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ADVANCED SERIES IN MANAGEMENT VOLUME 23

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EDITED BY

RITA BISSOLA
Università Cattolica del Sacro Cuore, Italy

BARBARA IMPERATORI
Università Cattolica del Sacro Cuore, Italy

United Kingdom – North America – Japan
India – Malaysia – China

Emerald Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2020

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-78973-536-9 (Print)
ISBN: 978-1-78973-535-2 (Online)
ISBN: 978-1-78973-537-6 (Epub)

ISSN: 1877-6361 (Series)

ISOQAR certified Management System, awarded to Emerald for adherence to Environmental standard ISO 14001:2004.

Certificate Number 1985
ISO 14001

INVESTOR IN PEOPLE

This volume is dedicated to all the incredible HRM scholars and professionals working within the e-HRM community. We thank them for their passion, engagement, and hard work in developing such an inspiring research stream.

A special thought also goes to Luigi Manzolini for having challenged us in combining HRM and innovation.

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About the Contributors

Fabiola Bertolotti is an Associate Professor of Management Engineering at the University of Modena and Reggio Emilia. She was a Visiting Scholar at the University of Texas at Austin. Her research focuses on team dynamics in knowledge-intensive contexts and has appeared in *Human Relations, Organization Studies, Academy of Management Learning and Education, Strategic Organization*, and *Research Policy*.

Rita Bissola is an Associate Professor of Organization Design and Organizational Behavior at the Department of Economic and Business Management Sciences, Università Cattolica del Sacro Cuore, Milan, Italy. Her research interests focus on HRM innovation, creativity, and employee engagement. She has published articles and contributions in both international and national journals and books.

Tanya Bondarouk is a Professor of Human Resource Management at the University of Twente, the Netherlands. She has been working in the research area of innovating HRM function, with a focus on digital HRM, and areas such as the implementation of e-HRM, management of HR-IT change, HRM contribution to IT projects, roles of line managers in e-HRM, implementation of HR Shared Service Centers.

Claudia Canali is an Associate Professor at the Department of Engineering "Enzo Ferrari" of the University of Modena and Reggio Emilia. She holds a master's degree in Information Engineering and a PhD in Information Technologies. Her main research interests focus on online social networks, cloud computing and gender equality in STEM.

Elizabeth A. Cassady is a Global Supply Chain graduate of Clarkson University in Potsdam, NY. Her studies focused on logistics, project management, and human resources. Elizabeth lives in Norfolk, VA, and currently works as a Business Process Analyst and Quality Process Manager at CMA CGM America.

Claudia Dossena is an Assistant Professor of Organization Design and Management Information Systems at the Department of Economic and Business Management Sciences, Università Cattolica del Sacro Cuore, Milan, Italy. Her main research

interest focuses on the strategic role of web-based technologies in HR management and in organizational change.

Linda Evans is the Deputy Dean of the School of Sports and Professional Practice at the Faculty of Life Sciences and Education, Glyntaf Campus, University of South Wales, UK. Her research areas are health policy, public health, and patient and public involvement.

Tommaso Fabbri is a Full Professor of Organization and Human Resource Management at the University of Modena and Reggio Emilia, Scientific Coordinator at Fondazione Marco Biagi, and was a Visiting Professor at the Pennsylvania State University. He has authored numerous books and articles on organizational learning, well-being at work, performance management, and change management.

Sandra L. Fisher is an Associate Professor of Organizational Studies in the School of Business at Clarkson University in Potsdam, NY. Her research is in three main areas: the use of contingent work, the implementation and strategic use of e-HRM, and effective design of technology-based training.

Milou Habraken is a PhD Candidate at the University of Twente, the Netherlands. She obtained a Master's degree in Business Administration (University of Twente) and a Research Master in Economics and Business (University of Groningen). Her PhD research is focused on smart industry (industry 4.0). Herein she examines the label itself and its effects on HRM, in particular characteristics of jobs.

Barbara Imperatori is a Full Professor of Organization Design and Human Resource Management at the Department of Economic and Business Management Sciences, Università Cattolica del Sacro Cuore, Milan, Italy, where she is the Director of the Master's in International HR Management. She published several contributions in international and national journals and books.

Daniela Isari is a Lecturer of Organization Design at the Department of Economic and Business Management Sciences at Università Cattolica del Sacro Cuore of Milan, Italy, where she also teaches Human Resource Management and Organizational Behavior in postgraduate Master's programs and executive programs. She published contributions on new forms of work and collaboration enabled by social networks and by digital transformation processes.

François L'Écuyer, DBA, is an Associate Professor of strategy and information technology at the Université du Québec en Abitibi-Témiscamingue. His research has been published in academic journals (*Employee Relations*) and conference proceedings (HICSS). His main research interests are the e-HRM, IT alignment, and IT new business models.

Janet H. Marler, PhD, is a Professor of Management at the University at Albany–State University of New York. A leading expert in the strategic use of HR technology and HR analytics, her research appears in leading scholarly journals,

book chapters, and the book *Making HR Technology Decisions: A Strategic Perspective*.

Marcello Martinez is a Full Professor of Organizational Studies and Human Resource Management, Università degli Studi della Campania Luigi Vanvitelli. He is a Coordinator of the *PhD program in Entrepreneurship and Innovation*. He is the President of ASSIOA Association of Italian Organization Studies Academics, Milano. He is a co-Chief editor of the journal *"Studi Organizzativi" FrancoAngeli*, Milano.

Lorenzo Mizzau is an Assistant Professor at Università Cattolica del Sacro Cuore, Milan, Italy, and a Research Affiliate at ASK Centre for Research, Bocconi University. Besides HR, his research focuses on strategic and organizational practices in pluralistic contexts such as cities and cultural organizations, using mainly qualitative methodologies.

