DIGITIZATION IN THE TEXTILE INDUSTRY - 4.0 INDUSTRIAL REVOLUTION IN CLOTHING PRODUCTION

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Abstract:

The paper presents the fourth industrial revolution in the European sector for textile and clothing. It is defined that the 4.0 Industrial Revolution is the digitization and interconnection of every machine in the company, every technological component and practically every piece of material that goes through the manufacturing process of garment manufacturing. The needs of investing in research and development, work education - to make the vision of a smart textile factory a reality were discussed. A “smart factory” is explained, which allows links between innovation subject, universities and other educational institutions, industry in the areas of procurement and distribution, as well as state administration and banks. There are 4 key innovative topics highlighted that will shape the textile and apparel industries of the future: advanced materials, digitalization, sustainability and emerging growth markets. The importance of training staff for new jobs in the 4.0 Industrial Revolution was emphasized. The example of the French company Lectra explains the digital transformation of the clothing industry in strengthening brands and manufacturers from design to production. The influence of the generation of Millennials born in 1980-2000 on changes in the fashion market is explained. They make up 20-30% of the world’s population.

Keywords:
4.0 industrial revolution, clothing production, millennials, personalization

1. INTRODUCTION

Today, things are changing rapidly, so sometimes we don’t notice, for example, how much we are dependent on mobile phone, what our new habits are, how to make business decisions. Things will continue to change rapidly and therefore it is important to participate in digitalisation, i.e. digital transformation. By definition, digitization represents the analog signals by a series of numbers. It can also be said that digitization is the processing of information into digital form. Digital form is the form of data that computers can process.

Today, the term of digitization is getting much wider meaning. Digitization is when a mobile phone can replace a paper map of the city, or when we use the phone to enter the application instead of entering the bank and paying the bills or obtaining the informations in a few seconds about cutting pattern of some jacket that we created 10 years ago.

Digitalisation isn't equal with technology! Technology and technique are only a tool, while digitalization is a concept. As such, this concept also includes everything that is not technology, but it is caused by its use. Digitalisation is everything that computers can do instead of us.

Industry 4.0 is a new concept of work organization in the industry and service sectors. This term was mentioned in Germany in 2011 by Deutsche Working Group. The aim of this concept promotion is reflected in the direction of investment in projects for industry modernization in the new conditions of widespread digitalization which is enabled by technique development. The main goal is adoption of new, modern work processes by developing techniques and products. Requirements are being made of necessary response to changing market demands, as well as aggressive and increasing competition.
2. 4.0 INDUSTRIAL REVOLUTION

The European Technology Platform (ETP) for the future of textiles and clothing is the largest European network that is dedicated for research and innovation in textiles (bringing together 500 experts). This network gives the following definition: The industrial revolution 4.0 is digitalization and interconnection of every machine in the company, every technological component and every piece of material that goes through the production process. The development of the 4.0 Industrial Revolution requires significant investments in research, development and work education so the vision of a smart textile factory could become a reality.

The European Technology Platform defines four key innovative topics that will shape the textile and clothing industry of the future and those are: advanced materials, digitalization, sustainability, new growth markets. Although it is expected that these events continue, additional powerful innovators will affect the future of this industry in the coming years. This includes the digitalisation of products, processes, factories, jobs, supply chains, distribution and retail. Key features of Industry 4.0 concept are:

- Full digitalization, computer monitoring and management of production and business processes, mutual communication of M2M (Machine to Machine), H2M (Human to Machine) and M2H (Machine to Human). Enabling machines, devices, sensors and humans to connect and to communicate on relation Internet of things (IoT) or Internet of people (IoP). It is necessary to unify the machine language, because there are many protocols and transport media that makes almost impossible merging and sharing data about machine. Today there are a range of machines that need to achieve connectivity and communication with each other as well as with the people, because there are many different languages in the world.

- Comprehensive networking from customer and supplier, banks, government, to development and education institutions.

- The ability of information systems to create virtual copies of the physical world with the characteristics of objects based on sensor data and to elevate their data to information of higher usable values.
The ability of the system to enable people through information to make decisions and solve urgent problems in the short term, as well as the ability of cyber-physical systems to do unpleasant, over-exhausting and dangerous jobs. [1-3]

The ability of cyber-physical systems to independently make decisions and perform their tasks as possible autonomously. Only in the case of exceptions, interferences or conflicting goals, the tasks will be delegated to a higher (human) level. [1-3]

Personalized and flexible production adopted to the end consumer or customer's wishes.

