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HOLONIC APPROACH TO MANUFACTURING SYSTEMS

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ABSTRACT

A holonic manufacturing system is a mode of organization based on the integration of people, process equipment and computers in autonomous and cooperative units in order to increase flexibility, and robustness system at perturbations and internal and external vibrations.
The work consists in preparing structural-causal model for the design and development of a methodology for continuous identification of a holonic structure, and adaptive-optimal techniques of management for production systems based on holon modeling and continuous identification .
In this context, businesses aimed increasing small and medium enterprises competitiveness through marketing more reactive and more adaptive management, obtained as a result of the design and implementation of new management techniques of manufacturing systems, using the concept of holon.

KEYWORDS: manufacturing system, holon, adaptive-optimal control, competitiveness

1. MANUFACTURING SYSTEMS OF SMALL AND MEDIUM ENTERPRISES

The company is a system composed of larger or smaller entities depending on its activities. As first subdivision the enterprise consists of sections which have technical and organizational coherence. At the same time there are external activities that relate to the supply, marketing, commercialization, costing, time calculation, scheduling production, company management.

It has mentioned a number of definitions necessary to clarify certain terms, as follows: manufacturing system is a set of operations and related activities including product design, material selection, scheduling production, inspection, management and marketing; holonic modeling: modeling system structure, characterized by the fact that each structural element is a Holon; management: action to determinate the system to evolve after a given trajectory; measurements status: characterizes the system status at a given time; variable control: measurements of condition whose value can be ordered; order: an action on the system that has the effect its passing in the current state into another state (state controlled); passing can take place on any trajectory; control: action to maintain system status measurements at a certain level of reference imposed, regardless of disturbances occurring; adaptive-control: control for controlled system model tracks the evolution in time of system behavior; identify: building model that describes the behavior of the system on base monitoring system and the completion of a database; optimal control: it controls the relationship between values of several sizes of condition.

A manufacturing system is composed of technological systems such as machine tools, tooling, operators or parts, which constitute the main elements of manufacturing system considered. At the same time it also contains auxiliary equipment of the type of fasteners, measuring devices, safety devices etc.

Based on considerations of the terms defined above and shown above context can support a number of ideas that will shape the future development of the research topic, as follows: bidding activity-contracting is cumbersome, slow, most often imprecise, constituting a brake on business mobility; mitigate these shortcomings would make the manufacturing systems to be more responsive to market and customer needs; at the level of manufacturing system, management and marketing are too based on knowledge and little correlated; integration into a unified whole management and

marketing manufacturing systems and their substantiating on direct knowledge would lead to increased competitiveness of enterprises.

In this context businesses aimed increasing small and medium enterprises competitiveness through marketing more reactive and more adaptive management, obtained as a result of the design and implementation of new management techniques of manufacturing systems, using the concept of holon.

2. HOLON CONCEPT APPLIED TO MANUFACTURING SYSTEMS

A holonic manufacturing system is a mode of organization based on the integration of people, process equipment and computers in autonomous and cooperative units in order to increase flexibility, and robustness system at perturbations and internal and external vibrations.

An important term that must be taken into account is the "holarchy" term. Holarchy is a mode of management based on autonomy and cooperatively of holons that are undergoing to a set of rules/regulations.

In this way it can be said that holonic manufacturing system is a holarchy that integrates whole range of activities related to manufacturing, including accepting orders, design, production and marketing activities in order to achieve a fast manufacturing enterprise.

1. Holon structure means identifying in the system of the elements that have holonic characteristics, which are:

a) autonomy: holon is able to make their own plan, a program to regulate their working arrangements, according to the targets it has and conditions at any given time; functioning mode is not influenced by the performance of another holon;

b) cooperation: holons are able to operate together, to make a plan together in conditions which each holon executes a part of it independently; in the end showing the finished product as required.

2. The considered holon is a closed structure that works autonomously, with links to the rest of holons and it is characterized by cooperativity (negotiation) with environment.

System structure lies in its breakdown in holon with attributes of autonomy and interaction with the environment. The enterprise is an autonomous holon itself interacting with the environment.

3. Holonic modeling of manufacturing systems

Modeling of manufacturing systems can be done in four stages classified as follows:

- Structural modeling, which has theoretical correspondent supervised learning theory (Supervised learning);
- Canonical modeling suggest identifying legalities proposed by the management and that govern environment in which acting technologic holons.
- Functional modeling, which has as a theoretical correspondent, learning through reinforcement (reinforcement learning), which means that environment to provide data about the fairness of actions taken by holon, but it don't say what corrective actions should be.
- Causal modeling, whose theoretical correspondent is unsupervised learning which means that the environment does not provide information about the correctness of actions taken by holon.