Francesca Mochi is a Post-doctoral Researcher at Università Cattolica del Sacro Cuore, Milan. Her primary research interests concern organization design, human resource management and especially e-HRM, and organizational behavior with a particular focus on leadership styles and creativity.

Michael Murdoch works as an Employee Relations Coach. He is a former Director of Employment Affairs at the BESA Group, a trade association headquartered in London, UK. He was previously a Senior Lecturer at the University of South Wales Business School, where he was the Program Leader for MSc HRM. His research interests are with Employee engagement and Workplace renewal strategies and in the transfer of HR practices across borders.

Esther Njoku has a PhD in e-HRM from the University of South Wales, UK, and is a Research Affiliate with the University. Her research areas are digital business strategy, e-HRM, and global talent management, with current research interest in AI and e-HRM's role in redefining the future of work.

Miguel R. Olivas-Lujan, Ph.D. is a Professor and Summer Chair at Clarion (Pennsylvania, USA). A Past Chair for the MED division of the Academy of Management, his research has appeared in leading journals and scholarly books on information technology, diversity, international HRM, nonprofits, and others. He serves on various editorial boards and has taught in Colombia, Germany, Mexico, and Poland.

Claudia Pelletier, DBA, is an Assistant Professor of information systems at the Université du Québec à Trois-Rivières. Her research has been published in the *Revue Internationale PME*, the *HICSS* and *AMCIS Proceedings*. Her main research interests are the IT strategic alignment process and the IT-enabled transformation, particularly in the context of SMEs.

Aurelio Ravarini is an Assistant Professor at the Università C. Cattaneo – LIUC (Italy), where he is also Coordinator for the "Business Services" and "Digital Consulting" Programs at the School of Management Engineering. His research expertise is in strategic information systems, knowledge management, and information systems development. He is an Affiliate Professor at Grenoble Ecole de

Management and Invited Researcher at Paris Nanterre University. He has worked as a Visiting Professor in several universities in Europe and the USA.

Hefin Rowlands is a Professor of Quality Management at South Wales Business School, University of South Wales, UK. His research publications cover quality engineering, quality improvement, AI applications to quality tools and techniques. His current research interest is in quality improvement methods applied to industry 4.0 developments.

Dr. Huub Ruël, PhD. is Professor of global talent management and international business at Hotelschool The Hague (The Netherlands), a top 5 hospitality business school. His research focuses on HRM & Technology, Talent Management & Technology and on the interaction between international business and diplomacy. He publishes in international research journals, publishes book chapters, he guest edited several special issues for journals, guest edited books and he is a book author.

Daria Sarti, PhD, is an Assistant Professor of Organization Studies and Human Resource Management at the University of Florence from 2009, where she served as a Research Assistant between 2005 and 2009. Her primary research interest is in human resource management, work engagement, and the impact of ICT on employee's well-being.

Anna Chiara Scapolan – PhD in Management, Ca' Foscari University of Venice – is an Associate Professor of Business Organization at the Department of Communication and Economics of the University of Modena and Reggio Emilia. Her main research interests regard organizational behaviors and human resource management; on these topics she has published book chapters and articles in national and international journals (e.g., *Studi Organizzativi*, *Organization Studies*, *International Journal of Human Resource Management*, *Urban Studies*, and *European Management Journal*).

Teresina Torre is a Full Professor of Organization Studies and Human Resource Management at the University of Genova (Italy). She teaches Human Resource Management, Organizational Behavior, and Organization Business. She is a Vice President of Assioa. Her research interests focus on the evolution of work and work organization in digital context and its implications for diversity management.

John Werkhoven worked at PwC (Partner) and IBM (Executive) as a Management Consultant in the domains of Information Systems and HRM. Currently he is working on a research program at Nyenrode Business University. His research focus is on the use of HR analytics capabilities for business value creation.

Sharna Wiblen is an Assistant Professor (Lecturer) at the Sydney Business School, University of Wollongong. Her research integrates talent management, information technology, and HR analytics to illuminate the complexity of deliberate and informed talent management. This work complements a decade-long research focus examining the implementation, use, and strategic value of technological innovations as organizations decide which operational and strategic processes and practices benefit from digitalization and those that require people.

HRM in the Industry 4.0 Era: Are Workers Still in the Center?

Rita Bissola and Barbara Imperatori

Technology has recently been undergoing a fast-growing innovation wave. We have already entered a new technological era: this phenomenon started early in the current decade, it has gradually emerged, is expected to widely involve all enterprises – regardless of their size – and substantially transform work. The distinguishing and most salient characteristic of the contemporary technological shift is that digitalization is now reaching the physical sphere (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014; Quint, Sebastian, & Gorecky, 2015).

Nowadays, powerful communication networks and new internet protocols – that together form the so-called Internet of Things – connect smart objects to flexible manufacturing systems, thus attaining the self-organizing cyber physical production systems (Annunziata & Biller, 2015). Such digitalization of industrial manufacturing is based on smart components – among which there are intermediate goods as well as products – which, by continuously exchanging large amounts of data, enable the production systems to learn and make decisions. This makes the industrial manufacturing flexible and able to meet personalization requirements. The new technological paradigm can efficiently deal with the huge amount of data (the so-called big data) stored on the cloud and allows for analytics to be continuously obtained on all the different aspects of the business activity, thus supporting a more informed and evidence-based business management (Rentzos, Mavrikios, & Chryssolouris, 2015; Rojko, 2017).

