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IFAC-PapersOnLine 49-30 (2016) 060–064

Functionalities of multi-agent systems in Programmable Logic Controllers

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Abstract: The consumer market ever more calls for diversified products in small batches and the industry lacks production systems that meet the demands with efficiency and ability to adapt quickly. Integrated manufacturing systems implemented have their management for programmable logic controllers and electrical interconnections, control logic and satisfactory robustness, but they do not attend the needs of diversity and flexibility in production. The solutions to these needs refer the company to migrate to the use of new technologies of control, circuit and logic. However, for an industry migrates is a very big and expensive step. Then, there is an urgent need for methods that implement the interface between logic controllers and multi-agent systems in order to evolve an integrated manufacturing system taking advantage of all electrical circuitry, control logic and the logic controller that installs itself, taking advantage of the self-adapting characteristics that the multi-agent systems provide.

Keywords: multi-agent systems, industrial manufacturing, agility, self-adaptive systems, self-x.

1. INTRODUCTION

The modern consumer behaviour is in constantly changing and the industry is facing the big challenge of accompanying these changes. On the one hand, consumers are seeking ever more customized products that represent their individuality, on the other hand, the industry, to remain competitive, needs to meet this demand of large-scale variety.

The study of (James; Smit, 2005) has pointed out that the business environment in the future would be characterize by constant changes in market demand and the global competitiveness would push the entry of new products.

The high-volume production continues to be processed; however, as pointed out (Beach Et al, 2000), there is a tendency to mass production of highly customized product. And it leads to a large volume of small lots. And the speed that the market demands products highly customized to be delivered is important. The production line space to adapt to a new product is smaller and significant to the final cost. As stated in (Cavalcante; Pereira; Barata, 2010), to cope with this new reality and achieve a competitive advantage over competitors, future productions systems must provide solutions for:

- Long time for system design, commissioning and setup;
- Complex variations requirements;
- Inflexible implementations;
- Scalability;
- Fault-tolerance or redundancy;
- Incompatibility between different technologies.

However, what method it is necessary to industries will migrate to new paradigms that attend the market requisites? One cannot simply dismantle the existing production systems and build new ones, with new paradigms. This work will be discussing the steps to migrate from a conventional manufacturing to a system self-adaptive, making use of all existing infrastructure and local logical.

This work shows a study of manufacturing industrial and the possible solution for new necessities of market. In section 2 approach how could-based can be used for support to self-organized systems. The section 3 shows de concepts of industrial manufacturing management. The section 4 shows the approaches this problematic by academics and researches groups. The section 5 discus a need of method to migrate of conventional system to self-organized systems. And section 6 shows the conclusion of this work.

2 CONTRIBUTION TO CLOUD-BASED ENGINEERING SYSTEMS

The requirements of diversity in production lead the industry to need versatile systems that use shared resources. One way is to share resources through Cloud-based. This concept computing systems applied in manufacturing, such as multi-agent systems, recourse to cloud environments to seek methods, algorithms, and means for obtaining a skill required by a new production process that is presented. The multi-

Peer review under responsibility of International Federation of Automatic Control.
10.1016/j.ifacol.2016.11.126

agent systems need not have all the variants of a production process to serve it with the diversity it needs, just to have these variants seek in a cloud environment, sharing resources with all agents in the system (XIONG et al.,2015).

With the computing resources evolution available to the manufacturing management, solutions using the "cloud" concept have emerged as a good alternative to systems that have high power of communication, but do not have elevated power to local processing. In (Ribeiro, 2012) the application of multi-agent solutions with cloud systems is approached and can be seen in (Fig. 1).

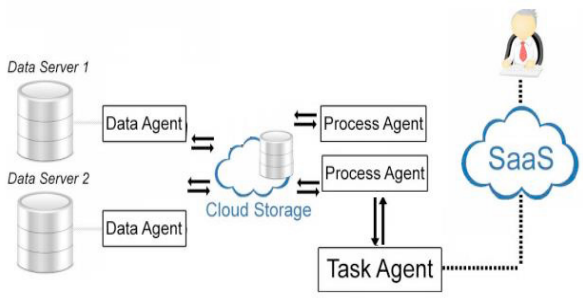

Fig. 1: Mult-agents using cloud concept, based on (Ribeiro, 2012).

In Figure 1 the Process Agents resorting to the cloud environment (Cloud Storage) to obtain data on the process as well as the Task Agent resorting to cloud environment (SaaS) to learn skills with humans (OTHMANE, HEBRI, 2012).

3. MANUFACTURING SYSTEMS MANAGEMENT

The management system has been constantly the subject of research and to every new demand that arises new paradigms are researched and implemented. This work mentions what it thinks to be the most significant in terms of solution presented to industry.

3.1 Management with Programmable Logic Controllers (PLC)

Manufacturing system has evolved from craft production with low volume, high variety and general purpose machines to production lines, dedicated machines and large enterprise, which enable the mass production (Peixoto, 2012). Mass production brought the concept of a manufacturing with a viewpoint centred on Programmable Logical Controllers (PLC), which operates in a loop: (i) read all inputs; (ii) execute defined logic (the process) to generate the outputs from the inputs; (iii) trigger the outputs conform the processing logic

3.2 Flexible Manufacturing Systems (FMS)

For the same equipment being able to perform more than one operation in manufacturing, it should be resourced to enable, through feeding device, change its functionality, providing distinct processes to be performed by the same equipment. A FMS is distinguished from other forms of automated manufacturing by considering the diversity of the products they want to produce (product flexibility) and adaptive characteristics of the machines (flexibility of the equipment) (Slack; Chambers; Johnston, 2009).

3.3 Computer Integrated Manufacturing (CIM)

CIM is a concept where the approach aims at integrating all process stages: sales, supplies, design and development, production and delivery. The paradigm is the integration of all the company activities through the use of information technology (Scheer, 2012), such as databases, networks, etc., that allows the data exchange and sharing between business units and its applications. Computer integrated manufacturing is the efficient use of information technology in manufacturing to increase productivity and efficiency of businesses.

3.4 Evolvable Assembling Systems (EAS)

EAS are the integrated systems with equipment that allow modularity, adaptability and scalability of the product. They are modules who should provide open hardware and software architecture with plug and play functionality; the connection is made without the other equipment being disconnected or reconfigured. The reconfiguration of systems allows the manufacture to be evolvable (PEIXOTO; PEREIRA; CAVALCANTE, 2012). The mounting system of the evolution is based on simple systems, reconfigurable elements with specific tasks (system modules), which allow a continuous evolution of the system. An EAS can co-evolve with the product and assembly process (Ribeiro, 2012). The EAS can be implemented by Service Oriented Systems (SOA), that is the basic element in the abstraction of services which has properties of autonomy, interoperability, platform independence, encapsulation and availability (LEITÃO; Et al., 2001), (LEITÃO, 2009), or by using Multi-agent Systems (MAS) defined as a paradigm derived from the distributed artificial intelligence field, characterized by decentralization and parallel execution of activities based on autonomous entities, called agents (Oliveira, 2004).

The table 1 shows a comparison among the proposed manufacturing management system, linking the paradigm employed, the main feature and the ability to use cloud approach.