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Do Machines Dream of Electric Workers?

Understanding the Impact of Digital Technologies on Organizations and Innovation

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Introduction: Do Machines Dream of Electric Workers? New Frontiers in the Debate on Technology, Structure, and Strategy

Abstract For a long time, the variable of technology has been a relevant dimension on the debate around organisations and organising. Technologies are the many resource organisations used for generating value, and since the Industrial Revolution to the digital revolution, technologies increased their importance for organising. The debate on the implications of technology use in organisations has strong roots in the organisation studies literature. Diffusion and adoption of digital technologies pose new opportunities and challenges to organisations and present new avenues for research to organisation scholars. The 2020 edition of the annual workshop of organisation studies scholars invited researchers to reflect on the relationship between technologies and to organise from a new and critical perspective. This book is a collection of the best-extended works presented at the conference discussing several aspects of impact, innovation, change, challenges, and performance of digital technologies and organisations. This introduction chapter draws a common framework presenting the different contributions and introducing how they investigate relevant phenomena and raise implications for managers and future research.

Keywords Organisation · Digital technologies

Androids, Machines, and Humans

Do androids dream of electric sheep? The wondered question is the title of a famous sci-fi novel authored by Philip K. Dick in 1968. The organisers of the 2020 edition of the annual workshop of organisation studies scholar took the question as an opportunity for inviting researchers to reflect on the implications of digital technologies for organising.

Dick's novel describes a dystopian future located in a post-apocalyptic San Francisco of 1992. A global war has significantly damaged the Earth's life, and most animal species are either endangered or extinct. The human beings live depending on machines in a world crippling under *kipple*, a sort of rubbish that builds up without any human intervention. In such a world poor of organic wildlife, owning a real pet

and not just an electric replica, is a dreamed status symbol and existential accomplishment target. The life of humans on Earth largely depends on machines. Humans live under the influence of machines they use to tweak their feelings and emotions. They are incentivised to move to off-world colonies by the possibility of counting on personal androids and robotic replicas of human beings with the role of serving humans in their needs. However, some of these androids rebel and escape to Earth, hiding from the retaliation of humans who, frightened by machines when they are no longer under their control, hunt and terminate them. In a context where mechanic life is designed to imitate organic life, the novel throws the question of the difference between nature and nurture.

Machines and Electric Workers

This book's title builds a metaphor inspired by Dick's novel, replacing androids with machinery, and electric sheep with electric workers, revamping the debate on technology and organising. The book contains a collection of original research papers authored by Italian scholars who participated to the annual edition of the organisation studies workshop and who discussed in their contributions several aspects on the implications of digital technologies for organising.

Technology has always been a central variable in organisation theory [1]. The study of the implications and relationships between the technology variables and other organisational-related variables depends on the fact that each organisation uses one or more technology to generate value transforming inputs into outputs [2]. However, technology has changed profoundly over the past years, raising many research implications for organisation theory. According to Perrow [3], technology summarises operations performed on objects through tools or mechanical devices to transform things. Innovation has pushed the nature of technology way beyond the original definition of Perrow. Technology is a variable under which different sets of tools, pieces of machinery, computers, competencies, techniques, and knowledge are used to pursue individual and organisational goals.

Digital technologies, in particular, are profoundly different from process technologies used to transform inputs into outputs, for three main reasons [4]. First of all, digital technologies are part of complex systems that do not behave linearly but present the user to continuous interrupts and changes of states with intricate patterns that make the understanding of how the overall system works complex for users. Secondly, digital technologies work continuously but need continuous updates and adaptations. Digital technologies are hence in an enduring state of constant becoming from a current state to a future state. Finally, digital technologies work at a high level of abstraction. Users interacting with digital technologies can form abstract maps of how digital technologies work. Nevertheless, these maps hardly ever perfectly match the internal processes under which the technology works, with unexpected effect, errors, and drift between expected use and use in action.

