Furniture Design for the Fourth Industrial Revolution

PHD stud Arh. Camil O. Milincu

1. Introduction

The term Industry 4.0, proposed in 2011 refers to the fourth Industrial Revolution (RI4). Based upon the computerization of traditional industries, it aims to generate the intelligent factory, characterized by adaptability and resource usage efficiency. This phenomena can be described as the liberation of the machines out of the automatism of series production. For the first time in manufacturing production, the industry will be able to adapt to specific requirements, in real-time and financially competitive.

The four defining characteristics of the Industrial Revolution (RI4) that distinguishes it from the other stages are: networking, virtualization, decentralization, real-time response, focus shifting on the services offered, modularity.

Previous industrial revolutions have had similar characteristics: they are fast, irreversible disruptive and destructive. Once the new technology is available, preventing its implementation is not a feasible alternative, although inevitably significant groups of the population are adversely affected. It can be assumed that the transition to RI4 will have similar characteristics.

What differentiates the Fourth Industrial Revolution from the previous ones is the scale at which its effects will be felt. Virtually all areas of manufacturing, design and service will be deeply affected. The area of influence will cover the industry value chain, the notion of labor and employment, social and economic component, security issues and ethics, changes in established patterns of trade and services.

This feature is the most important, polarizing at the moment the analysts. On one hand there is an optimistic group, which claims that after a period of disruption, like other revolutions, it will be possible to reintegrate the displaced workers and increase living standards. On the other hand there are opinions according to which it is considered that people can no longer compete with automation that will happen in increasingly rapid succession. Defining in this case is how the income redistribution will occur, current economical models not being able to offer plausible solutions.

1.1. Motivation for choosing the theme

Switching to RI4 will be a quick process. It is necessary to develop in advance studies on its implications and to determine the opportunities to influence further development.

Alarmist speeches on automation and its consequences spread by different media. In researches conducted in parallel, enthusiasm among both designers and producers of furniture in adopting any new technology is observed. More worrying is the fact that traditional methods are implicitly regarded as being inferior. However, furniture that endures is made mainly by artisans directly handling the material, something rarely encountered when using digital design tools

1.2. Purpose of the study

Identification within furniture design and fabrication of:

areas affected by automation
necessary skills for the designer (complementary to automation) in RI4
possible evolution directions in furniture design
possibilities and needs of influencing further development

1.3. Procedure:

A detailed analysis as a "wicked problem" (complex issue) in order to identify the determinants for each potential influence that will be significant in RI4 was made.

Wicked problems do not occur according to a schedule. It makes no sense to set deadlines to any forecast as they induce a false sense of security. In reality a strategy in such a problem can be considered valid only until a turning point in development is reached. Therefore, it is vital to identify these points.

In the case of Industry 4.0 such turning points can also be considered political decisions, changes in public perception technology, significant advances in artificial intelligence and robotics.

For the training of architects and designers it is important, in addition to skills developed in the areas of technical and creative issues, providing training especially in areas identified as bottlenecks in the automation processes. Besides this there must be an awareness of the complex environment in which they operate, of the implications of design decisions and the importance of innovation in order to maintain competitiveness.

2. Current situation

The furniture industry is an important sector in the economy, employing at EU level an estimated 1 million people in 130 000 companies. The furniture design is well represented within the innovation domain, accounting for 12% of the applications for registration of the design elements in the EU Office for Intellectual Property (EUIPO). This is reflected on the production of furniture, currently 2/3 of the world’s top furniture segment is designed and made within the EU.

Furniture production in Romania has a value which places it in at a medium level within the EU. There is an increase in recent years, the rate is one of the highest among EU countries, together with Poland, Lithuania and Slovakia, in particular based on the reduced cost of labor.

There is an increase in the production of raw materials, but unfortunately it is not about qualitative use of the wood, but the production of particle board. Companies engaged in manufacturing have the smallest proportion of staff employed in research and development.

Romania has the lowest rate of online shopping within the EU.