Products called Internet of Things (IoT) in itself have a computer and digital circuits that are concerned primarily about the proper operation of the product and its maintenance.

Market requirements or new innovative solutions and inventions from raw materials, production processes to the final product are implemented immediately or as soon as possible in the entire enterprise system.

Intensive data protection must be ensured, not only for products and manufacturing processes, but also for customers, because with general digitalisation privacy is compromised and abuse is possible.

3. "SMART FACTORIES"

Concept of industry 4.0 is about a "smart factory" that uses information and communication technology for production managing and manufacturing processes within marketplace, achieving better quality, low cost and flexible manufacturing of custom products. For "smart factory" is used the name "learning factory". This name is used because, in accordance with changes in the market, technology, science, available resources involved, the staff is continuously educated, and the company is immediately or quickly adapting to new conditions. [6-7].

![Smart factory in the environment](image)

The "smart factory" with the environment shows relationship between innovation entities, universities and other educational institutions, industry in the areas of procurement and distribution, as well as with government and banks (Figure 3). It should be noted that the development of innovation, and thus the economic development, is based on the key role of universities, industry and government through the creation of new institutional and social frameworks for the production, transfer and application of knowledge [6-7].

Industry 4.0 needs to improve financial and market results by reducing labour costs, as it will lead to the development of a manufacturing infrastructure that better support robotics and advanced automation. Also, new generations of machines will be more productive so there will be less workers in production lines as well as waste of materials. This will provide the networking of machines that will have a higher level of automation. Intelligent production will lead to lower product prices, which will attract a large number of new customers in the market. In addition, intelligent production opens the possibilities for providing additional customer service. Special emphasis is placed on personal...
production. It is the possibility of individual production for a known customer, according to his requirements, which thus participate in the creation of the product. The virtual creation of the products makes a new form of communication with customers. This raises the possibility for involving the wishes of customers in the process of experimenting with new products and its design. [2-3]

4. **4.0 INDUSTRY REVOLUTION - APPLICATION FOR MAKING CLOTHES**

Nowadays, the automation of clothing production isn't completely done, because in the industrial production of clothing, the participation of human labour in the final product is from 60-70%. However, changes in the market show that, in addition to mass production, there is a growing demand for custom made industrial clothing. There is a personal production that wants to comply with the requirements of each individual customer. This opens a new business challenge for conversion of production lines from large series to mass production. Mass production refers to a large number of products of the same production process but different: dimensions (size numbers), cuts, patterns, etc. This is a solution that represents the application of ideas and principles of the clothing industry4.0[6-7]

![Lectras production model](image)

*Figure 4: Lectras production model [5]*

An example, of today's developed system from design to clothing production is partly automated and includes: automatic taking measures of the customer, automatic correction of cutting parts according to customer's needs, virtual fashion show, model trying out, correction of identified deficiencies, partial automation of production and delivery to the customer of ready-made clothing. product. [6-8]
The digitalization of production for the conversion from mass production to individual (personal) production is offered by the French company Lectra. The difference in the production process between mass and individual production is shown in Figure 6.

A key development segment offered by Lectra is the digitized production department for cutting. This new solution for cutting department is capable to receive individual customers orders from just one clothing product in a production series. The production system provides the implementations of all requirements of the customer for the production of only one garment with the desired design, garment size, etc. A very strong computer is required to process all the information about clothing product that customers require. Individual companies cannot have this. For this reason, Lectra uses a "cloud", i.e. a shared computer or data centre, which is quite geographically distant from the companies. All companies connect to this center through the internet where they process their data. The processed data are returned to the company very quickly and serve to realize the production of the desired clothing product according to the technical characteristics specified by the customer. [5]
The new solution with the activities offered by Lectra, is shown in Figure 8.

The main segment of new digital solutions offered by Lectra is their cutting machine (cutter) is shown in Figure 9.

The thinking of large companies to change their production to personal production is due to the new generation of customers which uses the name Millennials. It is a generation born between 1980 and 2000. Millennials have access to product purchases that are very different from previous generations of customers. Figure 10 shows this generation.
The influence of Millennials

Figure 10: Millennials generation

They make 20-30% of the world's population, can access the world from their own pocket, seek personal style, want instant results ...

