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# Artificial intelligence, robotics, advanced technologies and human resource management: a systematic review

Demetris Vrontis[a], Michael Christofi[a], Vijay Pereira[b] (iD), Shlomo Tarba[c] (iD), Anna Makrides[a] and Eleni Trichina[a]

[a]University of Nicosia, Nicosia, Cyprus; [b]NEOMA Business School, Reims Campus, France; [c]Birmingham Business School, University of Birmingham, University House, Birmingham, UK

## ABSTRACT

Although academic production in intelligent automation (e.g. artificial intelligence, robotics) has grown rapidly, we still lack a comprehensive understanding of the impacts of the utilization of these technologies in human resource management (HRM) at an organizational (firms) and individual (employees) level. This study therefore aims to systematize the academic inputs on intelligent automation so far and to clarify what are its main contributions to and challenges for HRM. In a systematic search of 13,136 potentially relevant studies published in the top HRM, international business (IB), general management (GM) and information management (IM) journals, we found 45 articles studying artificial intelligence, robotics and other advanced technologies within HRM settings. Results show that intelligent automation technologies constitute a new approach to managing employees and enhancing firm performance, thus offering several opportunities for HRM but also considerable challenges at a technological and ethical level. The impact of these technologies has been identified to concentrate on HRM strategies, namely, job replacement, human-robot/AI collaboration, decision-making and learning opportunities, and HRM activities, namely, recruiting, training and job performance. This study discusses these shifts in detail, along with the main contributions to theory and practice and directions for future research.

## Introduction

Today, innovative technologies are dynamically reinventing the human resource management (HRM) landscape on a global scale (Ancarani et al., 2019). Indeed, with the accelerating development and wide application of Artificial Intelligence (AI) and other breakthrough technologies,

CONTACT Michael Christofi ✉ christofi.mi@unic.ac.cy 🏫 School of Business, University of Nicosia, 46 Makedonitissas Avenue, CY-2417, P.O.Box 24005, Nicosia CY-1700, Cyprus.

the interplay between firms, employees and customers is fundamentally changing and the automation of the administrative components of HRM activities and tasks is intensifying (Larivière et al., 2017; Marler & Parry, 2016).

Although the technological evolution in HRM can be traced back to the industrial revolution, technological advancements had simply altered either physical or mental services. Contemporary developments, however, are increasingly providing alternatives to human resources in functions traditionally requiring human interaction and communication (Malik et al., 2019; Luo et al., 2019), thereby changing both the organizational structures and the nature of work (Colbert et al., 2016). Humanoid service robots and artificial intelligence bots, for example, are increasingly attracting industry attention (Araujo, 2018; Go & Sundar, 2019; Larivière et al., 2017; Thomaz et al., 2020). These intelligent "beings" have revolutionized traditional human resource functions, providing growing strengths and potentialities for HRM but also formidable challenges including job-specific obsolescence (Malik et al., 2019; Larivière et al., 2017). At the same time, deep learning algorithms, smart objects and the Internet of Things (IoT) are particularly useful for businesses operating across borders as they can foster more productive coordination and cooperation (Cooke et al., 2019). Similarly, the introduction of electronic human resource information systems and other novel technologies offer several opportunities to improve upon and reduce the cost of HRM functions including, among others, the evaluation of job applicants (Bondarouk et al., 2017; Cooke et al., 2019) and employee performance appraisals (Abraham et al., 2019; Parry & Tyson, 2011).

HRM embodied by technological advancements is increasingly the focus of internationally oriented HRM studies (e.g. Bondarouk et al., 2017; Cooke et al., 2019; Dulebohn & Hoch, 2017; Schaubroeck & Yu, 2017). Remarkably, scholars emphasize how information technologies are changing HRM-related practices by introducing e-recruitment, e-training or e-competence management, contributing positively to HRM service quality in both local and international organizations (Bondarouk & Brewster, 2016; Bondarouk et al., 2017). As these technologies are introducing new actors like social robots to HRM practices, they unlock numerous possibilities and support various HRM services (Bondarouk & Brewster, 2016; Bondarouk et al., 2017). Consistent with this view, several studies highlight the ways in which computer-aided design, manufacturing and process planning are automating many tasks and enhancing effectiveness and speed (Buckley et al., 2004; Park, 2018). Most notably, an increasing body of knowledge pertains to HRM as an enabler of technological change and innovation at a global level through

work reorganization, such as working conditions and employee training (Seeck & Diehl, 2017; Zanko et al., 2008).

Academic production in technology-enabled HRM has grown rapidly. Despite the fact that the topic is rooted in HRM literature, it is placed at the crossroads of HRM research and information management (IM) research as well as has apparently attracted considerable attention in the international business (IB) literature. Thus, this topic is inherently multidisciplinary, melding concepts from different disciplines. In fact, the study of the utilization of intelligent automation in HRM has been undertaken within four research fields: HRM, general management (GM), IM and IB. In the main, although related, these literatures have been developed in parallel and their analytical connections remain unconnected so that scholarly work remains partial and fragmented (Loebbecke & Picot, 2015; Newell & Marabelli, 2015). Moreover, several reviews of the latest HRM developments due to diverse technological advancements are available (Bondarouk & Brewster, 2016; Bondarouk et al., 2017; Fleming, 2019; Garcia-Arroyo & Osca, 2019; Stone et al., 2015), but have partially analyzed technology-enabled HRM and focused on some aspects of technology and HRM. A systematic review is therefore warranted in order to gain a holistic view of the topic, by building knowledge conduits among the literatures. While studies continue to be published from the point of view of HRM, IB and other disciplines, scholars should find a multidisciplinary synthesis invaluable. In fact, our study responds to several calls to synthesise the current state of knowledge beyond the boundaries of individual academic disciplines in reference to intelligent automation (e.g. AI, machine learning, digitization) and work (Loebbecke & Picot, 2015; Markus, 2015).

The aim of this paper therefore is to conduct a review of the literature to systematize the academic inputs so far, clarifying what it means for HRM the utilization of intelligent automation. Note that we would seek to exclude work that focuses on Big Data, as it is already the subject of excellent review studies. For example, Wenzel and Van Quaquebeke (2018) review potential opportunities and risks in organizational research based on the central characteristics of Big Data and Giacumo and Breman (2016) analyze the utilization of Big Data in workplace learning. In particular, our analysis is guided by three specific questions:

1. What themes around intelligent automation in HRM have been identified and examined to date by researchers?
2. How does the utilization of intelligent automation in HRM affect firm performance and employment conditions?
3. Which issues need to be addressed in future research?