A further stream of new technologies was originally aimed at delivering tools that could replicate and hopefully more efficiently perform typical human capabilities, such as learning from experience and making decisions in unstructured contextual conditions, thinking creatively, feeling emotions, and intuit people's moods. As a matter of fact, the path to obtaining technological tools that could perform human abilities and increasingly behave like humans has already been pursued and has historically been represented in several outlets of popular culture, among which especially films and TV series (Colbert, Yee, & George, 2016; Schneider, 2018).

However, the current avenue of android technologies that connect artificial intelligence and robotics seems to be opening up an unprecedented business opportunity. Such technological implementation can further develop in two ways. On the one hand, these tools can empower human beings so that they can perform new activities or greatly improve their abilities in what they already do (e.g., augmented reality to train plane's pilots or the exoskeleton allowing to alleviate the workers' effort and increasing both efficiency and precision in automotive plants). On the other, such technological advancement may replace human work, with the consequent advantage of considerably reducing labor costs and thus gaining efficiency (Colbert et al., 2016; Klotz, 2016). Fully automated corporate warehouses, where no workers are employed, are already a reality. In the same vein, another well-known example is Amazon Go stores: in these shops, there are no cashiers as customers do not need to checkout. Technological solutions fully manage the stores and simplify the purchasing process, for which customers are only required to download an app on their smartphone. Furthermore, there are several other examples of technologies performing human activities and many more cases may become a reality in the near future.

Industry 4.0 and Work: A Human-centered Approach

The distinguishing trait of the current technological transformation is that digitalization now reaches and involves physical objects, thus not remaining restricted to services and intangible goods. The physical-digital convergence, also sustained by efficient communication networks, enabled the transformation of industrial manufacturing into what is called Industry 4.0. This is defined as "the increasing digitization of the entire value chain and the resulting interconnection of people, objects and systems through real time data exchange" both inside and beyond the organization boundaries (Hecklau, Galeitzke, Flachs, & Kohl, 2016, p. 2). A document of the Federal Ministry of Education and Research – urging the German government to invest in high-tech manufacturing, thus moving toward its digital transformation – introduced the term Industry 4.0 in 2011 (Lasi et al., 2014). Since then, the term has progressively become widespread among research, academic and industry communities. Furthermore, it has been used to refer to the exploitation of the potentials of the Internet of Things and the smart technologies to digitalize, connect, and integrate technical and business processes within and outside the organization (Rojko, 2017). The newly created "smart factories" further develop within the organizational contexts where big data, AI, advanced robotics, and, more generally, a wide bundle of new technology are radically transforming work (Schuh, Gartzen, Rodenhauser, & Marks, 2015).

One of the principles of Industry 4.0 in its first formulation is its human-centered focus. Industry 4.0 is reshuffling the way of working and these changes potentially support the centrality of human beings within the new labor processes: there is a

need for more qualified and unique competences. However, there are some potential risks and drawbacks.

The main assumption, both in the original German document and in a relevant part of the literature, is that Industry 4.0 aims to promote an improved human–machine interaction that, for example, can improve work safety, enable more ergonomic workplaces, or enhance the workers' scope (Lasi et al., 2014; Rojko, 2017; Schneider, 2018).

Industry 4.0 is changing the time and space of work: smart working and new digital production are only a few examples. Traditional 9-to-5 five-days-a-week jobs are likely to decline and more varied and flexible forms (as for work time and space) will arise. New forms of working are deemed to be more flexible across time and space, but the shift is not simply about where and when work occurs, it encompasses a new mind-set that must shift from "work as presence" to "work as results" (Bissola & Imperatori, 2018).

Industry 4.0 is also changing the nature of work that still includes traditional employees and managers, but also new "external" workers, such as freelancers, gig workers, vendors, and customers collaborating across organizational boundaries, also as a result of digital platforms (Lasi et al., 2014). The new ways of producing and delivering goods and services involve stakeholders more actively and enlarge the number of actors who directly participate in the business activities (Bondarouk & Brewster, 2016; Kane, Palmer, Phillips, Kiron, & Buckley, 2016).

There is evidence that these changes could have a positive impact on both people and organizations, enabling a better work–life balance for a wider cohort of workers. Smart working offers a more efficient way of designing work, reducing absenteeism, enhancing work productivity, and enabling cost savings in relation to buildings and general expenses (Holland & Bardoel, 2016). The changes produce a higher degree of organizational innovation, enable more agile organization forms, and lower organizational costs (Bissola & Imperatori, 2014). There is also evidence that more flexible and entrepreneurial working conditions could positively affect job engagement and intrinsic motivation, supporting individual creativity and job satisfaction (Rich, Lepine, & Crawford, 2010). The new digitalization enables internal and external stakeholders to share knowledge and collaborate across organizational boundaries, while also increasing their competences and experiences.

On the other hand, detractors of Industry 4.0 predict there will be unprecedented job losses and dramatic unemployment levels as the smart machines will replace human work and not only routine activities. Full-time employment will be substituted by a wide variety of more precarious work arrangements, forcing organizations to redefine and continuously change the architecture of their management practices to better cope with the increasing diversity of the workforce. This will negatively affect job security and employees' self-esteem (Markoulli, Lee, Byington, & Felps, 2017). Moreover, both research and practice suggest some potential risks of the digital workplace, for example a growing sense of job insecurity and technological angst. It also seems to influence the quality of social interactions toward a higher degree of personal isolation and closeness (Turkle, 2011). Moreover, continuous learning and the difficulty in separating the work and non-work domain could

cause work-life balance conflicts, stress, and burnout, especially for those who are not digital natives (Butts, Becker, & Boswell, 2015). Negative consequences could additionally affect individual creativity and critical thinking, forcing employees to focus on narrow work activities mainly driven by the pace and rhythm of machines (Jackson, Dawson, & Wilson, 2001).

