



UvA-DARE (Digital Academic Repository)

Multinational Enterprises, Industry 4.0 and Sustainability: A Multidisciplinary Review and Research Agenda

Ocelík, V.; Kolk, A.; Ciulli, F.

DOI

[10.1016/j.jclepro.2023.137434](https://doi.org/10.1016/j.jclepro.2023.137434)

Publication date

2023

Document Version

Final published version

Published in

Journal of cleaner production

License

CC BY-NC-ND

[Link to publication](#)

Citation for published version (APA):

Ocelík, V., Kolk, A., & Ciulli, F. (2023). Multinational Enterprises, Industry 4.0 and Sustainability: A Multidisciplinary Review and Research Agenda. *Journal of cleaner production*, 413, Article 137434. <https://doi.org/10.1016/j.jclepro.2023.137434>

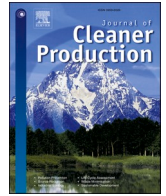
General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

UvA-DARE is a service provided by the library of the University of Amsterdam (<https://dare.uva.nl>)



Multinational enterprises, Industry 4.0 and sustainability: A multidisciplinary review and research agenda

Václav Ocelík^a, Ans Kolk^{a,*}, Francesca Ciulli^b

^a University of Amsterdam, Amsterdam Business School, the Netherlands

^b Tilburg University, Department of Organization Studies, the Netherlands

ARTICLE INFO

Handling Editor: Cecilia Maria Villas Bôas de Almeida

Keywords:

Multinationals
Industry 4.0
Digitalisation
Sustainability
Digital technologies
International business

ABSTRACT

Humanity is facing important challenges in the area of sustainability, for which all parties and means need to be brought together. Multinational enterprises (MNEs) are considered key actors for helping realise a successful transition towards a greener and more equitable future, in a time and age where much hope is set on novel digital technologies (often termed Industry 4.0) to expedite change ‘for good’. Despite this attention, however, there is limited insight into the actual state of the art regarding MNEs, Industry 4.0 and the implications for sustainability. As a result, academic knowledge of how MNEs develop and employ digital technologies, and what significance this has in relation to sustainability, is fragmented along disciplinary boundaries. We therefore conduct a systemic multidisciplinary review of the literature, examining the different types of digital technologies, the geographical scope of the studies, and the sustainability dimensions covered. Based on this critical evaluation, which considers both (potential) positive and negative implications, we present a promising research agenda for scholars on themes that are also highly relevant for organizations, individuals, societies and the planet.

1. Introduction

Humankind faces critical challenges to its survival, security and prosperity. Socio-economic inequality within and across countries is rising, with the risk of further exacerbating (inter)national conflicts and political polarisation (UN, 2020). Furthermore, the ecological disruption to our planet is worse than previously thought, and accelerating faster than predicted (UN, 2021a). While international calls for considering the human environment and a more sustainable development “that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 41), are not new (cf. Haas, 2022; Kolk, 2016), acting upon them now is widely considered as more urgent than ever.

An actor with a major impact in this regard is the multinational enterprise (MNE). MNEs constitute critical players when it comes to sustainability, broadly defined. They have extensive carbon footprints (López et al., 2019), resulting from activities around the world, and hold crucial positions in global value chains (GVCs), affecting jobs and livelihoods of entrepreneurs, workers and entire communities. Furthermore, MNEs have been facing growing pressures from stakeholders to respond to social, environmental and economic issues occurring in the locations

in which they operate (Kolk, 2016), and to develop a ‘corporate purpose’ (George and Schillebeeckx, 2022). In short, MNEs constitute agents of change in relation to sustainability, but it remains an open question whether the changes MNEs bring about are for better or for worse.

According to scholars and practitioners, digital or “Industry 4.0” (I4.0) technologies can contribute to the realisation of sustainability (Ching et al., 2022; Ghobakhloo et al., 2021; Sachs et al., 2019; Satyro et al., 2022). More specifically, these technologies have been argued to provide unique opportunities to, for example, tackle climate change (Cowls et al., 2023; EC, 2021), address poverty and hunger (FAO, 2018; Ning et al., 2021), and/or promote circularity (Ciulli et al., 2020; Jensen, 2021). Yet, it has also been noted that they can engender unprecedented challenges and risks, such as threatening human rights (UN, 2021b; Zuboff, 2019), fuelling inequalities (Schor and Attwood-Charles, 2017; UNCTAD, 2021) and increasing emissions (Cowls et al., 2023; Gibney, 2022).

Hence, how digital solutions are designed and deployed has a fundamental influence on the role they play in the transition to a greener and more equitable future. MNEs spearhead the development and utilisation of digital technologies: digital MNEs, measured by market value, are among the largest firms in the world (Fortune, 2022), and

* Corresponding author.

E-mail addresses: v.ocelik@uva.nl (V. Ocelík), akolk@uva.nl (A. Kolk), f.ciulli@tilburguniversity.edu (F. Ciulli).

non-digital ('traditional') MNEs have unique resources, capabilities and competitive motivations to pursue a digital transformation in their international activities and in that of their network partners. Hence, MNEs have the critical responsibility to realise the opportunities that digital technologies create and to mitigate their constraints, in order to contribute to sustainable development (Ciulli and Kolk, 2023). For these reasons, illuminating the implications for sustainability of MNEs' engagement with I4.0 is particularly relevant.

However, as this question has raised increasing attention from scholars in different disciplines over the last years, contemporary scientific understanding of the intersection between MNEs, I4.0, and sustainability is fragmented. This precludes academics from offering insights and recommendations to policymakers and practitioners on how to leverage the positive aspects of digitalisation, while preventing or mitigating the negative consequences. While extant studies consider the international business dimensions of corporate social responsibility (CSR) (Pisani et al., 2017); how I4.0 impacts the business operations of MNEs (Ahi et al., 2022; cf. Luo and Zahra, 2023); and the intricate dynamics between I4.0 technologies and the circular economy (Awan et al., 2022; Eisenreich et al., 2022; Hallioui et al., 2022; Rejeb et al., 2022; Toth-Peter et al., 2023), we are not aware of any work that systematically integrates the various strands of knowledge on how the implementation and diffusion of I4.0 by MNEs impacts sustainability. In other words, we lack a comprehensive, multidisciplinary framework that highlights what we know, and more importantly, what we do not yet know about the intersection between MNEs, I4.0, and sustainability.

Our review makes several contributions. To start with, it critically appraises the state of the art of multidisciplinary research at the intersection of MNEs, I4.0, and sustainability. In doing so, we synthesise academic knowledge from a highly heterogeneous set of disciplines, and thereby stimulate scholarship among complementary, yet very often distinct research communities. At the same time, our review exposes four important shortcomings in the current literature: the relative absence of conceptual and theoretical rigour; the overrepresentation of commentary and perspective pieces; the inattention to the specificities of MNEs; and the lack of focus on specific digital technologies. Stemming from the shortcomings identified in extant literature, we design a research agenda that can guide scholars in advancing knowledge at the intersection of MNEs, I4.0, and sustainability. More broadly, our review underscores the critical role of MNEs in digitalisation and sustainability. We submit that the positive and negative implications of I4.0 for society in social, economic and environmental sustainability depend for a large part on the actions and motivations of MNEs. Hence, it is incumbent upon managers to recognise their responsibility in facilitating the next push towards a more equalitarian and sustainable world.

This article proceeds as follows. Section 2 explains our methodology, outlining the sample, search procedures, the logic of the analysis and its key concepts. We subsequently summarise the 'state of the art' on MNEs, I4.0 and sustainability. Next, section 4 elucidates significant gaps in the literature and identifies several research avenues and questions scholars can explore. We conclude with a reflection on the theoretical, practical and policy implications of our work.

2. Methodology

2.1. Sample

The focal subject of this study is deliberately multidisciplinary given that the topic can be illuminated from different perspectives, such as international business, information systems and ethics. We therefore opted to cover a wide array of academic journals. Specifically, we consider all journals listed in the 2021 Academic Journal Guide (AJG) (CABS, 2021) with a ranking of 2 and above (N = 996). The AJG includes general management and IB journals, but also outlets in innovation studies, information systems, human resources, operations and technology management, regional studies and social sciences more broadly.

Our sampling method included conceptual, empirical and review articles, as well as editorials and commentary/perspective pieces. Conversely, we excluded book chapters, book reviews, scientific letters, data papers, and reprints. We covered the period 2009 up to and including 2022, and also checked forthcoming (online first/in press/early view) articles. It is important to note that, although the term I4.0 became widely used in 2015 (Schwab, 2015), we consider all articles that discuss the utilisation of digital technologies as potentially germane to our review. Hence, we define I4.0 as relating to the individual or complementary utilisation of digital technologies, such as artificial intelligence (AI), big data analytics, cloud computing, blockchain and the Internet of Things. For this reason, we took 2009 as our starting point, to make sure that all possibly relevant articles would be included (see below). We used Thomson Reuters' Web of Knowledge database and our keyword searches focused on the title, author keywords, and abstract.

Our search proceeded in four main steps (see Table 1 for an overview of the steps, including the keywords, operators, and search results). First, we retrieved all articles on the topic of sustainability, approached as covering environmental, social and economic dimensions (cf.

Table 1
Search procedure.

Number	Objective	Query	Results
1	Find all articles on sustainability	sustainab* OR green OR eco* OR environment* OR "climate change" OR clean OR circular* OR biodivers* OR pollution OR "human rights" OR hunger OR poverty OR poor OR social OR societ* OR health OR "well-being" OR peace OR migration OR education OR econ* OR "bottom of the pyramid" OR "base of the pyramid" OR inclus* OR "employment" OR "decent work" OR equality OR inequalit* OR "grand challenge"	13,472,002
2	Find all articles on multinational enterprises	multinational OR subsidiar* OR MNE* OR MNC* OR TNC* OR "transnational corporation"	81,785
3	Find all articles on digitalisation and Industry 4.0	digit* OR cloud OR "internet of things" OR "IoT" OR "machine learning" OR "artificial intelligence" OR "AI" OR "augmented reality" OR blockchain OR robotic* OR automation OR platform OR "social media" OR "social network" OR "sharing econ*" OR "additive manufacturing" OR "3D printing" OR cybersecurity OR "5G" OR mobile OR "big data" OR "Industry 4.0"	2,281,743
4	Find all articles on additional CSR dimensions	"social responsibilit*" OR "CSR" OR "social strateg*" OR "stakeholder*" OR "corporate citizen*" OR "ethic*" OR "corporate philanthropy" OR "corporate citizen"	485,747
6	All articles on the intersection of sustainability or CSR, MNEs, and Industry 4.0	(#1 OR #4) AND #2 AND #3	1754

Note: The search (on titles, abstracts and keywords) was performed on Thomson Reuters' Web of Science within the time period from 2009 up to and including 2022.

Elkington, 1994; Kolk, 2016; see also section 2.3). Second, we retrieved all articles on the topic of I4.0. As I4.0 is usually employed as an “umbrella term” (Szalavetz, 2019, p. 385) for multiple novel digital technologies, we sought inspiration from the work of consultants, policymakers, and prior academic research to compile a list of the most relevant underlying technologies, also shown in Table 1 (Ahi et al., 2022; EC, 2018; GeSI & Deloitte, 2019; McKinsey, 2018; PwC, 2016). Hence, in our search we approached the concept of ‘I4.0’ as denoting the individual or complementary utilisation of these digital technologies. Third, we identified the articles focused on MNEs. For this selection, a careful look was taken at recent literature reviews in top tier IB journals (Pisani et al., 2017; Sun et al., 2021) but, as our target was MNEs specifically, we excluded more generic terms such as ‘regional’ and ‘global’. Finally, we built on these searches to retrieve all articles at the intersection of sustainability, I4.0 and MNEs. At this point, our sample consisted of 1753 articles. It is important to note that we had not yet excluded any scientific journals at this stage.

Next, we proceeded with narrowing down the article selection to those published in journals of the 2021 AJG. For this purpose, we joined the AJG table with the table of 1754 articles based on the journals’ International Standard Serial Number (ISSN). This operation resulted in a new table which included all rows from the original table of 1754 articles, and the matching rows from the AJG table. If an article in the original table was published in a journal featured in the AJG, it should have the journal ranking indicated in the corresponding row. Instead, if its journal was not featured in the AJG, it would have a missing ranking in the resulting table, and could thus be discarded. However, due to unforeseen inconsistencies between these two tables in terms of the ISSN, not all journals in the AJG were properly matched.¹ We thus manually checked the rows with missing journal rankings to correct errors. For example, MIS Quarterly, a top journal in information systems, had different ISSNs in the two original tables. In the end, out of the 1754 articles, 601 were successfully matched. We also kept the list of articles for which a match was not found and checked whether the exclusions were correct. During this check, we identified certain journals that we decided to include, such as the Journal of International Business Policy, which is not listed in the 2021 AJG, but considered to be a strong and respectable outlet within the field of IB, as the sister journal of Journal of International Business Studies (both key journals of the Academy of International Business). Next, we filtered the list to only journals with an AJG ranking of 2 or higher.² At this point, we had 472 articles published in 202 distinct journals.

We proceeded to read the title, keywords, and abstract of each article to determine whether it should be included in the final sample. To qualify for our final sample, articles had to meet the following three criteria: (1) they included MNEs in a non-negligible form; (2) they addressed at least one I4.0 technology; and (3) they considered social, environmental, or economic sustainability in relation to one or more I4.0 technologies. One author took primary responsibility for coding, while another cross-checked the coding to ensure reliability. When discrepancies arose, we discussed and resolved inconsistencies. In the end, this resulted in a final selection of 60 articles³ (see Fig. 1 for an overview of the stages leading to the final sample).

¹ The reason for this is that, in some instances, the journal’s e-ISSN and regular ISSN were switched.

² Although for example Ajai and Kumar (2018) recommend to only include journals with a ranking of 3 and higher, given the emergent nature of the topic and the fact that some IB and sustainability journals (including the *Journal of Cleaner Production*) are ranked 2, we adjusted our approach accordingly.

³ The 60 articles covered in the literature review are marked with an asterisk in the reference list.