Overcoming the approaches of previous reviews, partially emphasizing some aspects of technology and HRM, the contributions of our study are fivefold. First, our study clarifies the complex nature of intelligent automation technologies and HRM at both firm and employee level, focusing on the short-and long-term positive outcomes and challenges of these technologies at the different levels of HRM strategies and activities. Second, presenting the main research themes, namely advanced technologies, AI and robotics, and their sub-themes allows us to understand how HRM is progressively shifting from eHRM towards an HRM defined by intelligent automation. Third, we provide an organizing framework for previous research that draws linkages between AI, robotics and advanced technologies with firm performance and future of employment. In doing so, we hope to encourage theory development and guide further empirical research on this area. Fourth, our study highlights the role of intelligent automation in supporting HRM and suggests how HRM managers can overcome the obstacles arise both at local and international level through employees' involvement in technological implementation processes and collaboration between human and machines. Finally, we shed light on a number of streams of multidisciplinary research, involving HRM, GM, IM and IB fields. In essence, we consider that the incorporation of intelligent automation in the HRM field is multidisciplinary in nature, and, thus, HRM, GM, IM and IB knowledge domains should be assimilated.

The remainder of this paper is organized as follows. We begin by offering a description of the methodology employed to search and select articles relevant to our research topic. The results are categorized in three research themes, namely advanced technologies, AI and robotics, and thematically presented highlighting the emerging perspectives of the studies and describing their impact on HRM. We then present a framework to draw linkages between AI, robotics, advanced technologies and firm performance, and AI, robotics, advanced technologies and the future of employment. Subsequently, we point to the critical implications of this review. Finally, we provide a set of recommendations for future research that arise from the synthesis of the findings by taking specifically an international business approach.

## Methodology

To delineate research patterns and discern avenues for future studies related to intelligent automation in HRM, we conducted a systematic literature review following the suggestions made by Tranfield et al. (2003) as well as Crossan and Apaydin (2010). A systematic approach was

deemed appropriate because it enhances the overall quality of the review by using a transparent and easily reproduced procedure (Crossan & Apaydin, 2010; Tranfield et al., 2003). In this regard, a systematic literature review methodology enabled us to critically analyze, synthesize and map the extant research by identifying the broad themes involved.

### Selection of articles

For the purpose of this review paper, we used two methods to search for the relevant articles (Cooke et al., 2017). First, we have focused on academic articles published in 38 premier journals in the HRM, GM and IB fields. For this part of our study, we have used the same lists adopted by Pisani (2009), Pisani et al. (2017), Hewett et al. (2018) and Gaur and Kumar (2018). It was deemed appropriate to also include IM journals. The reason is that these journals provide the foundations of research pertaining to technological advancements and information systems (Van Geffen et al., 2013). Considering that the lists we adopted from the aforementioned reviews (Gaur & Kumar, 2018; Hewett et al., 2018; Pisani, 2009; Pisani et al., 2017) focused on HRM, GM and IB journals ranked 3, 4 and 4* based on the Association of Business Schools (ABS) Journal Guide 2018, IM journals that have earned rankings of 3 or above were only included ($n = 21$). Table 1 reports the entire list of 59 journals used in our study. As the focus is mainly on HRM in this section, we included only those studies that overlap with HRM, excluding studies that did not cover HRM issues.

Second, following the systematic review conducted by Hewett et al. (2018) we have used two major databases: *Business Source Ultimate (EBSCO)* and *Science Direct*. The decision to use these databases is anchored in the observation that research related to technological advancements and HRM is mostly published in journals covered by EBSCO and Science Direct. Having selected our publication outlets and following other state-of-the-art systematic reviews, we limited our research to full-length, academic peer-reviewed publications written in the English language (Marler & Boudreau, 2017; Sheehan et al., 2010). We also decided to review both review, empirical and conceptual papers (Leonidou et al., 2020). In order to gain a deep and comprehensive picture of the topic, we chose not to set any timeframe restriction to the data collection (Andresen & Bergdolt, 2017) and thus included work published before the writing of this paper (January 2020).

To find relevant articles, we sought to establish the appropriate keyword formula. In order to do so, we performed an initial scoping search of relevant articles to identify trends in keyword usage. This process led to the identification of several keywords related to intelligent automation.

**Table 1.** List of academic journals searched in alphabetical order.

| Academic Journals | |
| --- | --- |
| Specialized IB Journals | GM Journals |
| Asia Pacific Journal of Management | Academy of Management Annals |
| Global Strategy Journal | Academy of Management Journal |
| International Business Review | Academy of Management Review |
| International Marketing Review | Administrative Science Quarterly |
| Journal of International Business Studies | Decision Sciences |
| Journal of International Management | Human Relations |
| Journal of International Marketing | Industrial Relations |
| Journal of World Business | Journal of Applied Behavioral Science |
| Management and Organizational Research | Journal of Applied Psychology |
| Management International Review | Journal of Management |
| | Journal of Management Studies |
| **IM Journals** | Journal of Occupational and |
| | Organizational Psychology |
| Information Systems Research | Journal of Occupational Psychology |
| MIS Quarterly | Journal of Organizational Behavior |
| Journal of Management Information Systems | Strategic Management Journal |
| Journal of the Association of Information Systems | Journal of Service Research |
| Computers in Human Behavior | Journal of Vocational Behavior |
| Decision Support Systems | Management Science |
| European Journal of Information Systems | Organization Science |
| Expert Systems with Applications | Organization Studies |
| Government Information Quarterly | Organizational Behavior and Human |
| | Decision Processes |
| Information and Management | Personnel Psychology |
| Information and Organization | Psychological Bulletin |
| Information Society | |
| Information Systems Frontiers | |
| Information Systems Journal | |
| Information Technology and People | **Specialized HR Journals** |
| International Journal of Electronic Commerce | Human Resource Management |
| International Journal of Human-Computer Studies | Human Resource Management Journal |
| Journal of Computer Mediated Communication | Human Resource Management Review |
| Journal of Information Technology | Industrial & Labor Relations Review |
| Journal of Strategic Information Systems | International Journal of Human |
| | Resource Management |
| Journal of the American Society for Information Science and Technology | |

The use of standard Boolean operators enabled the creation of a single search algorithm (Pisani et al., 2017). Thus, these keywords were combined with the Boolean operator 'OR' to search for relevant papers in the top-tier HRM, GM and IB journals. The keyword search algorithm performed was: technolog* OR autom* OR "intelligent automation" OR "smart device" OR "Internet of Things" OR "human involvement" OR "artificial intelligence" OR "conversational agent" OR "chatbot*" OR "service agent" OR machine* OR robot* OR virtual OR intelligen* OR "automated service interaction" OR computer*. For the IM journals, however, we took a different search approach. Given the vast and varied research on advanced technologies within the IM research field, HRM-related search terms were added to the keyword search algorithm so that the search results will exclude studies that do not cover HRM issues. The HRM-related keywords were drawn from previous systematic reviews

within the area of HRM (e.g. Cooke et al., 2017; De Kock et al., 2020; Voegtlin & Greenwood, 2016). Consequently, we combined the selected search terms of each theme, namely intelligent automation and HRM, with the Boolean operator 'AND'. The search used for IM journals was as follows: (technolog* OR autom* OR "intelligent automation" OR "smart device" OR "Internet of Things" OR "human involvement" OR "artificial intelligence" OR "conversational agent" OR "chatbot*" OR "service agent" OR machine* OR robot* OR virtual OR intelligen* OR "automated service interaction" OR computer*) AND ("HR" OR "HRM" OR "human resource management" OR "human resource" OR "IHR" OR "IHRM" OR "international HRM" OR "employ* relation*" OR "human resource development" OR "human resource performance system" OR "HRPS" OR employ* OR human).

