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Reshoring: A Road to Industry 4.0 Transformation

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The phenomenon of reshoring and its impact on global trade has recently garnered the attention of not only practitioners but also policymakers and scholars. Numerous scholars have highlighted the challenges of reshoring, such as supply chain disruption, labour shortages and sustainability issues, from various perspectives. Some have pinpointed technological advancements as enablers for addressing these challenges through the deployment of cloud-based artificial intelligence technologies and efficient remote management as part of the Industry 4.0 transformation. As Industry 4.0 shifts from being technology-driven to value-driven, this introductory essay for the special issue on reshoring delves into the current boundaries of our understanding and proposes recommendations for future research on this topic.

Introduction

In the wake of increasing inflation, rising costs of living and geopolitical risks, firms have been considering reshoring, following the COVID-19 crisis. However, businesses contemplating reshoring may encounter significant challenges due to potential risks, such as disrupted supply chains, unforeseen delays and production issues stemming from the unavailability of local labour, insufficient infrastructure and necessary resources. Scholars working at the intersection of management and technology have identified the Internet of Things (IoT), cloud computing, Big Data analytics and artificial intelligence (AI) as potential solutions to address reshoring challenges in the era of Industry 4.0. Nevertheless, in challenging times, should managers opt to reinvent the wheel through reshoring, or is offshoring operational functions to specialise a more viable and cost-effective strategy that

allows businesses to focus on their core strengths for accelerated growth and increased profitability?

Offshoring refers to companies seeking new markets beyond their home country by expanding to the periphery of their business territory (Barbieri *et al.*, 2022; Kano, Tsang and Yeung, 2020). However, events such as the trade war between the United States and China or the aftermath of Brexit between the United Kingdom and Europe have impacted many in various ways (Goulard, 2020; Handfield, Graham and Burns, 2020). Institutions have felt this impact as inflation (Tentreiro, 2023), while consumers have experienced rising costs in energy, groceries and the rental market (Behnassi and El Haiba, 2022). Businesses in both developing and developed countries have observed an increase in transportation and shipping costs (Saeed *et al.*, 2023) and challenges in sourcing raw materials. Consequently, companies that have offshored their business functions to other countries are now considering reshoring (Butzbach, Fuller and Schnyder, 2020).

Reshoring can result from geopolitical tremors that disrupt businesses operating in both global

We are deeply grateful to Michael Czinkota, who passed away in 2023. This special issue would not have been possible without the passion and support of Michael.

and local domains (Butzbach, Fuller and Snyder, 2020). Disruptions of any kind prompt managers to explore cost-effective options for managing their supply chains while ensuring superior control over quality and operations (De Lima and Seuring, 2023; Huq, Pawar and Subramanian, 2021; McMaster *et al.*, 2020). Reshoring from markets with high sales potential presents a significant challenge for managers, as the decision may lead to either a loss of sales or an increase in selling costs (Baraldi, Ciabuschi and Fratocchi, 2022; Barbieri *et al.*, 2022; Boffelli *et al.*, 2020). Companies generally decide in favour of reshoring due to political situations, such as changes in tariffs or the withdrawal of tax incentives by the host country, as such conditions threaten the primary objective of offshoring (Moradlou *et al.*, 2021). Over the past two decades, international businesses have also considered reshoring to combat threats like terrorism or other hazardous situations that may pose risks to human life (Czinkota *et al.*, 2010).

The decision to reshore impacts small firms in host countries that serve large firms from foreign markets (Sena *et al.*, 2022). Offshoring to a manufacturer outside the home country bolsters the job market in the host country by providing employment opportunities for both skilled and specific categories of unskilled workers (Piatanesi and Arauzo-Carod, 2019). However, reshoring removes these employment opportunities and diminishes the trade potential for local supplier ancillary firms in the host country (Gillani, Kutaula and Budhwar, 2022). Scholars and the Chartered Institute of Procurement and Supply in the United Kingdom reported in September 2022, based on a survey of 750 firms, that manufacturing is on the rise among UK companies due to reshoring (Bailey and Rajic, 2022; Rowsell, 2022). The study's findings revealed that approximately 45% of companies plan to move their production back to the United Kingdom in response to challenges faced during importing and a consistent increase in shipping costs (Rowsell, 2022). The globalization of business disrupts cross-border commerce and impairs outsourcing firms' ability to offer better value to customers by offshoring their manufacturing (Pananond, Gereffi and Pedersen, 2020). Reshoring from countries like China and India may result in stunted growth of brands in developed markets, as the cost of shipping can become a limitation for conducting business across national

borders (Fratocchi *et al.*, 2016; Wiesmann *et al.*, 2017).