2.2. Analysis

We scrutinised the 60 articles on the core dimensions in line with the focus of our paper as outlined above. First, we zoomed in on the specific novel digital technology addressed. As there are different stages of diffusion of digital technologies, this analysis aimed to assess the degree to which they have already been covered by extant literature. To this end, we classified the articles based on the categories specified in the search (see section 2.1). A substantial number of studies addressed more than one technology, with some grouping them using the I4.0 umbrella term. Further, some studies focused on “digitisation” or “digitalisation”⁴ in general terms, referring to various technologies in the text, but without using the I4.0 term. We also categorised these studies addressing digitalisation or covering multiple digital technologies as “Industry 4.0”.

Second, since digital technologies may differ in implications as well as degrees of adoption and diffusion across countries, we also considered the inherent IB “geographic focus” dimension, to map the locations included in the 60 articles. In keeping with previous work (cf. Pisani et al., 2017), we classified the countries covered into “developed”, “emerging” and “developing”.⁵ Studies that could not be assigned to any of the country categories, as they did not focus on a specific location or type(s) of countries, were coded as “generic” (conceptual or empirical). We also identified articles with a comparative approach (“comparative”) between different country types, or that had a very broad, albeit clearly defined, geographic focus (“multiple types of countries”).

Third, we analysed the sample on the sustainability dimension. For this purpose, we adopted the distinction into social, environmental, and economic sustainability, which has been employed in multiple studies on sustainability (e.g., Ciulli and Kolk, 2019; Hahn et al., 2010). We specifically sought, when going through the 60 articles, for topics related to Bansal’s (2005) definition of these three facets of sustainability, where environmental sustainability denotes those human activities that do not deteriorate the planet’s land, air and water resources; social sustainability entails that all members of society enjoy equal access to opportunities and resources; and economic sustainability promotes a reasonable quality of life. We captured both the (potential) positive and negative implications of I4.0 with respect to all three dimensions, as discussed in more detail in the next section that contains our findings.

3. Multinationals and Industry 4.0 through the sustainability triplet

As explained above, we identified 60 articles matching our search criteria. Fig. 2 plots the total number of publications per year. The results demonstrate how interest in MNEs, I4.0, and sustainability has grown in recent years: there were no papers fitting our criteria prior to 2012, just 1 each year up to 2017, and then a clear overall increase after 2018, although with some variation between the years. As could be expected given our focus on MNEs, IB journals account for the largest number of articles (15), the business and management journals for 11,

⁴ Most studies use the concepts of ‘digitisation’ and ‘digitalisation’ interchangeably, but Vila Seoane (2022, p. 1747) argues that “the former is considered a more restricted concept than the latter, because it refers solely to the turning of analogue data into digital, whereas digitalisation further covers the broader political implications of these processes and their connection to capitalism.” In light of this, we use ‘digitalisation’ in this paper given our focus on broader societal implications, even if specific articles use ‘digitisation’ as generic term.

⁵ Stemming from the World Bank (2021) classification of countries based on gross national income (GNI) per capita, developed countries include the countries with a GNI per capita of \$13,205 or higher, emerging countries have a GNI per capita between \$1085 and \$13,205, and developing countries comprise the countries with a GNI of \$1085 or lower.

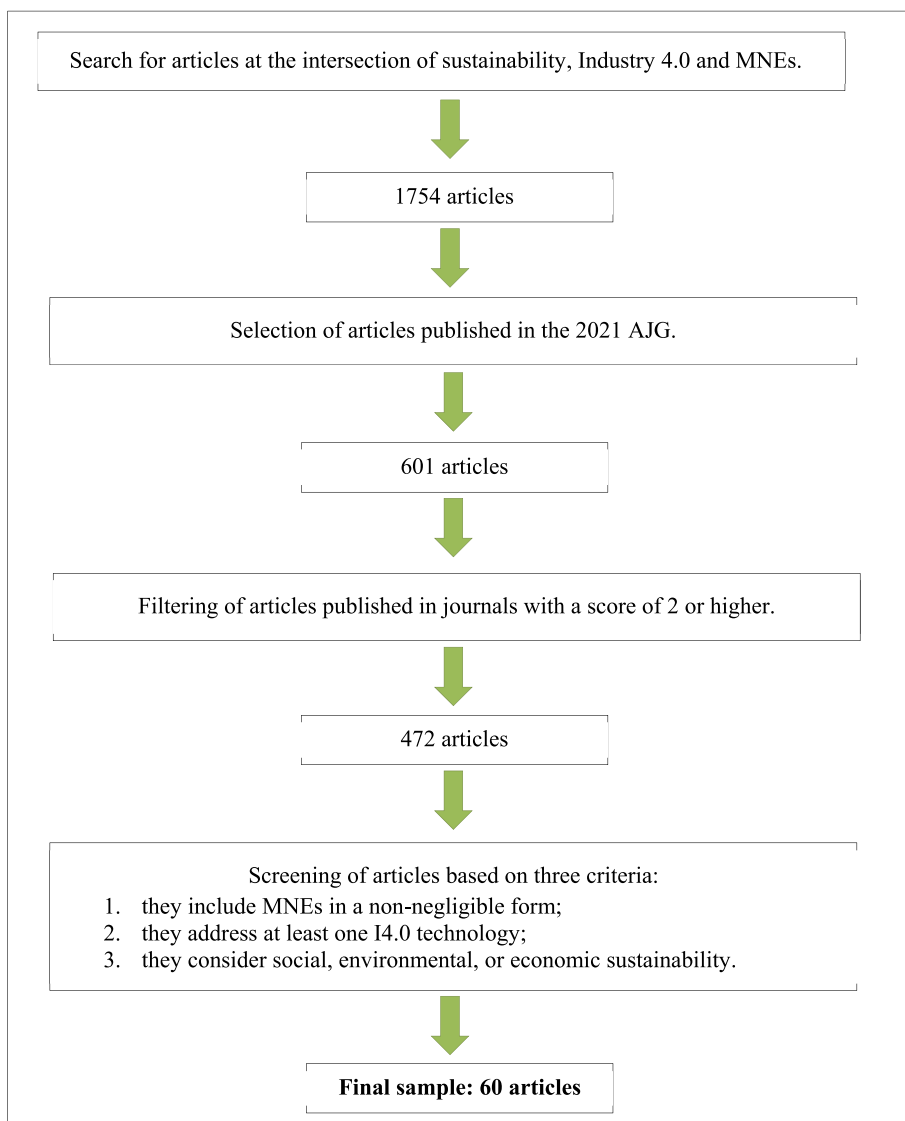


Fig. 1. Overview of the main stages leading to the final sample.

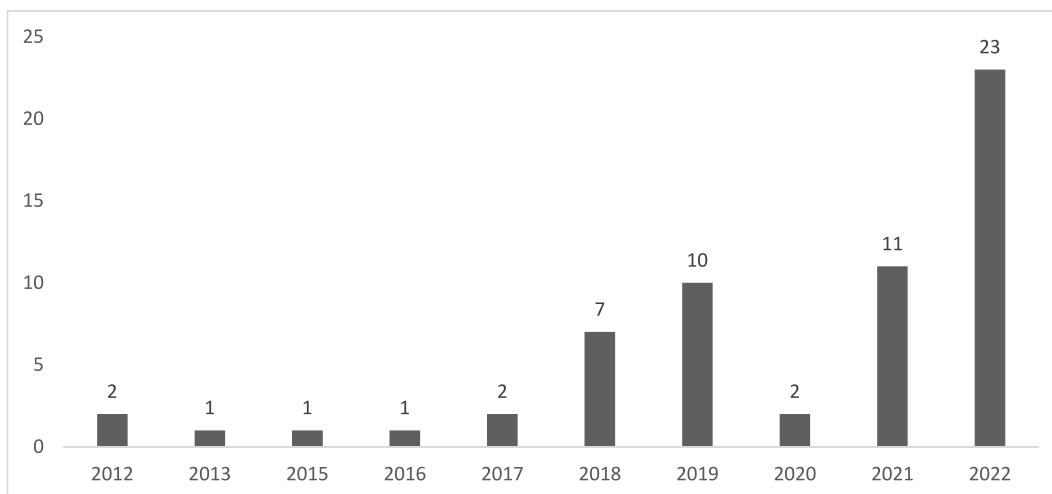


Fig. 2. Number of articles per year.

and the remaining 34 were published in other areas, such as information systems, operations research and marketing. The fact that research in these disciplines appears only a handful of times suggests that these studies are more ‘incidental’, rather than being part of a concerted research effort. Moreover, most journals in our list had only a single publication (for more details see Table 2), which seems to further underscore the fact that our subject matter is still in a relatively embryonic state. Two journals stand out in terms of the number of publications: Technological Forecasting and Social Change, and the Journal of Cleaner Production, which both have 5 publications and account for a quarter of all empirical research in our sample. As such, we observe that, although they are not IB outlets, these two journals are at the forefront of advancing academic knowledge at the intersection of MNEs, I4.0 and sustainability. Interestingly, most of the articles in our final sample are

Table 2
Overview of journals and number of articles for each outlet.

Journal	Field	Ranking	No. of articles
Technological Forecasting and Social Change	INNOV	3	5
Journal of Cleaner Production	SECTOR	2	5
Journal of Business Research	ETHICS-CSR-MAN	3	4
Business Process Management Journal	OPS&TECH	2	3
Journal of World Business	IB&AREA	4	2
International Business Review	IB&AREA	3	2
Journal of International Management	IB&AREA	3	2
Socio-Economic Review	SOC SCI	3	2
International Journal of Information Management	INFO MAN	2	2
Multinational Business Review	IB&AREA	2	2
Third World Quarterly	IB&AREA	2	2
Thunderbird International Business Review	IB&AREA	2	2
Journal of International Business Studies	IB&AREA	4*	2
Academy of Management Perspectives	ETHICS-CSR-MAN	4	1
Global Strategy Journal	STRAT	4	1
Human Resource Management	HRM&EMP	4	2
Academy of Management Discoveries	ETHICS-CSR-MAN	3	1
Business & Society	ETHICS-CSR-MAN	3	1
Business Strategy and the Environment	SOC SCI	3	1
California Management Review	ETHICS-CSR-MAN	3	1
Cambridge Journal of Economics Development and Change	SOC SCI	3	1
Energy Economics	ECON	3	1
Industry and Innovation	INNOV	3	1
Information Systems Frontiers	INFO MAN	3	1
International Journal of Human Resource Management	HRM&EMP	3	1
Journal of Business Ethics	ETHICS-CSR-MAN	3	1
Journal of International Marketing	MKT	3	1
Review of International Political Economy	SOC SCI	3	1
Strategic Organization	STRAT	3	1
Africa Journal of Management	ETHICS-CSR-MAN	2	1
Behaviour & Information Technology	INFO MAN	2	1
Competition & Change	ETHICS-CSR-MAN	2	1
Current Issues in Tourism	SECTOR	2	1
Economics of Innovation and New Technology	ECON	2	1
Information Communication & Society	SOC SCI	2	1
Journal of International Business Policy	IB&AREA	NA	1

Table 3

Overview of the number of articles per type of digital technology, geography and sustainability dimension.

Digital technology	No. of articles
Digital platforms	23
Digitalisation	15
I4.0	7
Big data	4
Automation	3
AI	3
Cloud	2
IOT	2
Blockchain	1
Geography	
Generic	22
Emerging	17
Developed	13
Comparative	5
Multiple	3
Sustainability	
Social	
Social inequalities and vulnerabilities	16
Human rights	11
Impact of digital technologies on workers	6
Stakeholder engagement	4
Corruption	3
Economic	
Increased unemployment	9
Inclusive growth	7
Noncompliance with labour market regulations	4
Environmental	
Resource efficiency	10
Pollution	9
Smart cities	3
Green FSAs	2

published in journals with a ranking of 2 or 3 (51 in total). Only 6 articles in our sample are published in journals with a ranking of 4, and just 2 in a so-called 4* journal, marked as the highest category in the AJG.⁶ The subsections below delineate the key insights emerging from the 60 articles, with respect to types of digital technologies, geographies, and sustainability dimensions (see sections 3.1, 3.2 and 3.3., respectively). Table 3 presents an overview of the technological focus, geographic scope, and sustainability dimensions covered by the articles in our sample.

3.1. Types of digital technologies

Digital platforms receive most attention in this category, but we also found numerous articles dealing with ‘digitalisation’. These articles do not focus on a single digital technology: they instead consider how multiple digital technologies, for example AI and blockchain (Ajwani-Ramchandani et al., 2021), complement each other in certain contexts; in other cases, scholars use the label I4.0 to capture the combination of different technologies. As we did not find significant differences in the bundles of technologies included under digitalisation (e.g., George and Schillebeeckx, 2022) or I4.0 (e.g., Dilyard et al., 2021), we discuss these two categories together. Interestingly, other individual technologies (such as cloud computing and the Internet of Things, IoT) are hardly studied in relation to MNEs and sustainability, as illustrated in Table 3. Given these frequencies, we first present the key topics addressed regarding digital platforms, followed by the I4.0 and digitalisation categories, and finally the other individual technologies.

Digital Platforms facilitate different kinds of exchanges, and several of the articles zoom in on social media, sharing platforms, internal enterprise platforms, mobile payment platforms, and other types of platforms

⁶ The remaining article was published in the Journal of International Business Policy, which is not included in the 2021 AJG.

owned by so-called “Big Tech” MNEs. The largest number of studies focus on social media, where scholars uncover multiple implications for MNEs and sustainability. A few studies address how social media platform MNEs expedite socio-political development within countries and communities by empowering individuals (Benmamoun et al., 2012; Kalliny et al., 2015; Kariippanon and Gurruwiwi, 2022). Relatedly, Li et al. (2022) direct their attention to social media users and uncover differences in their privacy preferences across countries that social media platform MNEs should recognise. Nwagbara (2013) explores the potential of social media to promote environmental sustainability and advance CSR communications of oil and gas MNEs in Nigeria, while Nasr et al. (2022) note that location-specific factors may affect user engagement with CSR posts shared by MNEs. Relatedly, Tian (2022) studies how political hostility impacts the rhetorical strategies of MNEs in China, underscoring the importance of social media channels to manage relationships with stakeholders and respond to socio-political conflict. Another group of articles focuses on sharing platforms. Much of this research scrutinises the sustainability implications of the business models of Uber and Airbnb, two MNEs centred on sharing platforms (Clancy, 2022; Dreyer et al., 2017; Marano et al., 2020; Parente et al., 2018; Punt et al., 2021; Uzunca et al., 2018). Scholars emphasise that sharing platform MNEs must consider the socio-economic impact of their operations on local stakeholders. For example, Dreyer et al. (2017) find that a developed-country sharing platform MNE like Uber must adapt its business model to local contexts in developing countries to avoid unintended negative impacts on vulnerable social groups, while Marano et al. (2020) assert that the disruptive business models of Uber and Airbnb generate distinct legitimacy challenges that confound market entry. Almost at the other end from an organisational perspective are internal enterprise platforms, where scholars scrutinise the sustainability consequences of MNEs adopting digital platforms within their firm. Research suggests that enterprise platforms can increase transparency and accountability inside the MNE (Hussain et al., 2019), achieve more sustainable energy usage (Loureiro and Labandeira, 2019) and facilitate greater external stakeholder involvement in innovation processes (Nylund et al., 2021).