Organisation scholars studied technology from different points of view. Depending on how technology-related variables were included in the research designs, the literature has seen three approaches [5]. The first saw technology as the primary driver of changes. The second considers the social structures and agency as forces shaping technology in use. The third considers the emergent process of mutual interaction between technology and the surrounding social and organisational environment.

Three Perspectives on the Study of Technology and Organisation

The research papers selected and published in this book analyse digital technologies and organisations from three different perspectives, each discussed in the subsequent subsections.

The first perspective of analysis is that of the relationship between the technical and social sides in the socio-technical interplay inside organisations. The androids that dream of electric sheep and the humans of the dystopian future live in a sort of equilibrium. Humans resort on machines for help in their living, but at the same time depend on them, and rely on them when they have no other options from reality. Androids are designed to be as human as possible until they rebel searching for emancipation from oppressing humans. We are not at the point of the human vs robot conflict described in Dick's novel. However, for large extent organisations rely on technology, and the use of technology comes with rules, actors, routines, and values that have to coexist with existing organisational structures [6]. Section "Technology and Organising" introduces the chapters in this book discussing the implications and consequences of technology and organisation's mutual adaptation.

The second perspective of analysis is that of innovation. In Dick's novel, androids and machines, in general, represent new solutions to humans' existential problems. Living in a post-nuclear war Earth, where the planet is short in natural resources and where the alternative is an off-world colony, machines are the solution to human life in general misery. Being dystopian, the novel captures the darkest side of technology innovation and raises concern on the potential negative implications of excessive technology exploitation. The chapters in section "Innovation" discuss possible negative consequences and new opportunities and venues for organisations resulting from the exploitation of digital technologies.

Finally, the third perspective is on the debate between the virtual and the actual dimension of organising. The discussion of what is nature and what is nurture is central in Dick's novel. The electric sheep is not only the surrogate of a pet that humans hardly strive to find, but also a faithful replica of an organic form of life almost indistinguishable from a real animal. Dreaming of an electric sheep is the unknown desire of androids being more human than humans, but also the doubt of not knowing exactly what happens inside the mind of a replica machine. Current

digital technologies are less sophisticated than these androids but for other aspects are instead way more complicated. The digital transformation adds the cyber dimension to the organisation [2], potentially not just replacing, or changing ways of organising, but throwing other forms of organising that raise several challenges on the opportunities and limitations of using digital technologies in the organisation. To this regard, the chapters in section "Nurture and Nature" discuss several aspects of the virtual dimension of organisations.

Technology and Organising

Philip K. Dick's androids are at the same time both similar but different from humans, and this difference is a source of contrast. Like the technology and the humans in Dick's novel, technology and organisations are different but tend to show similar characteristics emerging from mutual adaptation and imitation processes. The problem of combined technology and organisation adjustment is the cornerstone of the socio-technical system studies [7, 8]. These flows of studies consider technology as a source of structures that constrain or empower human agency. At the same time, in society or organisations, the human agency creates structures and frames, giving meaning and legitimation to the way people use technology [9, 10].

Digital technologies affect organising in different ways, also producing profound changes in the very concept of organisation [11, 12]. The use of digital technologies affected organisational size and control, fostering better horizontal coordination, vertical control, and new forms of inter-organisational coupling. At the same time, digital technologies afforded increased visibility and control over organisational actions, enabling real-time, flexible, virtual, and mass size collaboration among organisational actors and different organisations. Concerning the implications of technology for organising five chapters in this book studies the consequences of digital technology adoption on different organisational variables.

The chapter of Maimone "Organizing for Industry 4.0" reflects on the organisational implications of Industry 4.0 technology adoption. Instead of focusing on the technological perspective like many other studies, the chapter addresses the impacts of these technologies at the meso-organisational level, exploring commonalities of strategies and practices by firms adopting Industry 4.0 technologies. The chapter discusses how semi-autonomous systems that allow a certain degree of self-organising are better suited for Industry 4.0 technology adoption.