As frequently done by systematic literature reviews, we used this combination of keywords to search titles, keywords and/or abstracts (Crossan & Apaydin, 2010; Pisani et al., 2017). The first step thus included the title and abstract screening while for the studies for which the research focus was not clear from this initial step, we left it for full-text screening at the second step. We also employed a further step, by examining the selected articles' references lists to identify other relevant articles. Following that, we repeated the process of reviewing reference lists for any additional articles included.

Our initial sample of potentially relevant studies was 13,136 articles in the target databases. After reviewing titles and abstracts we omitted those studies that were not related to our research questions, leaving us with a total of 187 journal articles. Then, once we screened the full text of the remaining articles for their eligibility in regard to the inclusion criteria set, 42 passed the screening criteria. Cross-referencing led to the inclusion of 3 articles. Thus, a total of 45 articles were included for data analysis, 24 of which were empirical studies, 7 conceptual papers and 14 review articles. The oldest study included in our systematic literature review was published in 1986, while the most relevant study stems from the year 2020. These articles were published in 23 HRM, GM, IB and IM journals (see Table 2). Figure 1 shows the selection process of the articles included in the review.

It is important to acknowledge that the search might not have identified all articles relevant to the topic due to issues related to database unavailability or human error (oversight) (Cooke et al., 2017). Nevertheless, we feel confident that the pool of selected articles includes the majority of the articles in top-tier HRM, GM, IM and IB journals. Thus, it enables us to map out what has been researched and identify gaps and theory development opportunities.

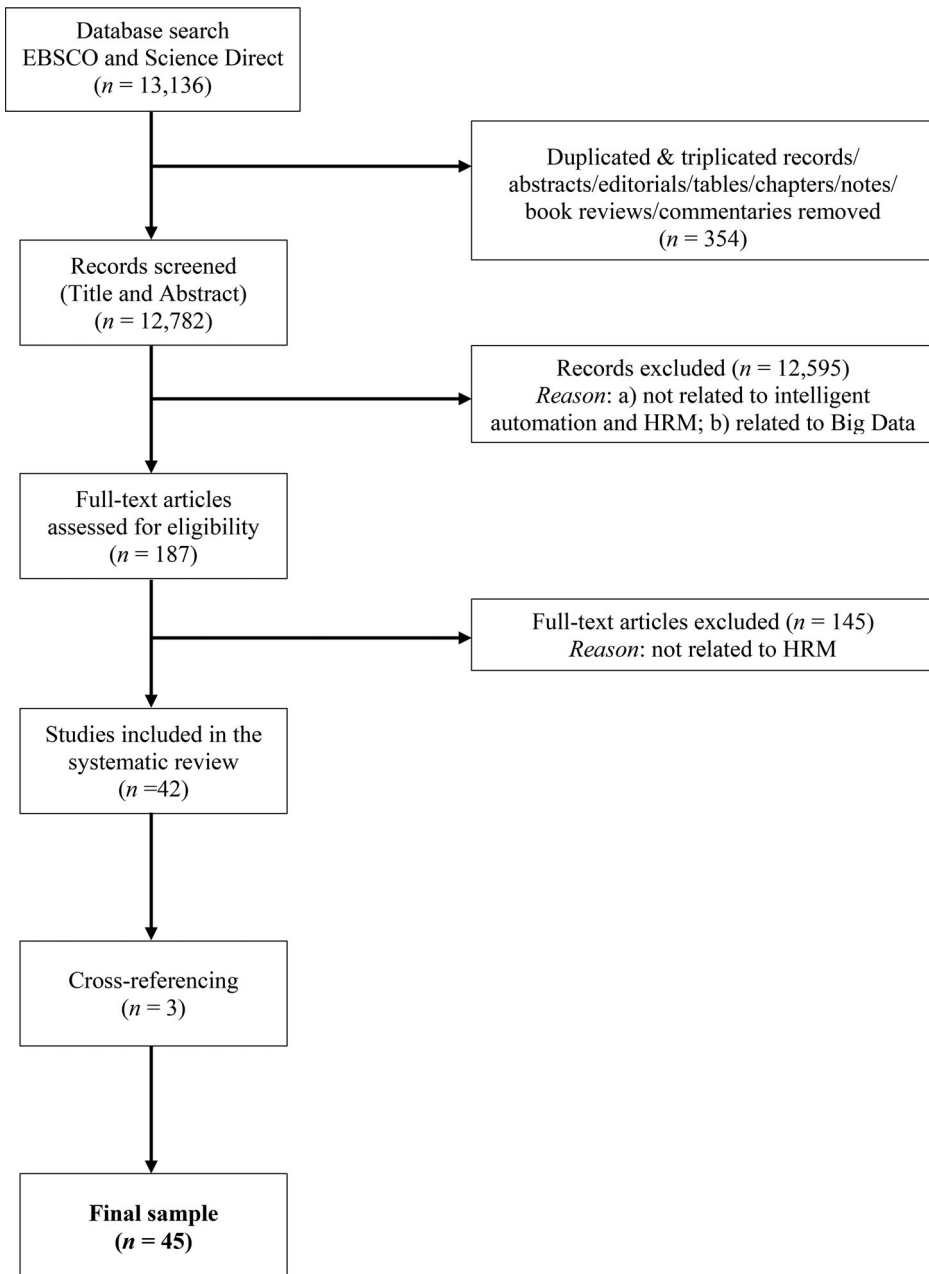**Table 2.** List of journals and number of articles found related to our study ($N = 45$).

| No. | Journal titles in descending order of number of articles | No. of articles found |
|-----|----------------------------------------------------------|-----------------------|
| 1. | International Journal of Human Resource Management | 6 |
| 2. | Computers in Human Behavior | 5 |
| 3. | Journal of Service Research | 4 |
| 4. | Journal of Applied Psychology | 3 |
| 5. | Journal of Management | 3 |
| 6. | Organization Science | 2 |
| 7. | Human Resource Management | 2 |
| 8. | Human Resource Management Review | 2 |
| 9. | Journal of Information Technology | 2 |
| 10. | Information Systems Frontiers | 2 |
| 11. | Human Resource Management Journal | 2 |
| 12. | Academy of Management Review | 1 |
| 13. | Human Relations | 1 |
| 14. | Academy of Management Annals | 1 |
| 15. | International Marketing Review | 1 |
| 16. | Journal of International Management | 1 |
| 17. | Journal of International Marketing | 1 |
| 18. | Management Science | 1 |
| 19. | Organization Studies | 1 |
| 20. | Personnel Psychology | 1 |
| 21. | Decision Support Systems | 1 |
| 22. | Information and Organization | 1 |
| 23. | Expert Systems with Applications | 1 |

## Coding

All articles deemed relevant for the purpose of this study were downloaded. We screened each article with the aim of extracting relevant information (Andresen & Bergdolt, 2017) and adding them to a data extraction form. Following Tranfield et al. (2003), this is done to eliminate human error and document the procedure for replicability and transparency reasons. Based on the objectives of our systematic review, the coded data were entered into an Excel spreadsheet and were classified in a number of categories, including publication details, type of the paper (empirical, conceptual, review), definition(s) provided relevant to our research questions, unit of analysis, effects of intelligent automation on HRM, key findings, future research directions provided by the author(s) of each study.

