Process planning in Industry 4.0 environment

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Abstract

Over the past few years world is facing the fourth industrial revolution. Working environment is demanded to be changed, rapidly, with hope that it will bring significant benefits in the future. Usual manufacturing processes are being automatized and connected to other activities within the company. One of the most important factors in Industry 4.0 environment is data management, big data management to be correct. It is done with use of cyber-physical systems (CPS), internet of things (IoT) and cloud computing. Human professions are obligated to adapt and change so the roles that are known are suggested to get a different structure in the future. Workers have to learn to deal with new situation and accept the term of life-learning process, constantly improving their performance. In the end, with use of both technological and human improvements, bigger productivity, product quality and income with lower product delivery (manufacturing) time and product price are expected. Apart from that, the term of mass customization has become very important and that demands very flexible manufacturing. This paper will deal with change the role of process planner who will be presented as "product planner" in the environment of Industry 4.0. Product planner is not only new profession, but is the name of software that is being connected to other parts of supply chain and uses advanced optimization algorithms to generate process plan, order of operations and scheduling automatically. The idea and structure of "product planning software" will be presented, as a completely new approach to process planning, operation sequencing and scheduling.

Keywords: industry 4.0; process planning; decision support; data management; lean manufacturing; scheduling; product planning

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1. Introduction

Industry 4.0 has brought many professions to change. People are obligated to learn new everyday tasks, but also to use hi-tech gadgets which are to become most important factor of their work [1]. Also, they have to rely on the data given by the machine, but also to be sure that the data is correct. With faster processes, they have to handle bigger amount of data and to make decisions from it, but also to make the predictive analysis [2].

This may seem as easy thing to young working force in developed countries, but when it comes to countries in transition, working force is slightly older and not familiar with new technologies available [3]. The education process is then longer and the resistance stronger [4]. One of those professions is a process planner that gets another dimension with coming of Industry 4.0. With implementation of Industry 4.0 concept, most of the working environment gets automatized with Cyber-physical systems and Internet of Things with data is being processed online using cloud computing [5]. Machine-machine communication is required, so the human is getting eliminated from some crucial parts of production process. Can process planning be completely automatized? What are demands for automatization and can knowledge of the human transport to future product? The decision making for primary process selection, operation sequencing and scheduling should be automatized and the knowledge of it should be imported in a system that could plan the process and do the scheduling based on the CAD and CAM model of future product and order from the customer as well. This is the new role and environment of a process planner in the Industry 4.0 that should be achieved. It is a continuous path from CAPP, implementation of artificial intelligence in process planning [6]. In the first phase of the research in this field the process planning in Industry 4.0 environment will be explored and presented and linked to previous similar achievements and approaches like CAPP that is the part of CIM. The future phases will be devoted to development of single parts of “Product planning” software.

2. Current process planning vs. Industry 4.0

Standard, traditional process planning, in some SMEs in Croatia is based just on the knowledge and experience of a single person or the team of co-workers. Those are technology experts not by the education but more of the experience. They are educated by traditional approach without the concept of life-long learning and without use of modern systems like CAPP. This only illustrates the basic situation and big obstacles one could face with implementing Industry 4.0 in such company, because those kinds of people are hard to be convinced in the obvious need for change [7]. The resistance gets bigger when it demands big initial investments in new equipment and digitalization process.

Since the demand for a change exists, existing solutions with characteristics of Industry 4.0 should be considered and reviewed. Industry 4.0 has been presented as an overall change by digitalization and automatization of every part of the company, as well as the manufacturing process. Very soon big international companies that use concepts of continuous improvement and have high standards for research and development will accept concept of Industry 4.0 and make themselves even more competitive on the market. SMEs with lower state of development will be left even more behind and couldn’t keep up with the changes and demands of the market. That is why it is very important for them to develop their own strategy for Industry 4.0 implementation on time.

New integrative in factory is that all manufacturing resources are being connected to data and information exchange with constant quality and process control. Also, Industry 4.0 has an effect on company’s business network and hi-tech communication with customers and suppliers [8]. Products are becoming so called “smart products” that carry the information and knowledge and are able to bring feedback from user/customer back to manufacturing system which is being analyzed and optimized with help of this data. Customers, as the center of the attention for every manufacturing company are able to be part of the process and to create customized products and give the suggestions easily and effectively [9]. Scheduling of the product manufacturing and in whole supply chain in environment of Industry 4.0 is being suggested to be resolved with dynamic scheduling with help of Structure Dynamics Control (SDC) approach. Still, it hasn’t been concluded what is the optimal volume of information services needed to ensure operation of physical systems and how these services shall be scheduled at the planning stage and rescheduled in dynamics at the execution control stage [10]. Process planning has so far being digitalized only in a case of the single existing technology – spot welding. Data and knowledge has been transformed to software that makes a decision based on specific input of material combination and technical specification of the order given [11]. This is acceptable when there is only one technology process, but what would happen if the
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