




What facilitates and impedes the adoption of sustainability in global value chains? A Grey-DEMATEL analysis

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Abstract

Trade was deep rooted in the world locally. The global doors opened up more recently and new ideas for trading and making product in multiple locations are even more nascent, close to the 80 s. This gave us the topic of global value chains (GVC) to study, reflect and understand the shift in global trade. Since then, the subject has gained interest from both academics and decision-makers. Since the development of the topic of global value chains (GVCs), production has altered a lot. Due to lower transportation and communication charges, many firms have abandoned the custom of making all their products and services in a single nation and inside their organisational borders. GVCs can offer various benefits for firms and countries, such as access to new markets, technologies, skills, and resources. However, GVCs also pose challenges like coordination costs, quality control, environmental and social standards, and value-added distribution. This has led to the advancement of literature; however, there remains a gap in understanding how the barriers and drivers of Sustainability in GVC affect it. This study has been undertaken to address this gap and has used the Grey-DEMATEL technique. Study shows significant relationships among factors like Greenwashing, the COVID-19 pandemic, and Blockchain technology, which policy-makers can use to improve Sustainability within the value chains.

Keywords Sustainability · Grey relational matrix · DEMATEL · Global value chains · Critical success factors · Grey theory

1 Introduction

Since the early 1980s, the structure of international trade flows has undergone a substantial alteration, giving rise to what some have dubbed the “Age of Global Value Chains” in a somewhat Hobsbawmian fashion (Amador & Di Mauro, 2015; World Bank, 2020). The topic has been on the rise ever since, drawing the attention of academicians and policymakers alike. The advancement of the GVCs has completely transformed how production is carried out. Due to decreased expenses of communication and transportation, many businesses have given up the tradition of manufacturing all their commodities or services inside their organisational bounds and within a single country (Ambos et al., 2021). This

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outsourcing has led to the advancement of topics of offshoring, production networks, and network fragments, among others. Furthermore, scholars have quickly jumped on the trend and advanced their knowledge. A significant body of literature has examined the geographic distribution of GVCs over the past 20 years (Suder et al., 2015; Turkina et al., 2016), the variables affecting the location decisions (Doh et al., 2009; Jensen & Pedersen, 2011; Ma & Van Assche, 2016), and related to governance (Gereffi et al., 2005). Other investigations explore what drives the dispersion of global production (Kedia & Mukherjee, 2009; Schmeisser, 2013), who are likely to pursue this trend (Farinas & Martín-Marcos, 2010), and how GVC scattering affects a company's output or employment (Brandl et al., 2017; Hummels et al., 2014; Kasahara & Rodrigue, 2008). Sustainability is an integral part of the global trade system. It is a crucial driver in the next stage of globalisation, as it will help ensure that trade will be more sustainable. Value chains consist of multiple industries that connect producers and consumers. Each stage in the chain creates a product with value and adds to the total sales figures. Consumers can influence sales by buying products; this leads to economic growth and creates jobs. Manufacturers can move from low-volume to higher-volume products by switching suppliers- these increase sales and create even more jobs. Firms can earn extra revenue by reselling products to other companies or individuals. This allows for a broader range of products at lower prices for more significant profit margins. Essentially, global value chains are essential for creating jobs and making money. However, these systems can be corrupted if not managed carefully. A vast and complicated term, Sustainability may signify multiple things depending on the situation and viewpoint. The ability to support a process or activity over time without endangering the environment or depleting natural resources is a popular definition of Sustainability. It frequently entails striking a balance between present and future requirements while also taking the economic, social, and environmental effects of human activity into account. Vandenbrande (2019) proposed a new definition of carry forward our present ecosystem to the future in a better shape. It is essentially a synergy between the present and future for an organic growth. Companies follow a sustainable value chain when following ethical guidelines at each stage. Firms should respect the cultures of countries where they manufacture goods. They should also respect workers' rights at each value chain stage. The environment should also be protected during manufacturing- only environmentally friendly materials should be used when creating new products. After manufacturing, products should be exported only to countries that uphold similar moral standards regarding worker rights, environmental protection, and ethical business practices. This way exported products can benefit both countries economically and culturally while maintaining ethical standards regarding global value chains. Therefore, we must study global value chains to prepare for the future. These systems have proven themselves helpful in creating jobs and selling goods worldwide. However, they can become problematic if not managed carefully. Green logistics do not necessarily add financial value to the organisation (Barut et al., 2023), but Wan et al. (2022) argue that it positively impacts environmental Sustainability. Companies need to follow responsible guidelines when following the chain- or risk ruining an effective system for creating wealth internationally. Researchers must stress how global value chains affect our future if they want to promote awareness about these issues in their writing. Only through careful study and public awareness will we be able to properly manage these complex systems for creating international wealth. To understand the subject area better, we must understand what factors facilitate and act as impediments when adopting sustainable practices. This research has been undertaken to keep in mind the same, and through this study, the below Research questions will be answered.

RQ 1—What are the major impediments/barriers and facilitators/enablers to adopting sustainable practices in global value chains?

RQ 2—Which criteria stand out the most from the views of both stakeholders?

RQ 3—How may decision-makers assess the connections between the cited facilitators and barriers?

The study is focussed on the barriers and enablers of Sustainability practises in the global value chain. This paper looks to answer the above research questions using data collected from a group of experts—both academicians and industry experts and then model their responses using Grey relational theory and the Decision-making trial and error laboratory (DEMATEL) technique of the Multi-criteria decision-making (MCDM) techniques available. The paper is arranged as follows—Section 2 is a comprehensive literature review with an introduction to the factors under study. Section 3 is methodology; Section 4 is the result section, which computes individual results for each respondent category and total. Section 5 is the discussion section with policy implications, and Sect. 6 is the conclusion.

2 Literature review

Gereffi is one of the founding fathers of the knowledge body of global value chains and has done sufficient work for scholar to understand the topic well. In his study of 2018, he describes value chains to be the forebearers of the intermediate goods more so than the final ones. He essentially talks about a diminishing north south divide when we dig deeper into “GVC economy”. As a result, nations at all stages of development are today more linked than ever before (Backer & Flaig, 2017; OECD, 2013). It is not surprising that sufficient literature is available on the topic. Despite that, the studies available do not answer the specific questions we wish to discover through this research work. A summary of the research work has been included and presented in Table 1.

The previous authors have made significant contributions to the subject of global value chains, but a lot of the time, the study is limited to specific industries or regions (Gereffi, 2018). Oelze (2017) has worked on the barriers and enablers, but the study is limited to the Textile industry. Özaşkın and Görener (2023) have used impressive techniques, including DEMATEL and others, for their study on supply chain management, but again work is limited to only barriers. The present study focuses on the global value chains. The authors have taken Enablers/Facilitators and Barriers/Impediments to the entire chain. There is no restriction to this study’s geographical or industrial applicability since neither has been a constraint in factor selection.