Forecasting studies conducted in the field, both at EU and US have reached similar conclusions. Emphasis should be placed on the company's identity, personalization of the product and innovation, as these are the main tools for

maintaining competitiveness against countries with lower production costs. Complex studies as a "wicked problem" are more suited for evaluating possible futures in a global market. The National Strategy for the furniture industry in Romania addresses a the period of 2015-2020, a relatively near horizon. Even if the national strategy identifies innovation as a factor influencing competitiveness, it does not recognize its true significance. Examples of industries where development is faster shows how benefits may be lost in the face of more dynamic companies, innovation-oriented, even if they do not take any other wrong decision.

3. Analisys of the determinant factors in RI4

It is necessary for defining the frame in which RI4 will initiate. Factors analyzed are:

3.1 Politics.

The major problem that will face will be the management of the disruptive effects of automation. Past examples show that a possible approach is the attempted to slow down the process and providing support for old tehcnologies. Possible actions are unpredictable based on the pressure of the masses or as a result of corruption.

3.2 Economy / tehnology.

Models based only on continuous growth can not be sustainable. For a short period of time, the risk of automation is to 50% of the jobs, without having a workforce reinsertion solution. This assumption is valid under a slow evolution in artificial intelligence and persistence of the actual bottlenecks in robotics. It can not be assumed that these problems can block the development. Possible scenarios of income redistribution are in various stages of testing. Although there are several approaches (post-capitalism, based on guaranteed minimum income systems, system D-unregulated economy), it is possible that large-scale functional hybrid forms will emerge.

3.3 Work / unempoyment

Automation will attack the middle income jobs, as it expands also to the domain of the cognitive and physical labors. Reinsertion of staff is made always to lower paying positions. The phenomenon continues until labor costs and the savings obtained through automation stabilizes. Even if the profession of architect or designer is not in the danger zone, some components will certainly be automated. The focus must be shifted towards complementary elements. Generally difficult to automate areas were identified as physical perception, dexterity, access to confined spaces, originality and generation of ideas, value and significance in the arts, social interaction.

3.4 Demographic changes.

The trend of population growth and the increase of the average age will remain valid. Significant effects will be due to generation change, in particular by the emergence of digital natives in the economy - Gen Y (Millenials) and Gen Z. This

results in a change in the consumer profile, such as interaction and as well as a way of relating with the materiality and technology.

3.5 Urban spaces / built spaces.

Densification trends and the emergence of functionally ambiguous interior spaces favors the emergence of innovative furniture, adaptable and multifunctional. Convenience and representation remain important functions. Types of necessity furniture, specific for the areas in recession, do not offer any possibilities for designers.

3.6 Materials.

In the case of distributed production based on identical models and machining, the material is one of the few elements that can differentiate the products.

The emphasis will be on materials which are: safe (healthy), sustainable ecologically, with small integrated energy and therefore cheap, possibly reused and recycled, with long service life, adaptable to customized production methods, innovative or using unconventional resources.

4. The Fourth Industrial Revolution

4.1 Automation implications

Switching to RI4 will lead to significant changes in how people will relate to technology in all its forms. The study focuses on issues associated with designing and building the furniture.

Web of Things, partially implemented at present is expanding and will connect about 26 billion items in 2020. The products have besides the physical and digital component, a component that gradually will generate higher revenue than the physical object. If in furniture the focus will be on the incorporation of digital technology, both to ensure integration in systems like BMS and to support the interactive component in the relationship with the user.

Digital divide / robotics divide.

The phenomena is defined by tensions arising between those with access to technology and those who do not, and its effects will increase in RI4. If economic barrier can be overcomed in part through the adoption of devices on the "second hand" or on the unregulated economy, the skills barrier is more difficult to overcome. Changes in procedures for procuring and assimilation of information for digital natives are observed, correlated with a higher efficiency of using digital technology of the immigrant generations, inclined towards hybrid solutions. The effects are observed in the social structures, economic relations, and the struggle for the imposition of standards. There are previous examples consisting of attempts to limit access by users who are already at an advanced stage of development.