Industry 4.0 and HRM 4.0: Toward a New Social Sustainability

The fourth industrial revolution (i.e., Industry 4.0) affects HRM activities from three different points of view.

First, Industry 4.0 challenges HRM in soliciting it to provide value for the new smart organization, where work overtakes the organization boundaries and a successful human–machine collaboration can potentially offer new advantages. The HRM department can assume a new crucial role as change agent helping the smart organization to develop the new workforce digital mindset and competences to interact with machines, as well as with colleagues and supervisors in an open community context (Bissola & Imperatori, 2018; Klotz, 2016).

Second, the workplace digital transformation requires a revision of the traditional HR practices: these should support the changing employee-organization relationship, in which employees can work anywhere, do not have an official working time, and can cooperate with people inside and outside the organization. In such conditions, hierarchical control loses effectiveness, performance evaluation gains importance, and all the employees are expected to actively contribute with ideas and decisions. In the same vein, smart technology offers opportunities to e-HRM to evolve and provide new HRM systems that generally enhance a more direct relationship between workers, the HR department, and the organization. Likewise, they better align with people's habits and behaviors toward connectivity, and support the more flexible work organization (Bissola & Imperatori, 2018; Colbert et al., 2016; Hecklau et al., 2016).

In this situation, HR systems must be consistent with the new way of working and with the new variety of workers, and should align the behaviors of supervisors and workers toward the new digital culture. Among others, performance must be clearly defined and measured in terms of work results; career paths must be organized consistently; the ways of interaction, the time and space for collaborations must be openly set; organizational spaces (i.e., office and plants) must be specifically redesigned for the new work processes, also allowing workers to better self-manage their time and space.

Moreover, HR practices should allow organizations to manage a composite and segmented workforce. Among others, there is a need for diversified people practices for a diverse workforce that could balance the organization and people's expectations in a sustainable and fair way. The new workers require new and aligned management practices to properly attract, select, and engage external, as well as internal stakeholders and to best match the demand and supply of skills and capabilities in

the entire product lifecycle (Bissola & Imperatori, 2012). The growing reality of real time employee data can provide meaningful insights and enable data-driven decision-making. The data require increasing the digital and analytical capabilities within organizations and those of HRM professionals (Bondarouk & Brewster, 2016; Strohmeier & Parry, 2014).

Third (and most important), the HR department should be the organization unit that commits more to the human-centered approach characterizing Industry 4.0, and that supports its implementation in a socially sustainable way (Hecklau et al., 2016; Schneider, 2018).

People are becoming more aware of the social impact of their activities and lives. The recent economic crisis exposed some of the contradictions of the capitalist socio-economic system and it has led to the emergence of negative phenomena, such as unemployment, austerity and social insecurity. The pressure on firms to be socially sustainable continuously increases and is generated by a range of stakeholder groups including customers, communities, employees, governments, and shareholders (Lockett, Moon, & Visser, 2006). Organizations have responded to this pressure in a variety of ways. "Society and business," "social issues management," "public policy and business," "stakeholder management," and "corporate accountability" are just some of the terms used to describe the phenomena relating to corporate responsibility within society.

As Wheeler, Colbert, and Freeman (2003, p. 17) have stated, sustainability is:

> an ideal toward which society and business can continually strive, the way we strive is by creating value, creating outcomes that are consistent with the ideal of sustainability along social environmental and economic dimensions.

HRM 4.0 can play a decisive role in designing and implementing socially sustainable solutions. It can provide stimuli to develop positive social change and adopt new digital systems and innovative organizational solutions in a sustainable way, supporting the positive outcome of the Industry 4.0 and preventing the possible drawbacks.

HRM professionals and scholars must help business leaders and workers shift toward the 4.0 mindset, that is, digital ways of managing, organizing, leading to and working for a positive social change. The HRM 4.0 can contribute to work innovation, people empowerment, building their competences, and enabling them to actively face the current labor challenges. For a long time, employees have been viewed as passive performers of their assigned job tasks. Recently, several scholars have argued that job design theory needs to address the influence of employees on their job design. HRM 4.0 could be the key driver to allowing people to exert more influence on their job characteristics, thus improving their work motivation and a social sustainable development.

The idea of an unnecessary trade-off between "doing well" and "doing good" needs to become a key consideration and HRM scholars and practitioners together have a great social responsibility in this new world.

This is also a new world for the HRM domain, potentially opening up new career opportunities for the HR professionals. In addition, it could transform the impact that scholars could have on people, business, and society at large, by supporting the positive and, moreover, sustainable side of the ongoing work transformation, and permitting a human-centered organization (Figure 1).

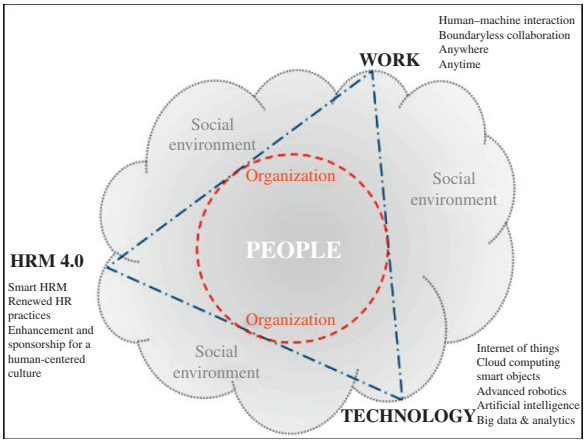

Figure 1. Ecosystems for Human-centered Approach in Industry 4.0.