We also found studies looking at other types of platforms owned by Big Tech MNEs. Tan and Tan (2012) posit that Google’s decision to exit the Chinese market was a culmination of the ethical and CSR conflicts with the government. Rikap (2022) discloses how Amazon predated value from suppliers and third-party firms participating in its platform. Coveri et al. (2022) argue that Amazon possesses enormous power due to its diversification strategy; control over digital technologies; uneven bargaining power with governments; and global labour fragmentation; and that it uses this power to dominate other firms and suppliers. Boyer (2022) instead juxtaposes a platform economy centred on Big Tech MNEs with those controlled by the state or by citizens, showing different implications for social relations and power distributions in society. Finally, a few studies focus on mobile payment platforms, discussing how they enable marginalised groups to access capital and new employment opportunities, and highlighting MNEs’ positive role in fostering their use in contexts characterized by institutional voids (Kabengele and Hahn, 2021; Onsongo, 2019).

As highlighted previously, both *I4.0* and *Digitalisation* are used as umbrella terms for a variety of digital technologies. A few studies take an industry-specific focus on digital technologies. Within the manufacturing industry, scholars find that digitalisation leads to greater unemployment based on the importance placed by MNEs on investing in digital technologies and upgrading firm-level capabilities (Plumwongrot and Pholphirul, 2022; Szalavetz, 2019). At the same time, Hauge (2021) argues that digitalisation can exacerbate power differences between the Global North and South, by allowing Western MNEs to appropriate increasing shares of profits over a larger market. Laurenza et al. (2018) examine the Italian health care industry and postulate that a healthcare MNE deploying digital technologies can improve patients’ wellbeing and quality of life, but also introduce privacy issues in terms of sharing

sensitive medical data. Forcadell et al. (2020) investigate the global banking industry and find that the combination of digitalisation and reputation for corporate sustainability lowers multinational banks’ governance costs and expands their economic activities.

Our sample also contains articles that consider how I4.0 technologies affect global business processes. These studies highlight the challenges of digital nationalism and vulnerability in internationalisation processes (Verbeke and Hutzschenreuter, 2021); why and how business seeks to influence digital policies (Kemmerling and Trampusch, 2022); the dynamics of digital technologies and corruption (Malik and Froese, 2022; Park and Xiao, 2021; Riaz et al., 2022); and the need to better understand how digital technologies shape international market entry, for example how AI minimises human interaction and thus potentially lower customers’ trust and commitment (Watson et al., 2018). Furthermore, scholars also contemplate how digitalisation fosters global innovation networks, producing both economic winners and losers (Cano-Kollmann et al., 2018), and improves the resilience and environmental sustainability of GVCs (Dilyard et al., 2021). Finally, several studies take a more generic perspective on I4.0. This body of work studies how I4.0 technologies optimise resource efficiency and minimise waste within firms, innovation ecosystems, and smart cities (Ajwani-Ramchandani et al., 2021; Gholami et al., 2022; Oyinlola et al., 2022; Van den Buuse and Kolk, 2019). It also offers general observations and research recommendations about the new challenges and realities for MNEs in a digital world, also in relation to sustainability (Ahi et al., 2022; Cooke et al., 2019; George and Schillebeeckx, 2022; Ghauri et al., 2021; Satyro et al., 2022; Srinivasan and Eden, 2021; Yi et al., 2022).

A more limited number of articles target specific types of digital technologies. Four studies concentrate on big data analytics. The concerns of relinquishing control over this technology to (foreign) MNEs raise most consideration. Specifically, Chenou and Radu (2019) address the “right to be forgotten”, as brought forward during negotiations between a big tech MNE, Google, and European Union (EU) regulators with respect to big data. Vila Seoane (2021) probes data localisation requirements in India, accentuating how foreign MNEs, in concert with foreign governments and local actors, lobbied the national government to alleviate these measures in favour of free cross-border data flows. Mann (2018) discusses the social and economic downsides of giving foreign MNEs unique access to big data on the poor in emerging and developing countries, and underscores the importance of fostering a fairer distribution of benefits and local economic development. *Automation* comes to the fore in three articles, which argue that, while this technology allows MNEs to implement higher labour and environmental standards, it also reduces employment opportunities for lower-skilled workers (Munsamy et al., 2019; Narula, 2019; Plumwongrot and Pholphirul, 2022). Three studies in our sample focus on *AI*. Budhwar et al. (2022) evaluate the effects of employing AI in international human resource management on job losses and employee wellbeing. Dauvergne (2022) offers a critical perspective on the supposed greening effect of AI on global supply chains. And Malik et al. (2022) find that AI-assisted human resource management enhances employee experience, resulting in higher employee engagement, loyalty and commitment. We also identified two articles that address the deployment of *IoT* in MNEs’ smart cities projects. Scuotto et al. (2016) detail how IBM adopted an ‘open innovation model’ to develop smart city projects in different locations, while Bresciani et al. (2018) highlight the importance of knowledge management capabilities and strategic alliances. There are also two articles that cover cloud computing. Gozman and Willcocks (2019) focus on the need for MNEs in regulated industries to manage the risks from outsourcing arrangements to cloud services providers, particularly with respect to data protection. Patchell and Hayter (2021) instead uncover how cloud MNEs develop new green firm-specific advantages (FSAs) inspired by the Sustainable Development Goals. Finally, *blockchain* is addressed in just one article, which investigates how this technology can be deployed by MNEs to increase the transparency of their global supply chains (McGrath et al., 2021).

3.2. Geographic focus

A key aspect relevant to IB is the geographic focus of studies. The largest number of articles, 22 out of 60, are *generic* in nature, as they are not geared towards a specific country or location. Within this body of work, 13 are literature reviews, perspectives or editorials (Ahi et al., 2022; Boyer, 2022; Budhwar et al., 2022; Cano-Kollmann et al., 2018; Dauvergne, 2022; Dilyard et al., 2021; George and Schillebeeckx, 2022; Ghauri et al., 2021; Parente et al., 2018; Srinivasan and Eden, 2021; Verbeke and Hutzschenreuter, 2021; Watson et al., 2018; Yi et al., 2022), and five are conceptual studies (Kemmerling and Trampusch, 2022; Malik and Froese, 2022; Nylund et al., 2021; Rikap, 2022). In addition, there are four empirical articles that either do not specify the countries in their research design, or cover topics that are global or location-agnostic in nature (Gholami et al., 2022; McGrath et al., 2021; Munsamy et al., 2019; Patchell and Hayter, 2021).

Interestingly, the second largest group of articles (17) focuses on *emerging markets*. Out of these 17, 11 are *single-country* studies. China raises particular interest with its unique and challenging institutional, technological and cultural context (Cooke et al., 2019; Park and Xiao, 2021; Tan and Tan, 2012; Tian, 2022). There is also attention for MNEs operating in emerging markets on the African continent, namely in relation to the potential of social media to promote sustainability in Nigeria (Nwagbara, 2013), sharing business models in South Africa (Dreyer et al., 2017), and mobile payment services in Kenya (Onsongo, 2019). Our sample also includes three studies on India, examining the circular economy (Ajwani-Ramchandani et al., 2021) data sovereignty (Vila Seoane, 2021), and AI-assisted human resource management (Malik et al., 2022); and one on Brazil, which investigates the environmental and social challenges and opportunities of I4.0 technologies, among others, for MNEs (Satyro et al., 2022). Further, several studies include *multiple emerging countries* grouped together under a particular label, such as the Arab world (Benmamoun et al., 2012; Kalliny et al., 2015), the Global South (Hauge, 2021), or 'simply' emerging markets (Kabengele and Hahn, 2021; Narula, 2019; Plumwongrot and Pholphirul, 2022).

Thirteen articles focus exclusively on *developed countries* and cover diverse topics and geographies. Most of this research constitutes *single-country* studies. Two studies in Italy examine how MNEs' adoption of I4.0 technologies facilitates the development of smart cities and the improvement of the health care system (Bresciani et al., 2018; Laurenza et al., 2018). A couple of studies in Australia examine the use of digital technologies by Aboriginal communities neighbouring a multinational mining company (Kariippanon and Gurruwiwi, 2022), and how digitalisation thwarts corrupt practices by enhancing the transparency of information flows (Riaz et al., 2022). A number of developed countries in our sample occur only once: scholars examine I4.0 technologies by MNEs' foreign subsidiaries in the Hungarian manufacturing sector (Szalavetz, 2019); the micro effects of I4.0 technologies and digital platforms in the UK (Hussain et al., 2019); sharing platform MNEs and the housing crisis in Ireland (Clancy, 2022); and how big data analytics architectures of MNEs advance sustainable innovation in Portugal (Santos et al., 2017). In addition to these single-country studies, five articles analyse empirical data from *multiple countries*. One study focuses on the EU (Chenou and Radu, 2019), two others scrutinise data from many developed countries (Gozman and Willcocks, 2019; Van den Buuse and Kolk, 2019), while the final two concentrate on a selection of three (Loureiro and Labandeira, 2019) and 14 developed countries (Forcadell et al., 2020).

We only found three articles examining *multiple types of countries*. Scuotto et al. (2016) employ data on smart cities from developed (Spain, Italy, Belgium, Qatar and the US) and emerging (Brazil) countries, but their analysis centres around IBM's strategy at the city level, most importantly its vision of smart cities and open innovation. Mann (2018) applies a political economy perspective to big data analytics using data from various African economies, both developing and emerging,

although her discussion refers to African economies as a whole. This concerns the need to move beyond treating the poor as beneficiaries of big data, to instead perceiving them as potential economic producers. Finally, Oyinlola et al. (2022) study how digital innovations can foster a transition towards circular value chains in Nigeria (classified as emerging country), Uganda and Zambia (developing countries). The authors find, in all three countries, that MNEs play a critical role in the national plastic value chains, but that a full transition towards sustainable circular value chains will require regulatory changes, namely addressing regulatory barriers to digital solutions and implementing extended producer responsibility regulations.

Finally, it is noteworthy that some of the articles take a *comparative approach to digital technology in developed and emerging/developing countries*. Interestingly, three studies compare the market entry of sharing platform MNEs in different countries. In particular, Uzunca et al. (2018) analyse the institutional strategies of Uber and Airbnb in Egypt, the UK and the Netherlands, underscoring that Uber's business model alleviates a public safety issue in Egypt: the sexual harassment of women in public transport. Punt et al. (2021) study the location decisions of Uber in North America, Europe, Asia, Africa, South America and Oceania, and obtain partial support for their hypothesis that Uber is attracted to locations with relatively weak labour market institutions. Marano et al. (2020) evaluate the internationalisation challenges faced by Uber and Airbnb in Australia, South Africa, the UK, India, Hong Kong and the US. In India and South Africa, the two MNEs experienced relatively strong enforcement actions aimed at abolishing their regulatory violations, including fines, seizing of corporate assets, police raids and jailing of service providers. With a different focus, Nasr et al. (2022) scrutinise the CSR marketing of MNEs from China, India, France and the US, showing that, in contrast to emerging markets, CSR posts in developed countries are not effective in obtaining legitimacy; in fact, they can diminish it. Finally, Li et al. (2022) note that social media platform MNEs should account for differences in platform users' privacy concerns in China, the US and South Korea.

3.3. The sustainability triplet

We now turn to our discussion of the sustainability dimensions covered in our sample. Table 4 summarises the key insights of each article in our sample related to the sustainability dimensions addressed, categorised by the type of research (as well as showing, through different font types, the geographic scope covered by the work). This table illustrates how the majority of the studies in our sample address social sustainability in relation to MNEs and I4.0 technologies, followed by environmental and economic sustainability, which both receive similar amounts of academic scrutiny. Considering this, we first discuss social sustainability, followed respectively by economic sustainability and environmental sustainability.

Social sustainability articles often discuss implications of digital technologies for human rights more generally, as well as for workers, marginalised and vulnerable social groups; there is also research on the opportunities that digital technologies provide to MNEs for communicating with their stakeholders; and studies that focus on how digitalisation affects corrupt behaviour. In the area of *human rights*, a substantial number of articles delineates how MNEs deploying digital technologies are urged to manage demands over (cross-border) privacy and data protection (Chenou and Radu, 2019; George and Schillebeeckx, 2022; Ghauri et al., 2021; Gozman and Willcocks, 2019; Laurenza et al., 2018; Li et al., 2022; Tan and Tan, 2012; Vila Seoane, 2021; Watson et al., 2018). A key insight emerging from this body of work is that the institutional context regarding these issues is highly fragmented, challenging MNEs to undertake an internationally coordinated approach. For example, George and Schillebeeckx (2022) highlight that MNEs are confronted with increasingly stringent local regulations that impose data privacy requirements and give citizens data ownership rights, while Gozman and Willcocks (2019) point at the challenges of the outsourcing

Table 4

Key insights of each article in our sample in relation to social, economic, and environmental sustainability (different fonts relate to findings from different settings; see note below table; table continues on next page).

