



Digital technology-enabled governance for sustainability in global value chains: a framework and future research agenda

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Abstract

Upholding sustainability in the global value chains (GVCs) is a new reality confronting multinational enterprises (MNEs). Although MNEs have realized *why* they need to take action to govern sustainability issues in the GVCs, *how* to implement this governance is unclear. In this article, I revisit the essence of governance mechanisms, propose a range of *digital technology-enabled governance* mechanisms and discuss how they overcome the constraints of traditional control and coordination and allow MNEs to uphold sustainability in their GVCs. Specifically, I draw on and integrate ideas from internalization theory and the literature on digital technologies to inform on the key mechanisms and boundary conditions. I conclude by discussing theoretical implications for the debates on the quasi-internalization literature and suggesting an array of future research questions.

Keywords Global value chain · Quasi-internalization · Digital technologies · Control · Coordination · Firm-specific advantages · Governance for sustainability

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1 Introduction

Global value chains (GVCs) (i.e., the separation between different stages in the production and consumption of materials and products of value in different parts of the world) account for about 70% of global trade (OECD, 2022). GVCs are economically efficient by leveraging different comparative advantages and specializations in different countries. Meanwhile, substantial environmental, social, and governance (ESG) related controversies are also GVC-linked. For instance, 80–90% of greenhouse-gas emissions are categorized as “Scope 3” emissions or indirect emissions that occur across GVCs (Practice et al., 2021). As another example, fueled by the drive for economic efficiency, GVCs also exacerbate social sustainability challenges, such as poor working conditions and modern slavery. With more sustainability controversies brought to light, MNEs, as the lead firms in GVCs, are increasingly held accountable not only for the activities of their own companies but also for those related to their GVCs (Egels-Zandén, 2014; Kim & Davis, 2016). In other words, “stakeholders view the firm’s responsibility boundaries as stretching much further than either its ownership or control boundaries” (Narula, 2019: p. 1632). An increasing number of researchers have studied the drivers and consequences of MNEs’ adaptiveness—or lack thereof—to this stakeholder demand. Despite mixed empirical evidence, existing studies, in general, agree that social and environmental controversies can result in significant reputational erosion and financial punishment among MNEs (Kölbel et al., 2017; Wang & Li, 2019).

Despite increasingly numerous standardized social and environmental responsibility programs (Kim & Davis, 2016), studies have found third-party certifications and social audits have limited effect in reducing the sustainability risks in GVCs (Chen & Lee, 2017). Moreover, such market-based screening and monitoring instruments are not readily available in certain industries and countries. Thus, growing stakeholder demand for sustainability is forcing firms to internalize, at least partially, the governance of sustainability issues in GVCs, reducing market failure. By internalizing GVC governance activities, MNEs may develop specialized skills and dynamic capabilities that could become a source of new firm-specific advantages (FSAs) in managing stakeholder expectations (Maksimov et al., 2022; Narula et al., 2019). Recent surveys found that sustainability is already a top criterion in choosing an employer for two-thirds of potential employees younger than 34 (Practice et al., 2021). Major investment firms (including BlackRock, Vanguard, and State Street) have started translating their sustainability-oriented mindset into action. Thus, the number of MNEs that have already pledged to push their GVCs toward a greater level of environmental and social sustainability continues to increase.

Although MNEs have realized *why* they need to take action to govern sustainability issues in the GVCs, *how* to implement this governance is unclear. In this article, I revisit the essence of governance mechanisms, propose a range of available *digital technology-enabled governance tools* and discuss how they overcome the constraints of traditional control and coordination and enable MNEs

to uphold sustainability in their GVCs. I conclude with suggestions for further enriching our understanding of the quasi-internalization arguments and elaborate on ways in which digital technologies might help in the practical task of tackling sustainability.

2 The essence of governance: control and coordination

Governance is a central and continuing issue for the management of the MNE networks (Doz & Prahalad, 1984; Ghoshal & Bartlett, 1990; Kostova et al., 2016). Scholars have long argued that governance is reflected by using a portfolio of *control* and *coordination* (Martinez & Jarillo, 1989). Although control and coordination overlap to some degree, they have a distinct focus and associated mechanisms. As Cray (1984) has explicitly explained, control is “a process which brings about adherence to a goal or target through the exercise of power or authority” but coordination is “an enabling process which provides the appropriate linkage between different task units” (p. 86). This distinction is especially critical in studying the governance of GVCs that involve complex interfirm relationships across different institutional contexts. In a recent review article, Kano et al. (2020) summarized that “in the context of a GVC, governance includes the overarching principles, structures and decision-making processes that guide the ‘checks and balances’ in network functioning, to make sure that the interests of the entire network (and broader societal/environmental interests where relevant) are served above and beyond localized interests of participating firms and individual decision-makers within these firms” (p. 599). Thus, it is time to *revisit* the essence of governance, including control and coordination, and understand the goals and constraints of each mechanism. Table 1 summarizes the definition, purpose, and key mechanisms of control and coordination.