Itakura (2020) talks about the trade war between the world’s two large economies—the USA and China (B5). When GVCs are considered, the negative impacts on bilateral trade are more felt globally, and the modified model shows a decline in global GDP, of almost US\$450 billion. This implies that the GVCs significantly influence trade responses at the segmented level. Many are blaming weak supply chains and rising transportation costs as inflation rises. In the global trade network, seaports are locations where supply chain bottlenecks may be seen. Normally, not a lot of attention is drawn to the topic of the Supply chains, but with vacant supermarkets and exorbitant prices for the products available in the USA, a new page was turned. Among the problems, the press and industry associations have emphasised the significant delays that port

Table 1 Summary of previous work done

References	Title	Description	Research Gap
Kumar et al. (2008)	Flexibility in global supply chain: Modeling the enablers	The authors have identified and created a hierarchy of the enablers of the global supply chain using ISM analysis	This study uses the Interpretive Structural Modelling method for analysis of enablers. Regardless, the topic of GVC has shifted since, and the factors identified vary greatly
Oelze (2017)	Sustainable Supply Chain Management Implementation—Enablers and Barriers in the Textile Industry	The author here explores how barriers and enablers of the textile industry supply chain can be managed for sustainable operations	This paper uses a case study analysis method but focuses only on the textile industry
Lahane et al. (2023)	Evaluation and ranking of solutions to overcome the barriers of Industry 4.0 enabled sustainable food supply chain adoption	For sustainability, the authors examine how to apply and integrate Industry 4.0 in the food supply chain	This study uses a multi-criteria decision-making approach; however, it focuses on Industry 4.0 and focuses on the food supply chain
Öztaşkın and Görener (2023)	An integrated multi-criteria decision-making approach for overcoming barriers to green supply chain management and prioritising alternative solutions	The authors have modelled the barriers to green supply chain in this study using DEMATEL approach	This study uses DEMATEL, EDAS and COPRAS methods of MCDM technique. Nevertheless, the focus is on green supply chains only. Furthermore, the study is on barriers alone

Source Authors' compilation

congestion results in when transporting goods to clients and businesses (Komaromi, Cerdeiro & Liu 2022). Increased pricing and delayed shipping have brought attention to the ports of Los Angeles and Long Beach and those of increased pricing (Isaacson & Rubinton, 2022). The intermodal chain's vulnerability on the landside was highlighted further by the rising port obstacles and pressure on ecosystems and health of the public. This led to more reliance on trucking services inland and a rise in overall emissions (Vukić & Lai, 2022). This brings us to the next Barrier—Shipping congestion in US Ports (B6). Market-based regulations (B7) talk about regulations and rules set up at the marketplaces to define and put in order the practises and identified best practices. According to the findings of research by Luo, Salman, and Lu (2021), market-based regulation (MER) has a detrimental impact on green innovation in China. Lade et al., (2018), argue that policy shocks, like market-based regulations, reduce the incentives for firms to invest in technologies that enable more sustainable manufacturing practises. Indigenous Technology (B10), discussed in Mahoney et al. (2022), talks about resilience by design and intervention, exploring the case of a tribe and supply chain shock from the pandemic. Such strategies help the community do away with the supply chain, but on the other hand, it implies lesser reach for the global manufacturer and consumer.

2.1 Barriers

To answer the first research question (RQ1), we have done an extensive literature review and found the following Facilitators or enablers and the Impediments/Barriers. The factors were further screened through expert opinion, and insignificant and overlapping factors were dropped after the discussion. Using a questionnaire created based on the variables, data are gathered from the expert panel using judgmental sampling. Some variables were eliminated owing to redundancy after expert judgement on the appropriateness and dependability of factors. When an agreement was formed, the experts discussed their findings and knowledge and only those elements that were both theoretically and practically reliable were incorporated. Following the removal of overlapping variables, a record of the finished factors was given to the specialists for approval. This list included definitions and references. The process was repeated until every possible combination was attained.) Pollution has become a menace in the past few years and, even so, is entangled in the global trade scenario. Chitaka (2021) talks about the desire of the value chain participants to reduce this pollution, but most of the time, they end up greenwashing (B1) rather than finding a sustainable solution. Lashitew (2021) also discusses their paper given the Sustainable development goals (SDGs) and from a measurement and reporting perspective. Antras (2020) has put together literature and brings evidence to prove that the world is now at the start of de-globalisation (B2), which may very well be the end of the global interconnected trade, although it may not hamper it entirely. Pegoraro et al. (2020) argue that the anti-globalisation movement is a more significant societal movement born out of dissatisfaction with globalisation. Circular economy (B3) has been found in the literature in multiple places, and authors have varied views, although they all expect it to have a specific impact on GVCs (Hofstetter et al., 2021; Awan et al., 2022; Schroeder et al., 2018). Kejžar et al. (2022) talk about the collapse of the trade network in the wake of the pandemic, COVID-19 (B4) in the European context, and Freidt and Zhang (2020) talk about the same in the Chinese scenario (Table 2).

Table 2 List of barriers

Barriers	Denotation	Description
Greenwashing	B1	"Greenwashing" refers to presenting a misleading impression or incorrect facts about how a company's products are more ecologically friendly. Does this have an impact on the longevity of GVCs?
De-globalisation	B2	Reducing the dependence on foreign countries for trade and supply
Circular Economy	B3	A method of manufacturing and consumption that prioritises sharing, renting, reusing, mending, and recycling already-existing materials and goods. Will this have an impact on the integration of sustainability and supply chains?
COVID-19 Pandemic	B4	The pandemic is a barrier to implementing Sustainability in the value chain
US-China Trade war	B5	Does the trade war affect the global value chains?
Shipping congestion in US Ports	B6	The shipping congestion of containers at the US ports. Also, congestion at other ports worldwide
Market-based Regulation (MER)	B7	Marketplace behaviour encourages organisations to pick up good practices. Will they function as a barrier to implementing Sustainability practices in the GVCs
Information Asymmetry	B8	Lack of information or adequate information along the value chain between parties
Best available techniques (BAT) permissions	B9	Best practices for minimising or eliminating emissions and environmental consequences are referred to as "best available techniques" (BAT)
Indigenous Technology	B10	Local production techniques or tradesmen-ships that do not require the import of technology

Source Authors' compilation from literature

2.2 Enablers

Coming to the enablers or facilitators of Sustainability in global value chains, we look at 11 items picked from an extensive literature review. The same has been enlisted in the table below. Blockchain (E1) has been identified as one of the main facilitators of Sustainability. Egwuonwu et al., (2022) suggest that Value chain participants will get fresh, timely insights into their supply chains using blockchain and more precise and trustworthy information about crucial processes, activities, and product characteristics, including quality, performance, and availability. IoT and blockchain integration would enhance start-to-end tracking and visibility and enable the quick recall of dangerous items. The information may be evaluated fluidly thanks to the openness. Some nodes (or system participants) can offer sustainability guarantees that can be verified inside the system, and data can also be verified using group consensus (Nikolakis et al., 2018). With Digital Transformation and Technology (E2) in the value chains, new business prospects open in the digital sphere, leading to the Globalisation of research and development and Interaction-intensity supply of customised digital services (Szalavetz, 2020). Strange et al., (2022) also add to this by focussing on how digital transformation can help expand the internalisation theory. Consumer habits and behaviours (E3) are another important aspect of how well Sustainability practises can be adopted by the GVCs. Growing supply chains and concepts like supply chain 4.0 are directed towards more consumer-centric chains than manufacturer-driven ones (Ferrantino & Koten, 2019). These also exhibit inherent sustainability goals. A consumer-centric chain also means much power in the hands of consumers, which can alter outcomes. This can be a game-changer, positively or negatively. The most common consumer buying behaviours are Collaborative, transactional, dynamic, and innovative solutions (Gattorna, 2013). In the past, economies have had command and control regulations (CCR) (E4) in all aspects, especially in the manufacturing industry. A study by Tang, Qi, and Zhou (2020) in the Chinese market suggests that the government should take down the homogeneity of CCR and make more suitable laws in the face of green innovation. Sinclair (1997) has also pointed out this right in the beginning, how a more flexible system should work better than just regulations, which may or may not change as per the change in scenario. Li et al., (2019), suggest that counties should not cut back all CCR; however, they may use it prudently along with other factors, implying we cannot rely fully on CCR to enable green innovation and other Sustainability practices in the value chains. The pandemic (E10) brought many challenges to the world of supply chains. Nevertheless, it also brought innovations that arose from the bosom of those challenges. Indigenous R&D (E5) is one such blessing. We have evidence to believe that this hampers the adoption of Sustainability into the Global value chains. Mahoney et al. (2022) talk about resilience by design and intervention, exploring the case of a tribe and supply chain shock from the pandemic. Such strategies help the community do away with the value chain, but it implies lesser reach for the global manufacturer and consumer. When we talk about the Virtual industry clusters (E6), Swierczek and Kisperska-Moron (2016), through their study, talk about how highly specialised industry support virtual clustering. Lopez et al. (2017) speak of how Best available techniques (BAT) (E7) implementation does not necessarily imply a pollution reduction, as per data and evidence from their paper. In the study by Huybrechts et al. (2018), for BAT-based rules to work as a possible facilitator – and not as an impediment– for strengthening the chain, three approaches are suggested for a more systemic evaluation of supply chain factors in the BAT understanding process. These methods include choosing “collaboration with upstream and downstream partners in the value chain” as a common rule for all industries, determining