5. PERSONNEL IN THE INDUSTRIAL REVOLUTION 4.0

It follows from the foregoing that jobs related to the use of computers and data processing (IT) will be required in the textile and clothing industries in the future. The textile and apparel industries will increasingly need personnel for robots and their programming, then personnel for industrial data processing, designers, or architects of IT solutions. Also, analysts of a large number of data, artificial intelligence and robotics experts, mobile application developers, web developers, database administrators, business intelligence analysts, designers, business systems analysts, etc. will be required. Previous occupations will also be required: clothing and textile technology engineers, financial experts, lawyers, project managers, etc. [1-7]

A key problem in the future will be a staff training for the digitalization of textile and clothing sector. Do we have the staff today for the goals of the 4.0 Industrial Revolution? What is the current situation? Here is an example of Serbia and situations for others countries in the region, we believe is not much different. There are 2000 companies, today in Serbia, engaged in the production of textile yarns, fabrics and finished textile products. For textile, clothes and leather there is 64.156 employed workers: 12.679 in textile production, 37.116 in garments, 14.361 in leather production. In the period January - December 2018, in the total textile industry of Serbia, exports were realized in the amount of 960.3 million dollars. [9]

The big question is whether a trained non-textile worker, who works with software can work on e.g. optimization of costs by considering the size of pattern repeats. The major obstacle, today, for the implementation of CAD/CAM in the clothing production are training of the operators for work with maximum equipment benefit. [10-12]

The major manufacturers of modern CAD / CAM solutions offer the possibility of obtaining production data, which largely provide making rational decisions that can significantly reduce production costs.
The right decisions of cost rationalization are made mainly on the basis of so called "Hidden time" in production that is difficult to see without information from the production process analysis provided by CAD / CAM solutions. So e.g. different cost reduction scenarios may be considered when fitting cutting patterns.

During the process of product development, many production parameters can be combined. Thanks to CAD / CAM advanced solutions, their impact on material production costs can be properly evaluated. Where are the cost reduction areas? Fabric design itself - basic material, garment design, pattern fitting, sewing method and more ...

Achivement of high quality and good product design with minimal costs in production with plaid materials, is very important. There are a number of production combinations that can vary greatly in the cost of the final garment. If it is known that the material in the cost of the clothing product has a share of up to 80%, then this is a serious item for analysis. Figure 13 shows one of the combinations of patterns on the materials and their effect on the cost of the final product.
Figure 13: Pattern combination on textile materials

Figure 14 shows another combination where the pattern on the fabric is rotated 90 degrees, which increases the efficiency of material consumption by almost 6%.

Figure 14: Another combination where the pattern on the materials is rotated by 90°

In the new combination, in Figure 15, the base material between the body shirt and the skirt can be replaced. This will reduce material consumption from 56.5% to 45.27%.

Figure15: The third combination is where the base material between the body and the skirt is replaced

In order to increase efficiency, motifs can be modified i.e. dimensions of the pattern repeating can be reduced from 25 cm to 17 cm. This change increases efficiency by 12%. 
Summarizing the various changes and their impact on overall efficiency, Figure 16, we conclude that an operator who does not know what a fabric pattern repeating is, cannot use the capabilities of above mentioned industrial software.

**Figure 16: Summarized various changes and their impact on overall efficiency**

### 6. CONCLUSION

The 4.0 Industrial Revolution is represented by digitalization and interconnection of every machine in the company, every technological component and practically every piece of material that goes through the manufacturing process of clothing manufacturing. The goal of the 4.0 Industrial Revolution is reflected in vision to textile "smart factory" became a reality. The "smart factory" provides relationship between innovation entities, universities and other educational institutions, industry in the areas of procurement and distribution, training of personnel, as well as with government and banks. The four key innovative themes that will shape the textile and clothing industry of the future are: advanced materials, digitalization, sustainability and emerging growth markets. Of great importance is the training of personnel for the new jobs in the industrial revolution 4.0. In the case of French company Lectra the digital transformation of clothing industry is explained. The influence of the generation of millennials born between 1980-2000 on changes in the fashion market is explained. They make up 20-30% of the world population, can access the world from their own pocket, they look for personal style, want instant results,…

### 7. REFERENCES


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