Social Sustainability				
Empirical	<p>Developed</p> <ul style="list-style-type: none"> Digital technologies can improve the quality of life of health care patients, as well as the quality of working conditions for employees and transparency in MNEs (Hussain et al., 2019; Laurenza et al., 2018). Digital technologies challenge contemporary perceptions of privacy and human rights (Chenou and Radu, 2019). The digitalisation of accounting standards addresses transparency problems in MNEs' corporate governance (Riaz et al., 2022). MNEs and their digital technologies help facilitate political and social reform within local communities (Kariippanon and Gurruwiwi, 2022). <p>Emerging</p> <ul style="list-style-type: none"> Ethical, political and cultural conflicts arise when digital MNEs expand business activities to countries with authoritarian governments (Tan and Tan, 2012). Circular economy business models must be adapted to local contexts to create stakeholder value and avoid unintended negative impacts on vulnerable social groups (Dreyer et al., 2017). Platform MNEs can help alleviate social problems and public safety issues, such as access to public transport and sexual harassment (Uzunca et al., 2018). MNEs and their digital technologies help facilitate political and social reform within countries (Kalliny et al., 2015). Digital technologies can encourage firms to engage in anti-corruption practices by contributing to their corporate reputation and innovativeness (Park and Xiao, 2021). MNEs lobby national governments in tandem with local actors and foreign governments to soften data localisation requirements (Vila Seoane, 2021). MNEs can use social media to improve their legitimacy, but must be aware of local cultural and social factors, as well as geopolitical tensions between their home and host countries (Nasr et al., 2022; Tian, 2022). AI-assisted human resource management enhances employee experience, leading to improved employee commitment, loyalty, and engagement (Malik et al., 2022). <p>Both</p> <ul style="list-style-type: none"> Conflicting national data privacy laws create regulatory challenges for MNEs wishing to benefit from cloud computing (Gozman and Willcocks, 2019). Digital platforms face unique internationalisation challenges due to their disruptive business models (Marano et al., 2020). Augmented reality has high applicability for product-level social sustainability development (Gholami et al., 2022). Platform MNEs must be mindful of between-country differences in privacy concerns and privacy decisions when designing their platforms (Li et al., 2022). 			
	Conceptual	<p>Both</p> <ul style="list-style-type: none"> Digital technologies are paving the way toward political and social change, and the social media phenomenon in the Arab world is being spearheaded by American MNEs, notably Facebook, Twitter, and Google (Benmamoun et al., 2012). Digital technologies introduce new opportunities and challenges to minimise the use of corruption (Malik and Froese, 2022). Industry 4.0 technologies have the potential to include stakeholders more intimately in a firm's innovation processes (Nylund et al., 2021). The power and control of large digital MNEs are to be understood as levers for coordinating global production and influencing world societies (Coveri et al., 2022). Digitalisation creates novel digital power resources for firms throughout sectors (Kemmerling and Trampusch, 2022). 		
		Generic	<p>Emerging</p> <ul style="list-style-type: none"> MNEs can deploy digital technologies to improve their relationships with stakeholders and promote CSR (Nwagbara, 2013). Industry 4.0 technologies are likely to exacerbate tensions between the high-knowledge and low-knowledge segments of emerging economies (Cano-Kollmann et al., 2018). Industry 4.0 technologies impact how workers are hired and trained, as well as their commitment and loyalty (Cooke et al., 2019). <p>Both</p> <ul style="list-style-type: none"> Digital technologies can both create and hinder trust between the firm and its internal and external stakeholders (Watson et al., 2018). The entry of foreign digital MNEs may trigger ethnic and socioeconomic discrimination (Verbeke and Hutzschenreuter, 2021). MNEs' digitalisation initiatives have substantial social impacts, both positive and negative, through their CSR initiatives and their GVCs (Srinivasan and Eden, 2021). Digital technologies might exacerbate power differences between the Global North and South by allowing Western MNEs to appropriate increasing shares of larger markets (Hauge, 2021). Digital technologies have the potential to afford Big Tech MNEs enormous social and political power (Boyer, 2022). Artificial intelligence can improve and decrease employee wellbeing, depending on how it is deployed (Budhwar et al., 2022). The idea of 'ecosystem social responsibility' constitutes a useful concept to examine internationalisation and extend global CSR research (Yi et al., 2022). 	
			<hr/>	
			<p>Economic Sustainability</p>	
	Empirical		<p>Developed</p> <ul style="list-style-type: none"> Sharing platforms increase housing prices, create taxation problems and incentivize illegal economic activities (Clancy, 2022; Uzunca et al., 2018). <p>Emerging</p> <ul style="list-style-type: none"> Digital platforms provide new employment and financial opportunities for disenfranchised groups (Dreyer et al., 2017; Kabengele and Hahn, 2021; Onsongo, 2019; Uzunca et al., 2018). <p>Both</p> <ul style="list-style-type: none"> Automation can lead to significant job losses for low-skilled workers and employment opportunities for high-skilled workers (Plumwongrot and Pholphirul, 2022; Satyro et al., 2022; Szalavetz, 2019). Digital platforms often do not comply with labour market regulations or seek out locations with lower regulatory scrutiny (Punt et al., 2021). 	
			<p>Environmental Sustainability</p>	
			<p>Developed</p> <ul style="list-style-type: none"> Digital platforms can reduce energy usage and facilitate sustainable heating and cooling patterns (Loureiro and Labandeira, 2019). Reputation for corporate sustainability can help address MNEs' digitalisation challenges (Forcadell et al., 2020). <p>Emerging</p> <ul style="list-style-type: none"> Technology and individual incentives can be combined to facilitate a circular economy and reduce pollution, given the right incentives and local context (Ajwani-Ramchandani et al., 2021; Oyinlola et al., 2022). <p>Both</p> <ul style="list-style-type: none"> MNEs and digital technologies can improve the environmental sustainability of cities, provided that MNEs acquire certain capabilities and local knowledge (Bresciani et al., 2018; Scuotto et al., 2016; Van den Buuse and Kolk, 2019). Digital technologies can substantially reduce the energy requirements of MNEs' operations (Munsamy et al., 2019; Santos et al., 2017). Blockchain technologies can improve transparency and sustainability across GVCs (McGrath et al., 2021). MNEs can develop and diffuse green FSAs, thereby contributing to the SDGs (Patchell and Hayter, 2021). Big data has the highest applicability for developing sustainable products (Gholami et al., 2022). 	

(continued on next page)

Table 4 (continued)

	Economic Sustainability	Environmental Sustainability
Conceptual	Both	
	<ul style="list-style-type: none"> • Big tech MNEs can, under certain conditions, predate value from suppliers and third parties participating on their platform, as well as accumulate vast amounts of political power (Rikap, 2022). 	
Generic	Emerging	Emerging
	<p><u>Automation reduces opportunities for unskilled workers and increases opportunities for skilled workers</u> (Cano-Kollmann et al., 2018).</p> <p><u>MNEs must consider the poor as autonomous economic agents in the context of data analytics</u> (Mann, 2018).</p> <p><u>Automation has detrimental consequences for the poor and uneducated, especially for women</u> (Narula, 2019).</p>	<p><u>MNEs can use digital technologies to promote environmental sustainability</u> (Nwagbara, 2013).</p>
	Both	Both
	<p>Further research is needed to understand the economic consequences of digital technologies (Parente et al., 2018).</p> <p>Firm internationalisation can be impeded by digital nationalism (Verbeke and Hutzschenreuter, 2021).</p> <p>Digitalisation presents the MNE with increasing geopolitical, organizational, and market tensions (George and Schillebeeckx, 2022).</p> <p>New digital technologies have significant economic implications for firm strategies and cross-border management (Ghuri et al., 2021).</p> <p>Advanced technologies have significant implications for MNEs' location choice, governance structures and exchange of knowledge (Ahi et al., 2022).</p> <p>Artificial intelligence will have a profound impact on job security (Budhwar et al., 2022).</p>	<p>Industry 4.0 technologies can be used to increase the resilience and sustainability of GVCs (Dilyard et al., 2021)</p> <p>Artificial intelligence might not be greening global supply chains due to increased resource extraction and overconsumption (Dauvergne, 2022).</p> <p>Digitalisation has the potential to reduce MNEs' emissions (George and Schillebeeckx, 2022).</p>

Note: The 'Generic' label includes literature reviews, commentary/perspective pieces, and editorials. Italic text corresponds to insights from developed countries; underlined text corresponds to insights from emerging countries; regular texts correspond to insights from both developed and emerging countries.

of cloud services that derive from conflicting (cross-border) data privacy laws across countries. Besides engendering potential risks for human rights, digital technologies may also support citizens in their fight for fundamental rights. Research particularly elucidates how social media platforms, made available by MNEs like Twitter and Facebook, empower citizens in authoritarian countries to push for political and social change (Benmamoun et al., 2012; Kalliny et al., 2015).

Regarding the impact of digital technologies on workers, there is research on the (potentially) positive consequences, for example by increasing employees' health, safety and wellbeing (Budhwar et al., 2022; Cooke et al., 2019; Hussain et al., 2019; Laurenza et al., 2018; Malik et al., 2022). Conversely, scholars also mention the downsides of I4.0 technologies, such as social isolation, social conflict and dehumanisation (Ahi et al., 2022; Cooke et al., 2019). We also identified several articles that cover the impact of MNEs deploying digital technologies on marginalised and vulnerable social groups. Here, researchers suggest that the digitalisation of MNEs' GVCs may result in the exclusion of their most vulnerable suppliers, and that the entry of foreign digital MNEs may trigger ethnic and socioeconomic discrimination (Verbeke and Hutzschenreuter, 2021), and exploitation of the uneducated and the poor (Dreyer et al., 2017; Marano et al., 2020). Others highlight the social impacts on local communities engendered by the entry of digital MNEs, such as Airbnb exacerbating the housing crisis in Ireland (Clancy, 2022), and social media platform MNEs triggering the erosion of traditional values in Aboriginal communities (Clancy, 2022; Kariippanon and Gurruwiwi, 2022). We also came across work that addresses or encourages research on social inequality from a more meso- and macro-level perspective, including the social and political strategies of MNEs and their business models (Boyer, 2022; Coveri et al., 2022; Hauge, 2021; Kemmerling and Trampusch, 2022; Oyinlola et al., 2022; Parente et al., 2018; Rikap, 2022; Srinivasan and Eden, 2021; Yi et al., 2022). Interestingly, some scholars find that digital technologies, when tailored to the local context, present new opportunities for MNEs to communicate and engage with stakeholders (Nasr et al., 2022; Nwagbara, 2013; Tian, 2022), and even involve external stakeholders intimately throughout the supply chain and innovation processes (Nylund et al., 2021). Finally, three studies address corruption, which digitalisation can both enable (Malik and Froese, 2022) and discourage (Park and Xiao, 2021; Riaz et al., 2022).

The set of *economic sustainability* articles largely centres around

increased unemployment, noncompliance with labour market regulations and inclusive growth. Specifically, a substantial number of articles suggest that the deployment of digital technologies among MNEs may cause higher unemployment, particularly for low-skilled workers (Budhwar et al., 2022; Cano-Kollmann et al., 2018; Dreyer et al., 2017; Ghauri et al., 2021; Munsamy et al., 2019; Narula, 2019; Plumwongrot and Pholphirul, 2022; Satyro et al., 2022; Szalavetz, 2019). For example, Plumwongrot and Pholphirul (2022) note the job losses triggered by MNEs' increased use of automation and robots, while Narula (2019) asserts investments in automation to be especially detrimental to employment opportunities for women in the Bangladeshi apparel industry. Concurrently, however, employment opportunities that are created by digital technologies for high-skilled workers exclusively (Plumwongrot and Pholphirul, 2022; Satyro et al., 2022) can further exacerbate conflicts and social resentment within and between nations (Cano-Kollmann et al., 2018). We also found studies on noncompliance with labour market regulations, where scholars point out that digital MNEs are often not (fully) compliant with such regulations or seek out localities with lower levels of consumer protection (Marano et al., 2020; Parente et al., 2018; Punt et al., 2021; Uzunca et al., 2018). For example, the fact that sharing platform MNEs consider workers as independent contractors rather than employees results in substantial limitations in the latter's negotiating power, for instance with respect to holiday pay and insurance (Marano et al., 2020; Uzunca et al., 2018).

On the other hand, there are articles that elucidate how digital technologies can promote inclusive growth. When deploying digital technologies, MNEs may enable groups that were historically excluded from economic opportunities, such as women and/or uneducated persons, to gain access to income or capital (Dreyer et al., 2017; Kabengele and Hahn, 2021; Mann, 2018; Onsongo, 2019; Oyinlola et al., 2022). For example, Uber's entry into South Africa gave local drivers access to "opportunities that were previously unavailable (access to car and smartphone, and income generation)" (Dreyer et al., 2017, p. 93). Moreover, the introduction of mobile money payment services by MNEs in African economies allowed individuals at the 'bottom of the pyramid' to acquire microloans that they used to finance new businesses (Kabengele and Hahn, 2021; Onsongo, 2019; Oyinlola et al., 2022). Finally, some articles call for further research on the economic consequences of digital technologies, such as national competitiveness (Parente et al., 2018).

Environmental sustainability research in our sample mostly emphasises the positive environmental impacts of digital technologies, particularly in terms of pollution reduction, resource efficiency, smart city development, and, more generally, in furthering green FSAs. Several studies show that digital technologies prompt MNEs to reduce pollution, particularly by decreasing the costs of monitoring their environmental footprint. For example, scholars find that this helps reduce plastic and packaging waste, and thus facilitates the realisation of a circular economy (Ajwani-Ramchandani et al., 2021; Oyinlola et al., 2022). In addition, scholars indicate that automation and IoT can allow MNEs to lower their carbon dioxide (CO₂) emissions (George and Schillebeeckx, 2022; Munsamy et al., 2019). Regarding improved resource efficiency, it was found that store managers of a Spanish MNE adhere to more sustainable heating and cooling patterns when they receive information on the financial and environmental costs of their energy use (Loureiro and Labandeira, 2019). Moreover, digital technologies can also be utilised to optimise energy demands throughout the MNE (Ahi et al., 2022; Munsamy et al., 2019; Santos et al., 2017), and even entire industries and GVCs (Ahi et al., 2022; Dilyard et al., 2021; McGrath et al., 2021). However, Dauvergne (2022) points out that digital technologies' micro-level gains in sustainability, such as productivity and efficiency gains, are likely outweighed by macro-level losses such as increased resource extraction and overconsumption. In the three studies on smart cities, there is attention for ways in which MNEs provide or utilise digital technologies to improve cities' environmental sustainability in areas such as energy, waste, water and transportation (Bresciani et al., 2018; Scuotto et al., 2016; Van den Buuse and Kolk, 2019). Scholars note that MNEs need to develop new (knowledge) capabilities and strategic alliances with local stakeholders to overcome barriers to smart solutions, such as low digital competences of certain societal groups and lack of local embeddedness. Finally, a few articles zoom in on green FSAs, pointing out that firms purposefully develop and deploy green resources. Forcadell et al. (2020) find that international banks can overcome their digitalisation challenges by building a strong reputation for corporate sustainability. Furthermore, Patchell and Hayter (2021, p. 1) assert that cloud computing multinationals are developing and diffusing "environmentally driven firm specific advantages".