the “value chain BAT”, and considering pertinent “cross-sector impacts”. The manufacturers now need a better understanding of green practices and certifications (E8) to come into the picture. Studies show how certified firms can make better outcomes (Migdadi & Elzzgaibeb, 2018). Schaefer and Crane (2005) talk about how environmentally sustainable consumption (E9) is meagre and is generated only from few environmentally influenced consumers. This can be borrowed for the value chains as well. Since the end users, the consumers, are not asking for it, the manufacturers do not go out of their way to make things greener. This acts as an impediment to Sustainability and GVC. In the study by Bloom and Hinrichs (2011), they talk about how informal regulations (E11) and mechanism, although branches of trust, fails to make a thorough connection and require more formal commitments (Table 3).

3 Methodology

3.1 Research design

The research followed is in two parts. The data once collected through questionnaires from experts are then converted into linguistic scales and further analysed to get the result. Thomas (2023), in their paper has done similar methodology for the modelling of factors in the FinTech domain.

Figure 1: Research Plan for Factor Identification and Analysis.

Table 5: Profile of the respondents.

3.1.1 Grey-DEMATEL method

Step 1: Compute Initial Relation Matrices.

Let ‘ n ’ be the total number of recognised crucial factors and ‘ l ’ be the total number of participants. The effect of factor ‘ i ’ over component ‘ j ’ is evaluated by each participant ‘ k ’ using a six-point normal scale, with 0 denoting no influence and 5 denoting extremely high influence. Table 3 shows the corresponding grey values. As a result, we will have ‘ l ’ initial relation matrices (Table 4).

Step 2: Compute Grey Relation Matrices.

Step 3: Compute Average Grey Relation Matrix.

Step 4: Compute Crisp Relation Matrix.

Step 5: Compute Normalised Direct Crisp Relationship Matrix.

Step 6: Compute Total Relation Matrix.

Step 7: Identify prominent factors; Obtain causal relationship; Plot cause-and-effect diagram.

Step 8: Set the threshold value to identify a significant causal relationship.

The Total Relation Matrix illustrates how one element affects another. To simplify things and prevent insignificant consequences, a threshold value must be specified. The mean and one standard deviation of the matrix T 's components are added to get the threshold value. If D_{ij} is true, factor i strongly affects component j (Table 5).

4 Research results

4.1 Data collection and respondent information

Table 3 Respondent profile

Category	Profile of respondent/organisational role	Type of organisation/Department	Education	Experience	Count
Industrial Practitioner	Vice President, Director, Senior Manager	World Economic Forum, Supply Chain industry	Master's Degree-4	Average = 20.2 years with a standard deviation of 3.5 years	4/7 = 57.14%
Academic Researcher	Professor, Associate Professor	Operations Management, Supply Chain Management, Transportation Engineering	PhD-3	Average = 16.7 years with a standard deviation of 2.4 years	3/7 = 42.8%

Source Authors' compilation

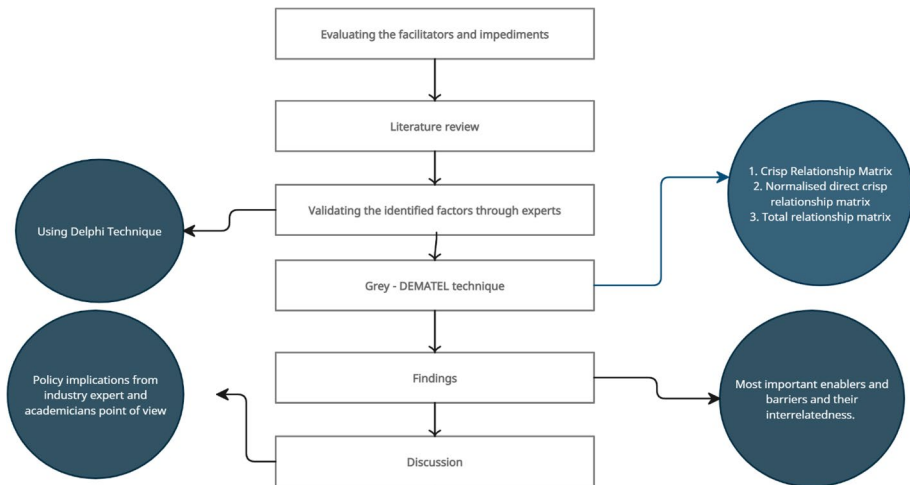


Fig. 1 Research methodology

4.2 Grey-DEMATEL results

4.2.1 Enablers

We analysed the enablers by taking responses from 3 academicians and four industry experts, a total of 7 participants. The results are as follows for the two categories and the combined results.

4.2.2 Academicians

The above table, Table 6 shows the computed values of the analysis. Here we have the relationship values for the Enablers. The results are based on the responses from the Academic experts. In the rest of the paper, we have similar table for each expert category and factor type as well. The values that are in bold font are the ones that are higher than the threshold values. The higher the value, the more its power.

This section talks about the Enablers or the Facilitators. Critically reviewing, we are looking at the factors that will help promote the Sustainability of processes, products and people within the value chain. The values that are in bold font are the ones that are above the threshold value (θ) (Table 7).

The highest value of the Di column is the most prominent factor. Similarly, the highest positive value in the Ei column is the factor with the highest driving value (Fig. 2).

Table 4 List of enablers

Enabler	Denotation	Description
E1: Blockchain	E1	Blockchain is a force in the global value chain. Its application or underapplication
E2: Digital Transformation and Technology	E2	Has technology and evolution had any positive impact on the value chain
E3: Consumer Habits and Behaviour	E3	Do consumers' habits and behaviour affect the global trade and supply chain?
E4: Command and control regulation (CCR)	E4	Government regulations are imposed to comply with environmental status, e.g., vehicle pollution checks—such regulations in the supply chain industry impact imposing Sustainability practices
E5: Indigenous R&D	E5	Local production techniques or merchants that promote Sustainability
E6: Virtual industry clusters	E6	Instead of actual clusters, having virtual clusters that enable knowledge transfer
E7: Best available techniques (BAT) permissions	E7	Techniques specifically designed to control or reduce emissions
E8: Certifications on green manufacturing	E8	If companies and stakeholders get certified in green manufacturing, will it promote Sustainability in the global value chain?
E9: Consumption Pattern Towards Sustainability	E9	The consumer preference and consumption pattern towards sustainable products
E10: COVID-19—global pandemic	E10	The impact of COVID-19 as a pandemic positively on supply chains
E11: Informal Regulation (IER)	E11	A code of conduct is informally formed that channels businesses to adopt suitable practices. Are informal regulations strong enough to promote Sustainability in value chain companies?

