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LEGAL ASPECTS OF THE IMPLEMENTATION OF CYBER-PHYSICAL SYSTEM IN PRODUCTION INDUSTRY

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ABSTRACT
At the gates of the new industrial revolution advocated by the European Union (EU), cyber-physical systems emerge as the backbone of the development of the forth industrial revolution, based on the European production platform. Cyber-physical systems represent the integration of the physical and virtual world. Because of that integration, new production systems have been created, which we need to understand, operate with and, in the end, master the complexity in such systems, respecting the legal and environmental principles advocated by the European production industry, which, on the other hand, cannot lose out of sigh the principles of subject integration systems, where the efficiency of legal standardization must be proportional to the level of legitimacy of legal interventions in the area of integration of cyber-physical system. Having in mind the high level of the processes of integration, which these systems carry with, as well as the high environmental standards the legal order of the EU is filled with, the legal context of our proportionality becomes that much more important, but also a sensitive question, from the view of the existing laws, as well as the view of the new law to be made.
Keywords: Cyber – physical systems, Industry 4.0, virtual production, EU legal system, efficiency of legal standardization, legitimacy of legal interventions

1. INTRODUCTION
The term "cyber-physical systems" was created in 2006, used for the first time by Helen Gill [1] from the National Science Foundation in the United States. Even though we are all familiar with the term „cyberspace“, which we connect with CPS, the root of the term CPS are older and deeper. The presence of the term „cyber“ in a broader society is noticed only with the commercialization of the Internet in the middle of 1990's. The modern use of the term cybernetics has started during World War II. The term cybernetics itself was coined by Norbert Wiener in the research of teleological mechanisms, and was popularized in the book“Cybernetics, or Control and Communication in the Animal and Machine” published in 1948. During the years, many developed definitions for cyberspace in different ways. For example, the Department of Defense of the United States considers cyberspace to be „a global domain inside which the environment is forming, which consists of interdependent network of informational infrastructures, including the Internet, telecommunication networks, computer systems and built-in processors and regulators“. Also, cyberspace becomes a synonym for the digital space around us, which we entered with out technological applications and information which we are able to share with others in this space.
Even though there is no joint definition for cyberspace, and those that are used are often ambiguous or lack key components, we can conclude the following: cyberspace is temporally dependent mutual connection of information systems and human users who are interacting with these systems.

2. CYBER – PHYSICAL SYSTEMS

Cyber-physical systems (CPS) are the integration of a computer with physical processes. Built-in network computers monitor and control the physical processes, usually with a feedback loop, where physical processes can influence the calculation and vice versa [1][2]. During the last few decades, the progress in computer science and communication technologies is significant, and we relate to it as a collective incentive to the revolution of the information technology (IT). All aspects of the contemporary society, social, industrial and economic services are highly dependent on such cyber-systems and technologies. In particular, the Internet has changed the way we used to communicate with each other, thus creating a distributed consummation of information. Continuing this trend, the appearance of all-present built-in computer systems and wireless network technologies becomes the key which, with the help of technologies we are interacting with, enables the control and construction of physically designed systems such as automobiles, airplanes, energy networks, production facilities, medical systems, as well as the construction of a system on which our contemporary society and economy are becoming highly dependent [3].

Potential advantages of the convergence of computer science, communication and operational technologies for the development of the next generation of the designed systems, which can be called CPS, are transformational in a broad range too.

3. CYBER – PHYSICAL MANUFACTURING SYSTEMS

Examples of possible implementation of CPS in industrial production are multiple. With the help of contextual use of interface, mobile and real-time systems constantly control and monitor production processes. Self-organization and networking of production equipment reveals and configures its parts and tools. In the case of absence of process parameters, they ask for them autonomously over the Internet. Therefore, they communicate with a production equipment similar to themselves or another user. Decentralization refers to a production equipment or products, collection, preparation, inspection and distribution of detailed information on the product and production processes. They gather data on energy management, control, life cycle or preventive maintenance. Logistic processes autonomously cooperate and plan their steps through work orders, in the whole value chain, while keeping the necessary material and assigning capacities to processes.

Cyber-physical systems enable the creation of smart application through large connected systems in heterogeneous components which are integrated by computers in industrial production processes. These control systems give independent control of the production process through the use of operating loops, in which sensors communicate with facilities and processors, in interaction with the course of the process during production. This highly integrated production network can significantly improve the efficiency of industrial processes. This kind of systems become the backbone on the road to smart factories.

All the terms and visions mentioned above are very promising prospects for the upcoming technological development. However, even though engineers and scientists constantly work on these terms, they still stay just a vision. Despite that, the story of success is a long road full of thorns, which goes into a multi-dimensional problem for solving, before the vision of a smart factory will transfer to reality. Zuehlke estimates that this development will enable technologies for at least 5-10 years [4].

Based on the analysis of the future production literature, properties which are desirable for smart factories would refer to flexibility and reconfigurability, low prices, adaptability or variability, agility and gracility. One of the ways to achieve some of this functionality is the implementation of modularity in regards to the production program /process technology and organization.