Threats.

Incorporation of digital technology extensively will amplify the negative effects as they quickly manifest in the physical environment. Among these there is the

susceptibility to attacks on systems, the possibility of illegal data acquisition, rapid propagation of errors. The product of design is in electronic format and therefore is subjected to aging phenomena formats (bit rot).

Work in the context of mass automation.

The perception of work will change as it is no longer a necessity. Alongside the psychological components, the most significant changes come from the dissociation of the design and execution to materiality. Breaking the cycle of physical perception leads to physiological changes. observed Two possible directions are observed. On one hand tackling a direct brain-machine integration with different degrees of invasiveness, the method is subjected to ethics polemics of autonomous systems. A more logical approach seems to be moving dialogue in human terms through the use of analog tools for data aquisition.

Responsability.

The discussions on ethics for autonomous systems have not yet reached a solution. The rules laid down cannot be imposed universally, especially given the existence of unregulated sectors. Technology changes arising from the perception of undesirable events will have an immediate effect in all areas incorporating technology, including furniture.

Copyright and piracy.

The product of design is a data file and therefore it is subjected to the rules of the internet. Regulatory attempts have failed so far. In addition the problem becomes more difficult with the completion of theoretical studies that attack the current concepts of copy, original, real value of an idea or a copy. Management systems of copyright based on current models can not operate. A solution may be the constant generation of new products and the attepmt to redefine the original concept within RI4

New automation attempts of the design process.

GDD type systems (Goal Directed Design) or AAI (artificial artificial intelligence) systems are used. In the case of problems that are very complex such as architecture the results are questionable, in the field of furniture they might have a chance of success. The area where these systems are effective is formal exploration and adaptation of the product to the punctual requirements within a defined framework in which it can vary.

Parametric approches

Parametric design is a component of partially automated design systems. Great results can be obtained in the field of automatic generation of complex shapes, made possible by processing on CNC machines. Theoretical studies in this field are towards automating the entire process of design and its reduction to an algorithm. Products made so far in this method lead to spectacular forms, but lacking a real complexity, the dominant component being visual. Elements of culture, tradition or personal influences are almost impossible to generate automatically.

Players within the IR4. The new framework defined by globalization, technological changes and the emergence of innovative forms of products and services will lead to a changing of patterns of organization that are feasible for

manufacturers and suppliers. We can identify four types, differentiated mainly by their relation towards innovation.

Sellers. Companies are organized in chains with global coverage. They do not make customized products, working only within large series. Production costs are low, especially due to economies of scale. Much of the trade moves online.

Custom Manufacturing. Producers with regional coverage. They provide the possibility to configure the product according to a selection of preset options. They have sporadic collaborations with designers. Relatively low cost, the basic structure is made in large series.

Manufacturers focused on product design. They have their own design center or collaboration with external designers. Production volume is ranging from large series to unique pieces. This type of production commands higher costs. Location in the territory becomes important in order to ensure an acceptable response time.

Manufacturers focused on innovation. They use an integrated design center and manufacturing. High production costs are compensated by generating disruptive forms.

4.2 The designer's relationship with technology.

In the period preceding the Industrial Revolution, the production was done in the manufacturing system. There was no differentiation between designer and maker.Hand tools were used, flexible, allowing for easy adaptation to the punctual requirements.

The initial phase of the Industrial Revolution addressed the raw processing of materials and subsequently evolved to automate more and more processes. This stage is defined by mass production, templates, tools specialized for each operation. Workers with a lower level of skills were needed, the ensuring of accuracy being taken over by the machines. It is the moment of the first appearance of the independent designer, acting to ensure the shape adaptation to the current possibilities of production.

