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Epilogue

At the dawn of the fourth industrial revolution, the benefits of the digital transformation of plants are gradually becoming evident. Manufacturers and plant operators are already able to use advanced CPS systems in order to increase the automation, accuracy, and intelligence of their industrial processes. They are also offered opportunities for simulating processes based on digital data as a means of evaluating different scenarios (i.e. "what-if" analysis) and taking optimal automation decisions. These capabilities are empowered by the accelerated evolution of digital technologies, which is reflected in rapid advances in areas such as cloud computing, edge computing, Big Data, AI, connectivity technologies, block chains and more. The latter digital technologies form the building blocks of the state-of-the-art digital manufacturing platforms.

In this book, we have presented a range of innovative digital platforms, which have been developed in the scope of three EU projects, namely the AUTOWARE, DAEDALUS, and FAR-EDGE projects, which are co-funded by the European Commission in the scope of its H2020 framework programme for research and innovation. The presented platforms emphasized the employment edge computing, cloud computing, and software technologies as a means of decentralizing the conventional ISA-95 automation pyramid and enabling flexible production plants that can support mass customization production models. In particular, the value of edge computing for performing high-performing operations close to the field was presented, along with the merits of deploying enterprise systems in the cloud towards high performance, interoperability, and improved integration of data and services. Likewise, special emphasis was paid in illustrating the capabilities of the IEC 61499 standard and the related software technologies, which can essentially allow the implementation of automation functionalities at the IT rather than the OT part of the production systems.

Special emphasis has been put in the presentation of some innovative and disruptive automation concepts, such as the use of cognitive technologies for increased automation intelligence and the use of the trending block chain technologies for the resilient and secure synchronization of industrial processes within a plant and across the supply chain. The use of these technologies in automation provide some characteristic examples about how the evolution of digital technologies will empower innovative automation concepts in the future.

In terms of specific Industry 4.0 functionalities and use cases, our focus has been put on systems that boost the development of flexible and high-performance production lines, which boost the mass customization and reshoring strategies of modern manufacturers. A distinct part of the book was devoted to digital simulation system and their role in digital automation. It is our belief that digital twins will play a major role in enhancing the flexibility of production lines, as well as in optimizing the decision-making process for both production managers and business managers.

Nevertheless, the successful adoption of digital automation concepts in the Industry 4.0 era is not only a matter of deploying the right technology. Rather, it requires investments in a wide range of complementary assets, such as digital transformation strategies, new production processes that exploit the capabilities of digital platforms (e.g., simulation), training of workers in new processes, and many more. Therefore, we have a dedicated a number of chapters to the presentation of such complementary assets such as migration strategies, ecosystem building efforts, training services, development support services, and more. All of the presented projects and platforms pay emphasis to the development of an arsenal of such assets as a means of boosting the adoption, sustainability and wider use of these solutions.

Even though this book develops the vision of a fully digital shopfloor, it should be outlined that we are only in the beginning and far from the ultimate realization of this concept. In particular, we have only marginally discussed integration and interoperability issues, which are at the heart of a fully digital shopfloor. Moreover, we have not presented how different components and modular solutions can be used to address the different needs of manufacturers and plant operators. Our Digital Shopfloor Alliance (DSA) initiative (https://digitalshopfloooralliance.eu/) aims at bringing these issues into the foreground, but also in creating critical mass for successfully confronting them.

Industry 4.0 will be developed in a horizon that spans across the next three to four decades, where digital platforms will be advanced in terms of

intelligence and functionalities, while becoming more connected. In particular, the following developments are likely to take place over state-of-the-art digital platforms presented in this book:

- **The establishment of industrial data spaces**, which will provide the means for interoperable data exchanges between different platforms and stakeholders. As a characteristic example, industrial data spaces that allow supply chain stakeholders to exchange production orders and materials information without only minimal effort for integrating their enterprise systems with the industrial data space infrastructure.
- **The enhancement of machines and equipment with intelligence features**, based on the integration of advanced digital technologies such AI. As a prominent example, future machines will be able to identify and in several cases repair defect causes on-line i.e. without a need for stopping production.
- **The development and establishment of open APIs** for accessing capabilities and datasets within these platforms. Such APIs will greatly facilitate their integration and access in the scope of end-to-end applications. For example, they will provide the means for processes that span multiple stations and platforms within a factory.
- **The provision of support for smart objects such as smart machines and industrial robots**. Smart objects feature (semi)autonomous behaviour and are able to operate as stand-alone systems in the shopfloor. Occasionally, they will be able to synchronize their state with the state of digital automation platforms that control the shopfloors. Hence, they will be able to co-exist with digital platforms in order to perform collaborative tasks in the plant.
- **The implementation of strong security features**, which will ensure secure operations for both IT and OT systems of the plant. Strong security and data protection will be required as a result of the expanding scope of the digital automation platforms, but also as a result of their interconnection with other CPS, IT and OT systems.

Overall, Industry 4.0 will be certainly an exciting journey for plant operators, providers of industrial automation solutions, IIoT solution providers and many other stakeholders. In this book we have provided knowledge and insights about where we stand in this journey, while trying to develop a vision for the future. We really hope you will enjoy the journey and will appreciate our efforts to help you get started with the right foot.