## Thematic analysis

Scholarly work on technology-enabled HRM has investigated diverse topics in different contexts, and thus the issues explored in the reviewed articles are many and heterogeneous. The aim of this section was to identify the key findings in the literature. We sought to find common features between articles in order to categorize them into research themes based on the unit of analysis, which would enable us to address our research questions (Bailey et al., 2017). Three main research themes were identified: (1) advanced technologies; (2) AI; and (3) robotics. We

```
┌──────────────────────────┐
│      Database search     │
│  EBSCO and Science Direct│
│       (n = 13,136)       │
└──────────────────────────┘
```

Duplicated & triplicated records/
abstracts/editorials/tables/chapters/notes/
book reviews/commentaries removed
(n = 354)

```
┌──────────────────────────┐
│      Records screened    │
│   (Title and Abstract)   │
│       (n = 12,782)       │
└──────────────────────────┘
```

Records excluded (n = 12,595)
Reason: a) not related to intelligent
automation and HRM; b) related to Big Data

```
┌──────────────────────────┐
│     Full-text articles   │
│  assessed for eligibility│
│       (n = 187)          │
└──────────────────────────┘
```

Full-text articles excluded (n = 145)
Reason: not related to HRM

```
┌──────────────────────────┐
│   Studies included in the│
│     systematic review    │
│       (n =42)            │
└──────────────────────────┘
```

```
┌──────────────────────────┐
│     Cross-referencing    │
│       (n = 3)            │
└──────────────────────────┘
```

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┌──────────────────────────┐
│      Final sample        │
│       (n = 45)           │
└──────────────────────────┘
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**Figure 1.** Process of selecting articles included in the review.

thus grouped the articles in these three research themes. The first theme (advanced technologies) included 16 articles that address the ways in which information technology and relevant technological innovations have started altering HRM in a more general perspective. The majority of articles ($n = 22$) belong to the second theme regarding AI and its influence on job replacement, human-AI collaboration, training, decision

making, and recruiting. The third theme (robotics) included 7 articles aimed at understanding the impact of robots on employment in terms of job replacement and how collaboration between humans and robots can be achieved in support of HRM, as well as their role in the creation of learning opportunities. In line with other state-of-the-art systematic reviews (Christofi et al., 2017; Christofi et al., 2019; Leonidou et al., 2020; Vrontis & Christofi, 2019), we focus on key findings, rather than providing an exhaustive analysis of each article. Appendix A provides a summary of the final sample of articles included in the review according to the three broad research themes.

### Advanced technologies

Information technologies have allowed significant transformations in the way people work and hence in organizational forms, routines and functions (Bondarouk et al., 2017). Consequently, the intersection between information technology and HRM, also referred to as eHRM, has gained increasing attention as scholars have sought to understand the external influences rather than internal influences on organizational operations and HRM practices in particular (e.g. Alcaraz et al., 2012; Parry & Tyson, 2011; Strohmeier, 2007; Strohmeier, 2009). These technologies not only have brought a new vocabulary to the HRM discourse but are altering the HRM profession. New ways of doing business are arising, thus leading to radical changes in workforce management practices and the creation of new products and services (Bondarouk & Brewster, 2016). Zammuto et al. (2007) describe five affordances – visualizing entire work processes, real-time/flexible product and service innovation, virtual collaboration, mass collaboration, and simulation/synthetic reality – that can result from this interplay.

The execution of the recruitment process online, resulting in what is commonly referred to as e-recruitment, has been widely addressed in the literature. Research thus far reveals that companies establish an e-recruiting system to reduce costs, to access more people, get quicker response and increase applicants' positive perceptions about the company (e.g. Parry & Tyson, 2008). Martinez-Gil et al. (2019) argue that automatic matching between job offers and suitable candidate profiles provides several advantages including reduced effort (in terms of cost and time) and elimination of the need for HR professionals to have knowledge pertaining to a specific professional field or skill. However, although the trend towards the use of information technology for e-recruitment has transformed the way firms recruit, select and retain employees (Stone et al., 2015), several issues impede its effectiveness. Feldman and Klaas (2002) and Stone et al. (2015) discuss these issues in depth.

Prior research also discusses other advanced technologies, for which information technology is the backbone, and their impact on HRM. The application of IoT in HRM involves changes and modifications in HR technologies (hardware, software and data), HR activities (flexibilization of employee working times, improvement of employee performance, personalization of employee working environments) and HR actors (tasks and qualifications) (Strohmeier, 2020). Employee self-service (ESS) technology allows employees to manage their own data rather than rely on HR professionals and register for training with the objective of efficiency-related gains (Marler et al., 2009). Electronic performance monitoring (EPM) has the potentiality to change various HR practices including evaluation, selection and training (Ravid et al., 2020). Many EPM forms are already widely used (e.g. call and internet usage monitoring, electronic medication administration records) and it is increasingly argued that technologies such as microchip wrist implants and body heat sensor desk hardware may be the future of work monitoring (e.g. Ravid et al., 2020). Algorithmic technologies can also help employers direct, evaluate and discipline workers (Kellogg et al., 2020). Of particular contemporary interest are virtualization technologies, that is to say, virtual representation of individuals who interact with each other in 3D digital environments. Although they have emerged from the computer games industry, they are increasingly being used to enhance interpersonal and organizational interaction and facilitate organizational learning (Dodgson et al., 2013).

Overall, research yielded contradictory results with regard to the strategic benefits of technology-enabled HRM. While information technology and other advanced technological innovations have offered several benefits (cost savings, harmonization and integration of HR activities, efficiency, support of international strategy), they have also created extra barriers (more HR administration, work stress, disappointments with technological properties) (e.g. Bondarouk et al., 2017; Stone et al., 2015; Strohmeier, 2007). Researchers also argue that the consequences of technology largely depend on context (Bondarouk et al., 2017). For some companies depending on the size, the industry and the country, technology-enabled HRM will have a negligible effect. For others, it can be seen as a key factor for success and survival in a highly competitive market.

As for employees, the implications still remain unclear. According to Levy and Murnane (2014) the number of jobs will increase, but the nature of these jobs will change. New skills will be required including problem-solving and communication that are particularly hard for computers to match. Bondarouk and Brewster (2016) argue that a decline in standard full-time employment and a growth in contingent forms of

work are inevitable. HRM transformations undoubtedly eliminate distance constraints, but the risk for an increasing lack of direct contact between the various stakeholders is lurking. Stone et al. (2015) highlight that, although there are a number of advantages, there is a danger lurking behind technology-focused HRM and suggest that technology should be viewed as a decision support tool that enhances and does not replace the HR professionals in organizations.