The moment is marked by the appearance of two directions that show their influences up to the current time. On the one hand the trend of automation continues. Different standards for dimensions and accessories are adopted. The designer moves away from the production process

As a reaction to the compromises needed to be made in order to exploit the advantages of the machines, the Arts and Crafts current appears. The relationship between the designer and the production is well established, there is often a direct involvement. Technology remains in a subordinate position to product often hybrid methods of work are used. Contemporary Groups continuing this direction are sufficiently coagulated in order to sustain the makers of quality hand tools.

In the pre-CNC technology pariod, users had an extreme approach: exclusive use of either hand tools or machines. Hybrid approaches are rare, but amid the emergence of hand tools begin to be more frequent.

The emergence of CNC tools made the relationship with technology more c omplicated. some basic ways of relating can be established.

Descendants from the Industrial Revolution line. They frankly adopt CNC technology as being just another tool. Its use is at a low potential, being used to

produce complex parts without the need for specialized manpower or for the ease ease of adapting production for generating customized solutions.

Arts and Crafts descendants. There is a distancing from CNC technology, seen as a way to cheat, suitable only for the mass production of generic objects.

Artists and sculptors. CNC technology, although it can offer a clear advantage is seen as a threat to the unicity and belonging of the object to the artist. The problem is related to the modification of the concepts of original and copy within CNC production, which is why the use is limited usually to raw processing.

Vanguard Groups. They use CNC technology creatively, innovating both in products and in the forms of tool usage. The adoption of this mode of production is independent of the existence of a genuine need. Problems appear in the area of product differentiation, especially where technical achievement is the defining element.

The Tehnofactory - or type IR4 factory can meet the punctual requirements, with minimal cost differences in relation to large scale production. Realistically it will be impossible to remove the economies of scale associated with large series production. In its full form the Technofactory ensures all processes from raw material to finished product. More interesting from the designer's point of view the CNC machining center. It offers the opportunity to customize or design parts for custom or mass produced furniture, whether to take on the role of producer.
New directions of development for the designer in this framework are specialization as a product configurator or adviser on the customization. It can also take advantage of the ability of expression in the applied arts (digital) or to take over the role manufacturer working in conjuncture with a machining center capable of providing whole production process.

4.3 Digital manufacturing possibilities.
CNC Milling. The design limitations are given mainly by the technical possibilities and human ability in CAD modeling.Limitations of CNC processing systems are exploited successfully by hand tool users, being capable to generate an image capable to ensure product differentiation. There is a need to conduct studies regarding the aesthetics of machined surfaces (to what extent the toolmarks can be perceived as a texture, and not as a defect) and in the integration of the production process as part of object's identity.
3D printing or CNC based on the addition of material. It can generate forms unachievable by subtraction. Limitations of surface quality or materials used are all possible to be exceeded in a short time. For designers, in addition to formal exploration it becomes important ability to manipulate material properties beyond visual component.

4.4 Trends. The popularization of CNC tools brings both the continued decline in equipment prices and the emergence of systems made by amateurs (DIY). This has as a consequence the disappearance of differences between industrial and amateur production. They get to compete on similar positions with renowned designers. Advanced users go beyond the novelty phase of the new technology and are working

toward a hybrid approach to design using CNC machining only where traditional methods are no longer feasible.

4.5 . Education. The exercises held during design classes tend to integrate the entire design process including the object making phase. Experiments where innovative CNC tools are being used resort often to tool customization. Objects have original forms, serving to increase the visibility of institutions both in the physical world and also online. Attempts are made to move the entire design process in the digital environment, even if it has been observed to perpetuate some problems: material selection is subject primarily to the CNC milling conditions and excessive emphasis is put on the visual component, neglecting joints or parts of detail.

5. Major furniture types. Evolution.

5.1 Furniture made in Small series.

Represent the area with highest risk in IR4. The pieces are not made to order or customized. Also, from the small scale the producer can not benefit from economies of scale as in the mass production.

Furniture of necessity. The defining criterion is the low price, which leads to compromises to materials, workmanship, design. It works by exploiting existing niches of the larger producers in terms of market coverage.