The differences between control and coordination are indicated by (1) the goal, (2) the representative tools and (3) the main concern. First, control and coordination have different goals. The goal of control is to “minimize idiosyncratic behavior and to hold individuals or groups to enunciated policy, thus making performance predictable” (Cray, 1984: p. 86). Fundamentally, control enables the allocation of decisional rights and incentives. In contrast, the purpose of coordination is to achieve integration among specialized and different entities to accomplish a collective set of tasks (Ven et al., 1976). Hence, the mechanism of coordination is any administrative tool for achieving integration among different units (Martinez & Jarillo, 1989). It is important to note that the goals of control and coordination can be complementary. Hence, firms can adopt a portfolio of multiple control and coordination mechanisms.

Second, control and coordination can be achieved through different tools. Common control tools include input, behavior, and output controls (Snell, 1992), bureaucratic and social devices (Harzing, 2001), as well as equity and information controls (Wang & Li, 2019). In contrast, coordination stems from the need to set up integrating mechanisms. Commonly, coordination is closely related to the activities (e.g., manufacturing, research and development, etc.) of associated parties. Typical coordination tools include sharing resources (e.g., physical, information, knowledge) and setting up the codified blueprint of activities among related parties. These tools can

Table 1 A summary of governance purpose and mechanisms: control and coordination

Governance	
	Coordination
	Control
Definition	A process that enhances predictability and reduces uncertainty through the exercise of power or authority
Goal	Achieve predictability and reduce the uncertainty of decision making
Representative tools	Equity control (ownership control): decision-making rights and responsibilities derived from equity holding Output control (bureaucratic control, performance control): Evaluation of files, records, and report Behavior control (process control): Direct supervision Social control: Hierarchical command system, socialization
Main concern	Lack of flexibility
	Coordination
	An enabling process that provides the integration among different task units among related entities through shared resources or value
	Achieve integration and accomplish a collective set of tasks
	Structurization: centralization and formalization Standardization: Written policies, rules, and standard procedures Planning: Strategic planning, budgeting, scheduling Personal coordination: Training, the development of culture Informal communication: verbal and non-verbal feedback
	Cost of management

be formal or informal. The focus of control tools is to obtain power or authority, whereas the focus of coordination tools is to foster resource sharing and value integration. When compared to control, coordination tends to have “a longer time horizon” (Cray, 1984: p. 88).

Third, it is also important to pinpoint the key concerns associated with control and coordination. The major concern associated with control is a lack of flexibility (Geringer & Hebert, 1989; Li & Li, 2010). When the environment is uncertain and violent, flexibility—open options that allow MNEs to respond to changes more quickly and smoothly—is preferable to control. The main concern associated with coordination is cost. The additional effort coordination needs is usually very expensive in terms of an executive’s time and attention. When the marginal cost of increased coordination becomes too high, the benefits are eroded. Thus, the level of control represents a compromise between the desire for predictability and the need for flexibility, whereas the level of coordination is a tradeoff between the desire for integration and the cost of maintaining coordination.

Partly because of data constraints, existing empirical studies have predominantly concentrated on control (particularly ownership control), and most studies do not study control and coordination simultaneously. Distinguishing between the two concepts is vital in the GVC context, in which non-ownership-based control and coordination mechanisms are particularly important. For instance, the term “buyer-driven global commodity chain” captures, to some degree, how MNEs coordinate the disintegrated chains (Gereffi, 1999; Gereffi et al., 2005), although the coordination focus is not on ESG issues. Moreover, sustainability challenges in GVCs represent a longstanding global grand challenge, which is a large and complex societal problem that calls for collective action (Buckley et al., 2017; George et al., 2016). Hence, a more participatory or collaborative approach to governance is critical for effective stakeholder management in GVCs (Berrone et al., 2016; Ferraro et al., 2015). This approach highlights the collaboration and interaction among as many individuals, firms, governments, and institutions as possible. The rationale is that participatory governance models are especially effective when stakeholders face a grand challenge with no agreed-upon solution. In summary, sustainability-specific issues in GVCs attenuate the constraints of traditional control and coordination tools.

