Chapter 4
Multi–Criteria Decision Making in Manufacturing Systems:
Identification of Critical Factors for Establishing a Smart Factory Using ISM and MICMAC Approach

Hande Erdoğan Aktan
Akdeniz University, Turkey

Ömür Tosun
Akdeniz University, Turkey

ABSTRACT

In this study, an Industry 4.0-oriented electronic goods producer company's smart facility location selection problem is analyzed. The proposed problem is evaluated under environmental, economic, social, and technological criteria. The relationship between criteria are analyzed with interpretive structural modelling (ISM) and Matrice d'Impacts Croisés-Multiplication Appliquée á un Classement (MICMAC) methods. ISM method is used to assess the mutual relation of the criteria and their dependencies, whereas the MICMAC method is used to identify the importance of criteria based on their driving and dependence power. It is expected the methods used in this study which are related to evaluation of the criteria affecting the selection of the plant for a smart factory and the results of it will be useful for decision-makers and practitioners to categorize and differentiate the criteria. This study will be one of the first spearheading research to evaluate the criteria for establishing a smart factory.

INTRODUCTION

In today's manufacturing environment where the competition is tough, industrial manufacturing comes up against many critical difficulties such as decreasing product life cycle and increasing demand on small quantities of customized products. The manufacturers should be flexible and efficient in their processes, in order to do they need to use less resources and satisfy the customers with lower costs. Many advanced systems like flexible manufacturing systems, agile manufacturing systems etc. have been recommended to eliminate the disadvantages of the current manufacturing conditions. Among these recommended models, Industry 4.0 which was first introduced in 2011 in Hannover Fair has become prominent (Wang et al., 2016; Jazdi, 2014).

The first industrial revolution 'mechanisation', broke out with the invention of steam engine (Industry 1.0), the second industrial revolution 'mass production', emerged with the use of electricity and electronics (Industry 2.0) and information technologies have led to the third industrial revolution 'digitalization' (Industry 3.0). Following all these revolutions, the fourth industrial revolution (Industry 4.0) emerged in today's industry with the support of German Federal Government, using cyber-physical systems (CPS) and internet of things (IoT) (Jazdi, 2014; Lee et al., 2014).

Industry 4.0 is a manufacturing system focused on cyber-physical system that integrates the manufacturing facilities with other systems. The smart factories that are designed in order to cope with the shorter product life cycles, highly customized products and harsh global competition is a significant element of Industry 4.0 that focuses on manufacturing systems with vertical integration and network for smart manufacturing (Wang et al., 2016; Weyer et al, 2015; Shrouf et al., 2014).

Companies do not have any alternatives other than being productive to compete in today's business environment. Companies are also aware of need to make decisions quickly to compete. Therefore, companies are obliged to transform the big data into significant and useful information. Managing the big data is possible by turning all processes into "smart" and transforming factories into "smart factories" which can develop products rapidly, produce flexible and cope with complex environments (Brettel et al., 2014). IoT, briefly defined as a system of smart networking devices, is a very important element for real-time data and information exchange in smart factories. With IoT, it is much easier to adopt to changing market demand and selecting technology in these factories (Shrouf et al., 2014). With the help of cyber-physical systems used for communication between labor, machines and products, smart factories are equipped with smart technologies that can combine smart things with big data and integrate every element with the internet (Wang et al., 2016).

There are many elements in a smart factory from smart machines to smart processes, from big data to cloud programming, from sensors to smart engineering

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