Like the topic, the chapter of Margherita and Braccini "Consequences in the Workplace After Industry 4.0 Adoption: A Multiple Case Study of Italian Manufacturing Organisations" further explores the organisational implications of Industry 4.0 technology adoption. The chapter explores the relationship between capital and labour, particularly addressing the potential implications of job losses consequent to increased automation in manufacturing organisations. Adopting a multiple case analysis, authors discover mixing results with forms of labour disruption coexisting with forms of emancipation and empowerment. The chapter further highlights the

positive outcomes of Industry 4.0 technology adoption and formulates managerial implications on mitigating the potential disruption due to automation.

The chapter by Curzi et al. "Remote Locations Are not All the Same: Determinants of Work Well-Being Among Home-Based and Mobile e-Workers" analyses instead the impact of remote e-work on workers' well-being. They address an aspect of technology with which several people worldwide had to feel under their skin in the exceptional events of the year 2020 linked to the diffusion of the COVID-19 disease. They study the perception of work-related stress and job satisfaction on remote workers, exploring how these perceptions change depending on the type of location chosen for remote work. Their work highlights that workers who autonomously decide the location of their job show reduced work-related stress. Once the world has the pandemic beyond its shoulders, the work of Curzi et al. will be relevant to exploit real value out of smart and remote workers when the choice of the location will no longer forcedly restricted to workers' homes.

The chapter by Fabbri et al. "Work Datafication and Digital Work Behavior Analysis as a Source of HRM Insights" reflects that digital transformation on the workplace increases networked collaboration and makes it observable with unprecedented timeliness and detail. The data tracked by virtual collaboration software represent valuable pieces of information from an HR management standpoint. The chapter discusses the results of an exploratory empirical analysis of data extracted from an enterprise collaboration software. It identifies a correlation between behavioural and digital work patterns and employees' attitude. Their work implies that an algorithmic model of analysis of electronic collaboration platform data would be valid to detect and represent employees' attitude.

Finally, the chapter of Gianecchini et al. "Shaping the Future of Work", the last one of this group, tackles the need of workers to update their competencies to remain attractive on the labour market with the diffusion of digital technologies. The focus is on workers' need to show adequate competencies for being still valuable on the workplace. Their work contributes to the T-shaped professional theory. They perform a quantitative analysis through a survey, and they find four different shapes of competency combinations in their sample of workers.

Innovation

Digital technologies are a potential source of organisational innovation processes. Digital technology adoption leads to different forms of transformation by introducing new structures, actors, practices, and values that can be part of organisational innovation processes [13]. At the same time, digital technologies are the driver of several forms of disruptions, and organisational actors have to continuously engage with the new and the unexpected, balancing forms of exploration and exploitation to seize future opportunities and to drop dead ends [14, 15].

Concerning the different dimensions of organisational innovation, five chapters in this book discuss the implication and consequences of digital technologies for different forms of organisational innovation and performance improvement.

To this regard, the chapter by Acciarini et al. "Blue Ocean or Dry Desert? Blockchain and Bitcoin Impact on Tourism Industry" focuses on the potential innovation in a relevant industry, the tourism industry, as a consequence of the diffusion of blockchain technologies. Analysing social media data, authors map the current discussion on the diffusion of cryptocurrencies and blockchain-based technology in the industry. Their analysis shows a rise of interest in the potential benefits of applying these technologies to travels and tourism and identifies the presence of influencers and dissemination brokers in such public debate.

The chapter by Bolici et al. "Ecosystems in Blockchain Competence Certification: An Explorative Multi-Perspective Analysis" explores the same kind of technology, blockchain, but in a different context, studying how the blockchain can play a role in the high education industry to generate value for all interested stakeholders. They present an exploratory study in which they interviewed key informants in two Italian universities, early adopters of blockchain certification systems.

