Preface

Future Industrial Infrastructures are expected to be complex System of Systems (SoS) that will empower a new generation of today hardly realizable, or too costly to do so, applications and services. New sophisticated enterprise-wide monitoring and control approaches will be possible due to the prevalence of Cyber-Physical Systems (CPS), which have made Machine-to-Machine (M2M) interactions a key competitive advantage and market differentiator. This will be possible due to several disruptive advances, as well as the cross-domain fertilization of concepts and the amalgamation of IT-driven approaches in the traditional industrial automation systems.

The Factory of the Future (FoF) will rely on a large ecosystem of systems where collaboration at large scale will take place. Additionally with the emergence of Cloud Computing, it is expected that Cyber-Physical Systems will harness its benefits, such as resource-flexibility, scalability, etc., and not only enhance their own functionality but also enable a much wider consumption of their own data and services. The result will be a highly dynamic flat information-driven infrastructure that will empower the rapid development of better and more efficient next generation industrial applications while in parallel satisfying the agility required by modern enterprises.

Designing and operating the factory of the future means dealing with several challenges such as structural, operational, and managerial independence of the shop floor and enterprise constituent systems, interoperability, plug and play, self-adaptation, reliability, energy-awareness, high-level cross-layer integration and cooperation, event propagation and management, etc. The future "Perfect Agile Factory" will enable monitoring, processing, and control information flow in a cross-layer way. As such the different systems composing the whole enterprise will be part of a distributed ecosystem, where components, hardware and software, can dynamically be discovered, added or removed, and dynamically exchange information and collaborate. This cross-layer, intra-enterprise collaborative infrastructure will be driven by business needs exposed and managed as individual and/or composed services by the system's components.

The application of the Service-Oriented Architecture (SOA) paradigm to virtualise the shop-floor allows it to expose its capabilities and functionalities as

"Services". These "Services" can be located on physical resources, i.e., smart devices and systems, but also on the cyber-space identified here as "Shop Floor Service Cloud". This book introduces the vision and describe the major results of research, development and innovation works carried out by several major industrial players, leading universities and research institutes, within the European Collaborative Project "ArchitecturE for Service-Oriented Process—Monitoring and Control" (IMC-AESOP). More specifically, IMC-AESOP consists of a Research, Development and Innovation (R&D&I) approach that covers several aspects of the fusion of "Cyber-Physical Systems" and the "Service-Oriented Architecture and Cloud Computing," which tackled from the architecture, technology, migration, and engineering angles, and demonstrated through some selected industrial use-cases.

Going through the following pages, the reader will get a deeper view of the IMC-AESOP approach from multiple angles:

- Chapter 1 is dedicated being an introduction to what the reader can expect being presented within this book. It provides an overview of the motivation, vision, and efforts carried out by the partners of the IMC-AESOP project, toward defining the vision of cloud-based industrial CPS and demonstrating its advantages.
- Chapter 2 provides a short summary about today's situation and trends in automation. To be successful and take the potential user from where it is today, every innovation has to start from the latest state-of-the-art systems within the respective domain. While investigating the introduction of Service-Oriented Architectures to automation, and even down to the shop floor, latest standards, proofed technologies, industrial solutions, and latest research works in the automation domain have to be considered.
- Chapter 3 deals with bold architecture vision for cloud-based industrial systems. Future factories will rely on multi-system interactions and collaborative cross-layer management and automation approaches. Within this chapter a Service-Oriented Architecture is proposed attempting to cover the basic needs for the next generation SCADA/DCS systems, i.e., monitoring, management, data handling, and integration, etc., by taking into consideration the disruptive technologies and concepts that could empower future industrial systems.
- Chapter 4 focuses on assessment of promising technologies available in an industrial context, utilizing Service-Oriented Architecture-based distributed large scale Process Monitoring and Control. Aspects of integration, real-time support, distribution, event-based interaction, service-enablement, etc., are approached from different angles.
- Chapter 5 focuses on the step-wise introduction of Service-Oriented Architecture into process monitoring and control, which requires a systematic approach to migrate from legacy systems into the next generation SOA-based SCADA/DCS systems. The migration procedure proposed aims to preserve the functional integration, organize the SOA cloud through grouping of devices, and maintain

the performance aspects such as real-time control throughout the whole migration procedure.

- Chapter 6 deals with engineering methods and tools. These are seen as key enablers for efficiently designing, testing, deploying, and operating any industrial automation infrastructures. An overview of the user and business requirements for engineering tools, including system development, modeling, visualization, commissioning, and change in an SOA engineering environment is provided. An appraisal of existing engineering methods and tools, appropriate to four IMC-AESOP industrial use case is presented, followed by the description of a tool cartography adequate for engineering systems based on the IMC-AESOP approach.

To better depict the advancements achieved with the application of the IMC-AESOP approach, a series of four chapters are dedicated to present field trials demonstrating and evaluating results of the IMC-AESOP investigations.

- Chapter 7 Here we explore how the Service-Oriented Architecture can ease the installation and maintenance of one of the lubrication system of the world largest underground iron mine run by LKAB in north Sweden, with a focus on migration aspects.
- Chapter 8 Here the high demand in scalability of SOA-based systems and the exposition of services on and consume services from the automation cloud is investigated.
- Chapter 9 Here it is shown that the energy management can benefit from the advantages of service orientation, event-driven processing and information models for increased performance, easier configuration, dynamic synchronisation and long-term maintenance of complicated multi-layer industrial process solutions.
- Chapter 10 Here it is illustrated how the IMC-AESOP approach support building System of Systems. Applied to the district heating domain, this chapter presents the major features associated to a smart house demonstration where six different, heterogeneous, distributed systems have been integrated.

Finally, in Chap. 11 it is argued that if the vision of future cloud-based industrial cyber-physical system infrastructures is to become a reality and broadly adopted, industrial consensus has to be built on the adoption of adequate technologies, methods, and tools. This means a considerable amount of technological, application-oriented, and human-oriented challenges has to be tackled. This chapter identifies some of these challenges that need to be addressed by future research, development, and innovation activities.

We hope you enjoy this book which will inspire you to further advance the bold vision presented here, so that one day in the near future it may represent an industrial reality.

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