Workstations Industry 4.0 for instrument engineering products

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Abstract. The actual task is to design an automatic work place to be applied in the Industry 4.0 to prepare electronically the item designing component technical documentation. An automatic work place is a part of Industry 4.0 digital factory instrument ware. Digital factory is a new type of project company functioning with innovation technologies. Here is an analysis of technical, program and algorithmic points of item projection in the existing companies of the Industry 3.0.

There is a functional scheme of designer automatic work place in the Industry 3.0 company. We can see that new progressive innovative technologies in project companies require new approach to organize an automatic work place. The given functional scheme of designer automatic work place in the Industry 4.0 company requires implementation into project procedures cloud calculation technologies, industrial internet of things and other.

1. Introduction

Item designing components projecting is a very important direction how to implement new digital informative technologies [1, 2] which is a part of concept known as Industry 4.0. Industry 4.0 means to create [3, 4] in project companies an informative environment and technical means to complete the construction objectives using digital methods of modelling and virtualization.

The approaches of the Industry 4.0 concept is based [5, 6] on projecting instruments division into physical level components and virtual level components (cloud environment). Physical level components have origin in the projecting theory and practice of the Industry 3.0 and some new automatizing instruments in addition. Virtual level components [7, 8] are formed within the company cloud environment and include cloud services to automatize the designer project activity.

The most important designer project activity automatizing element is [9] the method of imitation modelling as a project procedure which is a good change for physical tests with model. Modelling tests [10] mean load application to the item digital model being conducted on the PCs of high productivity.

An instrument PC (Personal Computer) is the core of the designer automatic work place for item designing components and being integrated with program and hardware resources which designers apply in their project activity. The constitution of automatic work places for designers of the Industry 3.0 company and the Industry 4.0 company are quite different being based on the projecting technologies accepted into the company.

2. Automatic work places in the Industry 3.0 company

The main result of the designer project activity in the Industry 3.0 company is the technical documentation for the item designing component which include:
- construction documentation (CD);
- program documentation (PD);
- technological documentation (TD).

Item technical documentation is prepared electronically with special software systems of automatic projecting (CAD) installed in the instrument PC. CAD software is an application software which grants the designer a limited range of projection instruments and being functioned with the software control.

CAD application software let the designer complete the following project procedures in the Industry 3.0 company:

- engineering calculations (for example, the calculation of radio elements parameters of the electric circuits being created by the designer as electric scheme);
- construction modelling (for example, the behavior simulation of digital scheme components being watched by the designer in the instrument PC screen as a time chart);
- creation of technical documentation (for example, the preparation of part drawings under formal rules for this kind of document from branch and state standards);
- the compilation of program initial code (for example, the preparation of file components being downloaded into processor of the items controlled by the software and other).

Designer automatic work place (AWP) functional scheme for item designing components being used in the Industry 3.0 project activity is given in figure 1.

![AWP functional scheme](image)

**Figure 1.** AWP functional scheme to project the item designing components in the Industry 3.0 company.

The completion of project procedures in the Industry 3.0 company requires the documents of processes and results of the designer project activity. The main way how to make documents of the project activity results is a set of peripheral printing equipment (printer, plotter and other) to create the technical documentation for the item designing component in paper. Documents in paper in the Industry 3.0 are used to create the exploitation documentation, additional notes of tests results for some stages of research and development activity, the sheets of concord for some construction documents and other.

All AWP for the designer project activity in the Industry 3.0 company are united into company local bus functioning with special net software installed in each instrument PC. Company net resources unite science and research and construction and technology departments with the company technical archive where the designer may access remotely. Company technical archive has in paper and electronically the following documents:

- construction, program and technological documents for the items being developed in the company to be manufactured later and delivered into exploitation (primary items);
- construction, program and technological documents for the items (technical accessories) which are special appliances which are necessary during the primary items manufacturing;
- norm documentation which is for accepted in this branch development rules and technical documents creation to control for designer the primary project procedures;
- technical tasks (TT) for primary items and technological accessories which have structural requirements of the ordering part for each type items and other.

3. Automatic work places in the Industry 4.0 company

Project activity result of the item designing component designer in the Industry 4.0 company is the electronic form of the item description. Electronic form of the item description is the item digital model with full geometry and properties of the item relevant for the exploitation. There are several forms of the item digital model:
- digital replica;
- digital shadow;
- digital twin,

to define the number of iterative project procedures done by the designer with electronic documents.

AWP core in the Industry 4.0 is an instrument PC connected to the communication environment of the project company functioning on the industrial Internet of Things (IoT) standards. The company communication environment is supported with the multi-agent access mode for designers to the company resources which are necessary for the project activity.

Designer automatic work place functional scheme for item designing components being used in the Industry 4.0 project activity is given in figure 2.

Company resources are placed in the cloud environment and have the following components:
- norm documentation (state and branch standards which are adapted for the company functioning in the digital economy);
- storage of projects (SQL (Structured Query Language)-like data base where in structural order CD, PD, TD of the primary items and their technological accessories are placed);
- technical task for the item development done in a format of text file, for example xml);
- cloud services as resources of program, computer, platform, infrastructure and other types.

An AWP let the Industry 4.0 company designers complete the following types of project procedures:
- to create electronic documents with digital signature of document executor and technical documentation quality norm controller;
- to conduct virtual tests with digital model to find out the project errors in the first stages of the item model creation;
- automatized or automatic completion of engineering calculations including the heat and electromagnetic fields calculations of the items being developed;
- technical documentation digital certification with the evaluation of correspondence to the requirements of the item digital model to the standards of the digital economy and other.

4. Conclusion
Project procedures of the Industry 3.0 and the Industry 4.0 companies today is based on the same type of technical means and different software for project activity. Projection automatizing technical means provide the designer a set of instrument functioning under software control component to prepare the documentation for the item. Projection automatizing program means have instrument to research different options of project solutions to choose the optimal one according to the technical task criteria for item realization option.

Item designing components projection instruments accepted in the Industry 4.0 is a result of digital informative technologies development defined the furthest technical progress in different fields of industry. The most important are the instruments of projection realized as cloud services which are capable to automatize the designer activity on the base of cyber and physical systems application.

A cyber and physical system is a combination of hardware and software components which together is capable to make higher the level of automatizing of project activity and production activity in the Industry 4.0 industrial companies. The development of mathematical system and software for cyber and physical system will help to improve the project procedure of the item designing components creation and to increase the quality of the item digital models. Item digital models is a form of technical documentation being developed in the Industry 4.0 digital factory and transferred to the Industry 4.0 smart factory to be manufactured.

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