3. STRUCTURAL MODELING

The research started from a number of key ideas that ensure integration terms and methods used (holonic systems) with classical features of manufacturing systems, as follows: ensemble of man-equipment-technology will be considered as a holon, and behavior will be described by a model; on input, sizes of status of holon will be range: size, speed, size measurement stability, time etc. Some of them will be considered sizes control; the output, the holon will have range economic indicators that measure performance: accuracy/surface quality, material consumption, energy consumption, use of labor, productivity etc; concept supervised learning, in which the environment offers both problems we have to solve holon, and the right answers to these problems. To achieve holonic modeling was taken in study the dump truck bins manufacturing.

The way of working involves the following steps: identify jobs; identify sequence actions in the workplace; setting status measurements and measurements control; setting the output or performance job.

Equipment manufacturing involves several operations: tracing; cutting; welding components; welding whole bucket; adjustment for stress relief.

From sequence of operations presented is found jobs involving the same operation and will consider first that will be a holon for each operation, in the logical order of operations as follows: 01 stakeout holon, 02 cutting holon, 03 welding components holon.

Do not forget that each holon can act alone and is simultaneously part of the system of production holonic. As such each must be characterized by input and output sizes, but also must be a size or more allowing holons order regarding succession of operations and type of product that results in the end.

Intuitive holonic model based on the description of its component parts, as shown above, consists of a series of schematic representations that by joining, lead to the representation of a manufacturing system holonic.

- Technique component consists of working equipment for each process;
- A technology component comprising data and information about the trial;
- A human component that achieve the process;
- A component of the work environment and utilities for each process.

Manufacturing of equipment for bodywork involves several components and stages and as a result several types of holons, of which we will consider three types of holons: cutting holon, holon for drilling and

welding holon. These are described by the status sizes as follows:
- holon for cutting with status sizes: the material type, cutting length, cutting size, cutting speed, number of pieces; and sizes of performance: time of cutting, operating cost, energy consumption, waste quantity;
- holon for drilling with status sizes: material type, diameter of hole, drilling speed, number of holes, number of pieces; and performance sizes:time for drilling, energy consumption, cost per operation, waste quantity;
- holon for welding with status sizes: material type, type welding, seam length, number of passes, the current intensity, the speed of welding, quantity of electrodes, number of pieces; and sizes of performance: welding time, energy consumption, cost per operation, waste quantity.
For drilling holon we will make a representation that includes status sizes and performance sizes.

4. MODELING CANONICAL

Each technological system as holon type has at its level a particular environment. Environment in which they act / work is governed by a series of laws, rules or situations. The rules of environment form a structure called canon. For example: we have an arrangement of machine tools such as drilling machines into a workshop of manufacturing of gearing, resulting a certain structure of the environment in which they work; the same types of machines arranged in a workshop for clutch housings has a different structure.

Canonical modeling means determining legalities governing environment in which acts a technological system type Holon. Some examples of policy covers commercial policy, purchasing policy, human resources policy, price policy, etc.
It must be said that the canonical modeling is modeling of a policy, fact characterized as being subjective, in that it is the result of the modeling of managerial policy decisions, which are the product of thought and action of people. Canon of environment in which operates a manufacturing system / technology is given by internal regulations, operating regulations, job descriptions and other regulations.

5. FUNCTIONAL MODELING

This type of modeling refers to a structure that interacts with the environment. If we were to represent this thing, we observe that information, materials, documents, etc are received from the environment and its products, reliable data, records are returned to the environment.
Functional Modeling consists cooperation between targets received and what returns holonic structure to working environment.

After interaction with the environment, there is a learning process, which is a process which resulted in Holon which learns improves his ability to act so that during some subsequent inquiries, holon take actions with high efficiency. Actions of holon have place within an environment, and depending on the interaction between holon and the environment, there are several types of learning, of which here are applied through reinforcement learning, in which the environment provides data about the fairness of actions taken by the holon, but does not say which actions are correct.
Practical, the learning model is through reiforcement, in that it the relationship between holon and the environment are modeled, describing the behavior of this relationship and holon is learned to interact with the environment so that the rewards be maximized and minimized penalties for a certain period of time. In this case, the holon must discover alone what actions lead to obtaining a greater rewards.

6. CAUSAL MODELING

Unsupervised learning is applied at causal modelling.The environment does not provide information about correctness actions of holon.

Causal Modeling is modeling an objective reality, which includes internal environment of firm under its economic, technical and organizational aspect. This type of modeling includes modeling functional because it includes both targets and independent variables, given by the working parameters and dependent variables given by the status sizes.

