Hardware open cyber-design

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Abstract. A relevant method of development of hardware equipment is an open cyber-design (OCD) to provide a collective method of the improvement of item constructive features. An OCD is an initiative interaction of qualified co-designers of the same product where all of the item constructive defects are revealed and corrected publicly. The OCD service tools support special digital platform (DP) solutions done on the basis of a communication net and containing a multi-user interface. There is an interaction scheme given for the open project (OP) co-designers and DP solutions. A collective way to design a product helps to implement some artful ideas from a third party specialist using the working space editors, which develop project works multi-system automatizing methods. The OP administrating is based on the designing stable mechanisms management, which may help to develop in several parallel products with a DP solution. The OCD results are the product itself, which technical specifications correspond to the co-designers independent group requirements. The OCD is an Industry 4.0 sub-technology to modify the existing project technologies and their application ways in the industry.

1. Introduction

Open cyber-design (OCD) is a method to create, to improve and to assist in exploitation (at all stages of the life cycle) of the item physical samples based on the collective (public) application of the project data, which the technical documentation contains [1, 2]. The OCD is a technological trend being realized on the communication industrial nets basis for uniting the item designers, manufacturers and consumers [3].

The idea of the product OCD is when the consumers may accompany the designs, which are being realized in practice to improve the item consumer properties by enhancing its construction, program or technological documentation [4, 5]. The designers’ young teams who do not have yet the full range of necessary competencies to get their project done in a better way as a part of the OCD tendency may require some assistance from independent and relevant co-designers interested in enhancing the item with methods and means of collective construction [6].

As a result of the collective designing an enhanced item configuration is done, which was created from its original construction considered as the basic solution. An OCD grants to the authors a full flight of phantasy in the question of the item modification and its rating including its modified technical documentation which creation was under some initiative groups of co-designers [7]. The technologies of the OCD are to formalize some intuitive ways of construction and help the specialist to make their way from a concept to a particular technical solution for some units and aggregates of the item being currently designed which may require some knowledge of narrow specialty [8, 9].

The OCD practical usefulness is to apply the initiative labor of some interested consumers who are
not related in their job to the organizations, which has the intellectual property of its original design [10, 11].

The relationships among the initiative co-designers are regulated in general with licensing agreements of copy-left, which do not include a necessary distribution of the intellectual property rights among the participants of the open project (OP) [12]. Potentially the OCD application effect includes the synthesis of the item options received with author modifications from a group of independent co-designers with a qualification in some multi-disciplinary fields of a single project [13].

An OCD is a type (a sub-technology) of the Industry 4.0 technologies, which are being dynamically developed today. An OCD means to create a special digital platform (DP) of co-designers free access to the construction and technological documentation for a project which is being done in public for a mass consumption of a new product, where no direct commercial interest of all level copyright holders is observed [14, 15].

2. Hardware OCD principles

The OP target audience is a society of co-designers working in not remunerated way and some specialists interested in developing their own advanced construction ideas in a global technical project. A collective development of industrial items is done in a protected integrated environment to improve the project properties by methods of object and orientation machine module architecture projection. A protected integrated environment is an OPDP where each co-designer use conventional for themselves projection means into modification implementation interaction and their own ideas probation on the basic construction of the existing items.

A DP base is some basic cloud environment service which is necessary for an OP collective development and compatible with project program systems being used by the co-designers.

In an OCD concept, solutions of the basic construction shall not be reconsidered, each co-designer proposes their own innovations to take out the existing project errors in the level of small parts development. Co-designers team project management excludes any hierarchy interaction model of the project co-executors in the favor of the specialist team model with equal rights oriented for the successful end product.

An OP identification as a collective development grants the project administrator a possibility to take more qualified specialist for the project procedures and unite them into project groups with a shared goal to form a quality product where all item construction defects will be revealed in the first stages of projection.

Under conditions of today, there is:

- programs commercial application designed for item automatized projection;
- an insufficient number of professionally prepared personnel.

The original construction co-designer basic abilities are limited with the application of designing legal means and specialists’ qualification, which are part of the project organization staff.

To get into project, intellectual and machine and program resources of some independent designers with increased preparation level and necessary right holders’ licenses may significantly increase the positive effect of the OCD method in the project construction completion and the project expenses.

A multi-system automatizing with some DPs with heterogeneous commercial program means and with some co-designers available today may require to create new ways how to integrate the solutions proposed by the specialists which oriented to make an evolution of OCD objects.

The OCD stage completion grants the project administrator a chance to add something to the designs repository which is available for co-designers into new project iterations with DP tools. The DP development by executors and OP administrator creates the condition for its continuous target improvement. Key OCD procedures are shown in figure 1.
3. Digital platform of OCD

OP co-designers interaction is done with DP tools, which grants to the project sections an open access to the technical specifications of the product being developed. Specialist open access of the technical specifications grants the idea leaders a possibility to implement some creative modifications done to the basic item original design at the level of some technical scheme innovations or technological modifications of some solutions, already implemented in the item. Sometimes the implementation of new ideas by independent designers into the item basic design provides a more successful solution for some complicated troubles of designing a unique product.

An OPDP is done on the base of a quantum supercomputer and which is a cloud infrastructure resource, which principles are to make documentation for an industrial item, which can be distributed freely. Each co-designer idea being implemented into technical documentation through a user interface is meant to improve the project and should correspond to the item basic specification.

The user interface grants to the OP designers a possibility to interact with the working space editor, which provides access for side specialists to the file cloud storage system or search and modifications for project data. The project co-designers data net exchange is based on the unanimously accepted into international documentation the construction and technological ideas representation formats for so-called «paperless items». The interaction scheme of co-designers and a DP for OCD is given in figure 2.

