interacts with the knowledge bank to achieve the machining model.

On basis of generated model, simulations are made and analyzed in control unit. This unit sends to the CNC machining system the manufacturing instructions that satisfy the customer demands in the competitive conditions of the enterprise.

For example, from the simulations (fig. 3.a) it can see that the minimum cost is obtained for the cutting speed v'_{op}=84m/min. The control unit sends to the CNC machining system the manufacturing parameters: cutting speed v'_{op}, feed rate *s*, depth of cut *t*.

Also, corresponding to this cutting speed, it can be read the necessary time τ for 1 cm^2 surface area machining (fig. 3.b), the profit rate *r* (fig. 3.c) and the environmental impact *I* (fig. 3.d). On basis of these simulations the manager can decide if the order is accepted or rejected.

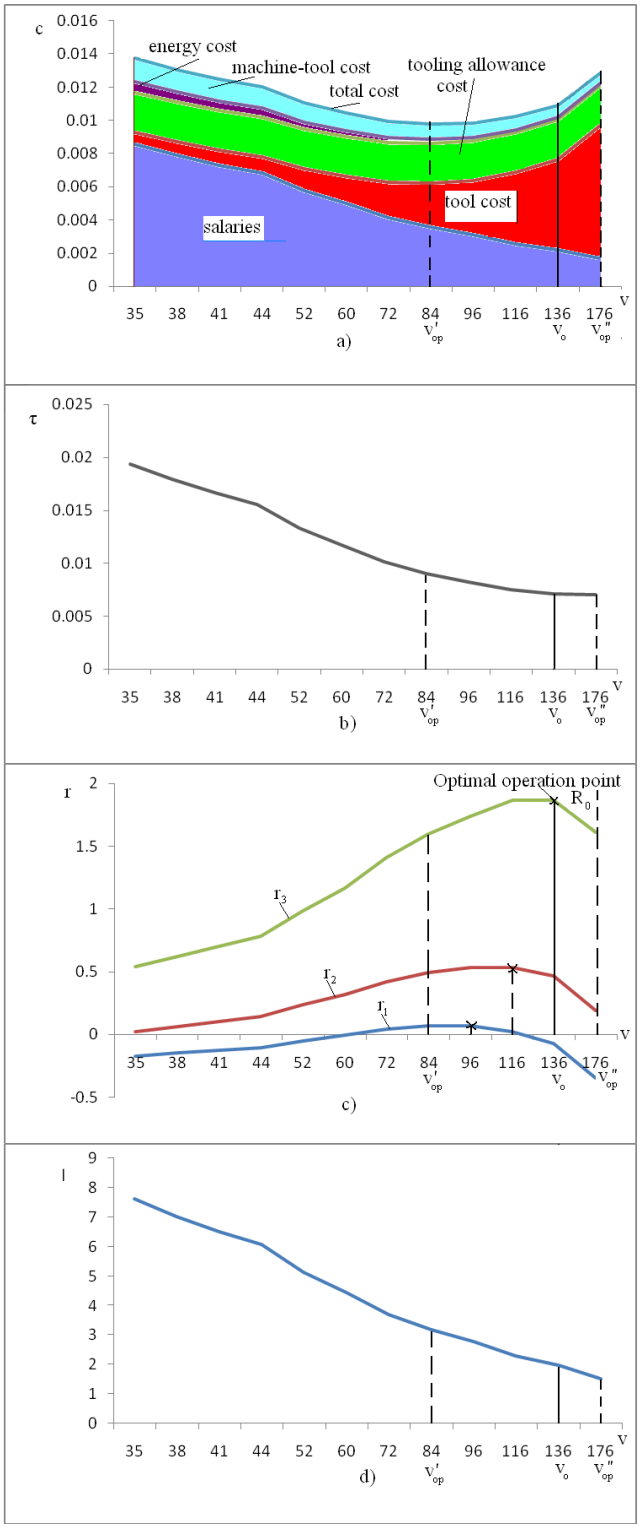

Fig. 3. Simulations for a turning process and system:

a) structure of the cost *c*; b) time τ; c) profit rate *r*; d) environmental impact *I*.

VI. Conclusion

In this paper the architecture of the knowledge management of the machining system was achieved.

Using and comparing marketing knowledge with stored and updated ones the machining model is carried out, analyzed and on its basis are generated instructions regarding the progress of the machining process in order to obtain maximum competitiveness.

By modeling and simulations, the manager can decide if the order is accepted and control the machining system to satisfy the customer demands.

To achieve these objectives, the competitive control uses the reinforcement learning to get to know the market and the unsupervised on-line learning technique to get to know the machining system.

Note that we propose to give managers a knowledge management model, so that they can interact with the economic environment (market).

This knowledge management model represents a technical-economic model that can be used for competitive control of the manufacturing process without requesting experiments and based on the extraction of the knowledge from the previous experience.

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