In the next section, I will explain how the development of digital technologies can break away from the traditional concerns of control and coordination and unlock their full potential of governance.

3 A framework of digital technology-enabled governance

3.1 Key properties of digital technologies

Before I dive into digital technology-enabled governance, it is important to understand the key properties of digital technologies. Fundamentally, digital technology-enabled governance leverages digital technologies to achieve information-based control and coordination. The core idea is that information can serve as an important governance tool when it creates “a chain reaction of new incentives” that presses

individuals or organizations to change their behaviors (Fung et al., 2007: p. 2). Thus, it reduces information asymmetries that are perceived as key barriers to preventing predictability and integration (the purposes of control and coordination) (Bergh et al., 2019). The advancement of digital technologies (e.g., platforms, algorithms, blockchain-powered systems, software, social media, etc.) can greatly improve the empowerment of information, its processing, and utilization by individuals and firms.

Scholars have provided rich discussion in terms of the key properties of digital technologies (Benbya et al., 2020; Majchrzak et al., 2016; Nasiri et al., 2020). As Wang et al. (2022) have summarized, digital technologies have four properties: programmability (i.e., the extent to which information can be analyzed and performed with different functions by users), accessibility (i.e., the extent to which information is easy to approach, reach, use, or understand), interactivity (i.e., the extent to which information is open to multi-directional communication and interaction) and associability (i.e., the extent to which information is readily connected to key specialized entities or initiatives). These properties escalate the scale and scope of information processing and exchange, which might alter GVC network structures and break the constraints of traditional controls and coordination mechanisms (Barbieri et al., 2021).

Admittedly, certain digital technologies may exert a larger impact on some ESG sustainability issues than others. Nevertheless, in all cases, enhanced intelligence and interconnectivity are the two fundamental purposes of digital technologies (Nasiri et al., 2020), thus overcoming the constraints of traditional control and coordination mechanisms. Digitalization has changed the ways in which firms communicate and interact with others in their networks. They transformed how managers access and disseminate information. As Nasiri et al. (2020) have summarized, digital transformation in GVCs stimulates fundamental changes in process, including “collecting massive volumes of data from different sources”, “stronger networking among business processes using digital technologies”, “creating an efficient customer interface” and “information exchange based on digitality” (p. 2). Hence, digital transformation in control and coordination is reflected in the transformation of information gathering, exchanges, communication processes, and collaborations, owing to digital technologies. To summarize, digital transformation has revolutionized the possibilities and tools for firms to handle and execute the greater monitoring and collaboration activities internally and externally in their GVCs.

3.2 Key mechanisms of digital technology-enabled governance

I argue that digital technology-enabled governance amplifies the advantages of information-based governance and meanwhile alleviates its related limitation. *The first component is technology-enabled information-based control (i.e., digital technology-enabled process that reduces the uncertainty in the adherence to a goal or target through full-scale information monitoring).* Digital technologies provide flexibility to MNEs with full-scale information monitoring and thus enlarge MNEs’ information processing capacity exponentially. Information processing refers to

the “gathering, interpreting, and synthesis of information in the context of organizational decision making” (Tushman & Nadler, 1978: p. 614). Leveraging related digital technologies, MNEs can use algorithms to increase the real-time updates and traceability of GVCs, enabling rapid error handling with automation and big data. MNEs can also link social media with ESG-oriented specialized entities and non-governmental organizations (NGOs). Such digital technology-enabled control provides data and transparency to all possible users (e.g., consumers, regulators, investors, NGOs, and so forth). In this vein, the task of monitoring GVCs and rewarding firms’ sustainability commitments can be performed by the “crowd” but controlled and coordinated by the MNEs.

Such a “crowdsourcing” approach allows an MNE to broadcast an open call to all stakeholders to become involved in monitoring and solving sustainability challenges (Sodhi & Tang, 2019). Thus, MNEs enhance their GVCs’ visibility and traceability—the ability to identify and trace the history and location of products, services, and raw materials. For instance, social media campaigns like #WhoMadeMyClothes, #IMadeYourClothes, and #MeetYourMaker invite and unite everyone to work together to trace where clothing is sourced, produced, and consumed. According to Meltwater, an online media monitoring company, the #WhoMadeMyClothes hashtag alone received 99.6 million impressions on Twitter and 170,000 posts on Twitter and Instagram in 2018 (Pinnock, 2018). By leveraging such social buzz, the crowd is empowered to ask questions and follow up on solutions, change the mechanisms of stakeholder interactions, and support traceability. Thus, MNEs can leverage information-based control to obtain the flexibility that allows managers to better grasp, understand, communicate, and solve uncertainties associated with their GVCs. As another example, Everledger has used blockchain to trace diamond provenance, including whether the stone originates from a war zone. Such flexibility provides an effective and yet loose association of key players (Nambisan & Luo, 2021), which is needed to make timely strategic adjustments and changes and avoid reputation erosion.