The aim of this essay is to enhance our understanding of the reshoring phenomenon in the post-COVID-19 era by examining past and current reshoring trends in research and providing novel insights on the influence of sustainable development goals (SDGs) on reshoring. Prior reshoring literature has been well studied on topics such as the motivations for reshoring (e.g. Fratocchi *et al.*, 2016; Gray *et al.*, 2017), performance outcomes of reshoring decisions (e.g. Brandon-Jones *et al.*, 2017), cultural aspects of reshoring (e.g. Lacity, Khan and Carmel, 2016) and barriers/challenges of reshoring (Albertoni *et al.*, 2017). However, the concerns surrounding sustainability in the context of reshoring have often been overlooked. In fact, it is crucial to emphasize the importance of thoroughly assessing the societal implications of sustainability when implementing reshoring initiatives, more importantly striking a delicate equilibrium between economic growth and long-term sustainability. Thus, our special issue aims to provide cross-disciplinary thinking about reshoring strategies in the context of SDGs. The contributed papers emphasize the importance of considering factors such as sustainability, consumer perceptions, socio-political contexts, stakeholder influence, environmental regulation and knowledge transfer when analysing the reshoring phenomenon. Collectively, these studies contribute to advancing the discourse on reshoring and its broader consequences, providing valuable guidance for both practitioners and researchers in this rapidly evolving field.

Moreover, we observe that the ongoing changes of Industry 4.0 technologies in the home country may trigger the implementation of reshoring. This essay concentrates on the role of Industry 4.0 technologies in reshoring and their potential to generate value for companies that have reshored. We offer insights for managers on how to optimally utilize Industry 4.0 technologies to facilitate reshoring and invigorate their reshoring initiatives.

Reshoring: Past and current trends

Reshoring, defined as 'the return of manufacturing and service operations from previously offshored locations to the headquarters' country' (Brandon-Jones *et al.*, 2017), has emerged as one of the

most prominent international business strategies to address global economic and political pressures. In recent decades, manufacturing locations have shifted primarily to low-cost countries. This shift was driven by cost-reduction strategies and a desire to expand globally. Nonetheless, as greater attention is directed towards the limitations of low-cost manufacturing locations and their potential impact on supply chain configurations, businesses have begun to reassess their manufacturing location decisions and contemplate reshoring as a viable response. In this essay, we summarize four main research themes from prior research on reshoring: (1) *reshoring behaviour and the decision-making process*; (2) *reshoring for global branding or localization*; (3) *reshoring as a disruptive process*; and (4) *reshoring and sustainable development goals*.

Reshoring behaviour and the decision-making process

Earlier works, such as Tate (2014), have provided insights into reshoring as a trend from a political perspective, highlighting how it became a platform for US politicians during presidential elections as they promised job returns, sustainability, cost-effectiveness and prosperity. Around the same time, several studies explored the motivation and limitation of reshoring decisions. For example, according to the eclectic theory, reshoring strategy in general relates to the global manufacturing or service location decision to chase four different strategic advantages, namely resource-seeking advantage, market-seeking advantage, efficiency-seeking advantage and strategic asset-seeking advantage (Dunning, 1998; Ellram, Tate and Petersen, 2013).

Gray *et al.* (2013) indicate that reshoring is a reversal of a previously made offshoring decision, and relates to a location that can take four different forms: (a) in-house reshoring; (b) reshoring for outsourcing; (c) reshoring for insourcing; and (d) outsourced reshoring. They further suggest that reshoring decisions may be driven by changes in cost drivers or a reassessment of the total cost of offshoring based on experience, and highlight the importance of organizational learning-by-doing and the potential influence of decision biases, such as availability bias and the bandwagon effect, on offshoring and reshoring decisions.

A theory-based classification of reshoring motivations was later developed by Fratocchi *et al.*

(2016), which explains the causes and effects of reshoring, contributing to critical debates on location decisions and advance theories of multinational enterprises (MNEs). From the host-country context, where MNEs have offshored, the motivations for firms to reshore can generally be classified by company goals, such as customer perceived value and cost efficiency (Fratocchi *et al.*, 2016), and location-specific factors (McIvor and Bals, 2021). More specifically, customer-perceived quality and product/process innovation are relevant to the former category (Di Mauro *et al.*, 2018; Johansson and Olhager, 2018), while direct costs (e.g. increased labour wage rates and exchange rate risks) and indirect costs (e.g. institutional changes and timeliness of required knowledge) occurring in the host country relate to the latter category (Foerstl, Kirchoff and Bals, 2016). Interestingly, an MNE's prior offshoring performance has been found to be a reason for relocating business services (Albertoni *et al.*, 2017). Although early literature made remarkable efforts to identify motivations or drivers for implementing reshoring strategies, there is relatively less research focusing on home-country contexts. Baraldi *et al.* (2018) suggest that studying micro-level factors, such as interactions and interdependencies within home-country business networks, can shed light on reshoring.

Reshoring decisions are often presented as a simple 'yes or no'. However, Baraldi *et al.* (2018) argue that reshoring strategy is not about a binary decision-making process (i.e. either reshoring the entire production line or service centre), but rather concerns the degree of reshoring (i.e. the extent to which specific activities may be 'brought back home'). For example, instead of reshoring its entire production line, Apple made a \$100 million investment in 2013 to produce the Mac Pro in the United States. Furthermore, the establishment of a reshoring strategy may also take into account the 'make or buy' question, involving a trade-off between regional/local outsourcing and complete insourcing (Hartman *et al.*, 2017). To address increased exogenous cost drivers (e.g. wage rates in foreign countries or potential quality problems) and improve public image, scholars have emphasized the strategic importance of properly implementing reshoring, from establishing the reshoring plan to announcing the reshoring decision to the public (Fratocchi *et al.*, 2016; Grappi, Romani and Bagozzi, 2015; Gray *et al.*, 2017).