Source Authors' compilation from literature

Table 5 Linguistic Scale and corresponding grey value

Linguistic terms	Normal scale	Grey scale
Very High Influence	5	(0.9, 1.0)
High Influence	4	(0.6, 0.9)
Medium Influence	3	(0.4, 0.7)
Low Influence	2	(0.2, 0.5)
Very Low Influence	1	(0.1, 0.3)
No Influence	0	(0.0, 0.1)

4.2.3 Practitioners

The above table, Table 8 shows the computed values of the analysis. Here we have the relationship values for the Enablers. The results are based on the responses from the Industry/Practitioner experts. The values that are in bold font are the ones that are higher than the threshold values. The higher the value, the more its power (Fig. 3) (Table 9).

4.2.4 Total

We have the total computed values for all the respondents here in Table 10. We can see that certain factor like Blockchain, Digital Transformation and COVID-19 have many value that are in bold. Combining these results with those in Table 11, we can see that the factors that have most prominence are Digital Transformation and Consumer Behaviour, whereas the factor that has the highest driving power is COVID 19. It means, it can influence the other enablers more (Fig. 4).

4.2.5 Barriers

4.2.5.1 Academicians The above table, Table 12 shows the computed values of the responses from Academicians for the Barriers/ Impediments. The prominent factors are identified here and are marked in bold. In the next step of the analysis, we identify the driving and driven factors.

When we look at Table 13, we can see that the significant Barriers have been narrowed down to just three (Marked in bold), as compared to Table 12. While De-globalisation and Circular Economy are both prominent, COVID-19 still is the most influential and driving factor in the play of barriers. This analysis is based on the responses from the Academicians (Fig. 5).

4.2.5.2 Practitioners When we look at Tables 14 and 15, we see that the responses are slightly variant. While the prominent factors are still the same, industry practitioners have reason to believe that trade wars, information asymmetry and greenwashing have important roles to play in the realm of global value chains. Again, looking at prominence and driving factors, we have the same candidates as before, with the inclusion of Trade war having high influence over other barriers to GVC and sustainability (Fig. 6).

Table 6 Total relationship matrix for enablers (Academicians)

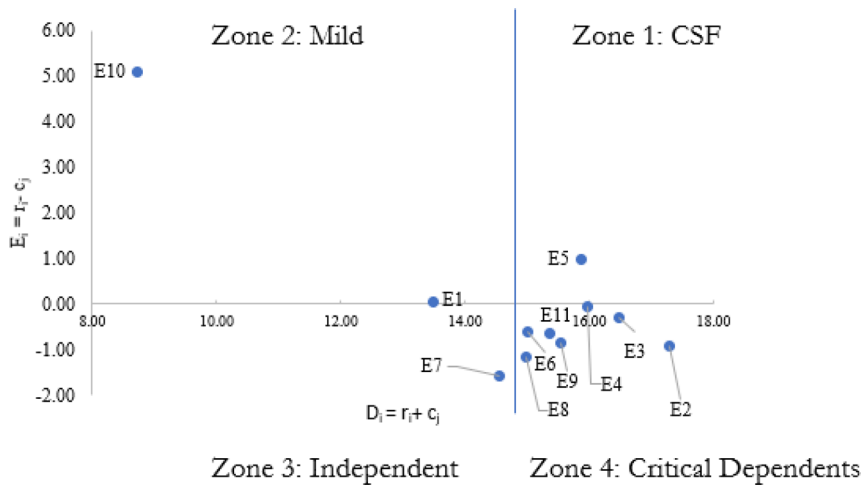
Enablers	Blockchain	Digital trans-formation	Consumer Behaviour	CCR	Indigenous R&D	Virtual Clusters	BAT	Certifications	Consumption Pattern	COVID-19	Informal Regulation
Blockchain	0.50142	0.79061	0.67110	0.69355	0.63847	0.68477	0.67351	0.67166	0.64925	0.14823	0.65382
Digital trans-formation	0.73555	0.81327	0.86583	0.81552	0.74095	0.80489	0.83978	0.78747	0.80750	0.18508	0.79175
Consumer Behaviour	0.65182	0.88930	0.74324	0.79525	0.74536	0.78235	0.80852	0.80957	0.84274	0.20915	0.81581
CCR	0.69472	0.87463	0.82166	0.70161	0.70922	0.711751	0.79554	0.83101	0.80658	0.17231	0.82775
Indigenous R&D	0.66794	0.93083	0.89394	0.84788	0.68377	0.83140	0.80029	0.85221	0.88698	0.21282	0.82638
Virtual Clusters	0.63073	0.79878	0.75651	0.70149	0.68392	0.61338	0.73058	0.70743	0.72809	0.14446	0.70649
BAT	0.51043	0.75898	0.68291	0.63238	0.63505	0.63696	0.57284	0.63560	0.64683	0.13147	0.64143
Certifications	0.54090	0.79201	0.72033	0.71645	0.61591	0.64343	0.68741	0.61374	0.72682	0.13831	0.71826
Consumption Pattern	0.57268	0.83405	0.79223	0.73163	0.67118	0.68135	0.74431	0.75611	0.66070	0.14773	0.74294
COVID-19	0.60506	0.80260	0.71023	0.64448	0.64188	0.70139	0.68553	0.65709	0.69369	0.13592	0.64027
Informal Regulation	0.60020	0.82540	0.73624	0.74191	0.68185	0.70743	0.73272	0.74457	0.75345	0.18373	0.64609

Source Authors' compilation

Table 7 Degree of Prominence (Di) and Net Cause (Ej) for Enablers (Academicians)

	ri	cj	$D = ri + cj$	$E = ri - cj$
Blockchain	6.77637727	6.711458515	13.48783578	0.064918755
Digital transformation	8.187597688	9.110453747	17.29805144	-0.922856058
Consumer Behaviour	8.093096856	8.394223201	16.48732006	-0.301126345
CCR	7.952545987	8.022146725	15.97469271	-0.069600739
Indigenous R&D	8.434444732	7.447565176	15.88200991	0.986879555
Virtual Clusters	7.201878945	7.804855033	15.00673398	-0.602976088
BAT	6.484869256	8.071031145	14.5559004	-1.586161889
Certifications	6.913574389	8.066457378	14.98003177	-1.152882989
Consumption Pattern	7.334901749	8.202636537	15.53753829	-0.867734789
COVID-19	6.918135553	1.809199534	8.727335087	5.108936019
Informal Regulation	7.353578616	8.010974048	15.36455266	-0.657395433

Source Authors' compilation from analysis

**Fig. 2** Prominent causal relationship for enablers (academician)

4.3 Total

The total responses, when computed add more clarity to the analysis and gives us an outlook into the lens of Academics vs practitioners. We can see through Tables 16 and 17, that overall, the factor with the highest driving force is COVID 19. This is also an interesting look into the topic of GVC as both the driver and enablers is coinciding to be the same. This gives us fresh perspective to dig deeper and understand how boon for one is bane for another (Fig. 7).