The second component is technology-enabled information-based coordination (i.e., a digital technology-enabled process that provides the integration among multiple entities to accomplish a common goal through constant information sharing). Digital technologies can reduce the cost of full-scale information sharing. The growth in combining smart hardware, software, platforms, and infrastructures makes constant information sharing possible and effective. For instance, given that the costs of cloud-based data storage and computation have decreased (Sodhi & Tang, 2019), digital technologies-enabled GVC coordination can augment sharing of information among all stakeholders (Doorey, 2011; Marshall et al., 2016). Digital technologies can support collaborative work for planning and executing business processes in GVCs. For instance, by leveraging digital technologies, MNEs can constantly retrieve data from the GVCs, program data to identify critical events, assess the impact of such events, and have conversations with all related stakeholders. Essentially, digital technologies allow the development of interoperable and participatory data architecture at a lower cost. MNEs can leverage algorithms to analyze the GVCs and determine the total ESG impact when controversies occur. They also can choose from a range of optimization methods to help them make informed

decisions to avoid ESG controversies. Digital platforms can support benchmarking and reveal hidden ESG strengths and controversies within the GVCs so that MNEs learn quickly where they can match or outperform industry norms. It may accommodate GVC-related global collaborations and diffusion of ESG innovation. As another example, Blockchain technology allows for data to be transferred with 100% authenticity to provide even more accountability and oversight. These technologies also allow for mass data to be visualized and interpreted in a meaningful manner for those that want and need it. In this way, coordination can be multidimensional, including top-down, bottom-up, inside-out, and outside-in approaches.

Taken together, digital solutions present new opportunities for information gathering and exchange in GVCs. Digital technology-enabled governance is characterized by efficient, flexible, and interconnected GVC relationships. At the heart of digital technology-enabled governance are high intelligence and high interconnectivity. This governance is communicable by following a set of agreed-upon protocols. Such processes amplify the benefits of control and coordination but meanwhile overcome their associated constraints.

3.3 Desired outcomes

The desired outcomes of digital technology-enabled governance are developing, maintaining, and augmenting ESG reputation in GVCs as new FSA. This can be achieved by reducing ESG controversies and/or developing competitive ESG initiatives. First, by reducing ESG controversies (i.e., avoiding harm), MNEs can avoid reputation erosion. Because of stakeholders' biases toward negative events, reputation, particularly, ESG reputation, is hard to build but easily eroded by irresponsible behaviors (Wang & Li, 2019). The reputation erosion can occur because of the violation of law and/or the failure to meet stakeholder expectations. Reputation erosion can be caused by external factors such as extreme weather or other unforeseen contingencies; it is also potentially due to managerial ignorance and lack of experience. Moreover, reputation commons (e.g., spillovers of corporate misconduct) (Barnett & King, 2008) are critical in the context of GVCs because of the interconnectedness among related parties. Thus, more information is helpful for the reduction of uncertainty. Hence, the desired outcome is to reduce ESG violations in GVCs by increasing traceability and monitoring of sustainability-related issues and business operations. In other words, the application of digital technology-enabled may help MNEs develop capabilities to reduce ESG-related risks in GVCs. This desired outcome is particularly feasible for MNEs that do not have evil will but lack enough information in order to coordinate and monitor GVCs.

Second, by increasing capabilities to spot ESG-related opportunities, MNEs can develop new tacit knowledge and eventually new FSAs. In this way, MNEs can truly serve the role of an orchestrating lead firm that can increase the relational capital of the GVC networks and enhance their international reputation in ESG sustainability. The extraction and analysis of the information generated will require substantial investments in both physical and human capital, and the mastery of the process will constitute an important FSA. MNEs can leverage digital technology-enabled

governance to reveal hidden ESG strengths within GVCs, as well as identify where they need to improve to match or outperform peers. For instance, Unilever’s crowd-sourcing-based transparency about palm oil sourcing has brought incredible reputational advantages to the MNE and damaged the reputation of its competitor, Procter & Gamble, which failed to do so (Jordan, 2021).