Goals of This Volume

This volume revisits the concept of e-HRM according to Industry 4.0; it focuses on the progression from e-HRM toward HRM 4.0 and it critically assesses the academic and business achievements in this field, as well as highlighting the latest developments.

We pick up the baton from the sixth e-HRM Conference that addressed the topic of the smart HRM and suggested following the growing development of the new technologies and the organizational digital transformation. The "human-centered organization" is inherently consistent with industry 4.0 and it calls for reflections. The HRM field needs to focus on non-routine, evidence-based, science-inspired, creative, and value-added actions. What should be the role of HRM in the 4.0 environment? How can HRM activities change to support sustainable 4.0 organizations? How should a human-centered organization be designed in an ultimately jobless scenario? What individual and organizational competencies will be required to meet the expectations of the latest 4.0 business developments? Which organizational solutions will enable a fruitful and creative collaboration between human beings and "smart things"? What will be the impact of the 4.0 revolution on employment relationships and management practices? How could HRM practices drive social value in the 4.0 scenario? Moreover, how can research into HRM 4.0 issues inform whether, how, and why changes occur?

All these questions will challenge the e-HRM scholars for the next years, and with this volume we aim to follow the digital developments, provide some stimuli, and move the field further.

The chapters of this book are a selection of the research projects presented at the seventh e-HRM Conference. They critically address the depicted changing scenario by adopting different levels of analysis and foci: from the industry 4.0 to the new HR tools and practices.

In the first chapter, Milou Habraken and Tanya Bondarouk open the discussion on the fourth industrial revolution, starting from the absence of a clear understanding of the different labels in the field, such as smart industry and 4.0 industry. Their interview-based research confirms that smart industry is more complex than how the official reports depict it and, given the extent of the overlap with industry 4.0, they recommend aiming for more conformity by choosing the label industry 4.0 over smart industry. Chapters 2 and 3 investigate, from an organizational perspective, the possible outcomes of adopting e-HRM. Esther Njoku, Huub Ruël, Hefin Rowlands, Linda Evans, and Michael Murdoch (Chapter 2) present evidence about the role of e-HRM in sustaining business performance and how e-HRM can create strategic value and enable HR to realize the benefit of achieving the transformational role of operating and contributing strategically. In Chapter 3, Daniela Isari, Rita Bissola, and Barbara Imperatori demonstrate how smart technology is reshaping the distribution of people management activities between the HR department and line managers, thus offering insights into the relationship changes between HR and line managers. In Chapter 4, Aurelio Ravarini and Marcello Martinez focus on an emergent organization model: holacracy. This is a network-based organization whose functioning highly relies on advanced technological platforms. The predominant role played by the technological infrastructure in such an organization model greatly restricts the activities of the HR department. The latter is in part replaced by a unit responsible for an internal social network used as the main coordination mechanism in the organization. Such a case study further suggests the need for HR department and professionals to invest in digital competences to become more aware of the potentials of the new technological tools. However, it also raises the question of whether digital tools and technology specialists can replace HR competences. Chapter 5, by Sandra Fisher and Elizabeth Cassady, deals with one of the most relevant transformations of work, that is, gig work. They analyze a wide sample of digital platforms from the gig workers' perspective and find that such platforms provide three functions of relational e-HRM systems, namely communication, training and development, and performance management. Nonetheless, some of the resources with the potentially highest value are available only to people in certain roles. Therefore, a large cohort of low-skilled workers actually remains excluded.

The following four chapters (6 to 9) offer an interesting overview of both smart HRM practices and the opportunities of applying digital technologies to existing HR and e-HRM practices. Sharna Wiblen and Janet Marler (Chapter 6) specifically investigate the role HR managers play in high-potential talent identification when Talent Management Information Technologies are introduced. Presenting a

qualitative case study, the authors provide a nuanced and in-depth analysis showing that perceptions and attitudes toward information technology, in combination with existing social systems, influence the relevance HR professionals maintain in increasingly digital organizational contexts. In Chapter 7, Miguel Olivas-Lujan presents a detailed description of blockchains and, building on the Diffusion of Innovations theory and on well-known examples of blockchains applications, he hypothesizes HR domains such as, among others, employment screening and worker contracts and payments, could benefit from the introduction of such technology. Chapters 8 and 9 provide evidence on analytics and their adoption in the HR activities. John Werkhoven (Chapter 8) selects an exemplary case study to illustrate how companies can develop their internal HR analytics capabilities and the organizational conditions and integration mechanisms that can lead to synergistic outcomes. Tommaso Fabbri, Anna Chiara Scapolan, Fabiola Bortolotti, and Claudia Canali (Chapter 9) offer empirical results of a study performed by applying the HR analytics approach. They codify actions that a sample of employees performed through a digital collaboration platform and correlate them with the level of individual embeddedness. The findings show that workers who engaged in more activities on the digital platform also experienced an increased level of organizational embeddedness. Besides the organizational attitudes that the authors consider in their study, this contribution represents a concrete example of insights that HR analytics can provide to managers and, more generally, to the enterprise. The aim of the last three chapters (10 to 12) is contributing to the theorization in the e-HRM field by taking into consideration some specificities of the more recent digital technologies. Chapter 10 is a literature review on smart working. The authors, Teresina Torre and Daria Sarti, highlight that the topic is still being debated between scholars who depict it as a completely new approach to job design, and others who underline the continuity aspects with telework. The implications stemming from the two perspectives are then identified with particular attention to future empirical studies. Claudia Dossena, Lorenzo Mizzau, and Francesca Mochi conceptually investigate if and how the use of social media in HRM can support a more humanistic approach within firms. Chapter 11 is a theoretical contribution which, starting from some principles of Humanistic Management, develops propositions that could inform future research on social media and their potential in bringing the "human component" at the center of the organization. In Chapter 12, Francois L'Ecuyer and Claudia Pellettier contribute to the theoretical development of the adoption of e-HRM and social media in SMEs in particular. Their empirical results identify four main patterns that specifically explain the use of social media for recruitment in SMEs. First, social media is not the first choice when it comes to choosing a recruitment tool. Second, the use of social media for recruitment is not a structured activity. Third, recruiters use social media in the same way they do in their personal life. Finally, marketing people are often involved in recruitment practices on social media.