Table 8 Total relationship matrix for enablers (Practitioners)

Enablers	Blockchain	Digital trans-formation	Consumer Behaviour	CCR	Indigenous R&D	Virtual Clusters	BAT	Certifications	Consumption Pattern	COVID-19	Informal Regulation
Blockchain	0.481601609	0.624045664	0.581935921	0.509016773	0.533928869	0.542837536	0.437095269	0.473707807	0.490505279	0.424549933	0.430993355
Digital trans-formation	0.579688866	0.48192931	0.557254207	0.440206224	0.540732583	0.52002604	0.417722117	0.441929049	0.491540653	0.374839272	0.397021203
Consumer Behaviour	0.555336307	0.582223017	0.447506161	0.434276835	0.49351389	0.482912644	0.395039017	0.443228772	0.49734802	0.409824054	0.420679957
CCR	0.464450444	0.498289581	0.465757269	0.342528106	0.433022499	0.40575329	0.399415725	0.401514217	0.399453377	0.353980222	0.368612342
Indigenous R&D	0.44029032	0.466284468	0.444957311	0.407500681	0.356677441	0.417648005	0.400603015	0.395248608	0.40320144	0.320126365	0.349991718
Virtual Clusters	0.504625087	0.528446227	0.40967814	0.443258067	0.451374689	0.351180036	0.384379539	0.360204868	0.39268576	0.336700549	0.365965897
BAT	0.418151805	0.44502412	0.454848006	0.385307384	0.426107859	0.37303653	0.281309948	0.350544658	0.382204924	0.294507265	0.332586634
Certifications	0.521152129	0.521161865	0.512199135	0.450762045	0.468717287	0.407313283	0.389832431	0.343487693	0.466240438	0.317239281	0.385890844
Consumption Pattern	0.499251927	0.522082184	0.513633633	0.425866278	0.461353104	0.413018194	0.389128572	0.455904594	0.368247467	0.344862538	0.396508303
COVID-19	0.556114186	0.632867881	0.616601614	0.53357822	0.555863309	0.527639648	0.453618751	0.429604585	0.523877614	0.349706279	0.488318897
Informal Regulation	0.367486914	0.407905871	0.383209104	0.348885412	0.329033495	0.337365391	0.280573144	0.309435137	0.34868976	0.285550471	0.244626888

Source Authors' compilation from analysis

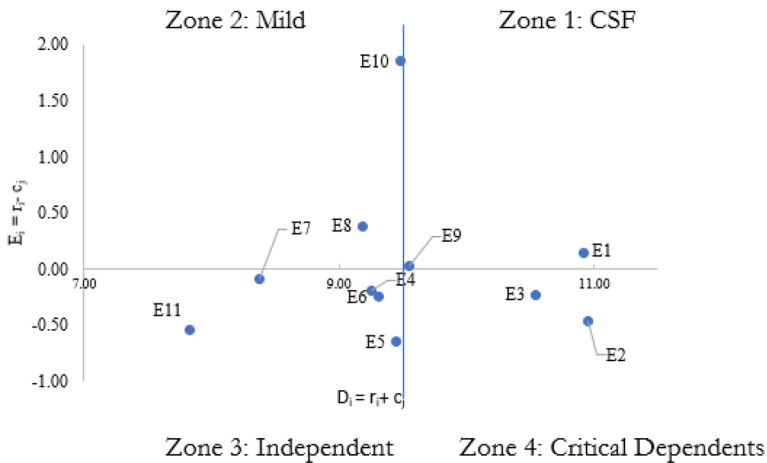


Fig. 3 Prominent causal relationship for enablers (Practitioners)

Table 9 Degree of Prominence (D_i) and Net Cause (E_j) for Enablers (Practitioners)

	r_i	c_j	$D = r_i + c_j$	$E = r_i - c_j$
Blockchain	5.530218016	5.388388306	10.91860632	0.14182971
Digital transformation	5.242889524	5.71026019	10.95314971	-0.467370665
Consumer Behaviour	5.161888674	5.387580502	10.54946918	-0.225691829
CCR	4.532777073	4.721186026	9.253963099	-0.188408952
Indigenous R&D	4.402768082	5.050325024	9.453093106	-0.647556942
Virtual Clusters	4.528498859	4.778730597	9.307229455	-0.250231738
BAT	4.143629133	4.228717527	8.37234666	-0.085088395
Certifications	4.783996432	4.404809986	9.188806418	0.379186446
Consumption Pattern	4.789856794	4.763994732	9.553851526	0.025862062
COVID-19	5.667790984	3.81188623	9.479677213	1.855904754
Informal Regulation	3.642761587	4.18119604	7.823957627	-0.538434453

Source Authors' compilation from analysis

5 Discussion

5.1 Outlook on barriers/impediments from different groups

We look at the factors in-depth to answer the second and third research questions (RQ2 and RQ3). The most critical barriers to Sustainability in the global value chains are Barriers to sustainable global value chains, which remain challenging in our modern world. Sustainable global value chains involve firms combining and utilising global resources to achieve long-term benefits. A few critical issues must be addressed if these chains are to be successful. The first barrier to sustainable global value chains is the inconsistency in legislation and regulations worldwide. Many countries have different laws surrounding areas such as labour, environmental protection, consumer protection, and competition policies. This

Table 10 Total relationship matrix for enablers (Practitioners)

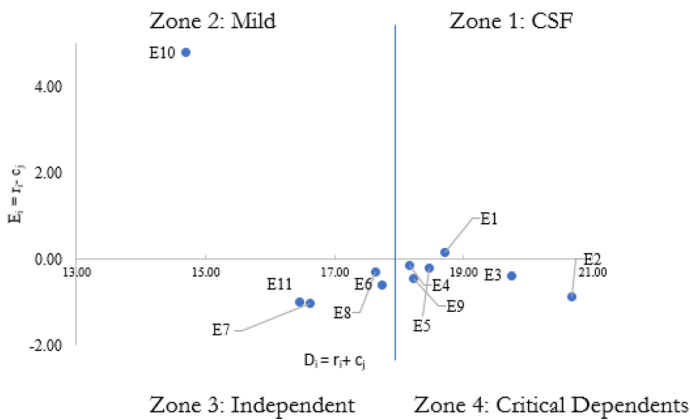
Enablers	Block-chain	Digital trans-formation	Consumer Behaviour	CCR	Indigenous R&D	Virtual Clusters	BAT	Certifications	Consumption Pattern	COVID-19	Informal Regulation
Block-chain	0.810263667	1.058762986	0.960260257	0.89547741	0.902252501	0.91692998	0.839512047	0.863060291	0.870566227	0.490150592	0.821530583
Digital trans-formation	0.983306141	0.984449784	1.034979562	0.906986804	0.956607657	0.957349646	0.896746411	0.891497464	0.940688712	0.497039644	0.858196446
Consumer Behaviour	0.920935352	1.064931911	0.898532976	0.883009045	0.917546177	0.912332856	0.858757854	0.890931774	0.947326402	0.521731483	0.872299297
Indigenous R&D	0.864835919	0.981799368	0.923043494	0.760771631	0.842180466	0.814254379	0.830445186	0.852862558	0.849605529	0.465072514	0.823459816
Virtual Clusters	0.839963412	0.987472585	0.939692794	0.86504379	0.784086133	0.871438964	0.829253087	0.854768611	0.885352217	0.468671763	0.807876687
BAT	0.850509933	0.957671336	0.847073727	0.815444653	0.8324889	0.726392418	0.78783051	0.766509672	0.802642884	0.42713837	0.761178652
Certifications	0.718199902	0.864844695	0.820036171	0.729964994	0.773887622	0.729939739	0.633841828	0.70836246	0.739497941	0.381480227	0.693574713
Consumption Pattern	0.820667502	0.957827783	0.902463748	0.836321239	0.818906568	0.781556826	0.779887921	0.72156971	0.85468913	0.411317537	0.788533549
COVID-19	0.827989608	0.980536443	0.938285045	0.829371332	0.843189077	0.804850029	0.807071348	0.856026782	0.767802767	0.437884611	0.806502574
Informal Regulation	0.916828113	1.086340004	1.014661972	0.902702392	0.932293756	0.929013535	0.868502816	0.845041788	0.926736585	0.446476556	0.863814978
	0.721366731	0.854500574	0.786433384	0.741755771	0.723541278	0.724728548	0.689084264	0.714762977	0.750299996	0.408445994	0.621921515