The chapter by Todisco et al. "Building the Digital Public Administration: The Impact of Social Media in the Public Sector. The Perception of Public Employees in Italian Local Context" focuses instead on public sector organisations and their potential innovation in the ear of social media diffusion. In a world where people communicate and interact through social media platforms, the chapter focuses on the implications for the public sector organisations in transparency, information diffusion, and effectiveness. In the chapter, the authors study the perceptions that civil servants have on the impact of social media on the transparency and quality of services for citizens, discovering how perceptions change with the age of civil servants, with younger groups more inclined to accept this form of innovation positively. The chapter also discusses how the differences in digital literacy levels between the two subgroups might influence their perceptions.

The chapter by Romanelli and Ferrara "Museums Driving Innovation by Technology, People and Organization" studies how knowledge-intensive organisations such as museums adopt innovation. In particular, they aim at exploring how technologies enable museums to drive innovation for creating value for their stakeholders. Their work highlights how museums can foster engagement of users through technologies and promote innovation by stimulated shared re-understanding of the museum's collection and how technologies boost museums' role as an information provider and information mediator.

The chapter by Cristofaro et al. "Measuring Healthcare Performance in Digitalization Era an Empirical Analysis" develops on performance measurement and performance measurement systems. They study how digital technologies can help healthcare organisations monitor and measure the performance of healthcare services through an exploratory study on one hospital ward that implemented such a system to improve the quality of the services offered.

Nurture and Nature

One aspect that digital technologies introduce in an organisation is the simultaneous presence of a physical and of a virtual dimension. Resorting on electronic forms of information transformation and transportation, organisations introduce the virtual dimension into their structure with virtual teams, online electronic communities of practice, and new digital collaboration forms [12]. Digital technologies afford organisations these forms of cooperation and afford increased visibility over organisational-related phenomena up to the point that they can be simulated or virtually reproduced.

Digital technologies hence afford organisations with new forms of digital cooperation. Members of virtual teams cooperate on a shared objective, regardless of the lack of proximity and synchronicity in their actions [16]. Just like the androids in Dick's novel show behaviour akin humans, but not identical, these virtual forms of organising raise new challenges for new forms of cooperation or impact traditional forms of cooperating when translated to the virtual dimension.

In this regard, three chapters in this book explore implications on the virtual dimension of organisations by introducing digital technologies.

The chapter by Bianchi "Practice Enterprise and MOOCs in Higher Education Real and Perceived Performances" focuses on both the simulated and the virtual dimensions of cooperation with the higher education industry, exploring the implications of combining simulation-based learning for management with massive open online courses. In the chapter, the author discusses how to assess such settings' performance, exploring how and if a common approach to assess performance is desirable, especially considering the differences between reality and simulation.

The chapter by Adinolfi et al. "Organizational Followership: How Social Media Communication Affects Employees' Behavior" studies the innovation in the communication process between organisations and their employees and explores the implications on the perception of reality when communication happens through digital platforms. Drawing from the literature on social network and organisational behaviour, their chapter aims at rethinking the concept of organisational followership as a consequence of the adoption of digital technologies. Their empirical study runs an experiment on Instagram, showing the persistence of potential cognitive biases in communication on social media between leaders and followers, and reflects on the organisational implications of such a result.

On a complementary perspective in relationship to the previous chapter, the chapter by Collino and Lauto "Reducing Cognitive Biases Through Digitally Enabled Training. A Conceptual Framework" studies the potential role of advanced digital technologies in reducing cognitive biases when used during training. Their work

is conceptual, and authors draw a framework for studying the relationship between training, cognitive biases, technologies, and task performance.