Based on that, the following conceptual definition is suggested [5] :

A Smart Factory is a manufacturing solution that provides such flexible and adaptive production processes that will solve problems arising on a production facility with dynamic and rapidly changing boundary conditions in a world of increasing complexity. This special solution could on the one hand be related to automation, understood as a combination of software, hardware and/or mechanics, which should lead to optimization of manufacturing resulting in reduction of unnecessary labour and waste of resource. On the other hand, it could be seen in a perspective of collaboration between different industrial and nonindustrial partners, where the smartness comes from forming a dynamic organization.

4. INTEGRATION OF CYBER-PHYSICAL SYSTEMS IN THE ENVIRONMENTAL LAW FRAME

The integration and implementation of these systems in practice demands, among other things, their integration into the environmental law frame, which is high on the priority list not only of the European Union, but also every other modern and developed society, which is based on the principles of permanent development, carefully connecting natural systems and social challenges, in which satisfying needs of our generation must not endanger and call into question satisfying needs of the generations to come. It is precisely because of this careful connection between the natural and social, and because of the significance of the relationship towards environmental challenges, which are global, same as our CPS, that we will talk first and foremost about two environmental sets of standardization. Of course, the first is the international one, which is not only declarative and programming, but also vital and enters obligatory into the subject field. The second one is European, by which we refer to the system of the European Union, which increasingly gains importance in its system of legal standardization, due to strong integration in an increasingly legal homogeneous community.

5. INTERNATIONAL LAW AND EUROPEAN ASPECTS

The United Nations Convention, as the foundation act of the most influential international organization, does not contain one article from the domain of environmental protection, nor does it promote environmental protection in its goals, which also means that it does not anticipate an authority which would deal with problems from the area of environmental protection. This does not mean that the interest of this international organization, when it comes to environmental protection, is devalued. On the contrary, a large number or international legal documents which pertain to environmental protection, was created under the wing of authorities of this world organization. All these international legal documents promote principles of saving natural resources, under which conventions and declarations understand also (clean) air, for the benefit of today's, but also future generations [6]. Those international legal principles are especially important which demand that emission of poisonous and other gasses, as well as releasing heat in the amounts and concentrations that go beyond the ability of the environment to change them into harmless, should be stopped and ensure that irreversible damage to the ecosystem does not happen [7].

With regards to that, one of the most significant international legal documents which includes specific goals connected to certain deadlines, specific mechanisms and authorities is the Kyoto Protocol [8]. Stabilisation of greenhouse gasses which are created mostly in industry, but in other areas as well, is stipulated with this international act which came into force by the Russian ratification, with respect to the fact that 55 member states that emit at least 55% of all CO_2 gasses had to ratify it. In achieving its goal of stabilizing greenhouse gasses, the Kyoto Protocol is based on obligations which stem from the Climate Convention:

- each state has to oblige to limit the emission of greenhouse gasses;
- by implementing home policy, each signatory state has to aspire to reduce all harmful gasses, and has to sustain from any activity which could produce harmful effects on the stabilisation of greenhouse gasses, especially in developing countries;
- signatory states are obliged to secure additional funding, with which the implementation of undertaken obligations with the goal of reducing emission of greenhouse gasses would be accelerated;
- signatory states are obliged to participate in the development, use and spreading of agreeable technologies for the environment.

In order to approach the fulfillment of these conditions in the area of industrial production, the European Union has passed several important documents, from which one of the most important ones is the Directive on Industrial Facilities [9]. The goal of this directive is stopping air pollution from industrial facilities, anticipating specific measures and procedures for stopping or reducing air pollution from the industrial facilities of the European community. Signatory states have to ensure that the production subjects for work of industrial facilities have to get appropriate environmental permits, otherwise the facility cannot operate, and for which the following environmental standards have to be fulfilled:

- introduction of the best technology (best available technique - BAT);
- use of facilities must not cause significant air pollution;

- not one border value of greenhouse gasses emission must not be exceeded;
- all border values for air quality must be respected [10].

This directive was crucial in the area of industrial facilities, which the European Union slowly replaces with several others, among which is the most important the Directive 96/61/EC – IPPC, which regulates the complete monitoring and prevention of air pollution.

This all points to the fact that our CPS enter one area which has a strong tendency to reduce the negative effect to the environment, and in that respect, when we speak of international legal and European level, and on the area of industrial production where the emission of harmful greenhouse gasses is on the top on the scale of problems with which modern societies face, CPS are not only revolutionary on the production domain, but they are also important for the reduction of harmful effect on the environment. This is not only the case in the European Union, but also on other legal wholes, such as the United States of America, which leads when it comes to the development and integration of CPS in the production practice, as well as in the environmental law frame. One of the examples of this integration are challenges which CPS carry in certain social areas, where trends of concretization of regulation are fairly complicated and demanding [11].

6. CONCLUSION

Regardless of all the social and natural challenges that CPS carry with themselves, they certainly pave a believable and promising way into our legal environmental and industrial world. The speed with which they move on this road will solely depend on our understanding and abilities to perceive and involve them in our integration frames. In these integration processes, legal standardization, as a sociological phenomenon, can never lose its efficiency out of sigh, which has to be based on legitimacy of subject integration systems, as well as environmental law integration processes, to which modern societies gravitate and for which they advocate. If both integration efforts are proportional, we can observe CPS as the key factor in the domain of industrial production, which will help us to reach the principles of permanent development, without endangering or calling into question the needs of the generation of today, as well as the ones to come.

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