Guest editorial: Human resource development in the digital age: recent issues and future research directions

1. Introduction

The fourth industrial revolution (4IR) has ushered in advanced information and communication technologies (Telukdarie *et al.*, 2018), like the Industrial Internet of Things (IIoT), big data analytics, artificial intelligence (AI) and blockchain that support better information sharing, thus increasing the supply chain visibility and improving business performance (Wamba *et al.*, 2017; Dubey *et al.*, 2019). Organizations generally use lean, six sigma and 10R practices for operational excellence, and recent research has shown that big data and predictive analytics can be beneficial in lean, quality management and sustainability programs (Bag *et al.*, 2020, 2021a; Zekhnini *et al.*, 2021).

In this digital era, machines on the shop floor can make autonomous decisions based on the real-time information gathered via wireless sensor networks in the cyber-physical environment (Telukdarie *et al.*, 2018). The autonomous decisions by machines will reduce human involvement significantly; but at the same time, organizations require big data and digital technology experts to work in the new cyber-physical environment (Bag, 2016). Previous studies have revealed that resources are capabilities are essential to fully exploiting 4IR technologies (Dubey *et al.*, 2019a; Bag *et al.*, 2021b, c). Dubey *et al.* (2019a) showed that tangible resources (TR) and human skills play a vital role in adopting digital technologies. Waller and Fawcett (2013) indicated that skills, such as statistics, forecasting, optimization, discrete event simulation, applied probability, applied mathematical modeling, finance, economics, marketing and accounting are essential in this digital age. Bag (2016) argued that technical knowledge, intellectual curiosity and business acumen are the most influential criteria that a big data analytics expert must possess to work in a smart factory. Technical knowledge is vital, for example, basic statistics, understanding of machine learning, querying languages (e.g. SQL, Hive or Pig), scripting languages (e.g. Python or Matlab), statistical languages (e.g. R, SAS or SPSS) and spreadsheets (e.g. Excel). Intellectual curiosity includes a logical approach to problems and problem-solving skills. Business acumen is also crucial to recognize the market change patterns. These skills are important in current times and the demand for these skills will increase significantly in the future (Bag *et al.*, 2021d). However, recent research studies highlighted that lack of trained workforce in 4IR technologies, fear of job losses and reduction in workforce, lack of coordination and collaboration among supply chain partners are some of the major challenges in adopting 4IR technologies (Kumar *et al.*, 2020). Firms can overcome these challenges through launching digital programs, which emerging economies like China and India have already initiated. Nonetheless, the challenges vary in depth and intensity between developed and developing countries. For instance, it is easier to get support from top management and develop a data-driven culture in organizations operating in developed countries, which is difficult in organizations operating in developing

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countries (Dubey *et al.*, 2019a; Bag *et al.*, 2021b). The complexity of supply chains makes it difficult to manage and bring all suppliers and sub-suppliers under the digital program. For instance, the readymade garment industry in Bangladesh, which attracts buyers from the West, faces similar problems because of a long and complex supply chain involving multiple tiers of sub-suppliers in the upstream part of the supply chain (Bhuiyan *et al.*, 2020). Digital technologies provide firms with agility, but an absence of alignment with the suppliers and business partners can hinder technological adaption in this digital era (Dubey *et al.*, 2019b). To tackle the human resource development challenges, Sivathanu and Pillai (2018) argued that changes in organizational structure and leadership styles are essential for implementing smart HR practices. Rana and Sharma (2019) suggested that human resource managers must take proactive actions to adopt 4IR technologies and update employees' organizations to fit in this digital era. However, the shift to 4IR is challenging. Organizations must take a methodological approach such as firstly understanding the new skill sets required in this digital era, then assessing the existing resources to bridge the skill gaps and develop capabilities to adapt to this technological change. Nonetheless, existing research has failed to answer many important questions such as what are the key variables that are influencing the human resource development in this digital age; second, how they are interrelated, and last, what is the underlying mechanism. To answer these questions and extend the theoretical knowledge base, we launched the special issue call for papers on "*Human resource development in the digital stage: Recent issues and future research directions.*"

2. Literature review

To evaluate the pace of research progress, we searched for in Scopus (www.scopus.com) using the keywords "human resource development" and "digital age" on 11.12.2021. The search syntax is presented in Table 1. The results revealed 239 documents upon the initial search. However, after considering only articles in the field of "Business management and Accounting" and those in English, the number of papers was reduced to 32 (see list in Appendix A1).