Furniture made to order. It is being made by local companies being able to meet the aesthetic requirements or the custom configuration required by the client. The products are varied, often they are developed by collaborating with designers. Within IR4 there will be a need to cooperate with CNC processing centers or the producers will need to retool with the CNC technology. The position on the market will be partially eroded by larger companies capable of manufacturing custom or amateur designers or makers using machining centers.

5.2 Mass produced Furniture:

Furniture of historical inspiration. Configuration and customization possibilities are made possible using preset models. CNC systems are used in a mixed system with traditional technologies, but with a low level of innovation.

Office furniture. It is a very dynamic area, especially due to changes in the nature of work required in an environment modified by large scale automation. The designer’s affirmation opportunities arise, given both the financial possibilities, openness to innovation and the shifting focus towards elements that provide complex sensory interaction.

Modular furniture. Tends to solve the problem of adaptation and personalization by using a large number of items that can be easily recomposed in various configurations. It is based on a standard that must be kept for a longer time. Possibilities of innovation must take place within the already established framework.

Designer objects. Although the area is not affected by the customization possibilities offered by IR4, it is influenced by changes appeared within the concepts of original and copy. In addition there will be a need to negotiate the relationship with companies specialized in the execution of copies, which will be even more difficult

when the production methods are virtually identical.
Generating new items that achieve a cult status remains an important objective, as well as changing the way the designer relates with the public.

IKEA. Is the largest furniture retailer network and it is still expanding. Future executive decisions will strongly influence the strategies of other competitors, especially if IKEA will adopt even a partial IR4 type system. IKEA has won the market through good design, functional and affordable products. However, some recent practices raise criticism: pseudo-ecology "greenwash", changes made to popular products or unsustainable practices.

5.3IKEA Hack and IKEA Custom. IKEA production supplies with base materials two important trends:

IKEA Hack - is based on a group of designers and amateurs focused towards innovation, using as raw material items mass produced by IKEA. In some cases successful models are copied by others or taken into production. It works as a virtual community based on the free sharing of information. They manage to create a serious competition to famous designers.

IKEA Custom. Independent producers are making compatible components that are used to customize standard IKEA products. The system works as small series production as well as making unique items. This niche presents opportunities for designers who are trying to assert themselves by generating both new items and the counseling the customer on the product customization.

5.4 DIY. Shows a steady growth after 1950. Those involved have mastered the technical component, in addition, having access to processing centers, are targeting the market segments of small producers.

5.5 Avant-garde furniture.

Adaptive furniture. Is an application of polymorphic robots to the interior environment. Furniture consists of modular systems capable of reconfiguration. In the case of the design, the focus moves on the interactive component and on system optimization by using the minimum number of active components. Collaboration becomes necessary on the in order to integrate robotics. The mitigation of the risks associated with autonomous systems becomes an important aspect.

Interactive furniture. It represents a higher form of integration of the real and digital environments. There is the possibility of changing the surface properties, of interaction and manipulation of real and virtual objects. For this to be successful, the designer requires a thorough knowledge of the effects of handling characteristics on the perception, otherwise there is a possibility of conflicts between real and simulated elements.

Virtual realities. There is a gradual overlap with the physical world of virtual reality in pure form (VR) via reality substituted (SR) and augmented reality (AR). Existing applications currently in marketing (AR) and entertainment (SR, VR) will migrate to the everyday objects. Minimum correlation between actual and simulated elements becomes important in order to maintain the illusion.

Interactive Blob. It can be assumed as the final convergence of digital trends

in the field. The furniture can become a mass without a predetermined shape, having configuration capabilities and being able to interact both with elements of the physical space (users or other objects) and with elements of the digital environment through WOT). The design moves from the formal to interaction area. In such an environment the only role left for traditional furniture is as an anchor in reality.

6.Case studies:

The studies are intended to test theories outlined in the theoretical part and the possibility of using the results to the amendment process of formation of the designer. The findings were published in articles in conferences indexed in the ISI database.

6.1 Perception Studies:

Tactile and visual perception of natural wood finishes.