Another stream of research in the field examines the effects of reshoring strategies. These ‘outcome-focused’ studies present novel research questions concerning the ex-post phenomenon of reshoring. For instance, scholars have found that announcing reshoring decisions results in positive stock market reactions, which in turn bring more wealth to the MNE’s shareholders (Brandon-Jones *et al.*, 2017). From a consumer stakeholder perspective, initiating reshoring has been shown to strengthen home-country consumers’ willingness to buy and pay for a company’s products (Grappi, Romani and Bagozzi, 2015, 2018). However, at the firm level, empirical findings on the performance outcomes of reshoring remain inconsistent (Johansson and Olhager, 2018; Stentoft *et al.*, 2018). Whether implementing reshoring strategies leads to positive firm performance is still an open question. In fact, the reshoring activities of an MNE could significantly impact the remaining subsidiaries in the host country. Furthermore, there is still a lack of clarity regarding the effects of reshoring on home-country suppliers.

Reshoring for global branding or localization

Consumers in developing markets appreciate the sophisticated and standardized products offered by large international firms with well-established, iconic global brands (Xie, Batra and Peng, 2015). When global brands offshore their manufacturing to specialty firms, they experience growth and profitability (Mudambi and Venzin, 2010). Offshoring helps these companies reduce costs while maintaining the consistency required for effective brand management (Lampel and Bhalla, 2011; Yadav *et al.*, 2018). At the same time, consumers tend to prefer global brands over local ones, as this allows them to participate in a global culture and connect with a worldwide community of users (Xie, Batra and Peng, 2015).

Global brands encourage consumers to view themselves as global citizens who endorse the brand’s actions and support the socially responsible values it offers (Werther and Chandler, 2005). In contrast, local brands resonate with consumers by instilling pride in their identity and fostering connections to their country of origin. The consumption of products offered by global brands reflects consumers’ aspirations for higher standards and their desire to integrate into a global community (Özsomer and Altaras, 2008; Steenkamp

and DeJong, 2010). Increasingly, consumers expect global brands to provide localized products (Ashby, 2016). Brands that embrace localization to bridge the gap between consumer desires and actions can become active players in a competitive market (Ashby, 2016). Brands offer localized products using standardized policies and branding theories to increase consumer engagement (Dey *et al.*, 2022). Successful localization has been demonstrated by industries such as food and banking, with companies like McDonald’s and HSBC as prime examples. Reshoring production to the home country enables companies to localize by offering products tailored to the local culture, language and tastes (Sirilertsuan, Ekwall and Hjelmgren, 2018). However, the globalization aspect of the market makes it challenging for managers to consider reshoring. Discussions about reshoring due to supply chain disruptions can disappoint brand consumers and make brand managers apprehensive.

In the case of reshoring, localization involves adapting the production process to the culture and materials of that country. Localization as a strategy refers to integrating consumer-specific requirements related to language, culture and taste into products or services (Wiesmann *et al.*, 2017). This could include using local materials and labour, employing local designers and craftspeople, and adjusting production processes to meet local regulations and standards (Grandinetti and Tabacco, 2015; Lacity, Khan and Carmel, 2016).

A global brand that offers standardized products with local service and content-based marketing in the local language demonstrates respect for local culture (Vecchi and Brennan, 2022). Consumers consider such brands to be relevant and accessible (Ashby, 2016). Superior accessibility of the consumer to localized products when offered by globally recognized brands increases the potential of success of the brand in a competitive market (Ashby, 2016). Thus, a comprehensive understanding of cultural and other specific features, when integrated into a product, can help global brands address the localization needs of consumers in their target markets (Grappi, Romani and Bagozzi, 2018). While technological advancements are making it easier for companies to consider reshoring with reduced risks, the globalization of products has increased consumer demand for localized offerings (Hohn and Durach, 2021). Consequently,