First, we first observed that the number of outputs increased significantly in 2015 for the first time and the second time in 2020 (see Figure 1). The most likely reason could be the introduction of new policies and awareness created by the Government to develop human resources in this digital age.

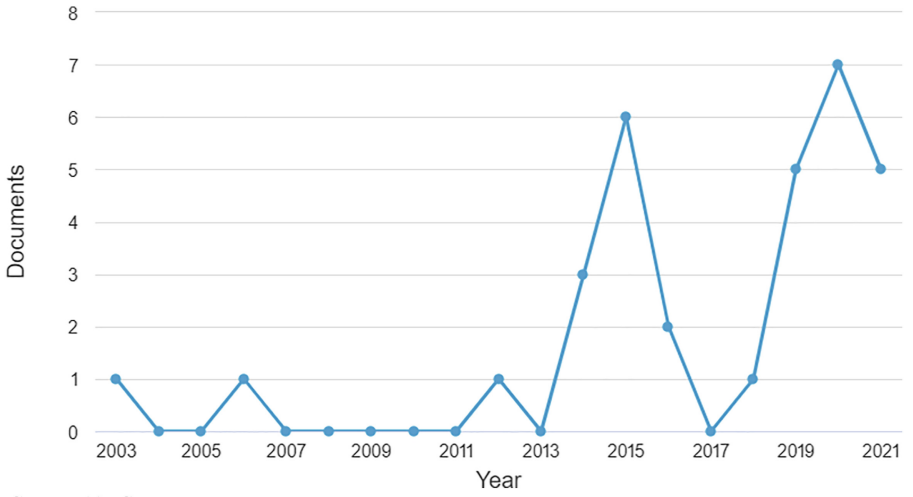
Second, we sorted the documents by author and further identified the top ten authors who have worked in human resource development in the digital age. The names of the authors are Akhter, Shahin; Barnardo, Claire; Bolcan, Aybike Elif; Bradley, Edith; Bradley, Joseph M.; Brown, Steve G.; Castelle, Kaitlynn M.; Dahiya, Ashish; Day, John W. and Dhiman, Mohinder Chand.

Third, we checked the documents by affiliation and further found the names of the top ten institutions contributing to human resource development in the digital age are Apeejay School of Management, Rohtak University, Heilongjiang Technology University, Harvard, Pa Leadership Charter School, Mercantile Bank Training Institute, Human Resources Directorate, University of Cape Town, State University of New York System and Dalian University of Technology.

Fourth, we checked the documents by country or territory and further portrayed the top ten countries (The USA, China, India, Russia, Turkey, the UK, Bangladesh, Canada, Croatia

Search syntax	No. of documents
(TITLE-ABS-KEY (human AND resource AND development) AND TITLE-ABS-KEY (digital AND age))	239
(TITLE-ABS-KEY (human AND resource AND development) AND TITLE-ABS-KEY (digital AND age)) AND (LIMIT-TO (SUBJAREA , "BUSI")) AND (LIMIT-TO (LANGUAGE , "English"))	32

