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Aspects of risk management implementation for Industry 4.0

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Abstract

Industry 4.0 is a comparatively new method of managing production processes. In the area of risk management, as a result of new approaches, modified frameworks, more complex IT infrastructure and so on, new types of risks may occur. In many cases, the implementation of Industry 4.0 has shown that the connections between humans, systems and objects have become a more complex, dynamic and real-time optimized network. On the other hand, there is the fact of data volume and availability enhancement in real time which causes new requirements of the infrastructure, management, technologies and so on. The aim of this paper is to conduct research on Industry 4.0 related to key aspects and presentation of a design of framework to implement risk management for the Industry 4.0 concept.

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Keywords: Industry 4.0; risk management; implementation

1. Introduction

Industry 4.0 deals with the connection of all parts of machines via integrated data chains and operations. It was proposed in Germany with the concept of Internet + Manufacturing. The last industrial revolution was based on the use of electronics and the proliferation of information technology (IT) in manufacturing. The fourth industrial revolution, on the threshold of which we are now standing, is marked by linking sub-components of the production

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process via the Internet of Things (IoT). Industry 4.0 was mentioned for the first time in 2011 at the Hanover Fair and can be defined as a collective term for the technologies and concepts of a value chain organization which creates together Cyber-Physical Systems (CPS), the Internet of Things and Internet of Services, the Internet of People (IoP), and the Internet of Energy [1,2]. More than 2000 companies surveyed [3] expect to dramatically increase their overall level of digitalization. It is expected that at the end of this transformation process, successful industrial companies will become truly digital enterprises, with physical products at the core, augmented by digital interfaces and data-based, innovative services. These digital enterprises will work together with customers and suppliers in industrial digital ecosystems.

With the inescapable changes which will accompany the transformation of the industrial era there is a very high probability of new risks occurring and having a negative impact on many aspects across companies. There is also the presumption that there is a need to develop and test new approaches for risk management. This paper deals with aspects of risk management implementation for Industry 4.0.

The integration of IT and key infrastructure for the digitalization of manufacturing creates a new potential danger. Namely, the risks from the IT world may affect the industrial manufacturing process and we may find new potential manufacturing industrial risks (cyber-attack, malware, spyware, loss of data integrity or problems with the availability of information). Manufacturing and maintenance data from technical documentation and specifications may become a goal for hackers and software pirates.

There is a new kind of software criminality in the global economy, and companies may have problems with data availability and reliability. This paper discusses how to use a risk management system to minimize the potential threats and unexpected situations. In this context, the following research question (RQ) arises:

(RQ) How can we implement a risk management system according to the requirements of the implementation of Industry 4.0?

This paper aims to present a solution to this research question.

2. Literature review

The increasing number of papers on this topic is evidence that it is starting to be the subject of research at many research institutions. Countries and their governments have adopted strategies that support the implementation of the concept of Industry 4.0. For example, the Czech government approved the document 'Initiative Industry 4.0' and allocated support for relevant research projects. On the other hand, the practical issue is how to implement the concept of Industry 4.0. This term is often used in international conference papers and journal articles. The aim of this literature review is to present the context that brings together Industry 4.0 and risk management based on the formulated research question. International sources - Scopus, Web of Science, and ScienceDirect - have been used to search for related literature. The relevant literature has been analyzed and used to find the solution to the research question. We have focused on the keywords: Industry 4.0, Risk Management, Risk and Performance Management.

2.1. The term Industry 4.0

The concept Industry 4.0, mentioned many times as the fourth industrial revolution, depends on CPS (Cyber-Physical Systems) as its key technology and is focused on the establishment of intelligent manufacturing components, smart objects and new production processes. In future manufacturing, factories will have to cope with the need for rapid product development, flexible production, and complex environments. Within the industrial context of interconnected manufacturing plants, these systems are also referred to as CPPS (Cyber-Physical Production Systems). This broad interconnection of ICT (Information and Communication Technologies) aligns with the vision of an IoT (Internet of Things) and services. It supports a close integration along established structures for value creation. The new method of controlling production processes is the main characteristic of Industry 4.0 [4], [5].

Integration within Industry 4.0 can be divided into both vertical and horizontal. Vertical integration indicates an increasing information exchange and collaboration among different levels of the hierarchy (management, corporate planning, production scheduling) within an enterprise. Horizontal integration describes a close collaboration between multiple enterprises within the same value creation network [6].

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