Source Authors' compilation from analysis

Table 11 Degree of Prominence (Di) and Net Cause (Ej) for Enablers (Total)

	ri	cj	$D = ri + cj$	$E = ri - cj$
Blockchain	9.428766541	9.27486628	18.70363282	0.153900261
Digital transformation	9.907848271	10.77913747	20.68698574	-0.871289197
Consumer Behaviour	9.688335125	10.06546313	19.75379825	-0.377128004
CCR	9.008330859	9.16684906	18.17517992	-0.158518201
Indigenous R&D	9.133620043	9.326980135	18.46060018	-0.193360092
Virtual Clusters	8.574881053	9.168786919	17.74366797	-0.593905866
BAT	7.79363029	8.820933271	16.61456356	-1.027302981
Certifications	8.673741514	8.965394086	17.6391356	-0.291652572
Consumption Pattern	8.899509616	9.335208353	18.23471797	-0.435698737
COVID-19	9.732412494	4.95540929	14.68782178	4.777003204
Informal Regulation	7.736840995	8.71888881	16.45572981	-0.982047815

Source Authors' compilation from analysis

**Fig. 4** Prominent causal relationship for enablers (Total)

makes it difficult for firms to achieve long-term Sustainability as they must adjust to the ever-changing regulatory environment.

“Greenwashing” means claiming something as environment friend while it is not, to be simply put. The circular economy is a system that aims to lessen waste and increase the usable life of commodities. Greenwashing and the circular economy have a complicated and contentious relationship. According to Choudhury, Islam, and Sujauddin (2023), greenwashing may promote circular consumption by increasing customer knowledge of environmental issues and encouraging them to learn more about Sustainability. Nevertheless, greenwashing sometimes prevents the circular economy and sustainable development by deceiving customers, diminishing consumer confidence, and undercutting sincere environmental impact reduction initiatives (Lopes et al., 2023).

In some cases, firms may also incur additional costs to comply with different laws in different countries. Another challenge faced is the cultural diversity of countries and regions. In different countries, workers have different values and perspectives, making it difficult for firms to ensure that all their employees understand their environmental and social

Table 12 Total relationship matrix for barriers (Academicians)

Barriers	Greenwashing	De-globalisation	Circular Economy	COVID-19	Trade war	Shipping congestion	MER	Information Asymmetry	BAT permissions	Indigenous Technology
Greenwashing	0.048945038	0.112498934	0.113458402	0.038125897	0.054325096	0.039474667	0.107072316	0.08095221	0.085980271	0.111939801
De-globalisation	0.208985094	0.331379433	0.362987242	0.162084061	0.259646164	0.265427513	0.32989428	0.251917316	0.36755318	0.429040381
Circular Economy	0.233311661	0.434500614	0.304442873	0.117168856	0.300772847	0.216317798	0.365013965	0.277320438	0.387145434	0.39997093
COVID-19	0.183356058	0.370758628	0.356924712	0.083366772	0.211784006	0.186134494	0.240653218	0.211138495	0.234628184	0.289704177
Trade war	0.220661547	0.466257102	0.39660455	0.134291082	0.190456121	0.242654774	0.30407744	0.238203937	0.329041627	0.378409212
Shipping congestion	0.170423762	0.31191866	0.275392091	0.070952881	0.18998285	0.102319041	0.207459798	0.170511614	0.214288554	0.251158106
MER	0.28628652	0.44958937	0.429422808	0.141920672	0.289419288	0.172815635	0.256881309	0.297176033	0.363456776	0.40426573
Information Asymmetry	0.221140402	0.391396875	0.340321104	0.144892288	0.214857571	0.136137989	0.28690883	0.161992752	0.236109496	0.307485079
BAT permissions	0.198896035	0.375661709	0.376242471	0.088183726	0.201350135	0.140338059	0.278186593	0.239237253	0.211006706	0.306222698
Indigenous Technology	0.278582277	0.544127244	0.470501993	0.220324693	0.310017979	0.226668721	0.422159221	0.3444648443	0.429680472	0.341734823

Source Authors' compilation from analysis

Table 13 Degree of Prominence (Di) and Net Cause (Ej) for Barriers (Academicians)

Barriers	ri	cj	$D = ri + cj$	$E = ri - cj$
Greenwashing	0.80023084	2.050588394	2.850819234	-1.25035755
De-globalisation	2.968914665	3.788088569	6.757003234	-0.8191739
Circular Economy	3.035965417	3.426298246	6.462263663	-0.39033283
COVID-19	2.368448745	1.201310928	3.569759673	1.167137817
Trade war	2.900657392	2.222612058	5.12326945	0.678045334
Shipping congestion	1.964407358	1.72828869	3.692696048	0.236118667
MER	3.091234141	2.798306971	5.889541113	0.29292717
Information Asymmetry	2.441242385	2.273098492	4.714340877	0.168143893
BAT permissions	2.415325387	2.8588907	5.274216087	-0.44356531
Indigenous Technology	3.588445866	3.227389147	6.815835013	0.361056719

Source Authors' compilation from analysis

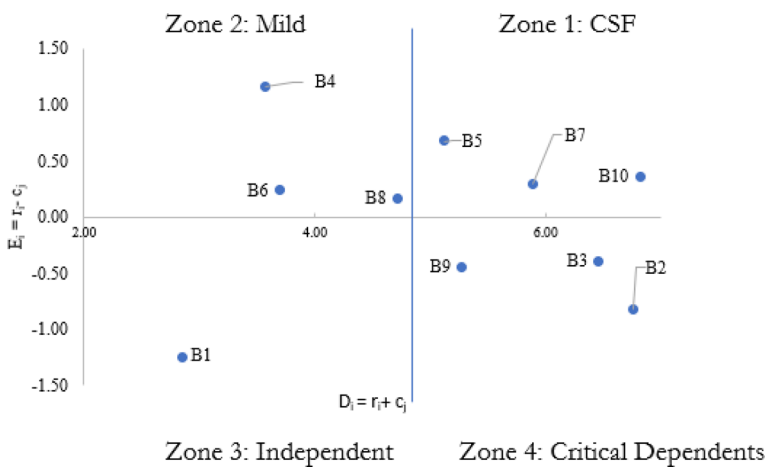


Fig. 5 Prominent causal relationship for barriers (Academicians)

responsibilities. Cultural differences can also lead to misunderstandings in how countries view products and services, making it hard to understand the firm's value chain globally. Furthermore, there is the challenge of inadequate infrastructure. Many developing countries lack the necessary infrastructure to efficiently transport goods and services, making it difficult for firms to achieve Sustainability. It is also crucial for firms to access reliable energy sources to reduce their emissions. Access to clean energy sources is still a significant challenge in many countries.