It aims to determine the characteristics on which a surface is preferred, using all the sensory space. A preference for a finish that does not generate a film, with a degree of roughness which provides a low friction interaction with the skin is observed. For these finishes are compromises ready to be made by users in the protection level compared to finishes that generate a perceptible film.

Wood grain figure influence in choosing a finish for wood.

The study follows a direction identified in a previous research. It verifies the influence of light reflection effects in dynamic mode on choosing a matte finish film to a glossy finish which accentuates these phenomena. There is a significant influence in the case of exotic species with reversible grain and in the case of radial cut beech.

In both studies, the choices made are sourced in elements of perception that are not possible to be integrated in design programs or that are very difficult to reproduce in a digital environment.

6.2 Studies in human-computer interaction :

The studies verify the possibility of adaptation of the designer to CAD design systems and the capacity to fully compensate the problems inherent in digital media representation.

Influence of CAD design aesthetics in the design of furniture.

The study focuses on the anti-aliasing effect in CAD, where it is accentuated in the case of lines with little deviation from the rectangular grid. A major influence of this effect is not noticed, however problems are observed on the correlation of estimated values of the angles and their perception of the physical space.

Improving the furniture design through direct experimentation.

The experiment verifies the possibility of the design of furniture details exclusively in CAD. After analyzing the physical model made in none of the cases they were not considered satisfactory. Prototypes made were amended, providing designers possibility of direct model interaction when making the changes. The profiles were compared with the results generated initially. Possible sources of discrepancies can be the perceived scale of the drawing in relation to the physical model and elements coming predominantly from the tactile space.

6.3 Case Study - critical points of change in design. Exercise in post-digital.

The study aims to verify the partial conclusions outlined in previous studies on the design process. This time the study was not done as separate components, but including all the steps from the generation of the idea to the finished object. The project consisted of guiding a young graduate of the Faculty of Architecture and Urbanism in Timisoara year student 1 Master "Current trends in interior architecture" to design a piece of furniture for participation in the national contest of design organized by the Manufacturers Association of Furniture form Romania and the physical realization of the product. There was no intervention in the design process by imposing solutions. Instead, the study concentrated on tracking critical moments of the design process and especially the moments where decisions that adversely affect previous versions occur. Periodically there have been ongoing changes in the environment of the design process (between analog and digital) to induce such moments or for presenting possible alternatives. The study confirms the results of previous researches. In relation to this it is observed in the case of generations of digital native designers a different perception of the relationship between furniture and embedded technology.

For the manufacturing phase there was adopted a mixed technique, conformed to the post-digital trend, entailing the effective method that leads to the desired result, whether it is an analog technique, traditional or digital manufacturing.

7. Conclusions:

The option of expectative can not be considered as viable given the major changes that switching to the new industry will bring. Major disruptive effects have been produced by previous industrial revolutions which comparatively had a limited action. Even if it is possible for the system to regulate itself for the transition period at the moment there are no studies to propose a feasible model.

The idea to stop and automation technology through various measures can not work in a global economy.

Development of strategies using the model of "wicked" problems becomes a process more common in areas of production, education, innovation, and specifically in the field of furniture. Strategies developed for a fixed period and considering a limited number of influencing factors can not be used in complex systems such as the IR4.

The furniture sector in the EU has in the global market the reputation and advantage of high-end production. In Romania, there are some significant opportunities in relation to most EU countries. A condition for taking advantage of this situation is the uniform development of the sector and avoid strengthening a position which amounts to the supply of raw materials and semi-finished products for the downstream sector. This requires attention to be directed towards research and development of innovative products. Even if various strategies recognize innovation as a factor influencing competitiveness, they do not recognize its true significance.

Given the magnitude and difficulty of retraining affected areas, it can not be assumed that the system will self-regulate without significant political factor.