### Artificial intelligence

AI could be viewed as computing technologies that simulate or imitate intelligent behaviors relevant to the ones of humans despite that they act different from them (Bhave et al., 2020). Research areas around AI applications in workplace are related among others to machine learning and deep learning and they can be applied in industries across the globe (Bhave et al., 2020). Importantly, in reference to HRM, the domain of AI research encompasses AI in the context of job replacement, human-AI collaboration, training, decision making, and recruiting.

One way to comprehend AI and its applications in HRM is to think of the services that AI will replace and how this will affect the world of work in general. One theory related to this asserts that job replacement by AI will happen first at a task level instead of a job level and for "lower" intelligence tasks as these are easier and less complex to be performed by AI than human employees (Huang & Rust, 2018). Progressively, however, AI, having the ability to perform human tasks and being able to think and feel like humans, will replace human labor entirely and, thus, human interactions will fade from sight (Huang & Rust, 2018). Consider, for example, the potential impact of virtual assistants like Siri. Dealing with queries and customer support internationally, they may enable organizations to operate 24 h a day, without engaging human employees as representatives at physical locations (Glavas et al., 2019). Cano-Kollmann et al. (2018) argue that due to the dramatic advances in AI, automation and digitalization, unskilled workers in advanced economies may not only become unemployed but also "unemployable", as human tasks and jobs are either offshored, cease to exist altogether or decline.

Taking into consideration the above, we find that the progress of AI may change the fundamental nature of work and pose a serious threat to human employment. However, it can also create significant opportunities for human-machine collaboration and integration. Within this context, several authors support the view that AI can be of great value in facilitating service or sales and creating more favorable, customized and valued service interactions (Marinova et al., 2017; Singh et al., 2017). Notably,

machine learning can assist in processing interaction-based knowledge, analyze variability across interactions and clarify ambiguous patterns using data from frontline employee (FLE) – customer interactions. In this way, it gives FLEs the possibility to use this data for the provision of efficient, effective and customized solutions to customers (Marinova et al., 2017). Similarly, artificially smart technologies, being capable of natural language processing and real time learning, play an important role in complementing human interactions and increasing problem-solving effectiveness (Singh et al., 2017). AI algorithms in the realm of journalism beyond the initial programming can also assist journalists in basic works, allowing them to focus on more investigative reporting, generating at the same time news faster, at a larger scale and with less errors (Jung et al., 2017). In addition, people can use AI, often in the form of personal digital assistants, to facilitate work activities regardless of temporal and spatial location (Golden & Geisler, 2007). Overall, these observations are consistent with the view that the effect of automation technology on staffing decisions greatly depends on a facility's vertical position in the local marketplace, thereby supporting the argument that automate intelligent technologies do not lead necessarily to reduced job opportunities.

AI concerns, inter alia, information processing, logical reasoning and mathematical skills (Huang & Rust, 2018). For employees, those challenging skills could be obtained through expertise and training. Researchers argue that AI applications could be of pivotal utility in HRM for training purposes. Simulations, defined as AI environments, can provide high degree of interactivity with other users and enhance learning opportunities (Bell et al., 2008). Despite the increased cost of using such technologies, simulation-based applications allow employees to interact and comprehend how to adapt their decisions to the interactive effects of the environment and multiple competitors (Bell et al., 2008). Research also highlights the use of intelligent animated characters for training purposes, giving feedback and providing support like a human trainer (Behrend & Thompson, 2011). These intelligent agents have the ability to learn in real time and amend their training to employees' preferences and external information, addressing issues related to low engagement and isolation in web-based training (Behrend & Thompson, 2011). Within the same context, AI computer agents have been examined as important tools in enhancing employees' skills when interacting in strategic and negotiation settings, saving considerable effort and offering better performance (Lin et al., 2014).

Recent research also discusses the ways in which contemporary advances in AI increasingly offer alternatives to the actual decision making of

HRM, offering several potentialities, risks as well as vulnerabilities to organizations. Early studies in considering AI as a decision-making tool in HRM suggest that expert systems – AI applications that embody the knowledge and decision-making abilities of a human expert – can increase the accuracy of HRM decisions made by non-experts and eliminate the time required by them to make HRM decisions (Lawler & Elliot, 1996; Hooper et al., 1998). Importantly, explanations produced by AI expert systems are useful to managers who are firstly assisted by this decision-making process and are able secondly to learn why a particular decision was made (Hooper et al., 1998). Other studies pertaining to AI applications in HRM decision-making highlight the ability to process large amounts of data at high speeds (Lindebaum et al., 2020), the possibility to help salespeople to acquire new customers more efficiently (Watson et al., 2018) and the potentiality to effectively evaluate and manage employee turnover risk (Wang et al., 2017). However, even when AI improves task performance and poses no immediate threat, its extensive use in HRM decision-making is likely to be perceived as a threat to human employees' autonomy, status and job security because it can provide more options to them and confuse them, increasing perceived complexity (Lawler & Elliot, 1996). Ötting and Maier (2018) emphasize the importance of procedural justice in decision situations because it enhances beneficial employee attitudes and behavior regardless of whether these decisions are taken by human leaders or AI systems.

Moreover, the adoption of AI technologies provides several opportunities for recruiting and can simulate real work conditions towards evaluation and recruitment. Specifically, the introduction of AI applications in HRM allows HR employees to conduct background checks of job applications and develop compensation packages for certain positions (Cooke et al., 2019). AI-enabled recruitment platforms can also extrapolate possible behaviors in terms of job fit and performance while being less biased and more objective than humans (Van Esch et al., 2019). Consistent with this view, Sajjadiani et al. (2019) suggest that machine learning can greatly assist HR practitioners and firms by transforming the selection process into a more systematic process by eliminating the occurrence of recruiters' biases or even applicants' influence methods to deviate the selection process. Certainly, the numerous advantages that AI provides to HRM recruiting constitute a positive development for HRM. However, these positive effects have been questioned in a number of ways in reference to ethicality of acquiring and progressing of data as well as in terms of favorability among applicants (Suen et al., 2019; Bhave et al., 2020). Indeed, AI machine learning and deep learning applications in HRM raise questions of privacy and offer a fruitful discussion

of ethical challenges. Notably, direct applications in the employment and HR context through AI machine learning, including the analysis and collection of digital records to support traditional psychometric tests in evaluating talent and predicting work-related issues, entail several questions concerning human privacy (Bhave et al., 2020). Similar privacy issues arise when employing image and video recognition in digital interviews through AI deep learning in order to capture verbal and other interpersonal behaviors and amend them to create a psychological profile and predict possible fit (Bhave et al., 2020).

Overall, given the discussion above and recalling our analysis around advanced technologies, we can argue that with the increasing involvement of AI in the HRM field, we are witnessing a shift from eHRM to a new phase. In this phase, AI intelligent automation constitutes the tool that drives the transformation of HRM by utilizing AI applications in recruiting, training and decision-making. And although there are more paths yet to be uncovered and a number of challenges to be addressed, we need to acknowledge that AI has a say in the future of HRM.