In summary, MNEs that seek to reduce the negative ESG impact of their GVC activities or aim to develop competitive new ESG initiative can leverage digital technology-enabled governance to discover opportunities to avoid FSA erosion and build new FSAs. In doing so, MNEs can effectively tackle global sustainability issues in their GVCs.

3.4 Boundary conditions

There are boundary conditions during the process. On the one hand, MNEs need complementary resources that facilitate the digital transformation of GVC governance. For instance, a managerial mindset for learning and change is essential for MNEs to exploit digital technologies and eventually build digital FSAs to capture new pathways of value creation and value appropriation in the global market (Nambisan & Luo, 2021). Similarly, MNEs with resources that can provide compatibility with perceived digital opportunities have stronger incentive to digitally transfer their governance, particularly when digital governance is more closely aligned with unique local and/or foreign market needs. MNEs with more complex GVC are more likely to adopt digital technology-enabled governance because of the more urgent needs. For instance, in 2020, Starbucks launched a blockchain traceability app that enables customers to follow their purchase “from bean to cup” (BrainStation Magazine).¹ Additionally, they can “meet” the farmers who grow the brand’s coffee beans and uncover any desired information about the specific farm or country. By leveraging blockchain technology, the company aims to enhance the Coffee And Farmer Equity (C.A.F.E) practices by letting customers interact with the farmers and growers via the application to ensure critical human rights practices are upheld. Thus, digital technologies allow Starbucks to connect customers with suppliers to establish a relationship and ensure appropriate standards are met.

Furthermore, it is important to consider the effect of contextual factors—home and host institutions. (i.e., intensity and patterns of information asymmetries, regulation of sustainability, power of civil society, and shared values among stakeholders). The institutional contexts include external regulations, norms, standards, and values that either enhance or mitigate the effectiveness of digital technology-enabled governance. Because of their global reach, MNEs need to simultaneously meet heterogeneous market demands and stakeholder demands in different markets. Whether MNE’s digital governance can generate ESG-related FSAs is contingent upon the home and host institutional contexts. When home and host contexts share the importance of addressing sustainability issues (i.e., regulation stringency, shared values

¹ “Starbucks Launches Blockchain-Enabled Traceability.” BrainStation@<https://brainstation.io/magazine/starbucks-launches-blockchain-enabled-traceability>.

among stakeholders), MNEs are likelier to tap locational advantages and ESG-related FSAs derived from information sharing and exchanging. Moreover, such new FSAs are likelier to be portable across borders, allowing MNEs (and their partners in the GVCs) to gain competitive advantages. Finally, the intensity and patterns of information asymmetries among global stakeholders are critical contingency for MNEs to achieve their desired outcomes. Information asymmetries occur because some parties have more or better information than others. Although arguably information asymmetry is ubiquitous everywhere (Bergh et al, 2019), the intensity and patterns differ across countries. For instance, when asymmetry comes from the unobservable quality of actors, digital technology-enabled governance is more helpful in tracing, uncovering, and sharing information. However, when asymmetry is caused by structural barriers to information propagation, the usefulness of digital technology-enabled governance is likely to be discounted.

In summary, the complementarity of MNEs' activities, external resources, and contexts is the key boundary condition for digital technologies-enabled governance to be effective. Figure 1 graphically illustrates these mechanisms and boundary conditions.

4 Implications for the quasi-internalization debates

The governance for the sustainability of the GVCs provides an excellent context to advance the heated debates regarding whether and how quasi-internalization can serve as an extension of internalization theory (Asmussen et al., 2022; Forsgren & Holm, 2022; Luo, 2002; Narula, 2019; Sambharya et al., 2005). The last decade has witnessed the ubiquity of GVCs, as a product of deepening globalization directed toward reaping the benefits of specialization and national comparative advantages. But, at the same time, GVCs can hide shocking social and environmental controversies. MNEs, as the lead firms, face mounting pressure to uphold sustainability across an entire chain and thus need to reconsider their governance of GVCs in the new era.