The erosion of the middle class and concentration of capital are no real obstacles in the way of automation. There are various possibilities, partially developed and verified income redistribution. Without it will not be possible to draw

on advanced technological production and hence its development to its mature form. It is considered that the current bottleneck areas identified in automation will remain valid in IR4. Even though technically it would be possible, the costs of automation in these areas currently remain too high to justify the investment.

Even if current studies place architects and designers in a safe area with no likelihood of automation of trade, it can not be said that some components will not be affected or taken over by machines. Automation is not possible to take some important areas of:

• the generation of ideas worth and significance
• Social perception
• sensory perception

In designer training, emphasis should be shifted to areas difficult to automate. To use the full potential of future technologies is needed both the mastery "machines" as, more importantly, providing complementary skills, especially in areas where human interaction is required.

There has not been identified until now an area that can withstand automation indefinitely. In the design domain are in danger automation the tasks of routine 3D modeling and adapting the project to specifications within a framework with clearly defined boundaries. In the case of architecture, due to the complexity, a framework is difficult to make, instead similar systems may prove to be viable for furniture.

With the change of generations come changes of the customer profile. Careful monitoring of this phenomenon is needed in an attempt to identify the defining features of the "digital natives".

Furniture market is closely linked to developments in the economy and built space (densification or expansion territory).

Technological developments spawned the barriers (digital and robotics). The trend of embedding technology for connecting objects by WOT is true in respect of furniture. Designers will not be spared by this problem, the objects being more attractive since there are interactive component, based largely on autonomous functions. It is very important in this early stage that the technology insertion to be done carefully. Any errors can have effects that lead to feelings technophobia (pronounced enough by the problems brought by automation to the labor market). In addition, it is possible that any incident occurred as a result of design errors of interaction with the products lead to violent reactions within the market.

The emergence of CNC tools are making the relationship with technology more complicated, equally to producers, designers and clients. At the same time there is a theoretical framework adapted to technology that changes the concepts of original, copy, art, craft, the product of human creation or the result of an automatic system

Opportunities for designers in IR4:

- In relation to a processing center can attack the segment covered so far by small producers
- It can embrace the specialization of "product configurator", providing mediation relationship between customer and producer
- There is a new openness on the applied arts

New roles for designers in IR4:

- Addressing compliance components necessary for physical interaction with the human user. It's not just about ergonomics, which can be easily integrated into the design or shape aspects of the elements, but important aspects of fine manipulation of perception. This becomes especially important in reality interactive systems or substituted reality systems.
- Interactive component design, including negotiation autonomous system-related problems, especially in limiting the risks.
- Assigning an image to make the product differentiable

Threats to designers in IR4:

A similar degree of access to digital manufacturing technologies will have the members of the "hacker" group, DIY enthusiasts, artisans, all taking advantage of the perception of materiality, the creative use of technology and in operation within a framework which is already similar IR4. Even if they lack formal education in the field they will launch serious challenges.

The traditional design, using only the analog means can not be used when the tool with numerical control is used. At one point during the design process must be done in the digital transition.

Although at the moment limitations of approaches that take place exclusively in the digital environment are observed, they are still promoted at the expense of a hybrid working mode. The problem lies in the difficulty in the digital simulation of components of perception, particularly in the area of tactile, proprioceptive and fine visual, problems which are inexistent when working in the real world. There is also a prejudice that any new design or production are superior in all respects to the traditional methods that use intuitive or experimental (physical) and these are reserved for those who failed to make the transition to all-digital design.

In the process of training it is required to analyze the advantages and disadvantages of different ways of working, and the focus should be on achieving a complex object.

It is necessary and appropriate to constrain developers of digital design tools towards an increased emphasis on the conversion of analog to digital environment and developing interfaces for the purposes of moving the conversation in human terms.

Studies should be conducted on estimating the future development in education centers. Specialists in various fields are available and there can be performed complex analyzes on the model of "wicked" problems. On the other hand, the analysis and presentation of the development of possible results in the identification of which is preferably next to one another. Complementary to avant-garde, research in rational areas is needed, even if their results are less than spectacular.