# Role of CAD systems in the context of Industry 4.0

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***Abstract:*** *In the article has been analysed the role of CAD systems in the context of Industry 4.0.The fundamental principles of Industry 4.0 have been viewed and which features of CAD systems meet the principles of Industry 4.0 and which do not.The existing classification of designing have been analyzed and a new concept design classification is proposed,according the principles and the concept of Industry 4.0,whitch is more precise and adequate for smart products..*
***Keywords****: INDISTRY 4.0 PRINCIPLES,CAD SYSTEMS,MODULARITY.*

## *1. Introduction*

CAD systems obtained the processes of engineering calculations, engineering analyzes, designing.CAD systems are aggregation of technical resources(software and hardware),serving for solving engineering issues.The first CAD system was created in 1957 and continuously CAD systems becomes a fundamental engineering tool.In present CAD systems are part of the modern manufacturing.

Industry 4,0 is merging the physical and virtual world, creating smart products, smart technologies, smart factories. The term was invented in 2011 In Germany.

In many studies of Industry 4.0,CAD systems are part of application of Industry 4.0,therefore is important the principles of Industry 4.0 to be referred to designing and to be analyzed in which conditions usage of CAD systems meet the Industry 4.0 principless.

## *2.Principles of Industry 4.0 referred to designing*

The main designing principles of Industry 4.0 are(fig 1.):

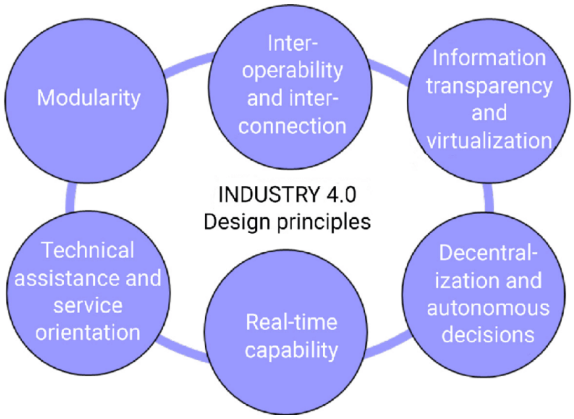


***Fig. 1*** *Industry 4.0 design principles[1]*

Interoperability and interconnection

Interoperability and interconnection is the capability devise,parts,machines,automation lines, systems, factories ,workers ,objects to exchange data.It is significant principle for Indistry 4.0 because without horizontal and vertical transferring of data it will be impossible to be created a new Industry 4.0 system.Even partial interoperability leads to duplication of data,lost connections and lowed productivity.The goal of Industry 4.0 4.0 is creating a data highway so every smart product to contain data from the designing to recycling(the entire lifecycle of the product.In the context of designing it`s about interoperability between different CAD systems(horizontal communication) and between CAD systems and other software, for example CAD/CAE or CAD/CAM(vertical communication). The subject of compatibility is very large and for full analyze it should be discussed about defined system of software.Generally the results may be full compatibility(entire and full functional transfer of data),full incompatibility(for example even not to open a drawing done by different CAD) and partial compatibility.Despite some solutions like neutral formats,transferring software,usage of familiar software core programs the issue is not fully solved by unifications or standardization.

Virtualization and information transparency means creating a virtual copy of an object.Virtualization may refers to every physical object-part,assembly,automated complexes,factory,city etc.The main goal of virtualization is to collect,summarize and analyze data from the objects.By using virtualization there is no space and time limitations. Digital twins are used for analyzes,tests and eliminate the expensive process of psysical prototyping (equipment ,materials,labor,energy sources etc.).CAD systems are virtual tools,so they fullfill the designing Industry 4.0 principle of virtualization.The degree of virtualization will be relevant to the tools of CAD using during designing.For full virtualization the entire designing process should be in virtual environment

Decentralization and autonomous decision

Decentralization in Industry 4.0 designing means the ability for decision making for every micro level of the system.The decentralization is important regarding the data safety and allows flexibility of the system.CAD systems are single part of the yystem so they are part of the decentralization and also perform autonomous decisions.

Real-time capability

For managing big data ,,selecting and analyzing of real time data is essential.Every delay may lead to wrong decisions,lower productivity and system collapses.This principle is entire related with intercoperability and modularity.Real time capability is also related to other factors like Internet of things,Internet of service etc.CAD systems are real time software so generally fullfils this principle.