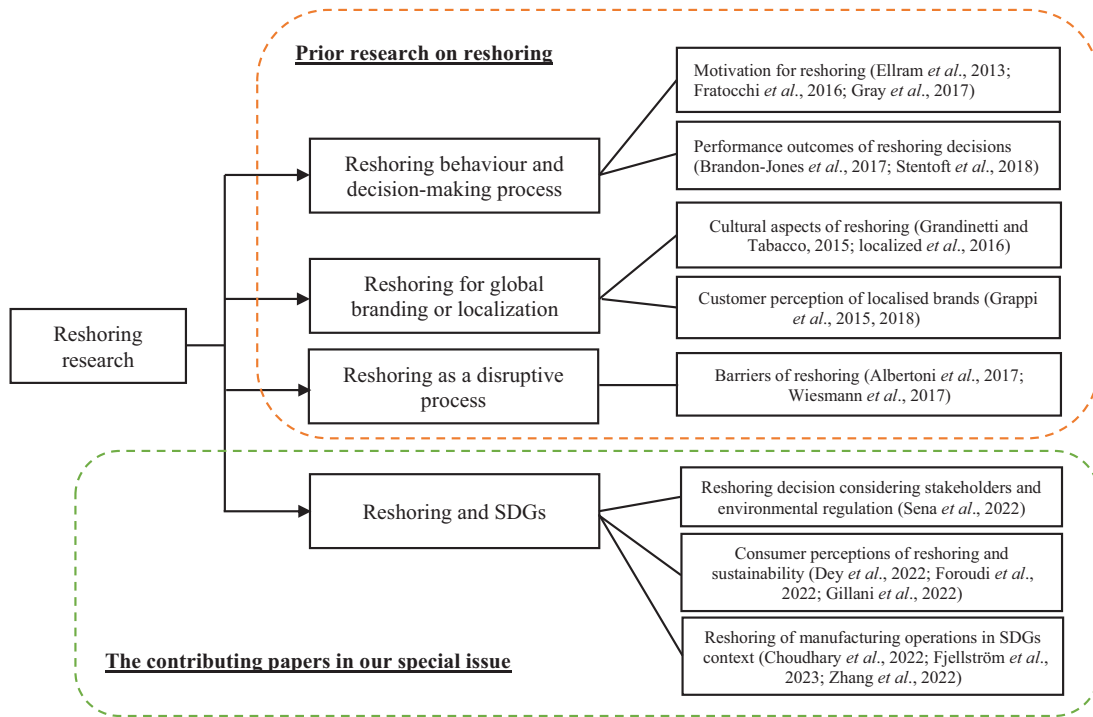


Figure 1. The landscape of reshoring research [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

the localization of products and services as the future of global manufacturing cannot be ignored.

Moreover, localization as a phenomenon originated from the need to offer content in various languages. The process involves translating marketing content, images and graphics while integrating local cultural elements to create a resonance between consumers and the product or brand across different markets (Kumar, 2018). Businesses can leverage localization to adapt their content to diverse cultures and regions, fostering a more personalized customer experience. Localization when used as a strategy to penetrate markets increases familiarity of the product for the target consumer (Khan *et al.*, 2017). Incorporating unique needs and preferences of consumers in the target market can achieve higher sales with consumer satisfaction (Hult *et al.*, 2019). Investing in localization will demonstrate commitment of the brand to establish itself in the market and build image and reputation for gaining confidence of the consumer in the brand (Ellen, Webb and Mohr, 2006). Localization is increasingly becoming important for brands operating in a global market, particularly as an important aspect of international expansion strategy of the brand (Deng, 2009). Reshoring

manufacturing with a standardized strategy for managing a corporate brand to be used for all markets and localizing product and product marketing strategies will strengthen the relationships a brand can enjoy with its stakeholders in its local market and improve its position in a competitive market (Grandinetti and Tabacco, 2015).

Should managers be encouraged to consider reshoring as the need for localization is increasing? Will localization of branded products need a local operational setup, or can it be managed remotely from the home country? Little is known about how to manage reshoring while ensuring effective localization. There needs to be more scholarly attention paid to advancing knowledge in the periphery of reshoring and branding to introduce this critical area of international business to scholars and to evaluate strategies that will support reshoring without disappointing consumers.

Reshoring as a disruptive process

Reshoring helps build resilient supply chains by reducing dependence upon suppliers located in far locations (van Hoek and Dobrzykowski, 2021). When a decision to reshore is made with the

Table 1. A summary of contributed papers in the special issue

Studies	Research focus	Theory	Method	Data source	Key findings/contributions
Fjellström <i>et al.</i> (2023)	Propose the knowledge ambiguity framework to explore the role of knowledge transfer in dynamic manufacturing relocation	Knowledge transfer theory	Case study	In-depth interviews with a headquarters in Sweden and its factory in China	<ul style="list-style-type: none"> As a result of the lack of knowledge transfer, limited learning outcomes result in operational and strategic consequences during the relocation process. Reluctance to transfer knowledge in offshoring leads to relocation ambiguity when reshoring.
Gillani, Kutaula and Budhwar (2022)	Examine consumer perceptions of reshoring and sustainability from a social, economic and environmental perspective	Attachment theory	Qualitative study	30 in-depth interviews	<ul style="list-style-type: none"> The 'made-in' effect may be perceived as divisive among British consumers, although there is an increasing interest in sustainability. Reshoring is perceived positively by consumers when it aligns with their sustainable values and beliefs.
Choudhary <i>et al.</i> (2022)	A network perspective on the decision to reshore and investigate its impact on both the resilience and sustainability of a focal firm's supply chain network	Network theory	Secondary data analysis	Two large-scale networks (i.e. Apple and Jaguar Land Rover) consist of 2066 and 1283 firms, respectively	<ul style="list-style-type: none"> Challenges the assumption that reshoring to domestic suppliers necessarily contributes to increasing the average sustainability of the supply chain network. The reshoring process should be viewed as a system reconfiguration, as opposed to merely a shift in location.
Foroudi <i>et al.</i> (2022)	An extended conceptualization of SDG perceptions from local consumers in the reshoring context	Moral psychology theory	A mixed-method approach for scale development	A sample of 1075 reshoring MNC customers	<ul style="list-style-type: none"> Seven local consumers' SDG perceptions in the reshoring context are identified (i.e. society/community wellbeing, affordable and clean energy consumption, economic growth, responsible consumption, responsible production, sustainable industrialization and innovation and gender equality). The impact of SDGs on customer perception differs across industries, but rather through different mechanisms (e.g. ethnocentrism and perceived reshoring quality).