This volume may serve as a prelude to the growing body of research and to the emerging request of theorization to face the challenges the e-HRM domain is encountering due to the fourth industrial revolution. The present book is a step

further in this direction and it opens new research strands, reveals different approaches, offers stimuli, and unwraps the debate on different levels: society, organization, and people.

We believe that each of the following chapters is an opportunity for additional discussion and investigation. Although much work remains to be done, we hope to see e-HRM researchers contribute to a future sustainable world, where workers (and people) will be and will remain at the center.

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Smart Industry or Smart Bubbles? A Critical Analysis of Its Perceived Value

Milou Habraken and Tanya Bondarouk

Abstract

Despite the fact that labels such as "smart industry" and "industry 4.0" (terms used to denote the fourth industrial revolution) have become popular topics within academia and in practice, their meaning remains an issue of concern. It's a concern that has drawn the attention of various authors. It is a struggle we engaged in as well – specifically regarding the Dutch "smart industry" label – to aid our aim of assessing whether our call to combine forces can be extended beyond industry 4.0 and industrie 4.0. We provide here initial indications of whether there is more unity in meaning and, thus, reasons to take steps toward combining labels. By means of 20 interviews with Dutch smart industry experts, a representation of smart industry was obtained as understood in the Netherlands. Based on this representation, we examined the extent of overlap between the Dutch "smart industry" label and the general term "fourth industrial revolution" as well as the "industry 4.0" label as defined by various scholars. Our findings showed that smart industry in the Netherlands does not match the denotation of an industrial revolution. Several signals were, however, detected indicating that the content observed under the Dutch smart industry label overlaps with what is being presented under the label industry 4.0. These results reveal that there is indeed more unity in meaning between the various labels that exist and, as such, strengthens our call to combine forces.

Keywords: Fourth industrial revolution; smart industry; industry 4.0; meaning; value; combining forces

HRM 4.0 For Human-Centered Organizations
Advanced Series in Management, Volume 23, 1–20

ISSN: 1877-6361/doi:10.1108/S1877-636120190000023018

> *The industrial world has never before known this freedom (p. 53) –*
>
> *New technologies appear; long-established businesses fall on hard times; the economic order is threatened; and society itself experiences drastic challenges to values and standards of behaviour (p. 54) –*
>
> *There are many unknowns (p. 64)*

Although the above quotes from Finkelstein and Newman (1984) address the third industrial revolution, they are just as relevant in the current situation since, once again, we seem to be facing economic upheaval. In other words, following the first three periods of turmoil, it is now being claimed that we find ourselves in a fourth industrial revolution. This revolution triggered the resurfacing of the employment debate again (see, e.g., Habraken & Bondarouk, 2017). But it is unique in that it has been announced a priori (Drath & Horch, 2014), and unlike the prior revolutions, there are many different labels used to denote this one. While the third was also known as the computer revolution, examples of labels currently used are industrie 4.0, industry 4.0, smart industry, integrated industry, advanced manufacturing, or industrial internet of things (Davies, 2015; Hermann, Pentek, & Otto, 2016). The presence of such a diverse set of labels makes it challenging to keep an overview of what has been published, leads to duplicates in the list of key words (e.g., Kang et al., 2016), and risks academic progress by implicitly forcing rediscovery of the wheel. The last point is the most important one since it creates a fragmented field of research. It is understandable if the variety in terms is accompanied by significantly different meanings; if not, this fragmentation is unnecessary and counterproductive for academia. The logic behind the previous sentence highlights an underlying problem of the matter we aim to address. That is, we raise the issue of whether the diversity in labels serves an essential purpose. But the field also struggles with the absence of a clear understanding of these labels, a concern that has recently been addressed by various authors (e.g., Hermann et al., 2016; Reischauer, 2018). The publications by Hermann et al. (2016) and Reischauer (2018) also stress the point we want to emphasize (i.e., does the diversity serve a purpose?). While they each focus on a different label, industrie 4.0 versus industry 4.0, it can be concluded from the content of their papers that they consider the other term to be equal to theirs. So why then adopt both, especially in English, and hence international, publications? We would argue – let's combine forces and stop the use of fancy but superfluous words.

The aim of this study is to assess whether the call to combine forces can be extended beyond the labels industry 4.0 and industrie 4.0. We do so by focusing on the smart industry label. In other words, the value of smart industry is assessed by examining the level of overlap with the interchangeable label industry/industrie 4.0. This approach was chosen since their descriptions have already been addressed by scholars. A definition of smart industry is still required, however. To establish one, we conducted an interview-based study with smart industry experts from the Netherlands. We therefore do not claim to offer *the* definition of smart industry. But we provide initial indications of whether there is more unity in meaning and, thus, reasons to take steps toward combining labels. As a result, our research firstly

contributes new insights to the present lack of a clear understanding for labels of the fourth industrial revolution. Second, we offer an initial reflection on the necessity of the multitude of terms and resulting fragmentation.