### Robotics

Robotics involves the creation of machines that can perform human movement and mimic human behavior. In a nutshell, the field of robotics is a set of sciences related to artificial intelligence, machine learning, electronics, nanotechnology and many others. The discourse focusing on the developments in the field of robotic technologies highlights the implications that robots will have on work and employment; whereas at the other end, there is considerable optimism about the learning and training opportunities that can create for business and people in organizations. Research efforts on robotic technologies can be therefore categorized in job replacement, human-robot collaboration, and learning opportunities.

Research on robotic technologies has predicted that many jobs will soon disappear and be replaced by automation and robotics. Chao and Kozlowski (1986) highlight that the jobs that are more possible to suffer the greatest effects of job displacement are those of welding, painting, and assembling jobs as well as those employees that are less educated, experienced and skilled. It is also plausible that humanoid robots like robot waiters in restaurants and virtual assistants that provide guidance to customers through a company's website will fully substitute human frontline employees (Van Doorn et al., 2017). Other studies suggest that the impact of robotics might be of great importance for HRM and more specifically for unemployment; however, this might occur in the future. Specifically, given the way that AI, digitalization and robotic technologies

are being shaped by socioeconomic and organizational forces, predictions about mass joblessness and replacement by robotics are not likely to be realized (Fleming, 2019). Van Doorn et al. (2017) argue that situations defined by strong needs for empathy, in which developing original and creative solutions is required or that necessitate high levels of social intelligence are not at high risk for automation and replacement. Shifting away from job replacement, several researchers emphasize the need to combine human capabilities with robotic technologies in HRM to bring more insightful HR solutions. In this regard, more skilled and educated employees are needed in the era of human and robots symbiosis and collaboration to be benefited from possible opportunities and reverse potential threats (Aleksander, 2017). Robotics can support human employees by offering them opportunities for more technical positions that are either created or enhanced by robotic technologies (Chao & Kozlowski, 1986). Robotic surgery is a notable example. Although robotics can enhance precision and reduce errors if applied correctly, the human knowledge remains a vital component (Jonsson et al., 2018). Importantly, the features of technology as well as the manipulations and knowledge of the doctor are required (Jonsson et al., 2018).

Robotic technologies have also brought several learning opportunities to HRM. Work on robotics emphasizes the ways in which robotic technologies can eliminate repetitive and routine activities handled by human employees, offering to them the possibility to engage in opportunities to use their skills more effectively (Lindsay et al., 2014). At the same time, this creates new learning opportunities combined with extensive training in order for the employees to meet their altered responsibilities and acquire the skills required to work with a robot. However, employees may exhibit differential perceptions towards robots based on their occupations. Chao and Kozlowski (1986) find that high-skilled employees have more positive attitudes towards robots and their implementation as they offer them opportunities to expand further their skills and knowledge. Inevitably, jobs designed based on AI and robotic technologies are about to bring uncertainty. Yet, these technologies offer the opportunity for the design of problem-solving strategies that will be of great value (Wall et al., 1992).

## Framework development

Based on the thematic analysis, an organizing framework that captures the impact of intelligent automation on HRM is proposed and shown in Figure 2. This model indicates that intelligent automation in HRM includes AI, robotics and other advanced technologies. These
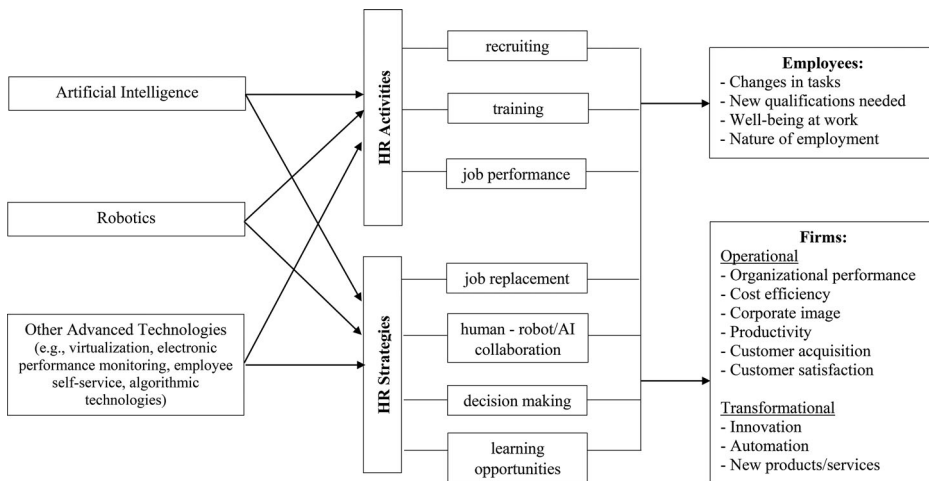
**Figure 2.** Framework summarizing the reviewed literature.

technologies are increasingly used in HRM transforming the practices of recruiting, training and job performance, altering organizations' decision-making processes, introducing job replacement issues, enabling collaboration between robots, AI technologies and employees and offering learning opportunities for employees. The model also highlights the consequences of intelligent automation in HRM for organizations and employees.

At first, AI, robotics and advanced technologies are obviously of relevance for HRM. As a model able to map the impact of these technologies on different levels, HR activities and HR strategies are considered. HR activities encompass HR functions like recruiting, training and job performance. HR strategies refer to the formulation of objectives and the implementation of HRM within the scope of job replacement, human – robot/AI collaboration, decision-making and learning opportunities. Taken together, an analysis of these components allows a depiction of intelligent automation's contribution to the future of work and overall organizational performance.

Having mapped intelligent automation within HRM settings in extant research, its actual consequences, whether beneficial or adverse, delineate a crucial aspect. Consequences occur at an individual or organizational level. Consequences at an individual level refer to impacts of technology on the nature of work like changes in tasks and qualifications and employee well-being. Leaning on extant work, consequences at an organizational level can be structured into operational and transformational. The operational consequences emphasize efficiency and overall performance outcomes. The transformational consequences refer to transformations in terms of doing business and business models.

The integrative framework proposed in this systematic review provides a road map for extant research on the topic and helps researchers in classifying and formulating the content. Hopefully, it will serve as a basis for advancement by future research incorporating other technologies, their impact on HRM and the subsequent employee-level and firm-level effects into the framework. Last, this framework relates academic research to the real-life situations that managers must deal with and thus offers important insights for practitioners.

## *Theoretical implications*

The main objective of this study was to conduct a review of extant research on intelligent automation within HRM settings to clarify what are the major implications and challenges for HR strategies and activities. This review resulted in the identification of 45 journal articles that provided us with an overview of the state of the art on this subject. Issues of those studies were addressed as opportunities or challenges for HRM, however, studies specified on AI and intelligent automation are scarce and focus mainly on other technologies or more recently on big data. Even though this is a new and emerging topic and there is lack of a solid conceptualization about the role of AI in organizational life, there are some important theoretical implications that should be pointed out.