Table 1. (Continued)

Studies	Research focus	Theory	Method	Data source	Key findings/contributions
Sena <i>et al.</i> (2022)	Investigate whether reshoring decisions made by multinationals are influenced by external stakeholders and country-level environmental regulation	Stakeholder theory	An event study	1845 subsidiaries owned by UK firms located in 39 countries	<ul style="list-style-type: none"> • Reshoring decisions may be accelerated if stakeholders are less close to the host country. • Country-level environmental regulation influences reshoring decisions. • Multinationals are more likely to reshore if offshoring activities cause negative publicity or reputational damage.
Dey <i>et al.</i> (2022)	Develop a consumer behavioural framework for reshored brands within a complex socio-political context	Socio-political view	Mixed-methods study	A survey of 415 respondents and 20 in-depth interviews	<ul style="list-style-type: none"> • Consumers' positive attitudes towards reshored brands have a significant impact on their purchase intentions. • Attitude towards Brexit and attitude towards reshored brands play mediating roles in the relationship between reshoring sentiment and purchase intention.
Zhang <i>et al.</i> (2022)	Examine whether environmental performance feedback influences reshoring decisions for multinationals	Behavioural theory of the firm	Quantitative study	Manufacturing MNEs in 15 developed OECD countries over the period 2013–2020	<ul style="list-style-type: none"> • Firms with below-aspiration environmental performance (BEP) are slower to engage in reshoring, while those with above-aspiration environmental performance (AEP) are quicker to do so. • Companies with BEP engage in reshoring activity even more slowly when they receive positive financial performance feedback. • Positive financial performance feedback does not appear to moderate the relationship between higher AEP and reshoring timing.

Table 2. Marketplace evidence analysis of reshoring with Industry 4.0 technologies




Reshoring company	Industry	Reshored business function	Industry 4.0 technology implementation	Picture of technology in use	Reference
General Electric	Consumer products	Assembly line	Automation accelerates production by employing robotic arms to pick and place components in a precise and repeatable manner. Additionally, automation reduces labour costs by diminishing the need for manual labour and enabling the assembly line to operate with fewer workers.		McIntyre (2017)
Neurophotometrics	Biotechnology	New product development	3D Printing. Neurophotometrics collaborated with Markforged to develop a 3D-printed swab for use in diagnostic testing for COVID-19. 3D printing allows Neurophotometrics to test prototypes within 36 hours, significantly improving their time-to-market performance.		Dunlea (2020); Med-Tech Innovation (2020)
Premier Plastics	Medical manufacturing	Thermoforming production lines	Industrial robotics. Developing new robotic automation system to shorten production time.		Moser (2021)

Table 2. (Continued)



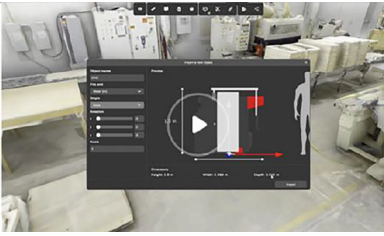


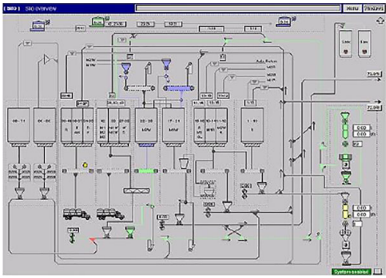
Reshoring company	Industry	Reshored business function	Industry 4.0 technology implementation	Picture of technology in use	Reference
Jabil Healthcare (formerly Nypro)	Medical manufacturing	Medical moulding and assembly line	Industrial robotics are used to perform unsafe and repeatable tasks.		Plastics Today (2012)
Maxim Integrated	Semiconductors	Production and monitoring of factory	Develop a cyber-physical system (CPS) development platform that incorporates real-time intelligence, adaptive manufacturing and distributed control functions to facilitate the efficient production and monitoring of the factory floor.		Reshoring Institute (2015)
Agropur	Dairy products	Production line	Utilizing 3D scanning and digital twins , Prevu3D has assisted Agropur in rapidly capturing detailed 3D models of their production plants and manufacturing lines. This technology enables Agropur to monitor the performance of their production lines in real time.		Muktadir (2022)

Table 2. (Continued)

Reshoring company	Industry	Reshored business function	Industry 4.0 technology implementation	Picture of technology in use	Reference
McLaren Technology Group	Motor vehicles	Production line	Equipped with active aerodynamics, race-ready chassis control and carbon ceramic brakes, the hybrid engine with monocoque achieves fuel efficiency, boasts an exceptional power-to-weight ratio and exhibits minimal turbo lag.		Williamson (2018)
Ypsomed	Medical technology products	Localization in production line	5G mobile edge cloud technology, in conjunction with sensors on crates and augmented reality for indoor localization, enables real-time evaluation of machine data, virtualization of resources and quality assurance in industrial environments.		Swisscom (2018)
Rīgas Dzirnāvieks AS	Food products	Automation of production process	Sustainable production, featuring electrical transmission, water restoration and energy efficiency indicators, has become possible through the use of supervisory control and data acquisition (SCADA) systems with human-machine interface (HMI) .		Baltic Course (2018); BTC Automation (2018)


Reference	Picture of technology in use	Chen (2018)
Reshored business function	Industry 4.0 technology implementation	The integration of AI-infused concepts, neural networks and IoT, along with 3D sensing cameras, enhances contract manufacturing processes.
Production process	Electronic components	
Reshoring company	Pegatron Corp.	