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Organizing for Industry 4.0

Fabrizio Maimone

Abstract The present paper is aimed to provide a theoretical framework for better understanding the relation between Industry 4.0 and organizing processes. The paper is based on a conceptual exploratory study and uses literature review to shed light to organizational strategies and configuration that may favourite the development of the so-called smart factory. Even though there are several articles and chapters on Industry 4.0, main works are focused on technology and operations. The analysis at meso-level of effective organizational strategies and practices seems to be still overlooked. This paper tries to feel this gap, trying to find out convergent elements between different organizational configurations, in order to highlight common strategies and practices. The findings of the exploratory study support the assumption that organizing and digital transformation associated with Industry 4.0 are entangled by a two-way relation: smart factory requires specific organizational strategies, model and practices. Moreover, organizational design impact of the level of digital readiness of firms and on the success of digital transformation. It is assumed that networked, flexible and semi-autonomous organizational systems that allow a certain degree of self-organization and internal/external networking seem to be more apt to face the challenge of industry 4.0. At the same time, it is possible to assume that there is not an "ideal" organizational form for Industry 4.0. The theoretical, methodological and practical implications of the main findings are discussed in the final part of the paper, and suggestions for future research are provided.

Keywords Industry 4.0 · Lean manufacturing · Networked organization

1 Introduction

According to Hess et al. [1, p. 124], digital transformation "is concerned with the changes digital technologies can bring about in a company's business model,

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which result in changed products or organizational structures or in the automation of processes. These changes can be observed in the rising demand for Internet-based media, which has lead to changes of entire business models (for example in the music industry)".

Industry 4.0 is a particular approach to digital transformation that was defined for the first time in a German government programme, aimed to increase the level of competitiveness of manufacturing industry [2]. Industry 4.0 programme was presented at the Hannover Messe in 2011 [3]. According to Buer et al. [4, p. 3], "The concept of Industry 4.0 describes the increasing digitization of the entire value chain and the resulting interconnection of people, objects and systems through real time data exchange. As a result of that interconnection, products, machines and processes are equipped with artificial intelligence and get enabled to adapt to spontaneous changes of the environment independently. Furthermore, smart objects become embedded in broader systems, which enhance the creation of flexible, selfcontrolling production systems".

Moreover, Sanders, Elangeswaran e Wulfsberg [5] affirmed that: "Industry 4.0 is the fourth industrial revolution applying the principles of cyber-physical systems (CPS), internet and future-oriented technologies and smart systems with enhanced human–machine interaction paradigms. This enables identity and communication for every entity in the value stream and leads to IT-enabled mass customisation in manufacturing [6–8]".

Salkin et al. [9, p. 4], then, pointed out that the term Industry 4.0 includes different concepts, such as improvement in mechanization and automation, digitalization, networking and miniaturization Moreover, Industry 4.0 (Ib.) implies the integration of dynamic value creation networks and it is (Ib.) "…operationalised as the usage of intelligent products and processes, which enables autonomous data collection and analysis as well as interaction between products, processes, suppliers, and customers through the internet".

According to Mrugalska and Wyrwicka [10, p. 470], that commented the results of the study "Industry 4.0", published by the Fraunhofer Institute, it is possible to find out six emerging design principles: "… interoperability, virtualization, decentralization, real-time capability, service orientation and modularity".

Industry 4.0 is considered the new "technological imperative" [11] of the first century the new millennium.

This conceptual paper begins with a critical analysis of the concept of Industry 4.0 and of the so-called technological determinism and then addresses the analysis of the emerging organizing strategies and practices that may contribute to the development of Industry 4.0.

And tries to provides a contribute to answering the following research questions:

RQ1: Does "Industry 4.0" represent a real disruptive innovation in contemporary manufacturing?

RQ2: What are the main pros and cons of Industry 4.0?

RQ3: What are the main organizing strategies and practices that emerge from the analysis of the literature review?

RQ4: What are the convergent and divergent elements that rise from this analysis?

RQ5: Is there an emerging organizational configuration that can be deduced by the analysis of the literature review?

This conceptual paper, based on the analysis and re-elaboration of the scientific literature, tries to answer these research questions, providing a complex theoretical framework.

Even though there are few articles and chapters on Industry 4.0, only [12, p. 17]: "Few contributions go into any detail on issues concerning the pure management and governance of firms, all without a comprehensive approach which is absolutely necessary in management studies (i.e., impact and changes in human resources, sustainability issues, social innovation lens)". This paper tries to give a contribution to fill this gap, providing an analysis at meso-level, of most effective organizational strategies and practices, that can be applied in different organizational configurations.

