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MULTIAGENT TECHNOLOGIES' METHOD IN MANAGING BUSINESS-PROCESSES OF THE TECHNICAL PREPARING FOR PRODUCTION

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The method of managing the process of the extended productions technological preparation is given. The method is used for integrating the automated systems of industrial assignment of CAD/CAM/SAPP and ERP systems.

Introduction

Process organizing the extended productions (EP) functioning puts the new tasks as for automizing management in the technological preparation of production (TPP).

At first it refers to managing task of loading the tools for all the participants (EP). As the toolkit for solving the TPP task we use the possibilities of the multiagents technologies which make it possible to realize the joined managing the parallel processes in various media and conditions, including the task solution of TPP in the conditions of EP [1].

Putting the task

Multiagents technologies can be used when solving the joint TPP tasks in the medium of extended enterprise where there are public description of both market orders and market of services. However, the availability of such descriptions is only the needed condition for using the multiagents technologies but it doesn`t define the essence and methods of such technologies.

The multiagents technologies are the sub-branch of the distributed artificial intellect, the main point of which is cooperative interaction of the distributed intellectual systems [1; 2]. The distributed artificial intellect is based on the classical foundations of artificial intellect taking into account the usage of the new methods of processing the distributed data and knowledge as well as the methods of decentralized management.

Under' agent' we mean an object existing in a medium where it can exert the definite actions, which is capable to interpret a part of the medium, it can communicate with other agents and it possesses the autonomous behaviour that is the result of its observations, knowledge and interactions with other agents [1; 2].

A man, a program subsystem or a module can act as an agent. Depending upon the proper complexity level, the agent can process the received messages as well as it can send them to other agents, it can deal with the target designation and with planning the actions, with coordinating the actions with the other agents.

When agents act as program modules of Product Data Management systems, initializing their work can be done:

– as the result of some external act, for example, receiving the order to fulfill the work on designing an item;

– in given time intervals;

– when obtaining the messages from other agents.

The agent is characterized by the scheme and method [1]. The scheme presents the whole complex of the names, their important features – that is an agent`s identificator, agent`s class, input and output attributes and so on. The method defines the agent`s behaviour and the algorithm of transforming the input attributes into output ones.

Let`s see the principles of constructing the multiagent system which allows to solve the tasks of TPP in conditions of EP on the basis of decentralized management providing the high level of automatization.

The method offered

First of all, it is necessary to define the structure and content of on open data medium (ODM) in which the agents must function. This medium is formed by the computer network, distributed on the enterprises – EP potential participants. Each enterprise supports in ODM a section where the following information is kept (fig. 1):

– the kinds of work which a given enterprise is ready to fulfill as a subcontractor;

– manufacturing resources given by an enterprise for fulfilling the task in EP medium;

– current loading and loading plan of given manufacturing resources.

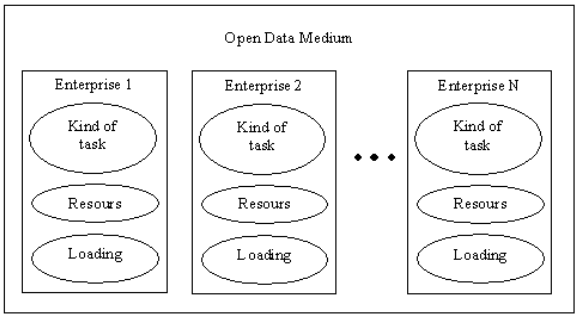

Fig. 1. Information placed by EP participants in ODM

Designing and producing the certain kinds of means of technological equipment (for example, mould for the injected casting with the limits as for dimensions and complexity), designing the different kinds of technological processes, executing the certain technological operations (for example, the operations of making holes on the electroerosive mashine-tool) can be referred to the kinds of tasks done in the TPP as a subcontractor.

Analyzing the kinds of tasks allows to define if a certain enterprise can fulfill the definite order. The information about the kinds of tasks must include approximate cost of their fulfilling as well.

