

ASPECTS OF SAFETY AND SECURITY IN INDUSTRY 4.0

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Abstract: Industry 4.0 includes the integration of Safety and Security. Their interconnection (influencing) is assumed. Application of control systems within Safety and Security changes the static principle to dynamic, assumes identification of all production and distribution processes, data mobility as a part of BIG DATA technology and human factor activity while ensuring the functionality of relevant applications. Industry Strategy 4.0 requires a proactive approach in risk analysis, based on the implementation of Safety and Security principles in the development and design phase of machines and complex technologies in the context of the use of CPS principles. It is important that rapid responses to the system's problems are monitored effectively, with simultaneous exchange of information at individual levels in the production process.

Keywords: SAFETY, SECURITY, INDUSTRY 4.0, DIGITIZATION

1. Introduction

The digitization and automation of production and logistics technology as part of Industry 4.0 bring many positive aspects. They create the conditions for expanding production capacities, enforcing in a competitive environment by increasing productivity and quality of produced products, new opportunities and new customers, replacing people in dangerous operations and events⁵.

Manufacturing and subsequently distribution technologies must adapt to meet these trends. They integrate the principles of new process tracking systems from acquiring relevant information about the properties of the subjects, through their mobility, processing to providing command signals for the implementation of appropriate measures. Fulfilling Strategy Industry 4.0 in real terms, however, is associated with applications of complex management systems. Their significant part also includes the effective management of the risks in the Safety and Security complex as part of the integrated security system. Methods and procedures for analyzing and assessing these risks must take into account the existence of a human factor as the most important part of management activities. Under intelligent industry conditions, with intensive use of digital techniques and technology, it is crucial for effective risk management to take action already at the preventive stage.

2. Industry 4.0

According to¹, a certain accumulation of innovative technologies quantity for applications in manufacturing systems contributes to the occurrence of one industrial revolution movement. In general, the First Industrial Revolution occurred due to the mechanization of production, affecting product volume dimension. The Second Revolution changed the industry through the advent of electricity and mass production. Third Revolution is characterized by use of Information Technology (IT) and electronics to pro-cess automation². Recent discussions are emphasizing the emergence of a Fourth Industrial Revolution, known mainly by the following labels: "Industry 4.0" or "Smart Factory", Fig. 1.

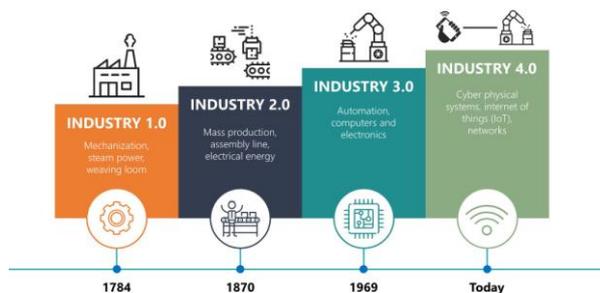


Fig. 1 Historical development of Industry 4.0⁹

The origin of the discussion about Industry 4.0 took place in Germany in 2011; it was based on the country's goal to strengthen the competitiveness of its industry to ensure its future in the advanced manufacturing segment, becoming a reference and providing technologies that allow the integration and interaction between the physical and the virtual world. This initiative was supported by the German government, which announced initial and priority recommendations to accelerate the development and deployment of Industry 4.0. It is worth mentioning that this concept was officially pre-sented in 2013³. This theme has gained worldwide recognition and is pres-ent in the industrial development plan of countries such as Germany, the United States, China, Japan, South Korea, France, the United Kingdom, Singapore and Brazil⁴. In general, Industry 4.0 provides different ways of managing and controlling the process, contributing to the increase of the flexibility level of the industry and its competitiveness by products mass customization.



Fig. 2 Industry 4.0⁷

Industry 4.0 pillars are⁶, Fig. 2:

- 1. Big Data and Analytics** - Big Data is a concept that is based on the huge amount of unstructured data that is produced daily and is difficult to process with traditional data processing methods.
- 2. Cloud Computing** - The term Cloud generally refers to space on the Internet where you can store all kinds of information. About Cloud computing talking as a service, or market application programs stored on servers on the Web, with the users of them can be easily accessed for

example using a web browser or client of the application and use virtually anywhere.

3. **Cybersecurity** - Cyber security is dedicated to the security of only a certain part of information assets, namely those that are processed in a virtual space called cyberspace.
4. **Horizontal and Vertical Integration** - Vertical integration digitizes and integrates processes vertically from product development through purchasing to manufacturing, logistics and related services. Horizontal integration goes from suppliers to customers and all key partners in the value chain.
5. **Robotics** - Robots make it possible to increase productivity, especially in mass production. Nowadays, cobots are coming to the fore. They are robots in cooperation with humans. Today's "conventional" robots do not understand with humans and must therefore be locked in cages or enclosed by safety barriers. Cobots in collision avoid obstacles and do not hurt a person because the arm moves slower and is controlled by many sensors.
6. **Augmented Reality** - Augmented reality (AR) is a combination of the real world with a virtual. Thus, AR complements the real world with elements of the virtual world. AR technology allows a person moving in the real world to perceive objects made in the digital world.
7. **Additive Manufacturing** - In the additive manufacturing process, the product is formed by applying layers to one another.
8. **Simulation** - These simulations leverage real-time data to mirror the physical world in a virtual model, which can include machines, products and human.
9. **Internet of Things** - The internet of things (IoT) is a computing concept that describes the idea of physical objects being connected to the internet and being able to identify themselves to other devices. The term is closely identified with RFID as the method of communication, although it also may include other sensor technologies, wireless technologies or QR codes.