The remainder of this chapter is structured as follows: first, we briefly illustrate the manner in which smart industry is depicted in reports from the Dutch smart industry team and the confusion that occurs here. Next, the research process is outlined, after which we present the results from interviews conducted with smart industry experts. On the basis of these findings, a viewpoint of smart industry is developed. Using this perspective, we finally turn to our question of what is the value of smart industry.

Strict Technological Determinism?

The first official mention of smart industry in the Netherlands can be found in the Dutch report from April 2014 (Huizinga et al., 2014). The team behind this report consists of five important parties: the Ministry of Economic Affairs, the Chamber of Commerce (KvK), the Dutch employers' organization for the technology industry (FME), the Netherlands organization for applied scientific research (TNO), and the confederation of Netherlands industry and employers (VNO-NCW). In this report, smart industry is defined as a strategic vision of the future industry. Such industries are stated to have flexibility in production, being able to (fine)tune to customers' needs, and make use of the entire supply chain for value creation. Subsequently, these outcomes are said to be enabled by a network-centric approach, utilizing the value of information, information and communication technology (ICT), and the latest available proven manufacturing techniques. A recap of this description can be found later in the report when it mentions that "smart industry – driven by information, digitization, networks, and manufacturing technologies – will improve quality, increase flexibility, increase automation, enhance participation within the value chain and enhance interaction with customers" (Huizinga et al., 2014, p. 25). The above highlights that smart industry is seen as a future view of industry stemming from technology. It reflects a cause-and-effect chain in which the origin of the change is viewed from a technological standpoint. In other words, these descriptions as well as descriptions that can be found in other documents adopt a strictly deterministic (Orlikowski, 1992), or technologically imperative, perspective on smart industry (Strohmeier, 2009). The report from 2018, for example, states that:

> smart industry is about future-proof industrial & product systems; these are smart and interconnected and make use of Cyber Physical Systems. Digitization, connectivity and new manufacturing & product technology are drivers for this. (Ahsmann et al., 2018, p. 9)

Though they are scarce, smart industry documents also include descriptions that point toward a less strict, deterministic approach:

> the previous sections mainly dealt with technologies, but this is too limited. Experience shows that the implementation of technologies for the purpose of benefiting from its opportunities takes special expertise and an innovative attitude (Huizinga et al., 2014, p. 2)

and

> smart industry is about more than technological developments, ICT and different business models. It is the employee who will have to make a difference and it is important that the employee has the right skills and knowledge. (DutchSmartIndustryTeam, 2015, p. 2)

They add a moderating effect, specifically the contextual variable "skilled workforce," to the causal chain stated earlier. In doing so, a more moderate deterministic or contingency model is adopted (Orlikowski, 1992; Strohmeier, 2009).

In summary, the first official definition of smart industry and even a more recent one from 2018 formulate the label in quite a strictly deterministic manner. However, several notions can be found that depict a different story, and hence nuances are visible that can impact the value of the label. A clearer picture was therefore developed, via interviews, of smart industry as understood in the Netherlands.

Method

Participants and Procedure

Along with the program office and the steering committee, the Dutch smart industry team consists of a forum group whose members represent a diverse set of sectors and are tasked with creating support, stimulating, connecting, exchanging knowledge, realizing togetherness, and making bottlenecks negotiable and solvable (Berentsen et al., 2014). Given this role and the diversity of the members of the smart industry forum, we approached them[1], via email, with the question of whether they would like to discuss the meaning of smart industry (see Appendix for details on respondents). The interviews were held between December 2016 and February 2017. After 15 interviews, data saturation started to occur. To achieve full saturation, an additional five interviews were conducted to prevent essential aspects of smart industry from being overlooked. Consequently, we conducted 20 interviews in total. Of these participants, 15 were members, or appointed alternatives, of the smart industry forum group. Five participants were non-forum members but had been recommended as knowledgeable and actively involved in smart industry. In line with the goal of the study, we held the interviews as open conversations and asked respondents how they viewed, defined, and interpreted smart industry and/or which aspects they associated with it. Interviews centered on this one single question, which was approached without the use of any preset topics in order not to influence the outcomes. Participants were encouraged to explain things more and provide examples if they did not do so themselves. Interviews lasted an average of 47 minutes and were digitally recorded where possible; this was the case for 17 out of the 20 interviews. We transcribed the recorded interviews verbatim (resulting in 106,315 words of transcripts) and emailed

[1]The study is based on the composition of the smart industry forum on November 2016.

them to the participants with an invitation to "review it and send any comments." Participants were asked to return any feedback or corrections within two weeks. All edits received were taken into account in the data analysis.

Data Analysis

Using Atlas.ti, we first open-coded all transcripts. Chunks of text received codes based on the content that was being discussed in that segment (e.g., background on prior industrial revolutions) or terms that were explicitly stated in that part (e.g., 3D printing, zero defect, big data). In subsequent rounds we only considered pieces of text that contained codes that were of relevance to the research goal of this chapter. Consequently, segments that contained codes addressing, for instance, the background on the three earlier industrial revolutions or insights into the Dutch smart industry team were omitted. The next rounds of analysis were used to develop the remaining codes. This implied that we rephrased code names to fit their content better and bundled codes with similar meanings under a new code (e.g., codes such as internet, IT, digitalization were combined to form the code "digitized"). We also created four headings to group several related codes. In doing so, the distinct direction of each code was maintained, compared to having bundled them under a new code. These headings contained codes associated with the expected changes in output of organizations (i.e., products) or the production phase (i.e., production process) and contained organizational departments (i.e., other processes) or types of interactions (i.e., relations) expected to be subject to change. Eventually, 31 codes remained, which we checked and found that they matched the notes taken during the three non-recorded interviews. The analysis of these written notes did not result in the necessity to add new codes to the 31 identified from the transcripts. After the initial open-coding process, we applied axial coding to the 31 codes found. This process resulted in the identification of four distinct categories: intended rationales, key developments, preconditions, and expected impacts. These four categories originated from the examination of the type of words or phrases used within pieces of texts belonging to the 31 codes (see Table 1).

