Modeling and Simulation in Machining Processes

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Abstract: - In today's society, where access to data and information is more easily achieved thanks to the rate of development of information and telecommunication technologies, the problem is to know more and more, to know how to use the immensity of information that we can have at one time. In the paper we aim to offer a strategic vision of knowledge management (KM) that takes into account the synergy between technological and behavioural issues so necessary for survival in the current economic context.
In this view, all business processes involve creation, dissemination, renewal and application of knowledge for the maintenance and survival of the enterprise.

Key-Words: - knowledge, knowledge management (KM), knowledge-based economy (KBE), machining process

1 Introduction

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 [1]. Consequently, it is necessary to exist a knowledge management system to avoid increased costs, waste of time and increassed errors.

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 corporate knowledge should be harvested, organized managed and shared. 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.

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. 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.

As shown above, 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.

2. Application of the Knowledge management on machining system

The architecture of KM model of machining system is presented in Fig. 1. The system showed in Fig. 1 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 unit 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.

The learning process, in general, is an action in which the machining system can improve its ability to react so that, during subsequent requests, this should take actions more efficiently.

Devising a real-time modeling methodology, based on reinforcement learning (which is a specific non supervised learning technique) of the machining system relationship with the economic environment means that the machining system 'learns' what actions to perform in certain situations,

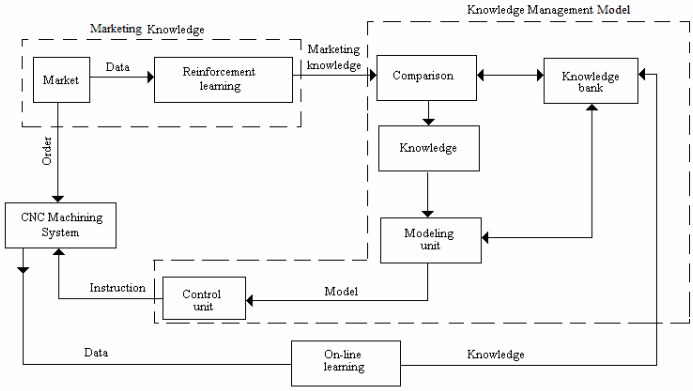

Fig. 1 Knowledge Management arhitecture of the Machining System

based on the data supplied by the economic environment, so that such actions increase the possibilities of achieving the aim pursued. The system should 'exploit' what it already knows to get profit, but at the same time it must 'explore' the possibility of finding other suitable actions for the future. The machining system should try a variety of actions and then choose those that seem best.

According to the competitive management, regarding the market-machining system relationship by reinforcement learning, from the data supplied by the marketing section of the enterprise (auctions situation), an evolution of the economic environment for a period of time is carried out and an overall modeling is provided on the basis of past events.

Reinforcement learning is to be understood as the machining system capacity to 'learn' in permanent interaction with the economic environment, to inform and update the information about the auctions and to anticipate, before deciding to conclude a contract, the level of costs, profit and what is the best way to act.

Modeling the market- machining system relationship simulates, based on a state of the environment and an action of the machining system, the behavior of the assembly and can predict what will be the next state and the result obtained.

The relationship is used for planning, to take decisions regarding the behavioral modeling of the machining system – market assembly while considering possible future cases before such situations are experimented.

After each possible situation, the machining system will adapt its behavior, so that it tends towards its next most favorable state. By the learning process, the machining system will be allowed to execute a number of actions in accordance with the instructions from the behavioral model operation of the assembly and that action will be selected likely to bring it to the maximum competitiveness state.

3. 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. 2) 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*.

On basis of these simulations the manager can decide if the order is accepted or rejected.

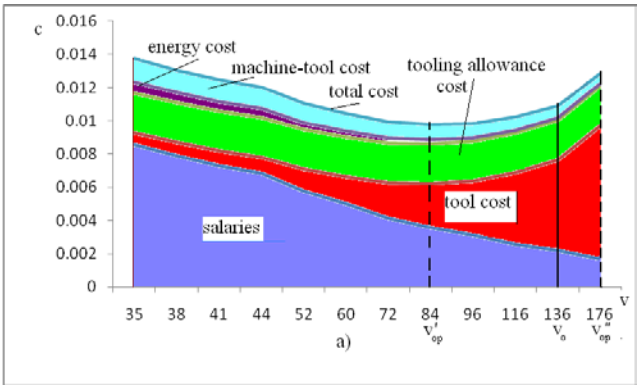

Fig. 2. Simulations for a turning process and system , a) structure of the cost

4. 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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