Quasi-internalization captures a situation when inter-firm relationships are neither arm's length nor an ownership relationship. Scholars have shared heated debates centering on *whether and how* MNEs can achieve some of the benefits of internalization without complete internalization. By proposing a framework of digital technology-enabled GVC governance, this paper contributes to the debates in three ways. First, my study advances our understanding of "controlling without owning" (Wang & Li, 2019). Specifically, I revisit the essence of governance by highlighting the importance of both control and coordination mechanisms. The latter is somehow forgotten in the internalization theory. I illustrate how the quasi-internalization processes—with the goal of creating and augmenting FSAs—are feasible because of the advancement of digital technologies. In the process, MNEs can leverage a combination of multiple tools of control and coordination to achieve quasi-internalization. In this vein, this paper also contributes to the debate by illustrating some actionable mechanisms for MNEs to leverage the advantages of the quasi-internalization discussed in the literature.

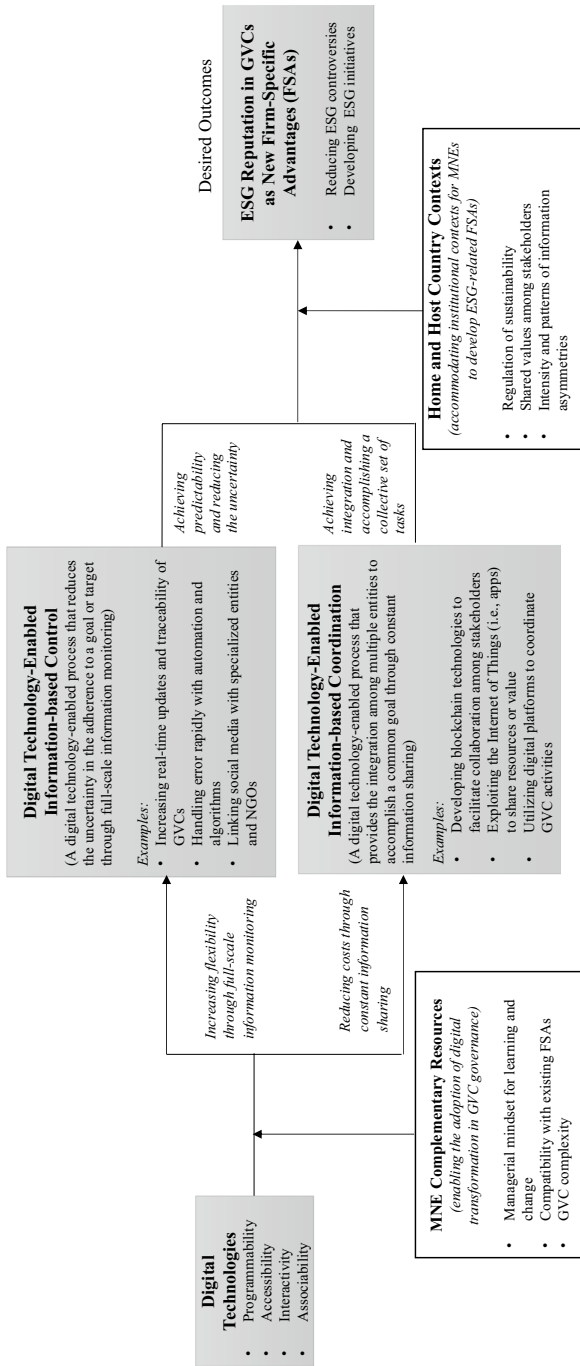


Fig. 1 Digital technology-enabled governance in GVCs

Second, I point out the importance of the unit of analysis in quasi-internalization. The application of traditional internalization theory is usually focused on the firm level, and in this paper, I illustrate a way to move this focus to the GVC levels. One important premise of this argument is that the governance of sustainability issues is no longer an issue that *only* concerns the MNE or the supplier. Rather, multiple global stakeholders, in home and host countries, share an interest in monitoring and improving sustainability in GVCs. Hence, MNEs can leverage digital technologies to understand associated governance costs and benefits both ex-ante and ex-post. I also highlight the contingency effect in the process so that the degree of quasi-internalization varies for different MNEs in different contexts. Thus, internalization theory does not have to assume that control and coordination are completely organized by MNEs. Instead, it is important to recognize that quasi-internalization can sufficiently influence the behavior of related agents to reduce uncertainty and improve the accomplishment of common tasks. Importantly too, the advancement of research design and data modeling techniques also allows the operationalization of related studies from the GVC level.