China is a big developing economy and contributes well to the global economy through its imports and exports. In a study by Jacob et al., (2023), China was the largest developing economy in global trade, accounting for the largest in the Asian economies. The literature also supported this notion with many emerging authors and articles from China. The trade war reduced China's exports to the US by 8.5 per cent in 2018 and 2019, affecting sectors such as electrical machinery, furniture, and plastics. This led to a loss of income and employment for some Chinese workers, especially those in the manufacturing sector.

Table 14 Total relationship matrix for barriers (Practitioners)

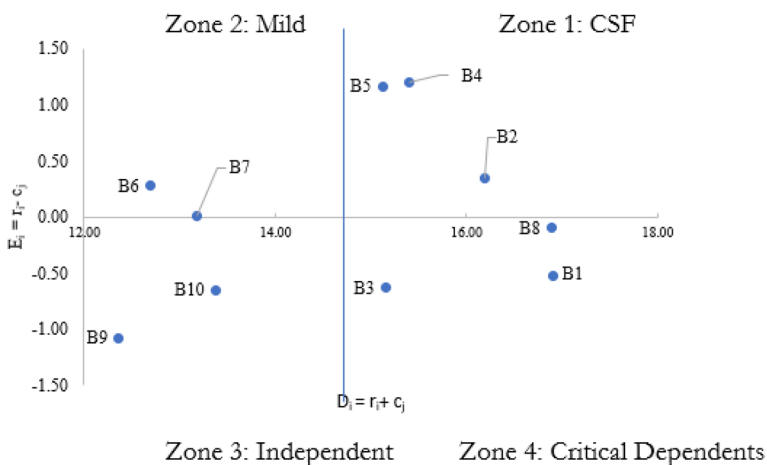
Barriers	Greenwashing	De-globalisation	Circular Economy	COVID-19	Trade war	Shipping congestion	MER	Information Asymmetry	BAT permissions	Indigenous Technology
Greenwashing	0.868592414	0.875433499	0.907971841	0.789611971	0.775670306	0.689008234	0.75399251	0.987199208	0.766880226	0.779998546
De-globalisation	0.984375972	0.792022152	0.879499009	0.817969245	0.796949201	0.710334388	0.761899166	0.939573851	0.781058458	0.801863028
Circular Economy	0.890159894	0.775243201	0.695800389	0.690722	0.686413487	0.619571608	0.651236408	0.870602734	0.67292946	0.709363467
COVID-19	0.973090822	0.913971863	0.874434346	0.718221073	0.812341623	0.732551547	0.745711905	0.989645205	0.740225739	0.805871025
Trade war	0.955863232	0.905611248	0.885355969	0.81005096	0.689317972	0.703364955	0.730869266	0.943230633	0.736492622	0.782471383
Shipping congestion	0.756669848	0.720213979	0.716510079	0.657861637	0.639493734	0.490000993	0.572188934	0.727858577	0.578362826	0.626135083
MER	0.80416066	0.720062872	0.729661901	0.649078215	0.617449888	0.546147576	0.528058372	0.777028858	0.621966864	0.601875926
Information Asymmetry	1.036175437	0.919223833	0.91810698	0.836933503	0.80045861	0.686223071	0.746275273	0.868107255	0.784892302	0.798082529
BAT permissions	0.699931258	0.601495565	0.609127054	0.520801898	0.531467054	0.475929092	0.531694831	0.642450381	0.45998225	0.568618171
Indigenous Technology	0.749212622	0.69957939	0.678379977	0.612245635	0.629208382	0.553670342	0.569241082	0.749682925	0.579210291	0.540530792

Source Authors compilation from analysis

Table 15 Degree of Prominence (Di) and Net Cause (Ej) for Barriers (Practitioners)

Barriers	ri	cj	$D = ri + cj$	$E = ri - cj$
Greenwashing	8.194358755	8.71823216	16.91259092	-0.5238734
De-globalisation	8.265544472	7.922857602	16.18840207	0.342686869
Circular Economy	7.262042646	7.894847545	15.15689019	-0.6328049
COVID-19	8.306065148	7.103496136	15.40956128	1.202569012
Trade war	8.14262824	6.978770257	15.1213985	1.163857983
Shipping congestion	6.485295692	6.206801806	12.6920975	0.278493886
MER	6.595491132	6.591167747	13.18665888	0.004323384
Information Asymmetry	8.394478792	8.495379627	16.88985842	-0.10090083
BAT permissions	5.641497554	6.722001037	12.36349859	-1.08050348
Indigenous Technology	6.360961439	7.01480995	13.37577139	-0.65384851

Source Authors compilation from analysis

**Fig. 6** Prominent causal relationship for barriers (Practitioners)

According to a research (by the National Bureau of Economic Research), the 2.5% of China's population who were the most exposed had a 2.52 loss in per-capita income and a 1.62 decrease in manufacturing employment. On the contrary, Yu, Zhao and Yeng (2023) talk about China's GVC trade cycle and industrial structure, emphasising the synchronicity between the two.

Finally, the rise of multinational corporations has made sustainable value chains more challenging. Multinationals have the resources to shift production to countries with weak labour laws, fewer environmental restrictions, and inadequate infrastructure. This can lead to firms cutting corners in wage, environmental, and labour standards, which could have a long-term adverse effect on the chain. Sustainable global value chains are possible, but the above-mentioned challenges must be addressed. Firms must focus on understanding different countries' regulatory environments and cultural differences to develop a successful and sustainable value chain. They must also focus on investing in infrastructure projects and looking for areas to reduce emissions. Finally, firms must focus on increasing anti-trust

Table 16 Total relationship matrix for barriers (Total)

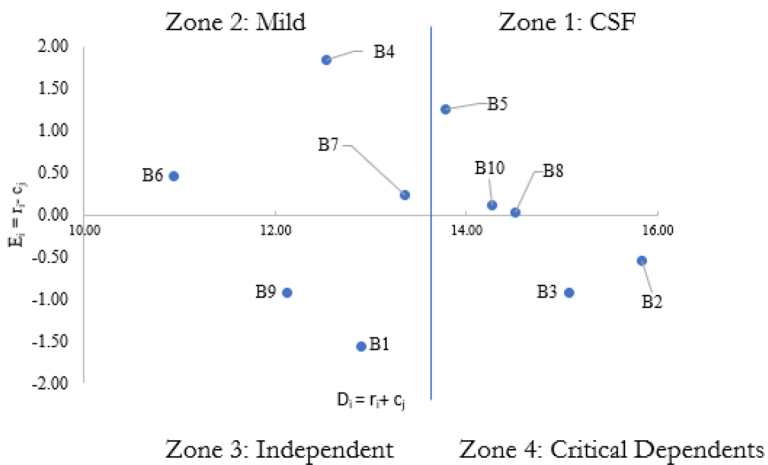
Barriers	Greenwashing	De-globalisation	Circular Economy	COVID-19	Trade war	Shipping congestion	MER	Information Asymmetry	BAT permissions	Indigenous Technology
Greenwashing	0.537274697	0.673975132	0.688196735	0.455867764	0.517400481	0.432468181	0.567944772	0.645497134	0.553921298	0.595622084
De-globalisation	0.8059829	0.816204755	0.883039823	0.627124723	0.718381863	0.629515749	0.757040221	0.802377829	0.768966614	0.83292269
Circular Economy	0.770468599	0.847333444	0.738330383	0.540437106	0.669817244	0.557573926	0.702799794	0.781144916	0.71001625	0.759298106
COVID-19	0.759105166	0.890144152	0.855336862	0.504539529	0.684617704	0.590764083	0.687975356	0.792527467	0.666715893	0.755001684
Trade war	0.792520722	0.944831632	0.90058455	0.609726925	0.616300995	0.614412691	0.724783776	0.798128643	0.723013828	0.796363388
Shipping congestion	0.60740138	0.71287689	0.693620493	0.4612145	0.553939745	0.393285552	0.543269187	0.595631272	0.539163615	0.602065998
MER	0.755183638	0.828027667	0.826736935	0.54084398	0.634406931	0.503792855	0.583923309	0.746908143	0.6772141	0.702395092
Information Asymmetry	0.818276958	0.901400134	0.876047954	0.608138858	0.67778184	0.536755508	0.709485305	0.690329312	0.695917048	0.756971267
BAT permissions	0.621723566	0.683347652	0.689654211	0.414656964	0.512340715	0.422607686	0.567006683	0.604362974	0.480938043	0.606393796
Indigenous Technology	0.758095481	0.890199811	0.844965723	0.585509726	0.681894175	0.560324609	0.713243886	0.787877178	0.708670995	0.665613071