Table 1.
Search syntax

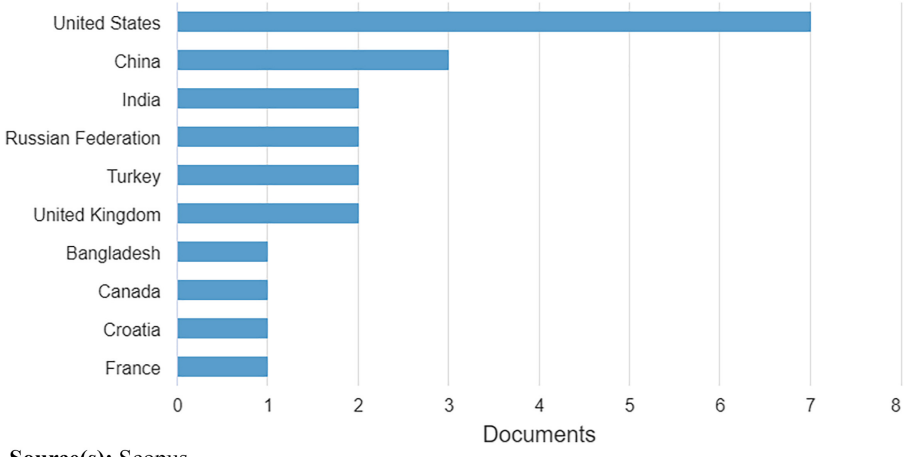


Source(s): Scopus

Figure 1.
Documents by year

and France) contributing to human resource development in the digital age. While the USA is a developed country with the greatest contribution, the second (China) and third (India) countries are developing countries where significant developments in digitalization have happened rapidly over the past few years (see Figure 2).

Fifth, we analyzed the documents by type and further portrayed the publications related to human resource development in the digital age (see Figure 3). The results indicate that 46.9% are articles, whereas 21.9% were conference papers, and most of the rest were books (15.6%). This division reflects that human resource development in the digital age is nascent, and therefore, much scientific work is published as research articles as scholars establish the body of literature.



Source(s): Scopus

Figure 2.
Documents by country or territory

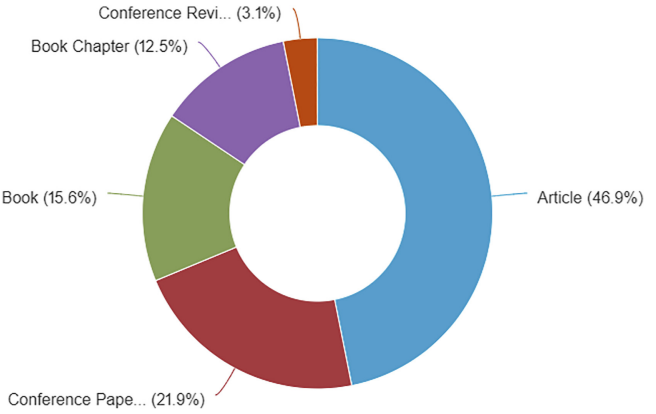


Figure 3.
Documents by type

Source(s): Scopus

Finally, we checked the top funding sources that have fueled the research in human resource development in the digital age. The results suggest that developed nations have lagged developing nations in funding or the research has not been published yet.

3. Contribution

We have attracted several important papers in response to the call for papers. The papers considered a poor fit for the Special Issue was desk rejected to allow the authors to find more suitable outlets for their manuscripts. In addition, we undertook an extensive review process guided by the journal guidelines. Finally, we accepted fourteen papers that we believe represented a significant contribution to human resource development in the digital age. We now discuss each contribution. Our SI addresses some critical issues related to quality management and supply chain management and big data with these 14 articles.

The first paper, "Human resource development 4.0 (HRD 4.0) in the apparel industry of Bangladesh: Conceptual framework and future research directions," draws on institutional theory and resource-based view theory to propose a conceptual model linking the institutional pressures and resources (workforce skills) in context to the apparel industry of Bangladesh. This paper is the first of its kind to offer a thematic analysis on human resource development 4.0 in the Bangladeshi apparel industry.