Finally, this paper contributes to the debate by highlighting the importance of the reputation effect, which has moved beyond the boundary of MNEs. With enlarged information exchange and processing, MNEs and suppliers in GVCs are aligned together through an additional mechanism—the reputational effect. As mentioned by Narula et al. (2019), quasi-internationalization provides a strategic motivation and can “outweigh cost-economizing motivations” (p. 1237). Digital technologies enable MNEs to scan their boundaries to access and exchange related information and orchestrate control and coordination of ESG reputation in the GVCs. Thus, it is helpful to integrate the internalization theory with the GVC approach (Benito et al., 2019; Strange & Humphrey, 2019). As mentioned by Benito et al. (2019), the internalization theory is fundamentally a theory “based on the notion of efficiency” whereas the GVC approach also looks at “‘power’ as co-determining how transactions between economic actors are governed” (p. 1415). I further point out how the advancement of digital technologies reshapes the scope of efficiency and restructures the power structure. The process takes place through the increasing flexibility of control gained through full-scale monitoring of information and reducing costs through constant information sharing. Meanwhile, efficiency is achieved through enhanced predictability and reduced uncertainty, and the power structure is reshaped because of the goal to achieve integration and accomplish a collective set of tasks. In sum, quasi-internalization is more than just a consequence of minimizing control costs, which is the core focus of traditional internalization theory. Rather, quasi-internalization, such as in the case of GVCs, allows maintaining reputation as a key strategic motivation that outweighs the consequence of minimizing control costs.

5 Future research agenda

This paper is the initial effort to theorize the potential value of developing digital technologies-enabled governance for MNEs to uphold sustainability in the GVCs. I have focused on why and how MNEs can identify and leverage digital opportunities

to develop ESG-related FSAs. I hope that future research will find the disentangling of digital technologies-enabled control and coordination proposed in this study to be a useful first step to further develop this line of research. The following suggested research questions are by no means exhaustive but only exemplary.

5.1 Understanding the motivation of digital transformation

Although the advancement of web 3.0 and newer technologies may indeed be a rising tide that lifts all boats, MNEs vary in their digital transformation. Future research is encouraged to study how managers affect the possibility and effectiveness of digital transformation in GVCs. For instance, how do chief digital officers (Singh & Hess, 2020) promote the digital transformation in GVC governance? Fundamentally, managers in MNEs are the ones who make the decision. It is unclear how their biases and attitudes impact the adaptation and learning process. The situation becomes more complex in the context of rising geopolitical tensions and tech-nationalism (Luo, 2022), which complicates the rational calculations of reputation benefits and risks associated with control and coordination in the GVCs. One fruitful research topic is to explore the role of relational governance (Kano, 2018), which might be not replaceable but re-defined in the digital era.

Another important area meriting further inquiry is the conditions that prompt or press MNEs to adopt digital technologies in their GVC governance, other than the complementary resources I proposed in this paper. For instance, one area warranting future investigation is the heterogeneity among MNE's network positions across geographically diversified regions and countries. It is unclear how the heterogeneity in firm-specific traits, such as GVC leadership and geographic diversity, might alter the roles of digital technologies and intelligence. Future research is also encouraged to study cognitive, structural, and behavioral support for digital adjustment in GVC governance. In order to further bridge this gap, more emphasis needs to be placed on focusing on both control and coordination, rather than simply focusing on ownership control of GVCs.

5.2 Exploring the heterogeneity among different digital technologies and different ESG issues

The term “digital technology-enabled governance” needs conceptual refinement and empirical validation. Digital technologies can create strong monitoring protocols and communication tools through various types of technology solutions—including mobile, blockchain, and artificial intelligence—all of which have distinctive strengths and weaknesses in governing ESG issues. Thus, future work is encouraged to quantify the measures of specific digital technology-enabled control and coordination and explore exactly what types of digital technologies can be more valuable in governing what types of ESG activities in the GVCs. For instance, one big role of social media is that it sets social agenda and enables real-time communication and faster sharing of information. Consequently, it might be more helpful to identify and trace human rights protection in GVCs. Differently, some digital technologies

that underpin automated factories might preempt the chance of hiring child labor or badly treated workers. As another example, drones have been used to predict the harvest so that farmers can secure a larger income because they are harvesting at the correct times and amounts. These harvest-predicting drones can also monitor the human rights issues in the plantations and at critical points along the global supply chain cycle.

Relatedly, future research is encouraged to study digital intermediaries in the process. Digital intermediaries can serve as the bridge between the firms and the stakeholders, and might expedite the adoption of digital governance. For instance, Laborlink is an app that allows factory workers to report abuse anonymously or identifiably, discriminate, or provide general feedback. Many major apparel and electronics companies use this intermediary, which can target factories that have seen historically poor working conditions and help with exposing what managers may be hiding during audits. It is thought-provoking for future research to investigate in what areas intermediaries can be more helpful to the implementation and functioning of quasi-internalization.

