# Chapter 6
# Connected BIM Models Towards Industry 4.0

**Daniela De Luca**
*Politecnico di Torino, Italy*

**Monica Dettori**
*Politecnico di Torino, Italy*

**Matteo Del Giudice**
*Politecnico di Torino, Italy*

**Anna Osello**
*Politecnico di Torino, Italy*

## ABSTRACT

*In the era of the fourth industrial revolution, the cyber physical systems, intended as enabling tools to generate an autonomous system, able to facilitate the relationships between different and distant objects and subjects, allow to digitalize the production system, in order to better outline what constitutes the smart factory. The benefit of such systems is the ability to associate to physical objects and virtual or digital models useful information related to the analyzed object, such as life cycle, geometry, mechanical properties, and parameters related to management and maintenance. This contribution aims to evaluate building information modeling methodology in the industrial context, as a cyber-physical system, developing flexible 3D parametric models as a data set, where information can be visualized and optimized management, using different visualization tools. The research has underlined the importance to share information between virtual and real worlds through virtual and augmented reality (VAR) systems.*

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## INTRODUCTION

The fourth industrial revolution is in progress and is evolving, it is characterized by a series of physical and digital technologies such as artificial intelligence, cloud computing, adaptive robotics, augmented reality, additive manufacturing, and Internet of Things (IoT). The term Industry 4.0 represents one of the most widespread fields of research in recent years. (Ustundag & Cevikcan, 2018)

Industry 4.0 embraces a range of topics from mechanization, automation, digitalization, networking to miniaturization. (Lasi et al. 2014)

New technologies and digital innovations have enabled the industrial sector to improve production processes, plant logistics, and energy efficiency. At the same time, progress in technology has facilitated the management of huge amounts of data and, above all, has allowed developing analytics based on big data sets to optimize production quality, to save energy, and to improve equipment service. Data from different sources, from equipment and production systems to business and customer management, are increasingly being collected, analyzed, and subsequently used to support choices. (Rüßmann et al., 2015)

In this context, data warehousing is a technological trend for business decision support process. It focuses on collecting, cleaning, and storing large volumes of information, and it is possible to fix three main uses of data warehouse. First, it is used for standard reports and charts presentation and allows data from different transaction systems to be consolidated in the warehouse and used in reporting. Second, it supports a type of query and reporting called dimensional analysis, and it can facilitate the comparison of the results between different dimensional values in particular time periods. Third, data warehouse enables a new technology called data mining that can automatically recognize patterns in data that can help end-users to describe existing data and predict future behavior. Data warehousing's success depends on the use of online information retrieval, artificial intelligence, and graphical user interface tools. (Ma et al., 2000)

From the point of view of data management, metadata plays a key role on the digital archive. They describe company data's meaning and structure and how they are created, consulted and used. (Devlin, 1997)

The following functions can be highlighted:

- Directory to help the analyst identify the contents of the data warehouse;
- Guide to mapping data when it is transformed from the operating environment to the data warehouse environment;
- Guide to algorithms used as a summary between current detailed data, slightly summarised, and highly summarised data.

The more data is stored, the more cloud and visualization systems will have to manage this amount of metadata in the best way, finding solutions and technologies suitable for the target purpose. (Dolk & Kirsch, 1987)

Moreover, visualizing data management through digital models allows us to show metadata through simple graphic representations. The interaction of them in real-time and the communication of the changing spaces with the management system allow us to optimize the developed digital models' connection. (Brooks, 1997)

Metadata and its efficient management requires the adoption of innovative methodologies to make its structure clear and connected to different uses and targets. For this reason, Building Information