4. A future research agenda

Our literature review offers five critical insights for scholars who conduct research at the intersection of MNEs, I4.0 and sustainability. First, notwithstanding growing interest from academics across various scientific disciplines, the relatively limited number of articles and the overrepresentation of 'lower level' journals in our sample suggest that research is still in its infancy. Second, the number of conceptual studies that introduce, apply, extend, or nuance theoretical frameworks and constructs is limited. Hence, there exist numerous opportunities to introduce more conceptual rigour in research on this topic. Third, a substantial part of the extant literature consists of commentary and perspective pieces, which offer useful reflections and ideas about future studies, but lack meticulous empirical analysis (see Table 4). Fourth, although the work we reviewed considered the role of MNEs, in several instances their specificities, such as ownership, governance structure, and internationalisation strategy, have received scant attention. As a result, the implications for sustainability of deploying I4.0 technologies in an international context have not been fully explicated. Fifth, while some articles hint at the possibility that different technologies have distinctive consequences for sustainability, articles focusing on individual technologies are limited, which means that technology-specific benefits and downsides have not been sufficiently illuminated. With this in mind, we propose a research agenda below to guide scholars interested in further studying MNEs, I4.0 and sustainability (see also a summary of main research avenues in Table 5).

4.1. MNEs, I4.0 and social sustainability

Our review highlights how previous studies touch upon the dynamics of I4.0 for *promoting human rights in the digital age*. However, extant literature is largely silent on how digital technologies can be used to suppress human rights. Negative social implications may emerge when authoritarian governments adopt digital solutions (particularly those based on IoT, blockchain and AI). Therefore, it would be interesting to conduct a comparative investigation of how digital technology MNEs from different political systems address the (risk of) misuse and harmful use of their digital solutions by such governments. One notable example is TikTok, which has received significant criticism in recent times regarding its data practices and close ties to the Chinese government, and as a result is now planning to cooperate with US MNEs to store data from American users in the US (Murphy, 2022). In addition, we advocate for more research on how the deployment of specific digital technologies by MNEs impacts human rights, and how this relates to country-differences in human rights concerns. AI offers a particularly interesting case, as these applications are seen as exhibiting different degrees of social risk and will have an enormous impact on the way people live and work in the coming decades (EC, 2022). Moreover, our review also reveals that privacy has received disproportionate attention in comparison to other human rights. Future research can thus analyse the risks of discrimination based on biased data powering AI applications deployed by MNEs. This is especially germane vis-à-vis vulnerable groups in lower-income countries, because collecting high-quality data is arduous in such "less digitized" environments (Gwagwa et al., 2021). In addition, while extant research hints at the possibility for digital technologies to alleviate societal problems in emerging countries, empirical evidence is scarce. We therefore welcome work that scrutinises how technologies such as digital platforms, IoT, mobile services, and blockchain relate to, for example, modern-day slavery, gender inequality and child labour, especially in emerging and developing countries.

Relatedly, our review suggests that there is ample opportunity to further our understanding of how MNEs manage *the regulatory landscape of digital technologies with respect to social issues*. For example, the adoption of the EU's General Data Protection Regulation (GDPR) imposed restrictions on all parties handling data within the EU and beyond, which affects MNEs due to its extraterritorial reach and 'copy-cat' data privacy laws enacted around the world. Even when often inspired by the GDPR, a phenomenon also labelled 'the Brussels effect' (Bradford, 2020), regulatory heterogeneity within and across regions and countries prevails. This offers several interesting research directions for IB scholars in general, and regarding nonmarket strategies in particular (for a recent review on international nonmarket strategies to which such work can be linked, see Sun et al., 2021). Areas for investigation might be how digital MNEs lobby and negotiate with different (sub-)national and regional policymakers, as well as civil society actors, about the design of governance frameworks addressing the societal implications of digital technologies. Here, we see ample opportunity to introduce theoretical frameworks from other disciplines such as political science and public administration. The literature on multi-level governance (Piattoni, 2009) is relevant in this regard, as it helps elucidate the distinct stakeholder pressures MNEs face in relation to the territorial organisation of governments. Furthermore, it would be worthwhile for scholars to help shed light on how foreign digital technology MNEs deal with regulatory voids on data- and AI-related ethics and rights when providing their digital solutions in host countries where "ethical scrutiny, transparency, and democratic control are lacking" (Vinueza et al., 2020, p. 3) or proper regulation is absent altogether (Gwagwa et al., 2021; Sharma et al., 2020). Such work has the potential to advance academic understanding of institutional strategies (for recent reviews, see Dorobantu et al., 2017; Marquis and Raynard, 2015), which has seldomly been conducted in relation to MNEs and digitalisation.

Furthermore, a number of articles in our review scrutinise *corporate*

Table 5
Avenues for research on MNEs, I4.0 and sustainability.

Sustainability dimension	Research Avenue	Research questions	Suggested Theoretical Concepts and Frameworks
<i>Social</i>	Human rights in the digital age	<ul style="list-style-type: none"> • How and when can MNEs prevent their digital technologies from being used to suppress or limit human rights in developing and emerging countries? • How do MNEs cope with differences between countries regarding preferences on how human rights should be embedded in digital technologies such as AI? • How can MNEs ensure that the adoption of AI does not perpetuate existing biases and discrimination in their operations and decision-making processes? • How do MNEs manage the need to democratize access to digital solutions and protect users' data? 	<ul style="list-style-type: none"> • Political CSR • Corporate citizenship • Corporate purpose
	The regulatory landscape of digital technologies with respect to social issues	<ul style="list-style-type: none"> • How do digital MNEs negotiate with different national and regional policymakers, as well as civil society organizations, about the design of a governance framework addressing the ethical implications and risks of digital technologies for fundamental rights? • How can foreign digital technology MNEs deal with regulatory voids on data- and AI-related ethics and rights? • What strategies can MNEs utilise to overcome regulatory inconsistencies between countries in relation to data governance? • What information strategies can digital MNEs use to achieve legitimacy in a foreign country, given the various local cultural and social factors at play? • How do geopolitical tensions between home and host countries impact the internationalisation of digital MNEs? 	<ul style="list-style-type: none"> • Multi-level governance • Resource dependence theory • Institutional strategy • Corporate political strategy
	Corporate power in the digital age	<ul style="list-style-type: none"> • How do digital MNEs manage the risk that data from which AI-enabled applications are designed are biased and unrepresentative of local contexts? • How do MNEs deal with accumulating corporate powers through I4.0 and how does this affect the rights of the most vulnerable persons in lower-income countries? • What types of power over other stakeholders do different digital technologies present to digital MNEs and what policies can be constructed to limit their negative effects? • Under what conditions do different digital technologies enhance or limit corporate corruption? 	<ul style="list-style-type: none"> • Game theory • Transaction cost economics • Corporate corruption • Power-dependence theory
	Employment	<ul style="list-style-type: none"> • How do the economic opportunities offered by I4.0 relate to MNE governance structures, ownership and internationalisation strategies? • How does the deployment of digital technologies affect individuals with intersectional disadvantages in developing and emerging countries? • To what extent does MNEs' deployment of digital technologies have a direct or indirect impact on inclusive growth in developed countries? 	<ul style="list-style-type: none"> • Bottom-of-the-pyramid strategies • Intersectionality
<i>Economic</i>	Working conditions inside the MNE	<ul style="list-style-type: none"> • How can MNEs deal with the dark side of introducing digital technologies to manage human resources? • How does the introduction of digital technologies impact employee satisfaction? • How do MNEs address the ethical challenges of using digital technologies to hire and train employees, and how does this impact their organisational commitment? 	<ul style="list-style-type: none"> • Corporate citizenship • Stakeholder theory • Organizational justice
	Localisation	<ul style="list-style-type: none"> • How do 'conventional' MNEs integrating I4.0 across their manufacturing subsidiaries interact with local governments with respect to employment-related effects? • How do foreign digital MNEs recombine their digital FSAs with local firms' assets to address economic sustainability issues? • To what extent does MNEs' location choice for data centres in emerging and developing countries have a direct or indirect impact on inclusive growth? • How can digital and manufacturing MNEs harness additive manufacturing's potential to empower local entrepreneurs in lower-income countries? 	<ul style="list-style-type: none"> • Asset recombination • Country-specific advantages • Glocalisation
	The environmental costs of digitalisation	<ul style="list-style-type: none"> • How do digital technology MNEs manage the environmental shortcomings of their digital solutions' international scaling? • How do MNEs define and measure the environmental impact of digital solutions? • How do business model- and location-specific factors affect the international scaling of IoT, blockchain- or AI-enabled circular business models? 	<ul style="list-style-type: none"> • GVC analysis • Business model innovation • Circular economy
<i>Environmental</i>	Greening GVCs	<ul style="list-style-type: none"> • How can MNEs recombine their digital FSAs with customers' local assets to increase circularity? • Does the participation in dataspace improve the environmental sustainability of MNEs global operations? • How do digital technology MNEs leverage diverse digital technologies and degrees of standardization or adaptation to accelerate a circularity transition across different countries? • How do MNEs facilitate a digitally-enabled green transformation within a GVC and address different challenges among their suppliers? 	<ul style="list-style-type: none"> • Ecosystem CSR • Green FSAs • Corporate sustainability
	Partnerships for digital sustainability	<ul style="list-style-type: none"> • How do digital technology ventures/MNEs leverage big data, IoT and/or AI to encourage customers' pro-environmental behaviour across different institutional contexts? • How do location-specific factors impact the efficacy of information strategies that digital MNEs utilise to encourage pro-environmental behaviour? • How do foreign digital MNEs interact with local stakeholders concerning the trade-off between digitalisation and energy costs? 	<ul style="list-style-type: none"> • Multi-stakeholder initiatives • Political CSR • Liability of disruption • Institutional entrepreneurship

(continued on next page)

Table 5 (continued)

Sustainability dimension	Research Avenue	Research questions	Suggested Theoretical Concepts and Frameworks
		<ul style="list-style-type: none"> • How do foreign digital MNEs interact and negotiate with local governments concerning the trade-off between the need for data sharing for environmental sustainability on the one hand, and data privacy and protection on the other? • How do digital MNEs interact with stakeholders in the standardisation of measurement and monitoring of the environmental footprint of digital technologies? 	

power in the digital age. Various scholars illuminate how I4.0 introduces pathways for digital MNEs to exploit vulnerable stakeholders. A critical issue of contention, which previous studies have addressed only to a limited extent, concerns MNEs' ownership and control of personal data collected from blockchain, IoT devices and mobile apps. Although the joint use of IoT and blockchain in particular can increase transparency and traceability, the adoption of these two technologies requires data sharing among different actors, which could also lead to 'big brother' type of control over suppliers and workers, particularly those with lower digital literacy. More insight is thus needed into how the shift by MNEs towards digital business models impacts supply chain partners, and how MNEs can properly account for data sharing and data privacy/protection issues. For example, empirical research could be conducted on how the digitalisation of supply chains affects power distribution, information asymmetry and opportunistic behaviour in transactions between the different actors involved. Similarly, we also advocate further empirical work on how digital technologies affect MNEs' (lack of) involvement in corruption across different institutional environments. Our review suggests that digital technologies can both encourage and discourage MNEs to engage in corrupt behaviours, but we lack a comprehensive understanding of how and under what circumstances different factors at the individual, firm, industry and/or country levels affect the decision to engage in corrupt business practices (or not). Furthermore, we believe that such research could also advance academic understanding of corporate corruption, which has received limited attention in comparison to government corruption (for a recent review on this topic, see Castro et al., 2020).

4.2. MNEs, I4.0 and economic sustainability

A key economic sustainability issue that emerges from our sample is the relationship between digitalisation and employment, such as the high risk of job losses elicited by the diffusion of I4.0 in MNEs' manufacturing processes. It would be valuable to shed more light on this phenomenon through two complementary research directions. First, we encourage empirical and conceptual work that clarifies the rift between the 'winners' and 'losers' of digitalisation inside the MNE. While extant research points to the differences between skilled and unskilled workers, it remains unclear how these skills relate to the specificities of the MNE, such as governance structure, internationalisation strategy and ownership, and to types of (un)skilled workers (cf. Heredia et al., 2023). In addition, our review reveals that inclusive economic growth has only been studied within the context of emerging and developing economies, overlooking the fact that certain regions and/or social groups inside developed countries are also limited in their economic opportunities. Hence, we would recommend scholars to explore the degree to which the deployment of digital technologies by MNEs can initiate inclusive growth in developed nations as well. Another fruitful avenue for research concerns intersectional disadvantages. While studies indicate that the economic disadvantages of I4.0 disproportionately affect the poor and lower-educated, there is a high degree of heterogeneity within these groups (Cooper, 2015). Indeed, extant research alludes to the fact that job losses due to automation disproportionately affect poor female workers, but there is a lack of comprehensive empirical evidence. Specifically, it is not clear how the diffusion of digital technologies affects the economic opportunities of disenfranchised ethnic, religious and

linguistic minorities, people with long-term physical and mental impairments, or people with different gender identities and sexual orientations – especially in emerging and developing countries. Such research could benefit from revisiting the original definition of a stakeholder, namely any individual or group that affects or is affected by the strategic objective of the firm (Freeman, 1984). This would entail the unpacking the concept of the 'digitally vulnerable' within 'bottom-of-the-pyramid' strategies of MNEs to explore heterogeneities within this group (cf. Kolk et al., 2014).