This paper, hence, is aimed to feel this gap, finding out convergent elements between different organizational configurations, in order to highlight common strategies and practices. The originality of the paper is related to the approach that is aimed to find out a set of organizational strategies and emerging practices that may be used to implement Industry 4.0 like organizational systems, adopting specific combinations that may meet the unique needs of one organization.

The originality of the paper is related to the approach that is aimed to find out a set of configurational trends and dynamic evolutionary processes, more than a set of stable organizational solutions that are difficult to be implemented in a dynamic and continuous transforming system, as it is supposed to be Industry 4.0. Therefore, the analysis is mainly focused on processes more than on structures, and therefore, the central focus of the paper is organizing.

2 The Research Methodology

The literature review has been designed following the indications provided by Webster and Watson [13]. According to these authors (Ib., p. xv): "A high-quality review is complete and focuses on concepts. A complete review covers relevant literature on the topic and is not confined to one research methodology, one set of journals, or one geographic region". Moreover (Ib., p. Xvi), "A literature review is concept-centric. Thus, concepts determine the organizing framework of a review".

Relevant articles were chosen searching the keywords "industry 4.0" and "smart-manufacturing" on the Google Scholars website and on the Scopus and JSTOR search engines. The searching was not limited to titles and abstracts but included also the body of text of the resources.

The works were selected on the base of the relevance of the contents reported in the works respect the main topics addressed in this paper and grouped on the base of the key concepts emerging from the paper analyzed.

The approach is qualitative and focused on descriptive rather than statistical methods [14, p. 1157].

Therefore, the literature review was aimed to develop a conceptual analysis in order to contribute to theory building.

3 Antinomies and Paradoxes of New Organizational Forms

Before addressing the key issues discussed in this paper, it is perhaps necessary to clarify a few crucial points, for the analysis to be followed.

Many authors have argued that there is a gap between the evolutionary trends of organizing and the theoretical models elaborated by organizational scholars. Daft and Lewin [15], for example, remarked regretfully that new organizational forms "…seem far removed from academic research".

The overlooking of contemporary organizational forms it is not only a matter of lack of attention, but also the negative of the lack of focus. In fact, in the last decades many organizational models were elaborated and proposed, but mainly by practitioners and managers. For example, holacracy, an organizational approach based on self-organizing and management of a team-based organization, was elaborated by Brian Robertson [16, 17], the founder of a software company, in order to provide a systematic description of the organizational practices adopted in his own company. TEAL was conceived too by a non-academic, Frederic Laloux [18, 19], a former associate partner with McKinsey & Company and business coach. In both cases, the focus of the models is not on "organizational solutions" that, according to Puranam et al. [20], may be defined as a set of solutions conceived to face universal problems, but on an alternative conception of organizing, which is considered as ongoing, dynamic and evolutionary process, influenced by complex system dynamics [21–23] and interconnected with a wider ecosystem.

The traditional approach assumes that organizational design should be aimed to find out organizational solutions for the four "universal problems" of organizing: task division, task allocation, reward provision and information provision [20]. It is very hard to say that contemporary organizational models (such as Industry 4.0) could be described only by using these four dimensions that presumes the assumption that organizational systems are hierarchical and centralized structures based on prefixed and stable goals, roles and tasks. According to Child and McGrath [24. P. 1137], among others, new organizational forms are instead characterized by decentralized goal setting, distributed power, flexibility, horizontality, relational orientation, fuzzy roles adaptation, adaptation, impermanence and orientation towards innovation. Therefore, it is very difficult to describe them adopting classic organizational design dimensions.

Moreover, Puranam et al. [20] assumed that organizational systems are characterized by identifiable boundaries, which is another statement that is very hard to be sustained, in the age of digital networks, globalized work teams and temporary jobs. In fact, Child and McGrath [24, p. 1137] affirmed that in the new organizational forms boundaries are permeable and fuzzy.