Source Authors compilation from analysis

Table 17 Degree of Prominence (Di) and Net Cause (Ej) for Barriers (Total)

Barriers	ri	cj	$D = ri + cj$	$E = ri - cj$
Greenwashing	5.668168276	7.226033107	12.89420138	-1.55786483
De-globalisation	7.641557167	8.188341267	15.82989843	-0.5467841
Circular economy	7.077219766	7.99651367	15.07373344	-0.9192939
COVID-19	7.186727895	5.348060075	12.53478797	1.83866782
Trade war	7.52066715	6.266881693	13.78754884	1.253785458
Shipping congestion	5.702468633	5.241500839	10.94396947	0.460967794
MER	6.79943265	6.557472435	13.35690508	0.241960216
Information asymmetry	7.271104184	7.244784867	14.51588905	0.026319316
BAT permissions	5.603032437	6.524537684	12.12757012	-0.92150525
Indigenous technology	7.196394655	7.072647176	14.26904183	0.123747479

Source Authors compilation from analysis

**Fig. 7** Prominent causal relationship for barriers (Total)

regulation to limit the power of multinationals and ensure fair competition. If these barriers are successfully addressed, sustainable global value chains can be achieved.

5.2 Multi-stakeholder perspectives for facilitators/enablers

Value chains came through the advent of internationalisation. The internationalisation theory proposes why and how firms look to gain foreign exposure. Using the Uppsala model, we see that firms first try to test the waters using exports and imports, slowly increasing the threshold for international business risk, implying trust (Benito, Petereson & Welch, 2019) and then we find ourselves amid completely fledged value chains. When we look at the results of our study, we find E3, E4, E5 and E9 to be our critical dependents. They are Consumer habits and behaviour, command and control regulations, Indigenous R&D and Consumption patterns towards Sustainability, respectively. We can see that they are

dependent on other factors. Namely, as per the analysis, our major critical factor is E1, Blockchain Technology. This implies that blockchain technology can drive the other factors to success for a sustainable value chain in the future. We also see the COVID-19 pandemic (E10) as a factor that can mildly affect and drive the other factors to success. Resilience to pandemics, like COVID-19, in the value chain governance significantly boosts the participants (Choksy et al., 2022). In a rapidly globalising economy, businesses have increasingly faced the challenge of creating sustainable value chains. Most regulatory factors, like Informal regulations (E11) and Best available techniques (E7), have come out as independent factors, and as such, we can understand that their impact is not directly affecting other facilitators.

Sustainable value chains emphasise creating long-term economic, social, and environmental returns while helping businesses remain competitive. To achieve this aim, enablers of sustainability need to be found and incorporated into value chains. Firstly, collaboration is one of the critical enablers of sustainable global value chains. To be sustainable, value chains must be developed in multi-stakeholder platforms with collaboration among suppliers, customers, environmental groups, and government agencies. This enables sharing goals and objectives and encourages understanding the importance of Sustainability in every aspect of the chain. Second, certification is another enabler of sustainable global value chains. This involves businesses implementing certifications and standards—such as Global Organic Textile Standard (GOTS), Fair Trade or SAS—to ensure the sustainable sourcing of ingredients and materials. This can enable businesses to ensure they are not sourcing ingredients that have been produced in an unsustainable or unethical way. Third, lifecycle analysis enabled businesses to understand the sustainability aspects of their value chain. This analysis considers the environmental, social, and economic aspects of production processes, from the sources of the raw materials to end-of-life disposal of products. Different parts of the chain—from sourcing to production and customer satisfaction—can be measured so businesses can identify sustainable options within the chain and make decisions accordingly. Fourth, thought leadership is vital in enabling sustainable global value chains. Business leaders must be informed and knowledgeable of sustainability issues, trends, and strategies to incorporate Sustainability into their decision-making processes. This should also be supported by business models designed to embed Sustainability in their operations, like the “triple bottom line” approach, which considers “economic, social, and environmental” factors when making operational decisions. Trade openness, especially green openness for the trade of goods, is crucial, and we have evidence to believe that green openness and environmentally sustainable goods have a positive impact (Can et al., 2021).

6 Conclusion

The globe has seen a steady rise of value chains in recent decades, yet only relatively recently have efforts been put into assessing their role in achieving sustainable development. GVCs are integral to the global economy and continuously grow as a trade tool. These chains typically involve multiple countries, with goods and services being bought, produced, and sold between countries, usually at a lower cost than individual nations could produce them alone. At the core of sustainable development are efforts to reduce poverty and provide equitable opportunities based on core principles such as access to resources and human rights. GVCs can significantly impact achieving this due to the interconnectedness

of the countries and resources involved. Developing countries, for example, are often left on the margin of GVCs despite their need to catch up, which means that matters of Sustainability tend to take a backseat. However, it has been found that increasing the involvement of developing countries in GVCs can often improve their economic standing. GVCs can thus be utilised to pursue sustainable development actively, but how they are managed and organised needs to be appropriately leveraged. This includes carefully considering power dynamics between countries, including their size, level of economic development and bargaining power, and various actors' roles and limitations along GVCs. GVCs can also drive equality through job creation and access to resources in poorer nations, but only if governments and private sector entities adhere to corporate and environmental regulations. The current pandemic has acted as a backdrop for further discussions around GVCs, labour and the environment, meaning the discussions on GVCs and sustainable development have taken on new importance. Communication and collaboration between private and public sectors and civil society are essential to ensure that GVCs can be leveraged to their most outstanding ability in driving sustainable development.

Furthermore, GVCs should be supported with the active engagement of indigenous peoples, who may offer unique perspectives and ideas on facilitating the most successful and resilient GVCs. In conclusion, GVCs offer an essential avenue for pursuing sustainable development, yet this requires their management and organisation to be tailored accordingly. Systemic shifts are also necessary, including private and public sectors and people in civil society, if meaningful progress is to be made. In conclusion, the success of sustainable global value chains depends on the ability of businesses to incorporate the right enablers. Effective collaboration, certification, lifecycle analysis and thought leadership are critical enablers that can help businesses build eco-friendly, resilient global value chains that create value for stakeholders, customers, and society.

Data availability The data for the paper will be made available to the team based on request to the author/s.

Declarations

Conflict of interest The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

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