

INTRODUCTION

Tanya Bondarouk and Miguel R. Olivas-Luján

The age of Smart Industry has arrived! Definitions of Smart Industry are abundant (Habraken, this volume); however, most authors agree on the following characteristics. It involves future-proof industrial and product systems, which are smart and interconnected, and make use of Cyber Physical Systems, digitization, connectivity, and new manufacturing and product technologies (Kagermann, Helbig, Hellinger, & Wahlster, 2013). The history of and discourse around Smart Industry originated in Industry 4.0, the initiative that took off in Germany during the industrial trade fair Hannover Messe in 2011 (Pfeiffer, 2017). Following the trade fair 2011, the vision behind Industry 4.0 has spread to other countries under names such as ‘Made in China 2025’, ‘Make in India’, ‘Advanced Manufacturing’ (USA), Industrie 4.0 Österreich (Austria), Indústria 4.0 (Portugal), IPAR4.0 National Technology Initiative (Hungary), and Smart Industry (Netherlands), to name a few. Despite different labels, advocates of this initiative describe huge potentials for manufacturing industries. Among the promises, we can identify creating dynamic business and engineering processes, meeting individual customer requirements, facilitating optimized decision-making, and solving broader challenges like demographic change and resource efficiency (Habraken, 2020). In this volume, we have brought together high-quality articles that focus on innovative, evidence-based, cutting-edge research, case studies, new conceptualizations, and viewpoints on management in the age of Smart Industry.

Paraphrasing Huizinga et al. (2014), we emphasize the importance of a strategic vision of the future industry: a high degree of flexibility in production, in terms of product needs (specifications, quality, design), volume (what is needed), timing (when it is needed), resource efficiency and cost (what is required), being able to (fine-) tune to customer needs and make use of the entire supply chain for value creation. It is enabled by a network-centric approach, making use of the value of information, driven by Information Technologies and the latest available proven manufacturing techniques.

Another unique characteristic of this book is the combination of research conducted in divergent traditions of social sciences and engineering sciences. We need knowledge from all types of studies if we want to understand the complexity of recent developments in Smart Industry.

Smart Industry – Better Management

Advanced Series in Management, Volume 28, 1–3



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ISSN: 1877-6361/doi:10.1108/S1877-63612022000028001

Thus, Agata Leszkiewicz, Tina Hormann and Manfred Krafft discuss the impact of adoption of artificial intelligence (AI) on various stakeholders of a business-to-business organization. The cost-benefit approach allowed the authors to define the social value of AI as the combined value derived from AI adoption by a (B2B) organization with multiple stakeholders. The chapter explores further the social value of AI as the trade-off between (1) the benefits and improvements this technology brings for stakeholders and (2) the costs and concerns that arise from it. Specifically, we look at the impact of AI on (1) the internal stakeholders in the firm (e.g., executives, employees, etc.), (2) business customers, supply chain partners and competitors, and (3) society at large.

Klaas Stek takes us further in the discussion and his article claims that there is a serious gap between the intended learning outcomes in higher education and the needs of employees in Industry 4.0. His analysis shows that the history of the preceding industrial revolutions had the drawbacks of personality and character education; politicians have abused it to control societies in the nineteenth and twentieth centuries. The logic that soft skills are necessary to carry out hard skills calls for a shift towards a new type of citizenship that shapes the research question in the chapter: whether soft skills in education can lead to improved citizenship.

Sylvia Przytuła, Katarzyna Tracz-Krupa and Susane Rank continue the discussion about readiness for the impact of Smart Industry, but in the organizations, specifically – within and through the HRM function. Their chapter clarifies the state of opinion on expectations towards, and preparedness for, the impact of Industry 4.0 on human resources management and the implementation of various types of ambidexterity in these companies. By means of interviews with key HR informants from manufacturing companies operating in Germany and Poland, the authors have found that Industry 4.0 has a significant impact on HR practices. In international companies, various digital solutions in employee recruitment, development and performance have been implemented. There have also been mature examples of structural, contextual and sequential ambidexterity. Marie Molitor and Maarten Renkema investigate effective human-robot collaboration and present implications for Human Resource Management. Their research presents results of a vignette study that investigated factors affecting intention to collaborate with a robot.

Fabian Akkerman, Eduardo Lalla-Ruiz, Martijn Mes and Taco Spitters take us further on the Smart Industry road, to the field of a supply chain distribution and logistics strategy for which less-than-truckload shipments are consolidated into full-truckload shipments, also called cross-docking. The authors present results of the literature review on cross-docking literature, from 2015 up to 2020, that allows them to conclude about growing attention for Industry 4.0 concepts in cross-docking, especially for physical internet hubs (PI-hubs).

Ednilson Bernardes and Hervé Legenvre explored the nature and functioning of the inter-organizational governance mechanism underpinning an increasing number of Smart Industry initiatives. They also considered the nature and position of the technology within the broader set of technologies and the selected governance mechanisms and their relation to value capture.

The article by Devrim Murat Yazan, Guido van Capelleveen and Luca Fraccascia provides a conceptual framework about the current status and future development of smart decision-support tools for facilitating the circular transition of Smart Industry, focussing on the implementation of the industrial symbiosis practice. Based on the principles of a circular economy, the utility of such practices to close resource loops is analysed from a functional and operational perspective. For each phase of the life cycle – e.g., opportunity identification for symbiotic business, assessment of the symbiotic business and

sustainable operations of the business – the role played by decision-support tools is described and embedding smartness in these tools is discussed.

Finally, the article written by Christian Versloot, Maria Jacob and Klaas Sikkels brings us to the companies that specialize in providing an analysis of the underground. Geophysical techniques such as Ground Penetrating Radar (GPR) are harnessed for this purpose. The authors present their work to amplify the analysing GPR data by means of Machine Learning (ML). In this work, harnessing the Action Design Research (ADR) design science methodology, an Intelligence Amplification (IA) system is designed for decision-making with respect to utility material type. It is driven by three novel classes of Convolutional Neural Networks (CNNs) trained for this purpose, which yield accuracies of 81.5% with outliers of 86%. The tool is grounded in the available literature on IA, ML and GPR and is embedded into a generic analysis process.

It is not difficult to notice that all nine chapters differ in terms of the research discourse and vocabulary, research methods in case of empirical studies, and application cases (types of industry). We have learnt a great deal from these chapters and engaging in the double-blind, peer-review process for all submitted manuscripts. To our knowledge, this is one of the first volumes that have combined manuscripts that describe one increasingly influential industry phenomenon in contemporary management – Smart Industry. We are convinced that this is the way to progress in science and practice: through integration of social and engineering research, to understand, cross-pollinate, and improve the discourse through approaches that are less familiar. The challenges brought about by the COVID-19 pandemic, particularly in the area of supply chain management, magnify the importance of such multi-disciplinary approaches into the future.

We are very thankful to all the authors, who joined us in this journey to explore the complexity of Smart Industry. Now, it is our readers' turn to contribute to this ongoing conversation!

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