Furthermore, scholars find that the integration of I4.0 technologies can improve working conditions inside the MNE by enhancing transparency and trust. However, extant literature places emphasis on potential efficiency gains rather than the rights and responsibilities of MNEs towards their employees, particularly in emerging and developing countries. We thus welcome additional research on *digital technologies' impact on working conditions inside the MNE*, including studies on how the integration of I4.0 inside the MNEs impacts employee perception of organizational justice, such as the fairness of hiring and firing; the degree to which algorithmic decision-making processes are viewed as legitimate; and how algorithmic management affects interpersonal interactions inside the MNE. Likewise, it would be interesting to explore if and how MNEs construct ethical guidelines for using digital technologies to hire, train and promote employees, and to what extent such guidelines differ between countries. Further empirical research is also needed on how digital technologies affect the working conditions inside MNEs. While extant work demonstrates that digital technologies can benefit employees through increased transparency and accountability, we lack empirical research on the 'dark side' of deploying such technologies, such as social isolation, dehumanisation and lack of trust. In addition, scholars can build on insights that automation and robotics may be complementary to 'human' labour and, by relieving workers from heavier, less complex tasks, they could improve working conditions, efficiency, competences and hopefully incomes (WTO, 2019). Such research could for example explore how the integration of automation and robotics in MNEs' operations works out in terms of "economic upgrading" (Barrientos et al., 2011; Gereffi and Lee, 2016) in developed, emerging and especially developing countries.

In addition, our review illustrates that, notwithstanding the observation in IB literature that digital technologies are location-agnostic (Luo, 2022), I4.0 has considerable economic antecedents and consequences at the local level. We thus recommend scholars to study the *localisation of digital technologies*. One promising area within this topic is exploring how 'conventional' MNEs integrating I4.0 across their manufacturing subsidiaries interact with local governments with respect to employment-related effects; whether they try to address the economic shortcomings of their digital transformation; and how location-specific factors affect their practices. Furthermore, our review highlights that collaboration with local actors and value co-creation can be critical for the success and scaling of digital solutions. Over the last years, local digital start-ups have burgeoned in lower-income countries, and future research could thus explore how foreign digital MNEs recombine their digital FSAs with these local firms' assets to address economic sustainability issues, but also whether there are barriers, for example because they may be competing with each another or there might be a lack of high-quality data or infrastructures. Regarding the latter, the location of data centres is said to affect the "speed with which the cloud's

capabilities can be accessed" (Fourie, 2019, p. 6) and can thus be important for the economic impact of digital technologies (Ciulli and Kolk, 2023). Notably, big tech firms such as Google and Microsoft have established AI centres in several African countries (Gwagwa et al., 2021). Yet we lack empirical research to assess the local economic effects of these facilities. It would therefore be worthwhile to investigate whether and when these MNEs' location choices have a direct or indirect impact on economic growth, for example in terms of locally AI-enabled innovation, job and income opportunities. In addition, future research can scrutinise the absence of infrastructure and connectivity, digital illiteracy and financial constraints, unclear regulatory structures and lack of information or misinformation (Tsan et al., 2021), particularly in (remote) areas where the contribution of digital solutions would be most important. For example, I4.0 facilitates distributed production, but it is an open question how digital and manufacturing MNEs can harness its potential to empower local entrepreneurs in lower-income countries when they lack the means, skills or infrastructure to realise these opportunities for inclusive growth.

4.3. MNEs, I4.0 and environmental sustainability

Our review indicates that digital technologies may help MNEs reduce pollution and energy consumption, and increase resource efficiency. Despite these promising findings, a set of relevant questions remain to be addressed in relation to the *environmental costs of I4.0*, especially how they influence the internationalisation of MNEs. Environmental drawbacks prominently come to the fore in the international scaling of digital technologies, which can compromise digital MNEs' legitimacy. A notable example of this concerns data centres, which facilitate digitalisation and economic growth but consume significant amounts of energy (cf. Liang et al., 2022). To tackle this trade-off, digital MNEs must interact with local governments and communities regarding the location choice of their data centres. Failure to build public support and legitimacy can land digital MNEs in dire straits. For example, Meta had to suspend its planned 410-acre data centre in Zeewolde (The Netherlands) following protests by local politicians citing its excessive energy requirements (Waterfield, 2022). AI may be highly energy intensive as well (Accenture, 2020). Particularly EU policymakers have emphasised the need for environmentally sustainable AI applications, calling for "the development and use of energy efficient algorithms" (Signatory Countries, 2021). Similarly, a key environmental shortcoming of the expansion of IoT is the escalating number of devices and equipment purchased by customers and the rapid obsolescence of gadgetry. This leads to considerable amounts of e-waste, which will increase dramatically with the diffusion of 5G (Council of the EU, 2020; Semuels, 2019), an issue that governments are trying to address to prompt circularity. Hence, we recommend scholars explore how the environmental drawbacks of digital technologies affect MNEs' internationalisation strategies in general, and location choice in particular. Such research would also complement and add nuance to similar studies conducted at the country- and city-level (Bildirici and Ersin, 2023; Kurniawan et al., 2023; Muhammad et al., 2022).

Furthermore, extant research asserts that digital technologies can be used to improve the environmental *sustainability of GVCs*. Yet we lack systematic empirical evidence about the actual net environmental benefits that different digital technologies offer in GVCs. While recent research suggests that I4.0 technologies have a direct and positive effect on sustainable supply chain practices (Khan et al., 2023), the international dimensions remain opaque. In particular, it is unclear how MNEs collaborate with their GVC partners to leverage I4.0 for low-carbon solutions (for a notable exception that does not focus on MNEs, see Niehoff et al., 2022). Such collaborations require MNEs to tackle a broad range of issues, including concerns about data protection and loss of control, digital sovereignty, resistance to change, as well as a lack of competences or infrastructure. Scholars point out that firms often lack incentives to share data, even when this would benefit the environment

(Serna-Guerrero et al., 2022). Future studies should thus investigate how MNEs facilitate a digitally-enabled green transformation in their GVC in light of these challenges. Interestingly, participating in so-called dataspaces is sometimes seen a route for MNEs to address the hurdles hindering this transformation. Indeed, in dataspaces, such as the Gaia-X Data Space Community (GAIA-X, n.d.), data exchanges between a broad range of organizations are made available for economic and societal purposes, while control and ownership are retained by companies and individuals generating such data. It would be worthwhile to explore if and how MNEs' participation in dataspaces can also help to improve the environmental sustainability of their internal operations and GVCs. Work in this realm could further our understanding of how MNEs develop and diffuse green FSAs within networks, especially if complemented with recent conceptual developments within internalisation theory (Banalieva and Dhanaraj, 2019). This would also introduce more theoretical rigour, as our review highlights the paucity of conceptual work, especially on environmental sustainability and digitalisation.

Moreover, our review suggests that the realisation of environmental sustainability necessitates *multi-stakeholder partnerships*. Extant research highlights how MNEs engage with (local) governments to provide digital green solutions, for example in smart cities. Yet, governments are likely to be sensitive to the risks tied to data sharing, for instance from IoT devices, even if this can contribute to reducing CO₂ emissions or increasing circularity. Therefore, a promising area of research is how MNEs interact and negotiate with governments concerning the trade-off between the need for data sharing for environmental sustainability versus data privacy and protection. MNEs may also collaborate with non-profit organizations to develop and deploy digital solutions that tackle environmental issues. Further studies should explore to what extent such cross-sector partnerships can improve the communication and relationships between digital MNE and other external stakeholders in host countries, such as regulatory authorities and local communities, hence helping MNEs to overcome the 'liability of disruption' (Marano et al., 2020). In addition, despite the rising environmental concerns around digital technologies, there exist no standardised measurements of their environmental footprint, which makes it difficult to gauge their net benefits and drawbacks. Digital MNEs can play a key role here, as policymakers require their technical and industrial expertise to design tractable standards and measurements. This has led, for example, to the creation of the 'European Green Digital Coalition', which consists of digital MNEs that have pledged to support the EU's twin transition by investing in green technologies, developing methods and tools to measure the environmental impact of digital technologies, and co-creating recommendations and guidelines for green digitalisation (Signatory Countries, 2021). Fruitful research areas would thus consist in scrutinising how MNEs measure and communicate to stakeholders the environmental footprint of digital technologies, and how they cooperate with policymakers and civil society to develop common standards and measurements, in order to appraise and monitor digital technologies' environmental impact. Relatedly, MNEs have started leveraging IoT, big data and AI also to encourage pro-environmental behaviour among their corporate and individual customers (e.g., Enel X, n.d.; Schneider Electric, 2022). Studying how digital technology MNEs harness IoT, big data analytics and AI to encourage customers' pro-environmental behaviour and practices across different institutional contexts would therefore be interesting. Particularly with regard to the circular economy, observers have noted that increasing energy efficiency, product longevity, recovery and recycling requires stronger interrelationships between firms and their individual customers (Atos, 2019). Hence, further studies could investigate whether novel digital technologies, especially IoT and mobile apps, might help strengthen this relationship to foster circularity, and how MNEs providing and/or deploying these technologies can recombine their digital FSAs with customers' local assets.

5. Implications and concluding remarks

Our article shows that there is growing, multidisciplinary attention for MNEs, I4.0 and sustainability. It summarised the ‘state of the art’, by distinguishing the attention assigned to diverse novel digital technologies, to their deployment by MNEs in different locations, and to the diverse social, economic and environmental implications. We find that scholars from various disciplines have devoted attention to the question of how the implementation of digital technologies by MNEs impacts social, economic and environmental sustainability. This attention is certainly warranted, given the critical role, for better or for worse, MNEs play in the world. We also note, however, that this multidisciplinary research has not at all lived up to its potential yet, with respect to the specific and potentially highly significant implications of novel digital technologies for the multiple sustainability issues that MNEs are confronted with. We therefore proposed many promising research directions for scholars interested in extending our knowledge on MNEs, I4.0 and sustainability.

Our review has several important implications for researchers, practitioners and policymakers alike. For researchers, our review highlights a lack of focus on specific digital technologies and concrete opportunities to increase the theoretical rigour with which they tackle the topic. More specifically, scholars need to move on from general perspectives and reflections on how I4.0 impacts the global business environment, including sustainability, towards empirical research that details the actual effects of different technologies, and how these relate to the motivations and actions of MNEs. For practitioners, our review underscores the central role of MNEs as agents of change in the transition towards a sustainable digitalisation. As such, we submit that managers must recognise this responsibility and rethink the essence of the MNE. Finally, our review demonstrates that the institutional environment can both enable and constrain the ability of MNEs to bring about positive change through the deployment of digital technologies. Interestingly, since policymakers are already exploring the links between digitalisation, resilience, ‘human-centric’ innovation and sustainability (‘Industry 5.0’), our field can truly contribute to such an agenda by rapidly moving forward in the directions suggested in this article.

CRedit authorship contribution statement

Václav Ocelík: Conceptualization, Data curation, Investigation, Methodology, Visualization, Writing – review & editing. **Ans Kolk:** Conceptualization, Methodology, Visualization, Validation, Writing – review & editing. **Francesca Ciulli:** Conceptualization, Methodology, Visualization, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

- The 60 papers resulting from the systematic search are marked with an *
- Accenture, 2020. Developing Energy-Efficient Machine Learning. Retrieved August 3, 2022. <https://www.accenture.com/us-en/blogs/technology-innovation/shar-ma-kaulgud-developing-energy-efficient-machine-learning>.
- * Ahi, A.A., Sinkovics, N., Shildibekov, Y., Sinkovics, R.R., Mehandjiev, N., 2022. Advanced technologies and international business: a multidisciplinary analysis of the literature. *Int. Bus. Rev.* 31 (4), 101967 <https://doi.org/10.1016/j.ibusrev.2021.101967>.