DP of an OP:

- integrates functional capabilities of the projection instrumental means engaged by co-designers into an OP and supports an integration of new program means;
- contains visual editor to display by co-designers the proposed constructive innovations;
- contains support means of OCD collective methods;
- supports a formalized exchange of project content and storage own formats and processing of any part of the project meta data into the projection informative system;
- may support an unlimited number of the OP co-executors;
- may form OP co-designers work space by graphical means of the projection results representation;
- may personalize the interaction of each OP co-designer with the projection informative system by the user interface setting;
- supports twenty four hours interaction of co-designers distributed in an area with the project data;

![Figure 1. Key OCD procedures.](image-url)
contains a technical documentation repository (specifications) of the base OP and the previous versions of modification;
- provides some tests of collective design results before the product is released;
- contains a data bank of typical and unsuccessful (erroneous) technical solutions done by the co-designers society in a collective OP;
- formalizes the role and protocols project actions of each OP co-designer;
- contains technical and program means for autonomous calculations of the close to reality project solutions computer models characteristics;
- supports a multi-user interface for co-designers in multi-session modes to provide constructive development of some projects being developed in parallel;
- supports OP co-designers interaction model which excludes a conflict of interests and provides a balanced responsibility of all creative executor teams for the quality of solutions being implemented into the construction.

So a DP accumulates a single technological resource available for OP co-designers of all levels with extended projection tools which function with client and server technologies and the Industry 4.0 virtual factory technologies.

To unite groups and individual co-designers within an OP on the basis of a DP provides:
- open access for all project participants to the available project solutions file archives;
- a possibility to modify an OP file content on a co-designer will (preserving the project data versions);
- documents for co-designers project procedures which are done through a participant user interface (personal login) in an OP.

Technological innovations moderation, which is done by a society of OP independent co-designers who act on their own initiative, which is done by a project administrator (manager). An OP administrator is a non-formal analogue of the projection center, which traditionally must be presented...
during a project. Each idea is to be verified in a data bank and a knowledge bank for project solutions. The project solutions bank information has some kind of the structure at the level of organized metadata, and because of that the administrator may analyze the applicable informative technologies construction ideas if they are compatible with the Industry 4.0 technologies.

An OP administrator has the following general project functions of the project management. One:

- coordinates co-designers collective interaction at all levels of the project to make sure that proposed target ideas correspond to the project tasks;
- controls the project resources within the OCD accepted methods;
- controls the OP configuration to form a set of ready solutions (technical documentation);
- makes a structure of ideas which corresponds the concept of the product being developed;
- forms OP design chart and controls the quality of ideas proposed by the co-designers;
- looks for and invites investors to develop OPDP functionality which are interested in the solutions being developed;
- adapts the projection means used by the co-designers to the OP realization collective methods consumer;
- forms and adds the projection means register and the co-designers register who participates in an OP;
- expertly selects the solutions proposed by the co-designers by its priority of the idea professional competence and sometimes by specialist competence rating (professional reputation).

Designing in the format of OP helps administrator to collect into a single concept the best ideas proposed by the active project participants which are concentrated in positive result.

The OP eco system supports the co-designers activity, which is to implement some private initiatives into the item construction and technological documentation. The co-designers behavior into the OP eco system can be described with progressive methods of social self-organization of the creative groups into the industry, which is oriented on the free distribution of the construction ideas.

The OPDP tools provide the co-designers with a full-scale support for any modification of the basic item in all new product technological construction chains. The primary result of the co-designers cooperative work is a project and production result (the item, the documents) with enhanced exploitation properties destined for a mass consumer.

An OPDP, co-designers collective interaction methods and means realize in practice the Industry 4.0 project technologies stable management mechanisms.

4. Conclusion

The product OCD technologies have an increased development potential in the field of digital modelling and constructive solutions computerized processing which use the methods of the digital model semi-natural experiments. Additionally to the creation of new product an OCD technologies help the creative groups to develop new projects containing intellectual know-how, which results are a public proud. In fact, the technology of an OP implements some cardinal changes into traditional and for now incompetent approaches to project new items automatically.

The unbeatable advantage of the OCD method is the idea that there is no competence for co-designers why any project participant cannot be discriminated. All of the co-designers teams who want to implement in the project their new solutions have the same rights to take part without any financial compensation to all OP executors. The co-designers participation initiative form in an OP and the absence of any monetary labor compensation create practically no expenses for an OP administrator and as a result the product will be cheaper in price and more attainable for the mass consumer.

The OCD method today is implemented successfully to develop the embedded calculation systems software (the project «open code») or when the informative knowledge banks are created (knowledge) in the Internet (wiki-projects). OCD method application into technical systems to develop the machines practically is not in usage; that is why some special technological solutions must be developed (digital resources) which may unite creative OP co-designers into engineer professional
societies and provide the innovative break-through for the Industry 4.0 technologies.

Apart from all advantages, which may be expected if an OCD technology is done in practice in the high-tech economy sector, an idea of project collective completion by the creative groups will reveal some new specific problems:

- the absence of mechanisms of any jurisdiction rights protection and intellectual property right holders legal interests for an OP components from any pretensions of non-reliable designing participants;
- OP initiative participation for physical persons and creative teams which do not have professional competences in the multi-disciplinary subject of the designing being done (unintentional negative project modifications);
- intentional reduction in consumption properties of the product being developed openly by intentional implementing into project some destructive construction solutions or solutions which are implemented to break down the project data integrity;
- application into an OP by some independent co-designers by their own initiative, their proprietary industrial ideas and technologies protected by the state secrecy law or some documents to defend the rights and others.

It is clear that all problems mentioned above and some other problems of organizational provision of the product OCD method will be solved in the near future as the converging of informative and production technologies of the Industry 4.0.

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