First, building on the theory of decision-making (Edwards, 1954) as well as on recent research that has analyzed how data allow HR managers to better informed about employees (Garcia-Arroyo & Osca, 2019), we found that AI algorithms and expert systems facilitate HR processes and allow better decision-making about human employees and HR practices. In doing so, they enhance the accuracy of HRM decisions made by non-experts and eliminate the time needed by them to make HRM decisions (Lindebaum et al., 2020; Lawler & Elliot, 1996). Hence, AI plays a crucial role in strengthening the quality of HR decisions.

Second, as our study has indicated, advanced technologies and AI technologies in HRM constitutes a multifaceted theme, which is associated with a variety of academic disciplines. Therefore, we suggest that it is studied adopting a multidisciplinary approach. For instance, HR researchers could be benefited from collaborating with IM researchers or computer scientists to analyze the ethical challenges of AI technologies in decision-making processes as well as the factors that affect the way that human employees can accept these technologies.

Third, the findings of this systematic review identify the effects of AI, robotics and advanced technologies on HRM strategies and activities at both firm and employee level, questioning the role of intelligent

automation on job replacement. Notably, despite the expectations that these advancements will have a dramatic impact on employment (Frey & Osborne, 2017), our findings suggest that we are still years away from wide-ranging consequences on HRM and levels of employment.

Fourth, the development of AI, robotics and advanced technologies, involve complex processes that should consider possible challenges and risks. Important methodological and ethical challenges are associated with the novelty of the subject and are likely to be addressed progressively as the use of AI and related technologies goes on; in this sense several authors have offered helpful recommendations. For example, considering the conflicts and ethical challenges that could arise from privacy interests of employees and employers operating at a regional and international level, this could be diminished with the development of a conflict resolution model drawing on efficiency, equity, and voice that would assist stakeholders in reaching an agreement (Bhave et al., 2020).

Fifth, there are some methodological strengths of our study worth mentioning. Although other reviews of the literature related to eHRM or big data have been conducted (e.g. Garcia-Arroyo & Osca, 2019; Giacumo & Breman, 2016), the present review, applying a systematic review methodology, scopes the whole field of HRM, making it more robust. Notably, the inclusion of journal articles from a variety of disciplines adds value to this study as we map the different research sub-areas about this subject that occur in different disciplines, uncovering their key findings as well as their main concepts.

Last, by developing a framework that draws linkages between AI, robotics and advanced technologies with firm performance and future of employment, this study enables future scholars to examine the various possible roles that technology may play in HRM and enhance our understanding of underlying mechanisms and conditions under which technological advancements will result in certain outcomes.

### Managerial implications

Considering that intelligent automation constitutes an emerging research stream in the HRM field, the findings of this systematic literature review are also of considerable practical worth. This research joins the scholarly voices calling upon managers to shift their attention to the benefits of these technologies on firm and employee performance. Artificially smart technologies complement human employees' interactions, enhance problem-solving for effectiveness, provide training, give feedback and support human employees (Behrend & Thompson, 2011; Singh et al., 2017). As a result, firms should establish an organizational environment in which human employees and

technology could coexist. Moreover, as our findings suggest, firms should focus on training and ongoing development of employees in order for them to meet the criteria and skills needed for working with AI agents (Lindsay et al., 2014). Managers could encourage employees to get actively involved in trainings that will enhance their learning routines and existing knowledge base. It is the managers' responsibility to assist employees in being more engaged in such activities that will offer them the technological knowledge required in the competitive international market. Ferraris, Erhardt, and Bresciani (2019) suggest that the technological knowledge required could be acquired through numerous flexible alliances with various government and public actors, research centers and universities.Notably, although there are a number of advantages, there is a danger lurking behind technology-focused HRM, suggesting that technology should be viewed as a supporting tool that enhances and does not replace the HRM professionals in organizations. In essence, a human mind is needed for the knowledge and manipulations required. Given our findings, we would suggest that intelligence automation can boost the positive effects for HRM, if managers refrain from letting technology dominate and substitute the core meaning and role of HRM. On the contrary, practitioners should focus on the mutual development of HRM strengths and intelligent technologies.

Technological developments in HRM, including the introduction of AI, machine learning and deep learning applications for the analysis and collection of digital records in predicting work-related issues, have raised a number of concerns pertaining to human privacy (Bhave et al., 2020). Considering the privacy and ethical challenges that these positions hold, there is an emerging necessity for the development of regulations that guarantee the rights of employees or potential employees for the protection of their data. Although considerable progress has been made with the General Data Protection Regulation (EU, 2016/679), the rapid technological developments imply ongoing updates that will raise the awareness of society and employees.

Finally, in the context of global HRM, thinking of how AI technologies eliminate distance constraints but at the same time how they minimize the direct contact between the various stakeholders involving digital mediations, managers need to consider ways to use these technologies for the benefit of firms and employees. This entails assisting diverse actors to use different technologies to coherently perform shared work arrangements (Jonsson et al., 2018).

## Limitations and future research directions

There are some limitations of this review that need to be acknowledged. First, the review is restricted to work published merely in peer-reviewed

journals, which means that we do not have the complete picture. Valuable work published in non-peer-reviewed papers, books and book chapters may be available; thus, future work should be complemented by other forms of existing research, which may result in other ways of classifying extant body of work. Second, our search might not have identified all academic peer-reviewed articles related to our topic as stated earlier. Third, the keyword formula used might not have allowed relevant articles to surface. Given the increasing complexity of the HRM architecture due to the emergence of technology, and the strong interdependence between HRM, GM, IB and IM issues, there could be more articles with a focus on intelligent automation that the search keywords did not capture. As a result, despite the fact that our final sample includes articles that examine various issues related to intelligent automation from the perspective of HRM, this may not be exhaustive. In addition, there has been a plethora of technological innovations, which were examined from heterogeneous approaches, and thus it is difficult to draw a precise line of studies for inclusion and exclusion. Nevertheless, we feel confident that the pool of selected articles includes the majority of the articles in top-tier HRM, GM, IB and IM journals, thereby enabling us to identify a broad pattern.

Strohmeier (2007) suggests that the body of knowledge relevant to HRM is patchy and the question of whether eHRM is able to transform into a valued strategic partner have yet to be sufficiently addressed. Ten years later, Bondarouk et al. (2017) address the same issue and state that we still lack theory-driven and evidence-based eHRM studies in this still immature research field. Indeed, much remains to be examined and the possibilities are enormous.

We envision that in the years to come the HRM landscape will change dramatically, as the technological advancements are pushing the boundaries of business and management. Although there are many promising areas for further research, we chose to develop future research directions focused specifically on the international context for the following reasons. First, we acknowledge the call for studying technology-enabled HRM with the focus on the international context and for exploring the effects of the international context on the implementation processes (e.g. Bondarouk & Brewster, 2016). Second, the take up and use of technological innovations seem to be heavily dependent on context (Van Geffen et al., 2013). Third, the technological revolution and the more rapid pace of internationalization leads to a more strategic role for HRM, representing a major determinant of success or failure in international business (Cooke et al., 2019).