- Ajai, G., Kumar, M., 2018. A systematic approach to conducting review studies: an assessment of content analysis in 25 years of IB research. *J. World Bus.* 53 (2), 280–289. <https://doi.org/10.1016/j.jwb.2017.11.003>.
- * Ajwani-Ramchandani, R., Figueira, S., Torres de Oliveira, R., Jha, S., Ramchandani, A., Schuricht, L., 2021. Towards a circular economy for packaging waste by using new technologies: the case of large multinationals in emerging economies. *J. Clean. Prod.* 281, 125139 <https://doi.org/10.1016/j.jclepro.2020.125139>.
- Atos, 2019. *Circular Economy, Your Digital Path*. White Paper.
- Awan, U., Gölgeci, I., Makhmadshoev, D., Mishra, N., 2022. Industry 4.0 and circular economy in an era of global value chains: what have we learned and what is still to be explored? *J. Clean. Prod.* 371, 133621 <https://doi.org/10.1016/j.jclepro.2022.133621>.
- Banalieva, E.R., Dhanaraj, C., 2019. Internalization theory for the digital economy. *J. Int. Bus. Stud.* 50, 1372–1387. <https://doi.org/10.1057/s41267-019-00243-7>.
- Bansal, P., 2005. Evolving sustainably: a longitudinal study of corporate sustainable development. *Strat. Manag. J.* 26 (3), 197–218. <https://doi.org/10.1002/smj.441>.
- Barrientos, S., Gereffi, G., Rossi, A., 2011. Economic and social upgrading in global production networks: a new paradigm for a changing world. *Int. Lab. Rev.* 150 (3–4), 319–340. <https://doi.org/10.1111/j.1564-913X.2011.00119.x>.
- * Benmamoun, M., Kalliny, M., Cropf, R.A., 2012. The Arab Spring, MNEs, and virtual public spheres. *Multinat. Bus. Rev.* 20 (1), 26–43. <https://doi.org/10.1108/15253831211217189>.
- Bildirici, M., Ersin, Ö.Ö., 2023. Nexus between Industry 4.0 and environmental sustainability: a Fourier panel bootstrap cointegration and causality analysis. *J. Clean. Prod.* 386, 135786 <https://doi.org/10.1016/j.jclepro.2022.135786>.
- * Boyer, R., 2022. Platform capitalism: a socio-economic analysis. *Soc. Econ. Rev.* 20 (4), 1857–1879. <https://doi.org/10.1093/ser/mwaa055>.
- Bradford, A., 2020. *The Brussels Effect: How the European Union Rules the World*. Oxford University Press.
- * Bresciani, S., Ferraris, A., del Giudice, M., 2018. The management of organizational ambidexterity through alliances in a new context of analysis: Internet of Things (IoT) smart city projects. *Technol. Forecast. Soc. Change* 136, 331–338. <https://doi.org/10.1016/j.techfore.2017.03.002>.
- * Budhwar, P., Malik, A., de Silva, M.T.T., Thevisuthan, P., 2022. Artificial intelligence – challenges and opportunities for international HRM: a review and research agenda. *Int. J. Hum. Resour. Manag.* 33 (6), 1065–1097. <https://doi.org/10.1080/09585192.2022.2035161>.
- CABS, 2021. Academic journal guide. In: *Academic Journal Guide*. Chartered Association of Business Schools. Retrieved July 16, 2022 from <https://charteredabs.org/academic-journal-guide-2021/>.
- * Cano-Kollmann, M., Hannigan, T.J., Mudambi, R., 2018. Global innovation networks – organizations and people. *J. Int. Manag.* 24 (2), 87–92. <https://doi.org/10.1016/j.intman.2017.09.008>.
- * Chenou, J.-M., Radu, R., 2019. The “right to be forgotten”: negotiating public and private ordering in the European Union. *Bus. Soc.* 58 (1), 74–102. <https://doi.org/10.1177/0007650317717720>.
- Ching, N.T., Ghobakhloo, M., Iranmanesh, M., Maroufkhani, P., Asadi, S., 2022. Industry 4.0 applications for sustainable manufacturing: a systematic literature review and a roadmap to sustainable development. *J. Clean. Prod.* 334, 130133 <https://doi.org/10.1016/j.jclepro.2021.130133>.
- Ciulli, F., Kolk, A., 2019. Incumbents and business model innovation for the sharing economy: implications for sustainability. *J. Clean. Prod.* 214, 995–1010. <https://doi.org/10.1016/j.jclepro.2018.12.295>.
- Ciulli, F., Kolk, A., 2023. International business, digital technologies and sustainable development: connecting the dots. *J. World Bus.* 58 (4), 101445. <https://doi.org/10.1016/j.jwb.2023.101445>.
- Ciulli, F., Kolk, A., Boe-Lillegraven, S., 2020. Circularity brokers: digital platform organizations and waste recovery in food supply chains. *J. Bus. Ethics* 167 (2), 299–331. <https://doi.org/10.1007/s10551-019-04160-5>.
- * Clancy, M., 2022. Tourism, financialization, and short-term rentals: the political economy of Dublin’s housing crisis. *Curr. Issues Tourism* 25 (20), 3363–3380. <https://doi.org/10.1080/13683500.2020.1786027>.
- * Cooke, F.L., Liu, M., Liu, L.A., Chen, C.C., 2019. Human resource management and industrial relations in multinational corporations in and from China: challenges and new insights. *Hum. Resour. Manag.* 58 (5), 455–471. <https://doi.org/10.1002/hrm.21986>.
- Cooper, B., 2015. Intersectionality. In: Disch, L., Hawkesworth, M. (Eds.), *The Oxford Handbook of Feminist Theory*. Oxford Handbooks.
- Council of the EU, 2020. *Draft Council Conclusions on Digitalisation for the Benefit of the Environment*.
- Countries, Signatory, 2021. *Declaration on a Green and Digital Transformation of the EU*.
- * Coveri, A., Cozza, C., Guarascio, D., 2022. Monopoly Capital in the time of digital platforms: a radical approach to the Amazon case. *Camb. J. Econ.* 46 (6), 1341–1367. <https://doi.org/10.1093/cje/beac044>.
- Cowls, J., Tsamados, A., Taddeo, M., Floridi, L., 2023. The AI gambit: leveraging artificial intelligence to combat climate change—opportunities, challenges, and recommendations. *AI Soc* 38, 283–307. <https://doi.org/10.1007/s00146-021-01294-x>.
- * Dauvergne, P., 2022. Is artificial intelligence greening global supply chains? Exposing the political economy of environmental costs. *Rev. Int. Polit. Econ.* 29 (3), 696–718. <https://doi.org/10.1080/09692290.2020.1814381>.
- * Dilyard, J., Zhao, S., You, J.J., 2021. Digital innovation and Industry 4.0 for global value chain resilience: lessons learned and ways forward. *Thunderbird Int. Bus. Rev.* 63 (5), 577–584. <https://doi.org/10.1002/tie.22229>.

- Dorobantu, S., Kaul, A., Zelner, B., 2017. Nonmarket strategy research through the lens of new institutional economics: an integrative review and future directions. *Strat. Manag. J.* 38 (1), 114–140. <https://doi.org/10.1002/smj.2590>.
- * Dreyer, B., Lüdeke-Freund, F., Hamann, R., Faccor, K., 2017. Upsides and downsides of the sharing economy: collaborative consumption business models' stakeholder value impacts and their relationship to context. *Technol. Forecast. Soc. Change* 125, 87–104. <https://doi.org/10.1016/j.techfore.2017.03.036>.
- EC, 2018. *Digital Transformation Scoreboard 2018. EU Businesses Go Digital: Opportunities, Outcomes and Uptake*.
- EC, 2021. *Digital Technology, the Positive Force for Climate Action*.
- EC, 2022. *Regulatory Framework Proposal on Artificial Intelligence*.
- Eisenreich, A., Füller, J., Stuchtey, M., Gimenez-Jimenez, D., 2022. Toward a circular value chain: impact of the circular economy on a company's value chain processes. *J. Clean. Prod.* 378, 134375 <https://doi.org/10.1016/j.jclepro.2022.134375>.
- Elkington, J., 1994. Towards the sustainable corporation: win-win-win business strategies for sustainable development. *Calif. Manag. Rev.* 36 (2), 90–100. <https://doi.org/10.2307/41165746>.
- Enel, X., HOMIX, a single solution for a smart home. Retrieved August 31, 2022 from. <https://corporate.enelx.com/en/stories/2021/03/homix-smart-home-system>.
- FAO, 2018. *Tackling Poverty and Hunger through Digital Innovation*.
- * Forcadell, F.J., Aracil, E., Ubeda, F., 2020. Using reputation for corporate sustainability to tackle banks digitalization challenges. *Bus. Strat. Environ.* 29 (6), 2181–2193. <https://doi.org/10.1002/bse.2494>.
- Fortune, 2022. Fortune 500. Retrieved. <https://fortune.com/fortune500/>. (Accessed 3 August 2022).
- Fourie, W., 2019. *Cloud Computing and the Sustainable Development Goals In South Africa: An Opportunity to Accelerate Progress*. South African SDG Hub. University of Pretoria.
- Freeman, R.E., 1984. *Strategic Management: A Stakeholder Approach*. Pitman Publishing.
- Gaia, X., Communication material. Retrieved September 17, 2022 from. <https://gaia-x.eu/press-room/communication-material/>.
- * George, G., Schillebeeckx, S.J.D., 2022. Digital transformation, sustainability, and purpose in the multinational enterprise. *J. World Bus.* 57 (3), 101326 <https://doi.org/10.1016/j.jwb.2022.101326>.
- Gereffi, G., Lee, J., 2016. Economic and social upgrading in global value chains and industrial clusters: why governance matters. *J. Bus. Ethics* 133 (1), 25–38. <https://doi.org/10.1007/s10551-014-2373-7>.
- GeSI, Deloitte, 2019. *Digital with Purpose: Delivering a SMARTer2030 – Summary*.
- * Ghauri, P., Strange, R., Cooke, F.L., 2021. Research on international business: the new realities. *Int. Bus. Rev.* 30 (2), 101794 <https://doi.org/10.1016/j.ibusrev.2021.101794>.
- Ghobakhloo, M., Fathi, M., Iranmanesh, M., Maroufkhani, P., Morales, M.E., 2021. Industry 4.0 ten years on: a bibliometric and systematic review of concepts, sustainability value drivers, and success determinants. *J. Clean. Prod.* 302, 127052 <https://doi.org/10.1016/j.jclepro.2021.127052>.
- * Gholami, H., Hashemi, A., Lee, J.K.Y., Abdul-Nour, G., Salameh, A.A., 2022. Scrutinizing state-of-the-art 14.0 technologies toward sustainable products development under fuzzy environment. *J. Clean. Prod.* 377, 134327 <https://doi.org/10.1016/j.jclepro.2022.134327>.
- Gibney, E., 2022. How to shrink AI's ballooning carbon footprint. *Nature* 607 (7920). <https://doi.org/10.1038/d41586-022-01983-7>, 648–648.
- * Gozman, D., Willcocks, L., 2019. The emerging Cloud Dilemma: balancing innovation with cross-border privacy and outsourcing regulations. *J. Bus. Res.* 97, 235–256. <https://doi.org/10.1016/j.jbusres.2018.06.006>.
- Gwagwa, A., Kachidza, P., Siminyu, K., Smit, M., 2021. *Responsible Artificial Intelligence in Sub-saharan Africa: Landscape and General State of Play*.
- Haas, P.M., 2022. *Stockholm+ 50: a look ahead in international environmental politics*. *Environ. Pol. Law* 52, 3–11.
- Hahn, T., Figge, F., Pinkse, J., Preuss, L., 2010. Trade-offs in corporate sustainability: you can't have your cake and eat it. *Bus. Strat. Environ.* 19 (4), 217–229. <https://doi.org/10.1002/bse.674>.
- Hallioui, A., Herrou, B., Santos, R.S., Katina, P.F., Egbue, O., 2022. Systems-based approach to contemporary business management: an enabler of business sustainability in a context of Industry 4.0, circular economy, competitiveness and diverse stakeholders. *J. Clean. Prod.* 373, 133819 <https://doi.org/10.1016/j.jclepro.2022.133819>.
- * Hauge, J., 2021. Manufacturing-led development in the digital age: how power trumps technology. *Third World Q.*, pp. 1–21. <https://doi.org/10.1080/01436597.2021.2009739>.
- Heredia, J., McIntyre, J.R., Rubiños, C., Santibañez, E., Flores, A., 2023. A configuration approach to explain corporate environmental responsibility behavior of the emerging economies firms at Industry 4.0. *J. Clean. Prod.* 395, 136383 <https://doi.org/10.1016/j.jclepro.2023.136383>.
- * Hussain, Z.I., Sivarajah, U., Hussain, N., 2019. The role of a digital engineering platform in appropriating the creation of new work-related mind-set and organisational discourse in a large multi-national company. *Int. J. Inf. Manag.* 48, 218–225. <https://doi.org/10.1016/j.ijinfomgt.2018.09.014>.
- Jensen, H.H., 2021. Why Digitalization Is Critical to Creating a Global Circular Economy. World Economic Forum. Retrieved August 3, 2022 from. <https://www.weforum.org/agenda/2021/08/digitalization-critical-creating-global-circular-economy/>.
- * Kabengele, C., Hahn, R., 2021. Institutional and firm-level factors for mobile money adoption in emerging markets—A configurational analysis. *Technol. Forecast. Soc. Change* 171, 120934 <https://doi.org/10.1016/j.techfore.2021.120934>.
- * Kalliny, M., Benmamoun, M., Cropf, R.A., Kim, S.H., 2015. The role of MNCs and information flow on institutional change. *Multinat. Bus. Rev.* 23 (2), 130–147. <https://doi.org/10.1108/MBR-09-2014-0048>.
- * Kariippanon, K., Gurruwiwi, G., 2022. Mobilising control and dissent: navigating the digital landscape in a remote Aboriginal community. *Inf. Commun. Soc.* 25 (2), 184–198. <https://doi.org/10.1080/1369118X.2020.1770314>.
- * Kemmerling, M., Trampusch, C., 2022. Digital power resources (DPR): the political economy of structural and infrastructural business power in digital(ized) capitalism. *Soc. Econ. Rev.* 1–26 <https://doi.org/10.1093/ser/mwac059>.
- Khan, S.A.R., Tabish, M., Zhang, Y., 2023. Embrace of industry 4.0 and sustainable supply chain practices under the shadow of practice-based view theory: ensuring environmental sustainability in corporate sector. *J. Clean. Prod.* 398, 136609 <https://doi.org/10.1016/j.jclepro.2023.136609>.
- Kolk, A., 2016. The social responsibility of international business: from ethics and the environment to CSR and sustainable development. *J. World Bus.* 51 (1), 23–34. <https://doi.org/10.1016/j.jwb.2015.08.010>.
- Kolk, A., Rivera-Santos, M., Ruffin, C., 2014. Reviewing a decade of research on the “base/bottom of the pyramid” (BOP) concept. *Bus. Soc.* 53 (3), 338–377. <https://doi.org/10.1177/0007650312474928>.
- Kurniawan, T.A., Meidiana, C., Dzarfan Othman, M.H., Goh, H.H., Chew, K.W., 2023. Strengthening waste recycling industry in Malang (Indonesia): lessons from waste management in the era of Industry 4.0. *J. Clean. Prod.* 382, 135296 <https://doi.org/10.1016/j.jclepro.2022.135296>.
- * Laurenza, E., Quintano, M., Schiavone, F., Vrontis, D., 2018. The effect of digital technologies adoption in healthcare industry: a case based analysis. *Bus. Process Manag. J.* 24 (5), 1124–1144. <https://doi.org/10.1108/BPMJ-04-2017-0084>.
- * Li, Y., Rho, E.H.R., Kobsa, A., 2022. Cultural differences in the effects of contextual factors and privacy concerns on users' privacy decision on social networking sites. *Behav. Inf. Technol.* 41 (3), 655–677. <https://doi.org/10.1080/0144929X.2020.1831608>.
- Liang, X., Goh, H.H., Kurniawan, T.A., Zhang, D., Dai, W., Liu, H., Liu, J., Goh, K.C., 2022. Utilizing landfill gas (LFG) to electrify digital data centers in China for accelerating energy transition in Industry 4.0 era. *J. Clean. Prod.* 369, 133297 <https://doi.org/10.1016/j.jclepro.2022.133297>.
- López, L.-A., Cadarso, M.-A., Zafrilla, J., Arce, G., 2019. The carbon footprint of the U.S. multinationals' foreign affiliates. *Nat. Commun.* 10 (1), 1672. <https://doi.org/10.1038/s41467-019-09473-7>.
- * Loureiro, M., Labandeira, X., 2019. Exploring energy use in retail stores: a field experiment. *Energy Econ.* 84, 104570 <https://doi.org/10.1016/j.eneco.2019.104570>.
- Luo, Y., 2022. A general framework of digitization risks in international business. *J. Int. Bus. Stud.* 53, 344–361. <https://doi.org/10.1057/s41267-021-00448-9>.
- Luo, Y., Zahra, S.A., 2023. Industry 4.0 in international business research. *J. Int. Bus. Stud.* 1–15. <https://doi.org/10.1057/s41267-022-00577-9>.
- * Malik, A., Froese, F.J., 2022. Corruption as a perverse innovation: the dark side of digitalization and corruption in international business. *J. Bus. Res.* 145, 682–693. <https://doi.org/10.1016/j.jbusres.2022.03.032>.
- * Malik, A., Budhwar, P., Mohan, H., Srikanth, N.R., 2022. Employee experience – the missing link for engaging employees: insights from an MNE's AI-based HR ecosystem. *Hum. Resour. Manag.* 62, 97–115. <https://doi.org/10.1002/hrm.22133>.
- * Mann, L., 2018. Left to other peoples' devices? A political economy perspective on the Big Data revolution in development. *Dev. Change* 49 (1), 3–36. <https://doi.org/10.1111/dech.12347>.
- * Marano, V., Tallman, S., Teegen, H.J., 2020. The liability of disruption. *Global Strat. J.* 10 (1), 174–209. <https://doi.org/10.1002/gsj.1366>.
- Marquis, C., Raynard, M., 2015. Institutional strategies in emerging markets. *Acad. Manag. Ann.* 9 (1), 291–335. <https://doi.org/10.1080/19416520.2015.1014661>.
- * McGrath, P., McCarthy, L., Marshall, D., Rehme, J., 2021. Tools and technologies of transparency in sustainable global supply chains. *Calif. Manag. Rev.* 64 (1), 67–89. <https://doi.org/10.1177/00081256211045993>.
- McKinsey, 2018. *Unlocking Success in Digital Transformations*.
- Muhammad, S., Pan, Y., Magazzino, C., Luo, Y., Waqas, M., 2022. The fourth industrial revolution and environmental efficiency: the role of fintech industry. *J. Clean. Prod.* 381, 135196 <https://doi.org/10.1016/j.jclepro.2022.135196>.
- * Munsamy, M., Telukdarie, A., Fresner, J., 2019. Business process centric energy modelling. *Bus. Process Manag. J.* 25 (7), 1867–1890. <https://doi.org/10.1108/BPMJ-08-2018-0217>.
- July 1 Murphy, H., 2022. TikTok Says it Is Working to 'safeguard' US Data and National Security. *Financial Times*. Retrieved. <https://www.ft.com/content/10861909-df55-4e41-8076-8d4a45255304>. (Accessed 3 August 2022).
- * Narula, R., 2019. Enforcing higher labor standards within developing country value chains: consequences for MNEs and informal actors in a dual economy. *J. Int. Bus. Stud.* 50 (9), 1622–1635. <https://doi.org/10.1057/s41267-019-00265-1>.
- * Nasr, A.K., Rashidirad, M., Yoganathan, V., Sadaghiani, A.S., 2022. CSR marketing through social media and contextual effects on stakeholder engagement: a multinational cross-industry analysis. *Inf. Syst. Front* <https://doi.org/10.1007/s10796-022-10273-6>.
- Niehoff, S., Matthes, M., Zwar, C., Kunkel, S., Guan, T., Chen, L., Xue, B., de Oliveira Pereira Grudzien, D.I., Pinheiro de Lima, E., Beier, G., 2022. Sustainability related impacts of digitalisation on cooperation in global value chains: an exploratory study comparing companies in China, Brazil and Germany. *J. Clean. Prod.* 379, 134606 <https://doi.org/10.1016/j.jclepro.2022.134606>.
- Ning, X., Ramirez, R., Khuntia, J., 2021. Blockchain-enabled government efficiency and impartiality: using blockchain for targeted poverty alleviation in a city in China. *Inf. Technol. Dev.* 27 (3), 599–616. <https://doi.org/10.1080/02681102.2021.1925619>.
- * Nwagbara, U., 2013. The Effects of social media on environmental sustainability activities of oil and gas multinationals in Nigeria. *Thunderbird Int. Bus. Rev.* 55 (6), 689–697. <https://doi.org/10.1002/tie.21584>.