Table 2. (Continued)

purpose of creating a locally located setup, it shortens the time required by the company to make products accessible to consumers on the shelves of retailers (Ashby, 2016). Simultaneously, reshoring aids building of superior consumer confidence with better managerial control over quality (Dey *et al.*, 2022). Despite the potential benefits of reshoring manufacturing, there are also significant costs involved that go beyond the initial expenses of setting up a new manufacturing unit. These costs were highlighted in a study by McIvor and Bals (2021), which found that the total loss incurred in such cases often exceeds the cost of developing a new facility with the required infrastructure (Albertoni *et al.*, 2017). These costs typically include country factor costs (e.g. labour and energy costs) and reconfiguration/restructuring costs (currency fluctuations, taxes and import duties) (McIvor and Bals, 2021). In addition, companies must ensure compliance with regulatory requirements and optimize the utilization of the production unit's capacity as a function of sales.

The complex requirements that influence competitiveness can deter companies from considering reshoring (Wiesmann *et al.*, 2017). A failure to assemble a team with efficient production planning capabilities, secure orders without compromising infrastructure utilization, or comply with regulations related to production (e.g. environmental, waste management, taxation and labour laws) may transform a profitable business into a loss-making enterprise (Putti, 2021). Additionally, the inability to identify suppliers providing quality raw materials and packaging materials, coupled with the lack of available transportation infrastructure or competitively priced logistics services, can negatively impact the cost-effectiveness of reshoring (Fan and Stevenson, 2018). Concurrently, shifting focus away from a company's core business or the strengths of its core team (e.g. from strategizing to manufacturing) may diminish the company's ability to address the innovation-related needs of their target consumers (Joubioux and Vanpoucke, 2016).

Reshoring and sustainable development goals

This special issue on reshoring and SDGs represents the culmination of work by various scholars in the fields of international business, international marketing and international trade. The contributed papers provide valuable insights into

the reshoring literature by examining the decision-making processes (Sena *et al.*, 2022), consumer perceptions (Dey *et al.*, 2022; Foroudi *et al.*, 2022; Gillani, Kutaula and Budhwar, 2022) and various factors influencing the reshoring of manufacturing operations (Choudhary *et al.*, 2022; Fjellström *et al.*, 2023; Zhang *et al.*, 2022) in the context of SDGs.

Choudhary *et al.* (2022) challenge the assumption that reshoring automatically enhances supply chain sustainability, arguing for a more nuanced understanding of reshoring as a system re-configuration. Foroudi *et al.* (2022) and Gillani, Kutaula and Budhwar (2022) explore local consumer perceptions of reshoring and SDGs, revealing variations in impact across industries and the importance of aligning with consumer values. Dey *et al.* (2022) develop a consumer behaviour framework for reshored brands, emphasizing the significance of positive consumer attitudes on purchase intentions, while Sena *et al.* (2022) examine the role of external stakeholders and country-level environmental regulation in reshoring decisions. Zhang *et al.* (2022) apply the behavioural theory of the firm to understand how environmental performance feedback influences reshoring decisions, and Fjellström *et al.* (2023) propose the knowledge ambiguity framework to investigate the role of knowledge transfer in dynamic manufacturing relocation. We summarize these contributing papers in Table 1 and position them in the landscape of reshoring research as visualized in Figure 1.

New road ahead: Reshoring with Industry 4.0 technologies

Industry 4.0 represents the fourth industrial revolution, emphasizing 'the crucial role of intelligent machines and smart automation in business activities' (Luo and Zahra, 2023, p. 404). These technologies provide the necessary flexibility for firms to manage the complexities of reshoring while maintaining competitiveness in global value chain activities (Ancarani and Di Mauro, 2018). For instance, process automation and advanced machinery have streamlined the monitoring of manufacturing operations. By minimizing reliance on human labour, automation results in consistent, high-quality outputs and enhanced productivity. Employing sensors and other digital devices

