# Chapter 7
# A Study on Deep Learning Methods in the Concept of Industry 4.0

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## ABSTRACT

*Nowadays, the main features of Industry 4.0 are interpreted to the ability of machines to communicate with each other and with a system, increasing the production efficiency, and development of the decision-making mechanisms of robots. In these cases, new analytical algorithms of Industry 4.0 are needed. By using deep learning technologies, various industrial challenging problems in Industry 4.0 can be solved. Deep learning provides algorithms that can give better results on datasets owing to hidden layers. In this chapter, deep learning methods used in Industry 4.0 are examined and explained. In addition, data sets, metrics, methods, and tools used in the previous studies are explained. This study can lead to artificial intelligence studies with high potential to accelerate the implementation of Industry 4.0. Therefore, the authors believe that it will be a handbook and very useful for researchers who want to do research on this topic.*

## INTRODUCTION

Industry 4.0 is defined as the fourth phase of the industrial revolution. The invention and use of steam engines led to Industry 1.0; the development of electric and batch production devices led to Industry 2.0; the use of robots and computers on production lines led to Industry 3.0, and lastly, the big industrial revolution today named as Industry 4.0 continues to impact our lives. The desire to create super-smart societies and not to make any mistakes will be referred to as Industry 5.0.

DOI: 10.4018/978-1-7998-7852-0.ch007

Industry 4.0 is a process that aims to reduce the costs by decreasing the human impact in the production to a minimum through artificial intelligence methods, internet of things (IoT), and big data. The purposes of Industry 4.0 include the transition of traditional factories into digital factories, fast and reliable productions, development of smart cities, creating data storages with instant notifications and obtaining more meaningful knowledge from the data, minimum use of energy, and reducing the environmental damage to a minimum.

Industry 4.0 is classified in multiple categories based on the improvements in the hardware of electronic improvement cards, sensor architectures and structures, cloud services and wireless communication systems, and electronic systems. These categories are; Internet of Things (IoT), Cyber-Physical Systems, Cloud Technology, Augmented Reality, Autonomous Robots, Layered Production, Cyber Security, Big Data and Analysis, System Integration (Süzen & Kayaalp, 2019; Tekin & Karakuş, 2018).

The main characteristics of Industry 4.0 include communication of machines with each other and a system, an increase of production efficiency, and improvement of the mechanisms of robots. These situations are required to use some new analytical algorithms for Industry 4.0. Various industrial challenging problems in Industry 4.0 can be solved by using deep learning-based technologies.

Deep learning is a machine learning method that uses large amounts of data to perform supervised or unsupervised activities including feature extraction, transformation, and categorization through mimicking the skills of observation, analysis, learning, and decision making that human brain uses for complex problems (Süzen & Kayaalp, 2018a). It is a machine learning method developed by expanding traditional neural networks.

Today's industrial environments produce large amounts of regular or irregular data. Processing the data generated with the right methods and strategies would allow for reduced costs, the ability to calculate the life of materials used, easy use of autonomous systems, taking measures for potential mistakes, and efficient energy usage.

This study is to examine and explain the Industry 4.0 concepts and deep learning methods in terms of the methods used, the success of recommended systems, the success of the metrics, and the data libraries used in the related studies in the literature. Therefore, a literature review will be provided with classifications by interpreting the findings of related studies in the field. The study will include the following sections; background on Industry 4.0 and concepts related, deep learning and methods, metrics used to measure the success of deep learning methods, literature review, findings, and discussion.

## BACKGROUND

In order to understand the literature review section better, this section will focus on the introduction of Industry 4.0, deep learning and success metrics of the research. The research strategy of the study is also mentioned.

### Research Strategies

We have used the SMS (Systematic Mapping Study) method to examine the studies in the literature related to deep learning methods that can be used for Industry 4.0. SMS is a literature review method that aims to classify by interpreting the outputs from the relevant studies to find answers to the research questions identified.