Research argues that, as far as organizational processes are concerned, the transfer of HR activities and strategies across borders can be

challenging and problematic (e.g. Chang & Smale, 2013; Ferraris et al., 2019). Thus, it would be worth investigating more closely how technology-enabled HRM is delivered in different country contexts in order to identify whether country-specific factors change the dynamics pertaining to the role of intelligent automation in HR activities and strategies or whether a global HRM model can be achieved. Developing an understanding of the contexts under which technology-enabled HR practices converge or diverge would be of great importance to firms that operate in various countries (Kivimaa et al., 2019). Furthermore, research is needed to identify those macro-contextual barriers to the implementation of intelligent automation in HRM across borders and examine how they can be overcome.

Another rather unexplored area that is ripe for future research is employees' reactions and responses to the technologically induced shift in the organizational role of HRM. Adopting a cross-cultural perspective is particularly suited for gaining insight in possible cross-national differences and similarities pertaining to employee behavior that can support or hinder the implementation of intelligent automation in HRM. Moreover, it is increasingly clear that robots will replace certain human jobs. Yet, the use of robots is likely to significantly affect not only those displaced but also managers and supervisors. Thus, it would be an interesting avenue for future work to address not only what intelligent automation has in store for various actors across the organization hierarchy but also internationalization's added layers of complexity that managing people must deal with.

From the customer's perspective, Watson et al. (2018) argue that evidence of customers' acceptance of AI is unambiguous. It would thus be an interesting avenue for future work to examine whether customers are receptive of these technologies and in which contexts AI is more effective for building customer relationships. More importantly, there is a need to identify customers' acceptance levels with an eye to specific contexts internationally, rather than accepting a universalized perspective. Undertaking cross-national comparative research in future will inform practice on how to make international strategic decisions of whether and when to replace workers with AI. While exploring the trade-offs that customers are willing to make is crucial for implementing new technologies, we argue that the impact of smart technologies on customer engagement is nonlinear and can increase and decrease over time. Thus, the time-level effect of AI and robotics in HR practices is another issue worthy of future study.

On a final note, the role of technological advancements in HRM is much more complex than just supporting or altering HR processes.

When we take into account internationalization aspects, a question is inevitably raised as to how universal the processes and effects may be. Multidisciplinary research to address this complex and hybrid topic and illustrate how traditional and new ways of managing the workforce can be balanced for the benefit of all stakeholders across the world is sorely needed. We hope that this paper will inspire future research to explore and expand on our proposed pathways, which ultimately will be of paramount importance for practice.

## Conclusion

The objective of this paper was to conduct a review of research related to intelligent automation in HRM. We searched for potentially relevant studies in 59 top-tier HRM, GM, IB and IM journals in order to clarify what is the novelty of intelligent automation for HRM. The selection process led to the identification of 45 articles that offered an overview of the state of the art on this topic. Although not exhaustive, this article shed light on the impact of AI, robotics and other advanced technologies on HRM. Recommendations for future research were also provided, which target opportunities for theoretical and empirical advancement of the field by taking specifically an international business approach. Collectively, we hope that the contributions of our study will advance the next generation of research, which will be meaningfully extended and validated in practice.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## ORCID

Vijay Pereira 🆔 http://orcid.org/0000-0001-6755-0793
Shlomo Tarba 🆔 http://orcid.org/0000-0002-1919-084X

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**Appendix A.** Categorization of articles based on research theme.

| Research Theme | Topics Included | Relevant Articles |
|---|---|---|
| Advanced Technologies (16 articles) | The application of IoT and visualization technologies in HRM involves changes and modifications in HR technologies, HR activities and HR actors. Electronic performance monitoring (EPM) and employee-self-service technology can change various HR practices including evaluation, selection and training. Algorithmic technologies can help employers direct, evaluate and discipline workers. Some HR activities have benefited by using eHRM (cost savings, harmonization and integration of HR activities, efficiency, support of international strategy), whereas others created extra barriers (more HR administration, work stress, disappointments with technological properties). | Alcaraz, Domènech, and Tirado (2012); Bondarouk and Brewster (2016); Bondarouk, Parry, and Furtmueller (2017); Dodgson, Gann, and Phillips (2013); Feldman and Klaas (2002); Kellogg, Valentine, and Christin (2020); Marler, Fisher, and Ke (2009); Martinez-Gil, Paoletti, and Pichler (2019); Parry and Tyson (2008); Parry and Tyson (2011); Ravid et al. (2020); Stone et al. (2015); Strohmeier (2007); Strohmeier (2009); Strohmeier (2020); Zammuto et al. (2007) |
| Artificial Intelligence (22 articles) | AI techniques, manifested by machines defined by human intelligence have been applied in various HR aspects. AI, including machine learning or intelligent agents could be used in HRM to improve recruiting of staff and training purposes. Potential uses include also collecting and analyzing digital records or large amount of data to supplement decision-making and evaluation of employees' processes or predict work-related outcomes such as employees' turnover. Using video recognition of candidates profile based on AI assists to capture candidates, analyze candidates' behaviors, translate them into a psychological profile, and predict potential job placement. The wide use however of employees' data entails also important implications for privacy issues and data protection laws. Additional research on AI and HR, debates on whether AI and technologies will replace humans and result in jobs loss or they can be employed to complement and support human employees. | Behrend and Thompson (2011); Bell, Kanar, and Kozlowski (2008); Bhave, Teo, and Dalal (2020); Cano-Kollmann, Hannigan, and Mudambi (2018); Cooke, Liu, Liu, and Chen (2019); Glavas, Mathews, and Russell-Bennett (2019); Golden and Geisler (2007); Hooper, Galvin, Kilmer, and Liebowitz (1998); Huang and Rust (2018); Jung et al. (2017); Lawler and Elliot (1996); Lin, Gal, Kraus, and Mazliah (2014); Lindebaum, Vesa, and den Hond (2020); Lu, Rui, and Seidmann (2017); Marinova et al. (2017); Sajjadiani, Sojourner, Kammeyer-Mueller, and Mykerezi (2019); Singh et al. (2017); Suen, Chen, and Lu (2019); Van Esch, Black, and Ferolie, (2019); Wang et al. (2017); Watson et al. (2018); Ötting and Maier (2018) |
| Robotics (7 articles) | Robotics technologies are deployed in a growing variety of work activities in which they may act as coworkers and technological tools for human employees. Robots have the potential to alter several HR practices, including the elimination of routine HR activities and allowing for opportunities for employees to use their skills more effectively and receive new learning opportunities. Research on AI and HR has also emphasized on how robots can act as employees' partners or how automation and robotics can progressively replace jobs. For employees, the implications of robotics on job replacement still remain questionable. | Aleksander (2017); Chao and Kozlowski, (1986); Fleming, (2019); Jonsson, Mathiassen, and Holmström (2018); Lindsay et al. (2014); Van Doorn et al. (2017); Wall, Jackson, and Davids, (1992) |