The second paper, "Developing human capital 4.0 in emerging economies: an industry 4.0 perspective," investigated the human capital skills and HR-related challenges faced by top management in industry 4.0 in emerging economies. In addition, the importance of key resources related to human assets that help attain competitive advantages, while adopting newer digital technologies, are identified. This study prioritized factors in a coordinated manner and finds relative importance in the context of industry 4.0. Therefore, it will help further identify and deploy human capital with the right skills and play a significant role when formulating organizational and HR-level strategies.

The third paper, "Analysing workforce development challenges in the Industry 4.0," aimed to identify and analyze workforce development challenges in the digital age by first presenting these challenges and relationships between them and then proposing a structural model that categorizes these challenges and proposes suggestions for managers to improve human resources practices and firm performance. The originality of this paper is in the presentation of a systematic structure for workforce development in Industry 4.0 that systematically considers challenges.

The fourth paper, "Impact of AI on employees working in industry 4.0 led organizations", attempts to develop a practical understanding of the positive and negative employee experiences due to AI adoption and the creation of technostress. It unravels the human resource development-related challenges with the onset of Industry 4.0. This research uniquely contributes to establishing a qualitative hierarchy of prominent factors constituting unintended consequences, positive impacts, and technostress creators (among employees) of AI deployment in organizational processes.

The fifth paper, "Developing human resource for the digitization of logistics operations: readiness index framework" aims to identify important factors for logistics organizations from the perspective of workforce readiness for digitization of logistics operations. The study prioritizes the identified factors and evaluates the workforce readiness index for the digitalization of logistics processes. The study's novelty lies in developing a framework for workforce readiness for digitalization in the logistics sector. The logistics field remains under-researched and provides the scope for developing strategies for improving workforce competencies for Industry 4.0. Logistics companies can improve their performance by making their workforce ready based on results from the readiness index.

The sixth paper, "Prevention is better than cure: Challenges in engaging employees through gamification," intertwines the flow and engagement theories to know the challenges faced by companies in India in implementing gamification in their various HR practices engage their employees. The findings contribute to the online engagement literature by exploring antecedents in the context of gamification of HR practices for greater work engagement.

The seventh paper, "The role of human resource practices in the implementation of digital transformation," studies some HR practices in the digital age that favor the implementation of digital transformation. The authors' arguments suggest that, for personnel to be a key asset in digital transformation processes, strategic alignment is necessary to drive the company toward these objectives. The theoretical model and hypothesis testing provide strategic value for understanding some determinants of digital transformation in relation to human resource management.

The eighth paper, "Big data and predictive analytics: A tool to retain employees in the organization," attempted to understand how big data and predictive analytics (BDPA) can help keep employees. The study offers several valuable contributions which attempt to unfold the complex nexus between human resource management, information management, and strategy. The study contributes to the BDPA literature, and how it helps retain employees is one of the areas that remain elusive to the academic community. Moreover, the managers are still skeptical about BDPA applications and human-related issues because of a lack of understanding of how and to what extent the employee-related information can be stored and processed. The findings further open the new avenues of research that need to be tackled.

The ninth paper, "Examining the influence of mindfulness on organizational role stress (ORS): A monitor acceptance theory perspective," examines the influence of mindfulness on organizational role stress (ORS) based on the monitor acceptance theory (MAT) perspective. This study provides pioneering findings establishing empirical evidence between mindfulness (M) and ORS. Training employees on M can help in effectively handling ORS.

The tenth paper, "Analysing the impact of sustainable human resource management practices and industry 4.0 technologies adoption on employability skills," examines the influence of Sustainable Human Resource Management (SHRM) practices and Industry 4.0 Technologies (I4Te) adoption on the Employability Skills (ES) of the employees. The study has undertaken examines four SHRM practices of Training (TR), Flexibility (FL), Employee Participation (EP) and Employee Empowerment (EE), to measure their impact on the employability skills along with I4Te. No research has been previously conducted on

exploring SHRM, I4Te and ES together. This pioneer in the HRM fields explores the inter-relationships and influence among the five constructs undertaken in the study.