Given the above considerations it is necessary to mention the following:
- holon could be the type:
- neural network with specific techniques;
- database, the processing of model it is made by data processing from this database and search in this database will be made by an algorithm that is called decision tree and uses a special technique;

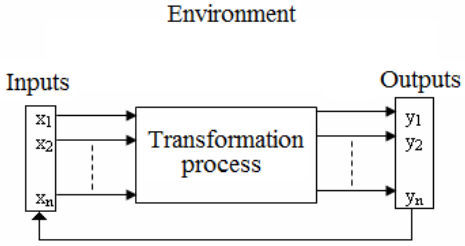

Fig.1 Entreprise

- neural network model and database;
- the neural networks can't have attributive variable;
- adaptive character of leadership is given by the fact that for identification of the holon is used only one set of recent data (latest developments, not historical data), taken over a period in which it is considered that the system didn't change his behavior; identification is made with a certain frequency and always it takes the latest events;
- because, frequently manufactured products are identical / similar, the holon works in a restricted vicinity of an operating point. So, the models used will have to be simple, to describe the behavior in the vicinity of the operating point; instead of complex

models / general will be built several local and temporal patterns;
- it will assess performance indicators using fewer initial data and legitimate synthetic, stable and influential, which will be revealed during use model.
It should be emphasized that the functional modeling is a reflection of circumstances that characterize the relationship holon environment that is governed by some laws that are conjuncture. In the same time, the relationship with the market is a circumstantial relationship, because if it is described in this time, it is not certain that this will be the same over shortly.

To conclude we can say that, to model holonic manufacturing system means his modeling through point of view in terms of those 4 points modeling.

7. THE GENERIC HOLON

As we have previously mentioned, we describe the holon model discussed the production system.

The basic model consists of the following:
- a technical component of the work equipment made for each process;
- a technology component comprising data and information about the trial;
- a human component which develops this process;
- a component of the work environment and utilities for each process

We can describe the model holonic as a box closed, in which enter a range of sizes necessary of process. It takes into account the sizes of status according to how the system works and it results, based on dependency relations, dimensions of performance that allow us to measure the effectiveness and efficiency of system operation. So, it results the optimum of the objective function of the trial in question.
The industrial company is an organizational link in that occurs has merger between the factors of production in order to produce and loosen economic goods in the structure, quantity and quality required by the market and profit.
It can be seen as an artificial system opened in which a human group is oriented towards production of goods and services and whose existence depends on the sale of the product its activity (Fig. 1).
In this system the entries are made up of production factors structured on elements, outputs are represented by the products and services obtained and transformation process is concretized in all conscious acts of employees, based on the use and transformation of factors of production.
Production volume must be estimated according to the analysis of expected market requirements so that its fluctuations are covered by quantitative production programs related to fluctuations in market demand. A correct planning of production must maintain a production performance in terms of product cost and volumes of products but that may remain in stock.
System performance depend on the quality of the system as leader, the ability to eliminate or prevent potential disturbances, ie factors that make the outputs to deviate from the baseline. Under this aspect, the industrial company is a self-regulating cybernetic system, characterized by the occurrence of the feed-back.
Based on these theoretical considerations, the enterprise is a set of material, financial and human resources available to it at a time in order to accomplish the mission and strategic goals, around which revolve the entire activity.
For a intuitive description of how manifestation of shares in a holon we will appeal to the scheme (Figure 2).

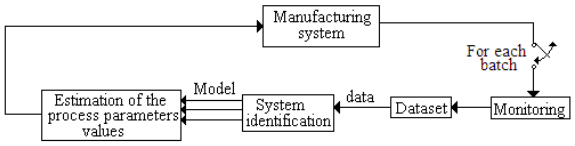

Fig.2 The proposed control algorithm

8. CONCLUSIONS

The work consists in preparing structural-causal model for the design and development of a methodology for continuous identification of a holonic structure, and adaptive-optimal techniques of management for production systems based on holon modeling and continuous identification .

As a result, we can identify the following conclusions:
It was introduced the concept of holon applied to manufacturing systems;
- were established defining characteristics of the holons from production systems;
- It was developed the approach holonic modeling of the manufacturing systems;
- It were introduced and developed 4 types of holons modeling which describe the of manufacturing;
- It was developed structural modeling of holon, presenting the construction of a structural model of holon of the manufacturing systems;
- Canonic model highlighted the relation of the holonic manufacturing system with the environment.
- Functional modeling highlighted relationship of the holonic system of production with the environment and ways of response to environmental requirements;
- Causal modeling emphasized that this is a reflection of circumstances that characterize the relationship holon with environment that is governed by some laws that are cyclical;
- It was presented the model of holonic generic of the manufacturing systems.

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