- * Nylund, P.A., Brem, A., Agarwal, N., 2021. Innovation ecosystems for meeting sustainable development goals: the evolving roles of multinational enterprises. *J. Clean. Prod.* 281, 125329 <https://doi.org/10.1016/j.jclepro.2020.125329>.
- * Onsongo, E., 2019. Institutional entrepreneurship and social innovation at the base of the pyramid: the case of M-Pesa in Kenya. *Ind. Innovat.* 26 (4), 369–390. <https://doi.org/10.1080/13662716.2017.1409104>.
- * Oyinlola, M., Schröder, P., Whitehead, T., Kolade, O., Wakunuma, K., Sharifi, S., Rawn, B., Odumuyiwa, V., Lendelvo, S., Brightly, G., Tijani, B., Baiyeola, T., Lindunda, L., Mtonga, R., Abolfathi, S., 2022. Digital innovations for transitioning to circular plastic value chains in Africa. *Afr. J. Manag.* 8 (1), 83–108. <https://doi.org/10.1080/23322373.2021.1999750>.
- * Parente, R.C., Geleilate, J.-M.G., Rong, K., 2018. The sharing economy globalization phenomenon: a research agenda. *J. Int. Manag.* 24 (1), 52–64. <https://doi.org/10.1016/j.intman.2017.10.001>.
- * Park, B. il, Xiao, S., 2021. Doing good by combating bad in the digital world: institutional pressures, anti-corruption practices, and competitive implications of MNE foreign subsidiaries. *J. Bus. Res.* 137, 194–205. <https://doi.org/10.1016/j.jbusres.2021.08.014>.
- * Patchell, J., Hayter, R., 2021. The Cloud's fearsome five renewable energy strategies: coupling sustainable development goals with firm specific advantages. *J. Clean. Prod.* 288, 125501 <https://doi.org/10.1016/j.jclepro.2020.125501>.
- Piattoni, S., 2009. Multi-level governance: a historical and conceptual analysis. *Eur. Integr.* 31 (2), 163–180. <https://doi.org/10.1080/07036330802642755>.
- Pisani, N., Kourula, A., Kolk, A., Meijer, R., 2017. How global is international CSR research? Insights and recommendations from a systematic review. *J. World Bus.* 52 (5), 591–614. <https://doi.org/10.1016/j.jwb.2017.05.003>.
- * Plumwongrot, P., Pholphirul, P., 2022. Are Robots stealing jobs? Empirical evidence from 10 developing countries. *Econ. Innovat. N. Technol.* 1–17. <https://doi.org/10.1080/10438599.2022.2051020>.
- * Punt, M.B., van Kollem, J., Hoekman, J., Frenken, K., 2021. Your Uber is arriving now: An analysis of platform location decisions through an institutional lens. *Strat. Organ.* <https://doi.org/10.1177/14761270211022254>.
- PwC, 2016. 2016 Global Industry 4.0 Survey - Industry 4.0: Building the Digital Enterprise.
- Rejeb, A., Suhaiza, Z., Rejeb, K., Seuring, S., Treiblmaier, H., 2022. The Internet of Things and the circular economy: a systematic literature review and research agenda. *J. Clean. Prod.* 350, 131439 <https://doi.org/10.1016/j.jclepro.2022.131439>.
- * Riaz, Z., Ray, P., Ray, S., 2022. The impact of digitalisation on corporate governance in Australia. *J. Bus. Res.* 152, 410–424. <https://doi.org/10.1016/j.jbusres.2022.07.006>.
- Rikap, C., 2022. Amazon: a story of accumulation through intellectual rentiership and predation. *Compet. Change* 26 (3–4), 436–466. <https://doi.org/10.1177/1024529420932418>.
- Sachs, J.D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., Rockström, J., 2019. Six transformations to achieve the sustainable development goals. *Nat. Sustain.* 2 (9), 805–814.
- * Santos, M.Y., Oliveira e Sá, J., Andrade, C., Vale Lima, F., Costa, E., Costa, C., Martinho, B., Galvão, J., 2017. A big data system supporting bosch braga industry 4.0 strategy. *Int. J. Inf. Manag.* 37 (6), 750–760. <https://doi.org/10.1016/j.ijinfomgt.2017.07.012>.
- * Satyro, W.C., de Almeida, C.M.V.B., Pinto Jr., M.J.A., Contador, J.C., Giannetti, B.F., de Lima, A.F., Fragomeni, M.A., 2022. Industry 4.0 implementation: the relevance of sustainability and the potential social impact in a developing country. *J. Clean. Prod.* 337, 130456 <https://doi.org/10.1016/j.jclepro.2022.130456>.
- Schneider Electric, 2022. Climate Report.
- Schor, J.B., Attwood-Charles, W., 2017. The “sharing” economy: labor, inequality, and social connection on for-profit platforms. *Sociol. Compass* 11 (8), e12493. <https://doi.org/10.1111/soc4.12493>.
- * Scuotto, V., Ferraris, A., Bresciani, S., 2016. Internet of Things applications and challenges in smart cities: a case study of IBM smart city projects. *Bus. Process Manag. J.* 22 (2), 357–367. <https://doi.org/10.1108/BPMJ-05-2015-0074>.
- May 23 Semuels, A., 2019. The World Has an E-Waste Problem. *TIME*.
- Serna-Guerrero, R., Ikonen, S., Kallela, O., Hakanen, E., 2022. Overcoming data gaps for an efficient circular economy: a case study on the battery materials ecosystem. *J. Clean. Prod.* 374, 133984 <https://doi.org/10.1016/j.jclepro.2022.133984>.
- Sharma, A., Ajadi, S., Beavor, A., 2020. Artificial Intelligence and Start-Ups in Low- and Middle-Income Countries: Progress, Promises and Perils. *GSMA*.
- * Srinivasan, N., Eden, L., 2021. Going digital multinationals: navigating economic and social imperatives in a post-pandemic world. *J. Int. Busin. Pol.* 4 (2), 228–243. <https://doi.org/10.1057/s42214-021-00108-7>.
- Sun, P., Doh, J.P., Rajwani, T., Siegel, D., 2021. Navigating cross-border institutional complexity: a review and assessment of multinational nonmarket strategy research. *J. Int. Bus. Stud.* <https://doi.org/10.1057/s41267-021-00438-x>.
- * Szalavetz, A., 2019. Industry 4.0 and capability development in manufacturing subsidiaries. *Technol. Forecast. Soc. Change* 145, 384–395. <https://doi.org/10.1016/j.techfore.2018.06.027>.
- * Tan, J., Tan, A.E., 2012. Business under threat, technology under attack, ethics under fire: the experience of Google in China. *J. Bus. Ethics* 110 (4), 469–479. <https://doi.org/10.1007/s10551-012-1494-0>.
- * Tian, X., 2022. The art of rhetoric: host country political hostility and the rhetorical strategies of foreign subsidiaries in developing economies. *J. World Bus.* 57 (5), 101360 <https://doi.org/10.1016/j.jwb.2022.101360>.
- Toth-Peter, A., Torres de Oliveira, R., Mathews, S., Barner, L., Figueira, S., 2023. Industry 4.0 as an enabler in transitioning to circular business models: a systematic literature review. *J. Clean. Prod.* 393, 136284 <https://doi.org/10.1016/j.jclepro.2023.136284>.
- Tsan, M., Totapally, S., Hailu, M., Addom, B., 2021. The Digitalisation of African Agriculture Report, 2018–2019.
- UN, 2020. World Social Report 2020.
- UN, 2021a. United in Science 2021. September 15 UN, 2021b. Urgent Action Needed over Artificial Intelligence Risks to Human Rights.
- UNCTAD, 2021. Digital Economy Report 2021. Cross-Border Data Flows and Development: for Whom the Data Flow.
- * Uzunca, B., Rigtering, J.P.C., Ozcan, P., 2018. Sharing and shaping: a cross-country comparison of how sharing economy firms shape their institutional environment to gain legitimacy. *Acad. Manag. Discov.* 4 (3), 248–272. <https://doi.org/10.5465/amd.2016.0153>.
- * Van den Buuse, D., Kolk, A., 2019. An exploration of smart city approaches by international ICT firms. *Technol. Forecast. Soc. Change* 142, 220–234. <https://doi.org/10.1016/j.techfore.2018.07.029>.
- * Verbeke, A., Hutzschenreuter, T., 2021. The dark side of digital globalization. *Acad. Manag. Perspect.* 35 (4), 606–621. <https://doi.org/10.5465/amp.2020.0015>.
- * Vila Seoane, M.F., 2021. Data securitisation: the challenges of data sovereignty in India. *Third World Q.* 42 (8), 1733–1750. <https://doi.org/10.1080/01436597.2021.1915122>.
- Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S.D., Tegmark, M., Fuso Nerini, F., 2020. The role of artificial intelligence in achieving the Sustainable Development Goals. *Nat. Commun.* 11 (1), 233. <https://doi.org/10.1038/s41467-019-14108-y>.
- March 30 Waterfield, B., 2022. Facebook Halts Dutch Data Farm Plan after Vote to Dislike. *The Times*. Retrieved <https://www.thetimes.co.uk/article/facebook-halts-dutch-data-farm-plan-after-senate-vote-to-dislike-r0c33v3dc>. (Accessed 3 August 2022).
- * Watson, G.F., Weaven, S., Perkins, H., Sardana, D., Palmatier, R.W., 2018. International market entry strategies: relational, digital, and hybrid approaches. *J. Int. Market.* 26 (1), 30–60. <https://doi.org/10.1509/jim.17.0034>.
- WCED, 1987. Our Common Future.
- World Bank, 2021. World Bank Country and Lending Groups. Retrieved August 31, 2022 from <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>.
- WTO, 2019. Global Value Chain Development Report 2019: Technological Innovation, Supply Chain Trade and Workers in a Globalized World.
- * Yi, J., Li, J., Chen, L., 2022. Ecosystem social responsibility in international digital commerce. *J. Int. Bus. Stud.* 54, 24–41. <https://doi.org/10.1057/s41267-022-00561-3>.
- Zuboff, S., 2019. The Age of Surveillance Capitalism. *Profile Books*.