3. Aspects of Safety & Security

Industry 4.0 in its implementation in the company is emerging new safety requirements. On the one hand, such systems may not endanger people and the environment - "corporate (internal) safety" and, on the other hand, such devices must be protected for misuse and unauthorized interference - particularly in the area of data misuse, protection against unauthorized interference – Security, Fig.3.

Hence, the risk management methodologies in both production and logistics processes, and therefore also individual machines and machine systems, must meet the requirements of interconnection on the basis of Integrated Safety & Security at all levels of organization management⁵.

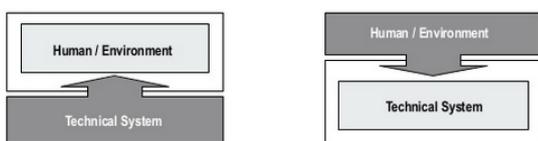


Fig. 3 Safety vs. Security⁸

Safety and Security modeling serves for a general description of the system within Industry 4.0. Safety defines the conditions of human

protection against the influence of the machine and Security includes the protection of the object (property) against external human intervention. The following scheme describes the differences between Safety and Security, Fig.4.

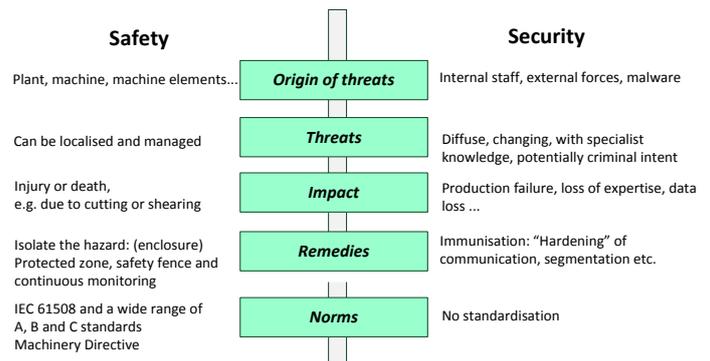


Fig. 4 Safety and Security differences

Industry 4.0 requires a more proactive approach to safety than before, notably through an integrated approach to Safety and Security in the design and planning of machines and complex technologies. It is expedient for evidence of the safety of objects, machines and their components to be secured by identifying and quantifying risks as part of their design process, where they can be identified and compensated, and then during operation by user information to define the resulting risk of a complex system.

4. Results of discussion

It cannot be assumed that there are fewer risks in a company with a lower level of digitization, but the nature of risks is changing, as well as the manner of their management. If Industry 4.0 strategy is implemented, there will be fundamental changes to the conditions for employees, Fig. 5, in the conditions of the process of goods and services production. By implementing individual stages of Industry 4.0, work at production lines will be refined and humanized. Simple manual activities will disappear. Employees will be coordinators who will ensure smooth production and intervene only when the machine prompts them.

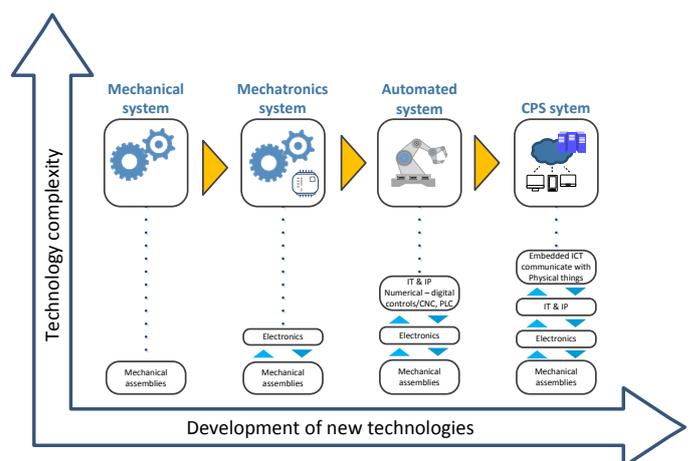


Fig. 5 Changes in requirements for human knowledge with the development and application of new technology for production facilities

It can be stated that areas with a smaller range of Industry 4.0 elements will be more Safety-oriented, while areas using Industry 4.0 more actively will be more Security-oriented.

5. Conclusion

Industry 4.0 strategy includes the integration of Safety and Security. Safety and Security supposed to be interconnected (influencing). Application of Safety and Security control systems changes the static principle to dynamic, assumes identification of all production and distribution processes, data mobility as part of BIG DATA technology and human factor activity to ensure the functionality of relevant applications. Industry Strategy 4.0 requires a proactive approach to risk analysis, the essence of which is to implement the Safety and Security principles into the development and construction of machines and complex technologies in the context of using the Cyber Physical Systems principles.

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