The technological equipment, machinery and instrument used are referred to the productive resources. The information about resources makes it possible to analyze the capabilities of an enterprise`s fulfilling the order in details.

For example, in the list of kinds of tasks for an enterprise is producing the moulds, but if a required mould needs the operation of making holes, but the enterprise doesn`t have the electroerosive mashine-tool for completing the task. The enterprise can be an executor only in the case if it cooperates with another enterprise capable to fulfill this operation. It makes cooperation between the customer and the enterprise less preferable.

The information about loading the equipment allows to appreciate the possibilities of the enterprise more detailed as for the fulfilling the given order. If the needed equipment is loaded completely at present, it leads to the more prolonged terms for fulfilling the task; it may be unacceptable.

Let`s define four classes of the program`s agents **A,B,C** and **D** in a proposed multiagent system.

The function of "**A**" agent is searching in ODM a great number **M** of the enterprises $\{\Pi_i\}$, the kinds of the work done which $\{BP(\Pi_i)\}$ include the possibilities of fulfilling the given order Z:

$$M=\{\Pi_i\},\ i=1, \ldots, Z;\ Z \subset \{BP\ (\Pi_i)\}. \quad (1)$$

The function of "**B**" agent is:

– receiving data from "**A**" agent containing the information about the order Z and an identificator of one of the enterprises $ID(\Pi_M)$, which meet the condition (1);

– analyzing the resources and loading capacities of the enterprise Π_M from the view point of efficiency of fulfilling the order Z;

– giving the enterprise Π_M a rating R_M characterizing the efficiency of fulfilling the order Z.

Rating R_M, in particular, can be defined owing to the formula:

$$R_M = AS/S + AT/T, \quad (2)$$

where S is the price of fulfilling the order Z; T is time needed for fulfilling the order Z; AS and AT are weighting coefficients.

For specifying precisely the cost and terms, "**B**" agent can use an interactive operational mode in ODM with corresponding representatives from the enterprise – subcontractor. For all this the enterprise uses all the information about it in ODM for estimating the order.

The function of "**C**" agent is:

– receiving from the "**B**" agents the ratings $\{R_j\}$ of the enterprises meeting the needs (1);

– analyzing the ratings $\{R_j\}$ and choosing the performer Π^* for the order Z on the basis of some optimizing criteria (if primitively, the choice of the enterprise with the highest rating);

– transfering the data about supposed performer Π^* to the enterprise-customer.

The function of "D" agent is compiling "the summary list" which contains the information about all subcontractors chosen for fulfilling the tasks in TPP of a given item. For all this the order Z is considered as the element of some common package of orders Z for fulfilling the subcontractors' tasks in TPP of a given item ($Z = Z_j$).

Taking into account all the characteristics of ODM and program's agents given above, the algorithm of functioning the multiagent system is as follows.

1. The plan TPP done, the package of orders $\{Z_j;\ j=1, 2, \ldots, M\}$ for subcontractors defined at the enterprise fulfilling the production activity of a given item, this fact is recorded in PDM-system as some event S_j, transfering "**A**" agent in an active state.

2. The event S_j initializes the work of the agents' group $\{A_j;\ j=1, 2, \ldots, M\}$ that is, each order Z_j is processed by its A_j agent. Each agent on the basis of analyzing the kinds of the tasks done by the enterprises $\{BP\ (\Pi_i)\}$ defines a set of enterprises-possible subcontractors $\{\Pi_k;\ k=1, 2, \ldots, L\}$ according to the condition (1). Completing the A_j agent's work is recorded in PDM-system as some S_2^j, transfering "**B**" agents into active state.

3. The event S_2^j initializes the work of the agent's group $\{B_k^j;\ k=1, 2, \ldots, L\}$ that is each B_k^j agent processes the information of one possible enterprises-subcontractors Π_k for fulfilling the order Z_j. Processing the data is analyzing the industrial resources of a given enterprise and measure of their loading volume. As a result of analyzing carried out, the enterprise is given some rating R_k^j.

