

## Chapter 5

# Evolution of Maintenance Processes in Industry 4.0

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### ABSTRACT

*Several industries are looking for smart methods to increase their production throughput and operational efficiency at the lowest cost, reduced risk, and reduced spending of resources considering demands from stakeholders, governments, and competitors. To achieve this, industries are looking for possible solutions to the above problems by adopting emerging technologies. A foremost concept that is setting the pace and direction for many sectors and services is Industry 4.0. The focus is on augmenting machines and infrastructure with wireless connectivity, sensors, and intelligent systems to monitor, visualize, and communicate incidences between different entities for decision making. An aspect of physical asset management that has been enormously influenced by the new industrial set-up is the maintenance process. This chapter highlights the issues and challenges of Industry 4.0 from maintenance process viewpoint according to EN 60300-3-14. Further, a conceptual model on how maintenance process can be integrated into Industrial 4.0 architecture is proposed to enhance its value.*

### INTRODUCTION

Several industries are looking for intelligent systems, smart methods and functional processes to increase their production throughput and operational efficiency at the lowest cost. At the same time there is a steady need to reduce operational risk and product or service quality considering demands from stakeholders, governments and competitors. In this process, these industries suffer from operational flaws, human errors, systematic failures and process ineffectiveness leading to unanticipated delays in production and other negative incidences. To reduce these technical and operational deficiencies as well as improve their

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productivity, industries are looking for possible solutions to the above problems by adopting emerging technologies. A foremost concept that is setting the pace and direction for many sectors and services is industry 4.0. The focus is on augmenting machines, infrastructure and systems with wireless connectivity and sensors to monitor, visualize and communicate incidences between different entities for decision making. This new approach is essential for competitiveness in current industrial set up and for assuring a successful business enterprise.

This new trend entails the use of well - designed technologies process, and models in the form of internet of things (IoT), cyber-physical systems (CPS), cloud computing, Big Data and artificial intelligence (AI) to facilitate data exchange and automation. This disruptive revolution has caused substantial evolution in physical asset management. An aspect of physical asset management that has been enormously influenced by the new industrial set-up is the maintenance process. Maintenance practices, perception and prospect have been influenced in different industrial context, thus there is a need to adopt the concept of maintenance process according to the international standard EN 60300-3-14 into Industry 4.0 framework. This book chapter gives an overview on the evolution of maintenance function and the role of maintenance process in the bigger picture of industry 4.0 revolution. It also highlights the issues and challenges of maintenance process within the context of this new business approach. Some of the drawbacks of developing an industry 4.0 solution without adequate emphasis on maintenance process will be discussed. Further, some essential features and assisting technologies of industry 4.0 will be discussed with interest on how they can be used to connect the various elements of maintenance process. These elements include maintenance management, planning, preparation, execution, assessment and improvement according to maintenance standards. The purpose, characteristics and contents of each of these maintenance process elements differs thus there is a need to adequately investigate how they can be addressed in industry 4.0 context. This book chapter also gives a conceptual model on how maintenance process can be integrated into industrial 4.0 architecture. This conceptual model will support a seamless integration of operation and maintenance processes to facilitate effective and efficient maintenance decision making.

### **Concept of Maintenance**

Maintenance is a function that combines technical, administrative and management actions intended to retain an item in, or restore it to, a state in which it can perform as required (CEN, 2001). It is necessary for all physical engineering asset that are intended to add value to an organization or individual to be maintained in relation to its value creation capability. The maintenance function can be defined as “activities for retaining a system in an operating state or restoring it to a state that is considered necessary for its operation and utilization”. Hence, the important step in the effective management of the maintenance process is the precise identification of the need of maintenance, that is further demanded by the present and future state of the machine, and the necessary actions that need to be taken to restore it or retain it in an operating condition (Kumar, 2008). These activities cover the period from the creation of an asset to the end of its life. This is against the common misunderstanding of maintenance, where it's only limited to the operation phase of an asset life cycle (Ben-Daya, Kumar, & Murthy, 2016).

With recent advancements in technology, modern systems have become massive in size, extensive in functionality, complex in configuration and connected for automation. The sustainability and dependability demand on such systems are on the increase thus created need for new processes, technology, models and solutions for effective and efficient maintenance of the complex systems. This need is as-

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