Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 22 (2018) 1015–1022

Procedia MANUFACTURING

www.elsevier.com/locate/procedia

11th International Conference Interdisciplinarity in Engineering, INTER-ENG 2017, 5-6 October 2017, Tirgu-Mures, Romania

Digitising the European industry - holonic systems approach

Dániel Tokody[a,]*

[a]*Óbuda University, Doctoral School on Safety and Security Sciences, Bécsi út 96b, Budapest 1034, Hungary*

Abstract

It is a world trend that digital economy is merging with real economy. Through the use of digital technologies, investments and innovations take place in the fields of smart grids, self-driving vehicles, e-government, advanced manufacturing, etc. Our research deals with the question whether there is any general or formalised technology which could be equally used in various fields, and which could help to achieve digitalisation in everyday life, also in the industry or in manufacturing. Digital transformation is the key of competitive sustainable development in the long term. As it has been noted by industrial players, the fourth industrial revolution is happening now. In the centre of technological change, the fusion of the physical and virtual world is taking place. With elaborated technological recommendations, digitalisation could be realised in an efficient way. With the help of intelligent cyber-physical systems, a holonic (with distributed intelligence) manufacturing technology will be developed. Smart cyber-physical systems can help to make human life better and more convenient by having features which cannot be found in traditional systems. Their use is easier not only because they are smaller and more efficient, but also because they have such system-level characteristics as autonomy, distributed intelligence, self-organisation or co-operation based on adaptivity.

Peer-review under responsibility of the scientific committee of the 11th International Conference Interdisciplinarity in Engineering.

Keywords: Digital Single Market; Digitising European Industry; Digitisation of manufacturing; ICT; Holonic Manufacturing Systems.

* Corresponding author. Tel.: +36-30-950-7193.
E-mail address: tokody.daniel@dosz.hu

2351-9789
Peer-review under responsibility of the scientific committee of the 11th International Conference Interdisciplinarity in Engineering.
10.1016/j.promfg.2018.03.144

1. What is the digitalization of manufacturing?

The German Industrie 4.0, the American Advanced Manufacturing and the Chinese Intelligent Manufacturing is based on digitalisation. Since the 1850s we have come from Manual Production, through Mass Production/Customized Mass Production, to the manufacturing paradigm of Mass Customization (personalisation), meeting individual customer demands. As a consequence of this change, service oriented manufacturing has become a multi-factor high-complexity process. [1]

In the beginning, digital manufacturing meant the use of computers in manufacturing. By now the digital conception has further developed. Full digitalisation aims to achieve a closed production and consumption cycle driven by the idea of sustainability, where particular attention is paid to the goals of optimisation and customisation. In various digital strategies the most important fields have been systematically organised in the name of sustainability. [2] One such strategic goal is the Smart City, with one of its pillars being Smart Economy, which is based on Smart industry, one element of which is Smart Factory or Smart Manufacturing. [3] [4]

In today's modern factories, as the result of digitalisation, manufacturing processes are operated by intelligent cyber-physical systems. With the increased use of digitalisation technologies, constructive or additive manufacturing will be put in the forefront, due to its efficiency, as it generates much less loss than subtractive manufacturing. It is enough to consider the differences between traditional cutting technologies and 3D printing, which now also allows the printing of metals. Their practicality is undoubted, although these solutions are regarded as novelties in the process of digital transformation. This transformation in manufacturing is based on digitalisation, and it will bring a hybrid solution by merging the virtual and the real world. The important elements of industrial digitalisation are those individual components which, for example, are able to communicate with each other, or to manage and control their own operation.

In the followings, we will present the agent-based approach of a cyber-physical system, in a way that the structure of the agent will be brought back to its basic elements and a parallel will be drawn between the system on package approach and the structure of cyber-physical systems. There is no doubt that cyber-physical systems have long appeared in many fields of our everyday life. This trend can also be observed in the European economy, industry and manufacturing.

A Smart Factory has both physical and cyber infrastructure. Electricity is provided by the physical infrastructure, while cyber infrastructure refers to communication and computer networks which ensure monitoring and controlling functions and enable interaction and feedback through smart industry to social-economic networks.

In order to improve economic conditions, innovation and investments must be combined with accelerating digitalisation, and by using the synergy of different systems [5], smart economy, smart industry, smart manufacturing and smart products must be realised within a smart city. This trend fits into the concept of Industry 4.0.

Industry 4.0 refers to the 4^{th} industrial revolution which is going on today. It originates from the German industrial trend which brings a technological change in manufacturing. This change is due to, for example, the spread of cyber-physical systems, of the AI, IoT, Big Data, Cloud Computing and M2M communication. The complexity of the products manufactured today is continuously increasing, while their lifetime is becoming shorter due to this complexity. Computer supported manufacturing has long helped the work of industrial players. However, shorter product lifetime, fast-changing market trends, the great diversity present in every field of life and unique consumer demands mean that a flexible manufacturing structure is needed to produce the products of the future. Therefore, the real Smart Product [6] can only be produced by a Smart manufacturing system. [7]

2. Research questions and hypotheses

Our research aims to answer three major questions:

Research question 1. What is the relationship between automation, digitalisation and the development of intelligent systems?

Research question 2. What does Machine Intelligent Quotient (MIQ) mean and is it possible to measure and define it?