4. After all agents $\{B_k^j,\ k=1, 2,\ldots,L\}$ completing the analysis of the possibilities of the enterprises-subcontractors $\{\Pi_k\}$ for fulfilling the order Z_j, event S_3^j transfering "**C**" agents in active state is fixed in PDM-system. As the result, the work of C_j agent is initialized, C_j carries out the ratings analysis $\{R_k^j\}$ and chooses the performer Π_j for the order Z_j on the basis of some criteria of optimizing.

5. After fulfilling the operation of all the "**C**" agents, event S_4 is fixed in the PDM system, the event S_4 initializes the work of "**D**" agent. This agent compiles for the enterprise-customer "the summary list" containing the information about all subcontractors, chosen for fulfilling the work of a given item in TPP.

Generalized algorithm of interacting the program's agents in observing multiagent system is given in fig. 2.

Conclusion

Advantages of a proposed method using the multiagents` technology in comparison with the methods based on using the examination systems are in greater flexibility of managing TPP and in acceleration of TPP at the expense of parallel solving the tasks by the programs-agents.

However, realizing the proposed multiagent system makes much greater demands to the level of organizing ODM for the enterprises participating in the joint solving TPP tasks and operating as the part of the extended production.

Literature

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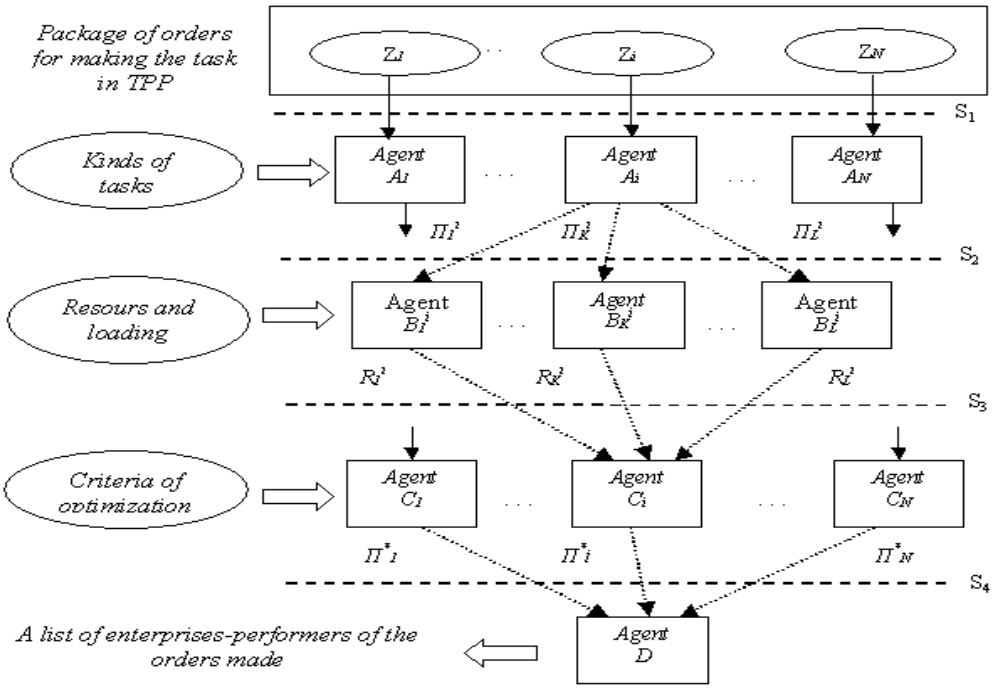

Fig. 2. Generalized algorithm of interacting the agents when solving the TPP tasks jointly

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Метод багатоагентних технологій у керуванні бізнес-процесами технологічної підготовки виробництва

Розглянуто метод керування процесами технологічної підготовки розширених виробництв, що використовують для інтеграції автоматизованих систем виробничого призначення CAD/CAM/SAPP/ і ERP систем.

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Метод многоагентных технологий в управлении бизнес-процессами технологической подготовки производства

Рассмотрен метод управления процессами технологической подготовки расширенных производств, используемый для интеграции автоматизированных систем производственного назначения CAD/CAM/SAPP/ и ERP систем.