Findings: The Meaning of Smart Industry According to Experts

An important element that arose from the interviews was the fact that smart industry is seen as a genuinely broad term. Not only was this pointed out by the respondents themselves, *For starters, smart industry is a very broad term, very comprehensive (R16)*, it was also evident from the number of identified codes as a result of the question of how respondents viewed, defined, and interpreted smart industry and/or which aspects they associated with it. These codes are discussed below under their respective category: intended rationales, key developments, preconditions, and expected impacts (Figure 1). We further discovered that though the Dutch smart industry platform adopted a narrow interpretation of the term "industry" to create focus for their

Table 1: Examples of Wording/Phrasing and Supporting Quotes for Each of the Four Identified Categories.

Category	Notable Phrasing	Example Quotes
Intended rationales	*The wording or phrasing used expresses rationales for; e.g.:* so that; original purpose; really to; has to do with; we need to; ultimately it is; we want to maintain; understand or see that	The original goal was mainly making sure that the Dutch manufacturing industry would not miss the boat given the digitization of its industry (R4) Thirdly, you see that to remain competitive you have to keep up with current advancements, so as manufacturing companies you have to excel in the area of digitization, robots, etc. (R2) We would create a response to industry 4.0, hence what this would mean for the Netherlands. So that we could present that on the Hannover Messe (R5)
Key developments	*The wording or phrasing used indicates the essence of; e.g.:* Play important role; facing us; introduction of formulated within enumerations; stated as an antecedent in comprehensive descriptions	And I think that is also where the breadth comes from, if you look at the internet of things – which is really about getting devices connected to the internet – a number of technologies immediately come together namely: those devices know something about their current state via sensors so you get a large piece of sensor technology, communication technology is involved since the devices are connected and subsequently there are all sorts of big data and artificial intelligence machine learning aspects involved to, for instance, arrive at new insights on the basis of those data (R9) A few things play an extremely important role within the manufacturing industry. Firstly, are the robots, robotics. Thanks to the use of robots we can: make a

		production process more flexible and provide higher quality products (R2)
		Another theme that is facing us, but which has difficulty with finding solid ground, is nanotechnology (R7)
Preconditions	*The wording or phrasing used expresses required necessities; e.g.:* then at least you know; must; will play a role; condition; important; unsustainable	Because you can bring technology in but you will have to get your people on board (R8)
		The whole security question but also the question of to whom does the data belong to becomes an issue with the increase in digital exchange of information (R17)
		So there are quite a few boundary/basic conditions like big data security and standardization (R5)
Expected impacts	*The wording or phrasing used express change; e.g.:* that means that; consequence of; affects given comparison then and now; stated as an outcome in descriptions	That is the result of the IoT, that you can discuss with your customers in a whole different way (R1)
		If I look at what the digitization means for us, then firstly it means a great deal for the product we make (R12)
		Look, industry 4.0 will affect all production processes and the infrastructure of every business in the Netherlands. And so whether it is about robots, 3D printing or internet of things, it affects the core of business processes (R11)

Note: Numbers between brackets, (R…), refer to a specific respondent.

platform, the aspects highlighted by the respondents can be considered as being relevant across industries. An example quote supporting this statement is:

> In fact, the broadest definition of smart industry is how the entire business community gets started with the fourth industrial revolution. Industry is then considered in the broadest sense of the word, so we are talking about hospitals, educational, provincial and municipal institutions, real businesses and business services. Frankly, that is the broad definition which I, not so much the steering committee, but I find important as social development. Eventually, it will impact every profession, industry, company and institution in the Netherlands. (R11)

Intended Rationales

Smart industry was addressed as a response to industry 4.0 in the sense that it presented what industry 4.0 means for the Netherlands. Two broader rationales were "alerting the industry," the creation of awareness for and acceleration of the changes that are underway and the establishment of support options herein, and "competitiveness," which referred to the importance of preserving the continued existence of organizations and Dutch welfare. We found these latter two motives to be closely linked to each other; example quotes displaying this link are:

> We have to wake our people up. We have to show them what it all means, what the possibilities, opportunities and threats are. SME's often indicate being busy with their daily work. So we have to indicate that they should think about their future for otherwise their future is suddenly gone, they end up like Kodak (R7)

and

> Anyway this is the objective, accelerating technological innovation and digitalization of the industry and increasing competitiveness of the Dutch industry which is crucial for future prosperity and welfare in the Netherlands. (R8)

Key Developments

Four distinct aspects were found, covered by the majority of the interviewees, depicting opportunities that have become available to the industry. One such opportunity that we observed is the continued creation of a digital world (digitized). The importance of this aspect became apparent by the frequent use of the word "digitization," but the use of words such as "internet," "digital," "online," and "electronic" also indicated the shift toward a more digital context. A second direction that we detected was the possibility of establishing connections between devices and/or systems within firms and with external parties worldwide (connected). Respondents again adopted a varied vocabulary to signal the significance of connectivity: internet of things or conjugations of the words "connect," "link," "communicate," and "talk." The third opportunity highlighted the ability of obtaining and analyzing great amounts of real-time data (informed). In other words, there is value in possessing data, and the amount of data we can possess has the potential