5.3 Investigating dark sides of digital technologies-enabled governance

It is important to note that digital technologies-enabled governance entails some risks of negative outcomes. First, despite growing excitement about digital transformation, many firms may lack the management experience to know how to effectively leverage technologies. Lack of vision and expertise might put the use of digital technologies in danger. For example, although social media, crowdsourcing, and the utilization of the Internet of Things (IoT) can be used to track human rights violations in the GVCs, the release of data may endanger individuals' rights to privacy, without appropriate knowledge of management. Similarly, when artificial intelligence (AI) is applied to analyze worker and supplier conditions in GVCs, potential biases may occur in the contract establishment and renewal. As another example, advanced technologies such as drones and satellite imaging can help monitor deforestation and help farmers predict harvests, however, this surveillance may cause privacy and/or other human rights violations to arise.

Second, and perhaps more importantly, it is debatable whether MNEs are aware of the controversies in the GVCs they lead. It is possible that they have chosen to ignore these controversies, and that such controversies have been an inherent and inevitable feature of their business models. If so, the utilization of digital technologies to enable governance only amplifies the reluctance. Thus, a cynical view might also suggest that MNEs will use the greater information made available by digital technologies to consolidate their control over their GVCs, which may or may not be good for the other stakeholders in GVCs. Thus, in the process, MNEs might privilege the goals of certain stakeholders over others in the GVCs. As Bergh et al. (2019) have emphasized,

lead firms' "self-interests influence the selection of mechanisms for managing it [information asymmetries]." It is also important to keep in mind that shocking ESG controversies occur not only in externalized GVCs but also possibly in "internalized" GVCs under direct control of the MNEs. Future work might extend this line of research by investigating the sources of self-interests among different stakeholders in the GVCs.

Finally, it is not the case that the more digital technologies are used, the more effective the sustainability governance will be. Governance challenges can also be posed by the uncertainty of sizable information generated by digital technologies. For instance, scholars have raised the paradoxical relationship between digital transformation and trust (Faruquee et al., 2021). Future research is encouraged to study how digital technologies need to be applied with a careful understanding of the ESG context. In the process, the levels of fragility among MNEs in digital risks are different such that their usage of digital outlets varies. The role of the wider institutional context (i.e., transnational institutions) in the process also requires more research.

5.4 Conducting multidisciplinary research

Both ESG sustainability and digital technologies have a strong multidisciplinary flavor. A multidisciplinary research approach emphasizes the investigation of a particular research question or a phenomenon from different disciplinary viewpoints. For a deeper understanding of digital technologies, it is important for future research to learn about conceptual insights and methodologies from related disciplines, particularly operational management, management information systems, and information technology (Majchrzak et al., 2016). For instance, the technology affordances and constraints theory (Leonardi, 2011), from the information systems field, is helpful for IB scholars to understand the drivers of the adoption of digital governance. Empirically, it is also important to work with scholars who have expertise in digital technologies-enabled research methodologies such as web crawling, text scraping and mining, social media analysis, sentiment analysis, issue network mapping, visualization, recommendation algorithms, and so on.

For sustainability topics, prior research has emphasized the importance of multidisciplinary research, intending to "construct a common, comprehensive definition of the problem, an explanatory view of relevant mechanisms and processes, and a manageable set of problem solutions" (Schoot Uiterkamp & Vlek, 2007: p. 176). For instance, depending on the nature of the sustainability challenges, it is helpful to know cutting-edge practices in natural science, energy study, climate research, chemistry, geology, biology, history, anthropology, political science, and so on. Of course, the process is not easy as scholars have also recognized the difficulties in practicing multidisciplinary research. Yet, future research needs to embrace the ongoing challenges in setting up and running multidisciplinary research to capitalize on a broader range of expertise to understand this complex role of digital technologies in addressing sustainability challenges.

6 Conclusion

To conclude, the paper pioneers the exploration of digital technology-enabled governance in the context of GVCs. Specifically, I review the control and coordination literature, identify key properties of digital technologies, explain how digital technology-enabled governance breaks the constraints of traditional control and coordination mechanisms, and propose key logic on which MNEs can leverage such governance to uphold sustainability in GVCs. I also highlight important implications for the ongoing quasi-internalization debates, as well as issues for future research.

Data availability No data is used in this paper.

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