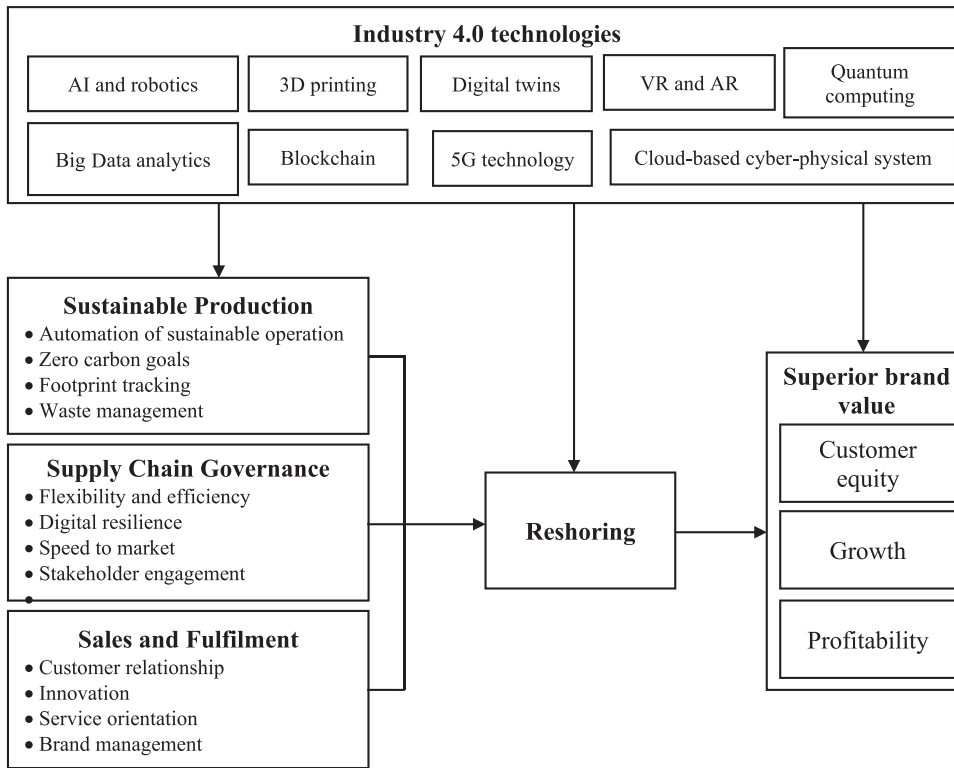


Figure 2. A conceptual framework of reshoring with Industry 4.0

facilitates improved oversight of production and supply chain management functions (Bilbao-Ubillos *et al.*, 2023).

The ongoing progression of technology-based applications, particularly in the realm of AI, has revolutionized the methods by which firms assess efficiency and profitability. AI empowers managers to tackle issues pertaining to reshoring (Ancarani and Di Mauro, 2018). For instance, data-driven alignment of resources with market conditions can facilitate cost control (Chung *et al.*, 2015). Utilizing data on the successes and failures of promotions enables firms to track and forecast future sales, thus supporting process optimization and production management (Wang *et al.*, 2020). Access to data and information allows companies to ensure traceability, maintain regulatory compliance and mitigate social damages arising from risks associated with supply and consumption. By harnessing technological advancements, manufacturers' reshoring decisions can yield the exceptional strengths necessary to sustain a competitive edge in the marketplace (Theyel and Hofmann, 2021).

Moreover, simulation-based robotics enhances production by lowering labour costs (Ronconi *et al.*, 2021). Cyber-physical systems (CPSs) contribute to prototype design suggestions and facilitate the development of products with advanced features, thereby invigorating the product lifecycle with novel additions (Ancarani and Di Mauro, 2018). The adoption of 3D printing technology empowers manufacturers to provide the customization necessary for localization efforts and accommodate low-volume production processes for both high and low-value products that might otherwise prove economically unfeasible (Kamble *et al.*, 2023). For example, Caterpillar experienced a substantial 90% cost reduction in some production projects after implementing 3D printing. This is in addition to the savings the company achieved by relocating its production facilities from China to the United States, where a state-of-the-art plant was established in 2012 (Rasmussen, 2016).

The transformation of manufacturing, integrating localization capabilities via digital technology, has rendered managers more inclined to

Table 3. Examples of research questions related to three aspects of reshoring with Industry 4.0

Three aspects of reshoring with Industry 4.0	Examples of research questions
Sustainable production	<ul style="list-style-type: none"> • What technical resources and knowledge are required for MNEs in the sustainable reshoring decision-making process? • How can MNEs collaborate with governments to establish local sustainable value chains for their reshoring initiatives using Industry 4.0 technologies? • What effective technical support can governments provide to MNEs to encourage them to initiate sustainable reshoring decisions?
Supply chain governance	<ul style="list-style-type: none"> • Does implementing Industry 4.0 technologies in reshoring efforts minimize the risks associated with outsourcing offshore (e.g. cybersecurity, data loss and customer identity theft)? • How can offshored IT functions be seamlessly integrated with the home-country company's IT infrastructure and ecosystem? • Does reshoring with Industry 4.0 technologies enhance supply chain resilience? • Does incorporating Industry 4.0 technologies in reshoring initiatives improve supply chain efficiency and flexibility? • How can Industry 4.0 technologies be leveraged to develop effective reshoring tactics and initiatives?
Sales and fulfilment	<p>Using a machine learning approach, we aim to understand:</p> <ul style="list-style-type: none"> • What differences can be found between the perceptions of home-country consumers and host-country consumers regarding MNEs' reshoring decisions? • How do host countries' consumers emotionally and psychologically react towards reshored brands, and what do these reactions imply for branding, communication and marketing strategies? • Can reshoring initiatives enhance MNEs' customer responsiveness, brand image and product/innovation differentiation in global markets? • How do different reshoring strategies and types of reshoring impact consumer responses and consumer-brand relationships? • How does the segmented nature of consumer responses to reshored brands influence the sales of reshored brands in host-country markets? • How do consumer preferences vary across countries, and how can companies leverage this variation to their advantage when reshoring?

contemplate reshoring (Joubiou and Vanpoucke, 2016). To elucidate the relationship between reshoring and Industry 4.0 technologies, we carried out a market evidence analysis by examining a sample of reshoring instances. Table 2 encapsulates ten cases, demonstrating how Industry 4.0 technologies have supported companies in reshoring their business operations.