The eleventh paper, "A study of artificial intelligence on employee performance and work engagement: the moderating role of change leadership," aims to explore employee perceptions of companies engaged in services and banking of the role of change leadership on the application of AI in organizations that will have an impact the performance and work engagement in conditions that are experiencing rapid changes. The development of this model presents the novel moderation of the change leadership variable because, in conditions that are experiencing rapid changes, the role of leaders is essential. After all, leaders are decision-makers in the organization. The development of this concept focuses on studies of companies engaged in services and banking. Employee performance is an essential determinant because it will improve organizational performance. In addition, AI applications in organizations will be tumultuous, so that they needed the critical role of leaders to achieve success with employee work engagement.

The twelfth paper, "Analysis of challenges in sustainable human resource management due to disruptions by Industry 4.0: An emerging economy perspective," aims to align human resource practices and policies with Industry 4.0. Sustainable human resource management has focused chiefly on employee welfare. However, the significant challenges of disruption caused by Industry 4.0 have not been addressed in the literature. The upskilling and reskilling requirements because of disruptions by Industry 4.0 range from recruitment to performance appraisal and every facet related to employee cycles through a company. Hence, there is a need to identify critical challenges for optimum adaptation to upcoming industry demands.

The thirteenth paper, "Investigating training effectiveness of public and private banks employees in this digital age: an empirical study," examined the pre-training and post-training variables influencing employee training effectiveness in the banking industry in this era of the digital age. The research is a pioneering effort to investigate training effectiveness that opens opportunities for financial institutions in developing nations, such as banks, to meet the challenge of the 4IR. The study also contributes to the extension of the theoretical and managerial doctrine in terms of the relationship among the pre-and post-training factors to enhance training effectiveness under the scope of the financial sector's employees to manage human resources and their development in the digital age.

The fourteenth paper, "The role of organizational culture and voluntariness in the adoption of artificial intelligence for disaster relief operations," explores the readiness of government agencies to adopt AI to improve the efficiency of disaster relief operations (DRO). For understanding the behavior of state-level and national-level government agencies involved in DRO, this study grounds its theoretical arguments on the civic voluntarism model (CVM) and the unified theory of acceptance and use of technology (UTAUT). The study offers a fresh perspective on how government officials' organizational culture and perspectives influence their inclinations to adopt AI for DRO. Additionally, it offers a multidimensional perspective by integrating the theoretical frameworks of CVM and UTAUT for a greater understanding of the adoption and deployment of AI tools with organizational culture and voluntariness as critical moderators.

4. Future research directions

The accepted articles have contributed significantly in the field of human resource development and took the theoretical debate to the next level; additionally, it has opened many research opportunities for the future that include: (1) how organizations can design human resource development programs in the digital age without compromising on the ethical aspects; (2) how organizations can develop human resources in this digital era to

enhance social sustainability among suppliers and sub-suppliers; (3) how organizations can train human resources to improve supply chain viability in this digital era; (4) how organizations can work jointly with the departments of trade and industry, other industry associations and universities in creating digital awareness and further develop plans for skill development in underdeveloped countries; (5) identifying appropriate institutional mechanisms to develop human resources in this digital age; (6) examine unique resource sets and develop dynamic capabilities to adapt in this technological change and lastly (7) propose skill development framework and training (technical and soft skills) and (short term and long term) plans that are more realistic and easy for immediate implementation by smart factories.

The business environment is highly dynamic, and new challenges will emerge with time, requiring constant research in this field. Hence, future researchers need to find answers to the above questions and explain the mechanisms for bridging the gap between theory and practice.

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Appendix

A1: List of papers downloaded from Scopus

Akther, S. and Rahman, M.S. (2021), "Investigating training effectiveness of public and private banks employees in this digital age: an empirical study", *International Journal of Manpower*, Vol. 43 No. 2, pp. 542-568, doi: 10.1108/IJM-04-2021-0240.

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