Technical assistance and service orientation

Unlike the Second Industrial Revolution, whose goal is to create mass production of individual standardized elements, the goal of Industry 4.0 is to create individual products without losing productivity. Industry 4.0 is fully tailored to consumer requirements.

Modularity

In order to create individual products, production must be modular and adapt to rapidly changing requirements. The more modular the production, the more customer-oriented it is. In practice, "smart products" are different modules. Not necessarily the modules may be of different configurations, may refer to a different color, different material, etc.Modularity and service orientation will be conditionally accepted for one principle,because in the context of designing the bigger volume of modularity will lead to better service orientation. CAD systems can serve both for the design of elements for mass production and individual modular elements.

## *3 Evaluation of CAD systems according the design principles of Industry 4.0*

The tabular assessment is presented in table 1,as grade 1 is for fully match,0 is for partial match and -1 is for fully unmatch.

***Table 1: Evaluation of CAD systems according the design principles of Industry 4,0***

| FACTOR/OBJECT | CAD systems |
|---|---|
| INTERCOPERABILITY | -1/+1 |
| VIRTUALIZATION | +1 |
| REAL TIME CAPABILITY | +1 |
| DECENTRALIZATION | +1 |
| MODULARITY?SERVICE ORIENTATION | -1/+1 |

The assessment shows that the usage of CAD does not lead to the implementation of the principles of Industry 4.0.and the entire design process must comply with Industry 4.0 principles.The first step of designing is to classify the type of designing. The design classification will be analyzed whether it is suitable for Industry 4.0 products.

## *4. Current design classification*

There are three types of designing - new, development and adaptive. New design represents the creation of a completely new product, unit, technology, etc., the shape of which is not known in advance. Using adaptive , the design algorithm is known, and the development one is a combination of both.[2]

Smart products created in the context of Industry 4.0 can be classified into all three design groups, which makes their classification imprecise and subjective.. "Smart products" can be classified as the result of new design (new generation design), can be classified as the result of adaptive design (designing configurations, because of the requirement for modularity), as well as the result of development design (designing new functions of already existing products).

This leads to the need for a new classification of design that fully reflects designинг in the context of Industry 4.0.The new design classification should be related to the main principles of Industry 4.0 and should be related to the terms of Industry 4.0.

## *5. Purposed a new design classification*

Taking into account the principles of Industry 4.0, the design should be modular and remodular. Modular design a design principle that subdivides a system into smaller parts called modules, modular design is not a new term, it is widespread in automotive, architecture, information technologists, etc.The proposed classification accurately illustrates the process of designing smart products according to Industry 4.0, as well as contains a major component of Industry 4.0.The new classification of designing divides the designing into two group and it`s simple and precise according the principles.

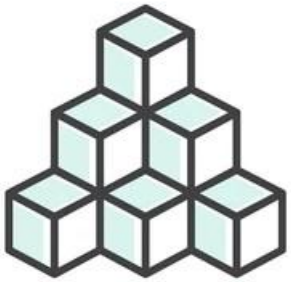

***Fig. 2** Modular designing [3]*

Modular design will be related to creating a new smart product.Modular design in the context of Industry 4.0 will cover the following processes:

- Design of new modules
- The introduction of already existing modules,
- Configuration of existing modules
- Binding (geometric, parametric or logical) of modules
- Creating layers with modules
- Create a network of modules

It`s not necessary every process to be involved,also the sequence for every design may be different according the service orientation. When editing an already existing product, remodular design will proceed. A module is any single component unit that has a customer orientation.One module is not related always with different geometry or type,it may be different colour,material etc.

## *6. Conclusion*

The analysis of the role of CAD systems in the context of Industry 4.0 showed that their use alone does not fulfill all the principles of Industry 4.0 and that without modularity and customer orientation in the design process there is no way to fully integrate Industry 4.0. Another main problem of CAD systems is that there is not always full operational compatibility with other software and hardware, and in this way communication, compliance and horizontal and vertical connectivity are interrupted, which is also an essential element of Industry 4.0. Full operational compatibility is possible with serious efforts towards standardization and the unification of elements.

The article also analyzed the existing classification of design according to the principles of Industry 4.0. Design in the context of Industry 4.0 can be classified into all three types of design, which makes the classification difficult to apply, subjective and imprecise.. A new classification according to the principles is needed, the approaches and terminology of Industry 4.0. A new conceptual classification of design is proposed - modular and remodular design. A module is any single component unit that has a customer orientation.

## *7.Refferencies*

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