Reshoring with Industry 4.0: Agenda for future research

To address the intricacies of reshoring, we propose a conceptual framework that capitalizes on digitalization and Industry 4.0 technologies (refer to Figure 2). Future research can scrutinize the assumptions from three distinct perspectives: (1) *sustainable production*; (2) *supply chain governance*; and (3) *sales and fulfilment*. This conceptual framework pinpoints Industry 4.0 technologies that can enhance business brand value. The suggested framework is centred on the primary

contributions, employing a testing approach as a measurement scale that may prove advantageous for managers.

An Industry 4.0 approach requires managers to orchestrate manufacturing and production processes by aligning available resources based on the analysis of various scenarios in a cohesive manner (Maghazei, Lewis and Netland, 2022). Through a transparent production management system, managers can identify, evaluate and address sustainability issues that may disrupt the process, resulting in diminished productivity or heightened environmental risks associated with supplier liability and consumer warranties. Liang and You (2023) investigated the potential for climate change mitigation and energy performance in photovoltaic panel manufacturing by comparing emissions and energy consumption in domestic production versus offshore manufacturing. Their findings reveal that domestic production in the United States reduces greenhouse gas (GHG) emissions by 23% and energy consumption by 4%. Conversely, manufacturing photovoltaic panels in Malaysia

generated 42% more GHG emissions than manufacturing in the United States. Liang and You (2023) further contend that technological innovations and advancements in reshoring production can contribute to the attainment of sustainability objectives.

Previous research has indicated that a firm's reshoring decision is influenced by host-country factors, such as overseas supply chain complexity and offshore supplier dependence (Chen and Hu, 2017; Srari and Ané, 2016). Supply chain governance in reshoring initiatives is vital for the successful execution and management of the reshoring process. It is crucial for companies to ensure that their supply chain partners maintain robust relationship ties and adhere to relevant laws and regulations. Importantly, Industry 4.0 technologies can be advantageous for optimizing supply chain networks (Lee *et al.*, 2023). For example, employing open-source cloud-based physical systems with IoT and digital twins can foster transparency and enhance visibility into processes, essential for a resilient supply chain (Lampón and Rivo-López, 2022; Leng *et al.*, 2021). Ford's One Manufacturing System enables its employees to work on multiple models and platforms within the same facility, facilitating the production of gas, electric and hybrid vehicles. Utilizing flexible robots, Ford has reinforced its reshoring initiative, returning 3250 jobs from Mexico to Michigan and Ohio in 2016 (Rasmussen, 2016).

Although numerous scholars have explored the potential of Industry 4.0 technologies for production and supply chain governance, few have examined it from a marketing perspective to guide sales and brand management (Luo and Zahra, 2023). This framework extends the management team's scope beyond resource alignment to include consumers seeking brands offering localization with sustainable capabilities. This essay calls for contributions to management, marketing and sustainability literatures by bridging the gap that elucidates the end-to-end business journey of a brand, from production to sales and brand management, utilizing Industry 4.0 technologies. Future researchers are encouraged to investigate the global impact of reshoring on brand image and the adoption of practices essential for Industry 4.0. Based on this conceptual framework, we also propose examples of research questions related to each component within the framework, as presented in Table 3.

Conclusion

Reshoring poses challenges due to the low economic viability and costs associated with transitioning from existing processes to reshoring initiatives (Ashby, 2016). In the short term, reshoring may compromise supply chain viability or efficiency, while in the long term it could jeopardize growth and profitability (Karatzas *et al.*, 2022). Unfavourable trade agreements and policies may negatively impact the economics of reshoring, resulting in a non-viable supply chain.

To address these reshoring challenges, this special issue provides a diverse array of insights into the complexities and obstacles surrounding reshoring, spanning from supply chain resilience and sustainability to consumer perceptions and the role of external stakeholders. Collectively, the papers in this special issue contribute to a more profound understanding of the reshoring phenomenon from a sustainability standpoint. By examining reshoring from multiple angles, this special issue underscores the necessity for a holistic approach to tackling the challenges and opportunities reshoring presents in an ever-changing global economy.

Furthermore, it is vital for managers to evaluate the overall impact of reshoring on their brands and consumers in distant markets, utilizing Industry 4.0-enabled tools. By integrating reshoring with a localization strategy and adopting an Industry 4.0 approach, companies can reap substantial benefits. Armed with Industry 4.0 technologies, managers are better equipped to achieve successful operations by controlling material flows before, during and after relocation. These technologies will offer valuable insights into various aspects, such as switching costs (including labour, transportation and regulatory costs throughout the product lifecycle), supply chain governance, manufacturing planning, financial incentives and workforce planning. This enables companies to make informed decisions and optimize their reshoring strategies for long-term success.

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