The integration of automatized systems and cyber and physical equipment of the Industry 4.0 item designing company

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Abstract. The task is being studied how to integrate information structure of an item designing company and its industrial and technological equipment. The main attention is paid to the information structure of an Industry 4.0 company: digital factory, smart factory, virtual factory. They supposed a scheme how to integrate internal and external components of an ecosystem which are used for project and production processes of an item designing component manufacturing applying digital technologies.

1. Introduction

Today while creating new companies and modernizing old designing companies modern specialized systems are used which give a significant automatizing in project and production processes of item development and manufacturing [1, 2]. Such companies today are considered to be the companies of the future - Industry 4.0 companies [3, 4]. The basic idea of the Industry 4.0 is for the economical industry to create project and production companies which are capable to function without humans. The companies of the future have three types [5, 6]: digital factory, smart factory, virtual factory. Digital factories mean to realize project company functions. Smart factories mean to realize the production cycle of the item designing component manufacturing. Virtual factories mean to realize support for the item designing component during its life cycle: from the stage of the marketing research until the stage of its recycling.

The Industry 4.0 companies have completely new approach how to realize item designing component project and production technologies and include the creation of humanless production companies and project companies with a deep automatizing of project technologies, for example the application of virtual testing technology and CAD (Computer-Aided Design) technology [7, 8]. The main disadvantage of such step by step development for the companies of the future which must constantly apply new software is the narrow specialization nature of each of such systems. That why there is an actual task how to develop an integration scheme of different information systems and technological equipment engaged in the production process [9, 10].
2. Ecosystem external components of the Industry 4.0 companies

The practical application of factories of the future (digital factory, smart factory, virtual factory) includes the creation of special ecosystem to support project and production processes of item designing component manufacturing.

Such ecosystem includes the following external components (see figure 1) [11, 12]:

- counterparties to make a supply of component parts (materials, element base), and production cooperation (the manufacturing of several component parts in other companies which have the necessary resources and technologies for that purpose);
- counterparties to assist in transport logistics chain to deliver the item designing components to the points of its exploitation like the warehouses of temporary storage or to component parts storages;

Figure 1. A scheme of interaction between external and internal components of an ecosystem which realizes project and production processes of an item designing component manufacturing with application of digital technologies in the Industry 4.0 companies.
- serial plants to make an item designing component manufacturing according to the letter electronic
documentation made in the project company with the special CAD software;
- branch science and research institutes (SRI) to make application and fundamental researches in a
subject area of the item designing (electronics item designing, optical item designing and other) which
is the specialty of a particular project and production company;
- the points of item designing components exploitation which are served to collect and process
previously the statistical data about item failures during its application (the appearance of constructive,
production and exploitation defects of the manufacturer);
- competent education centers (normally the institutions of high education), to prepare professional
qualified personnel units to form departments of the Industry 4.0 item designing companies.

3. Ecosystem internal components of the Industry 4.0 companies
The main internal components of a digital item designing company ecosystem are specialized program
software and technological production equipment which belongs to the type of cyber and physical
systems. Specialized program software forms together the so-called information infrastructure of a
company which components depend on the type of the company of the future.

For digital factories the main components of the information infrastructure which gives the personnel
a possibility to conduct project activity in the automatized mode in their automatized work places (AWP)
are systems of electronic documentation processing in the company like systems of computer aided
engineering for construction and program technical documentation, the system of automatized support
for engineering calculations and other.

For smart factories the main components of the information infrastructure which gives the personnel
a possibility to conduct project activity in the item designing company in the automatized mode are the
following components [13]:
- automatized systems to support technologically the production preparation process;
- automatized systems to control prognostication of the production activity vector (strategical,
tactical, operative prognostication);
- automatized systems which serve to prepare the software (3D-models, D - dimension) for the
machines with the numerical program control which make the production operations in the automatic
mode;
- automatized systems to control engineering data in the production process and other which are
united in a computerized system to the item life cycle in the production process.

Information system of virtual factories as «distributed companies» may include automatized systems
for counterparties interaction, automatized systems to control the sales of ready for consumption
production and goods, automatized systems to support the item designing components during its
exploitation period including the format of giving of instruments of development and access of the end
consumer to the electronic exploitation documentation. Such information systems normally belong to
the systems to realize the CALS-technologies (Continuous Acquisition and Lifecycle Support) for the
item designing components.

4. Interaction of the Industry 4.0 company components
The access to the information system of the Industry 4.0 company of production and project
development may be granted with the application of industrial Internet of Things (IoT) and cloud
technologies [5, 6]:
- to the personnel with the interfaces functioning with the technology Human-to-Machine being
provided with technical means of the automatic work place (personal computer (PC), cell phone, tablet)
to monitor the result quality of the production operations being conducted and also that includes the
function of situation control within the production;
- to the production equipment (cyber and physical systems) functioning with the technology
Machine-to-Machine (M2M) and Systems-to-Systems (S2S) to realize in the production the library
algorithms of the completion of the item designing component manufacturing technological operations.
Data processing generated in the factories of the future during the completion of the project and production operations can be done using the services of cloud technologies (resource level) including the technology of BigData.

5. Conclusion
The integration of information systems of the factories of the future into a single system of information and control is a perspective direction of development of the modern tendency of the item designing development. The main tasks which must be solved before anything else are subject of development and application to the program interface of different systems for component automatizing (libraries) which support the functionality of users (designers, production personnel) in the distant mode with different technical means of automatic work places organization.

Such components must give the users a possibility to exchange the project and production data among different applications which are normally processed and prepared in different services of cloud technologies to realize continuously the different stages of the item life cycle in the companies of the future like digital factory, smart factory, virtual factory.

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