(MEC-J) Management and Economics Journal
E-ISSN: 2598-9537 P-ISSN: 2599-3402
Journal Home Page: http://ejournal.uin-malang.ac.id/index.php/mec
Volume 10 Number 1, April 2026

Governance of the Volkswagen Group's Global Value Chain in Europe from 2019 to 2025

Muhammad Nur Rahardiansyah Ramadhan*, Swettie Ayu Calista, Thufailah Nafiisah Bilqiis, Adiasri Putri Purbantina

Faculty of Social, Cultural, and Political Sciences, Universitas Pembangunan Nasional "Veteran" Jawa Timur, 60294, Indonesia

*Corresponding author e-mail: aldiriardo@gmail.com

ABSTRACT

This study examines the governance structure of the Volkswagen Group's global value chain in Europe from 2019 to 2025. This period is marked by intensified environmental regulation in the European automotive sector, with stricter emission-reduction targets and accelerated decarbonization strategies. Existing research on Volkswagen's supply chain focuses on operational efficiency, production systems, and technological innovation, but pays limited attention to how environmental regulatory pressure shapes value chain governance in advanced manufacturing, even though global value chain theory suggests that regulatory pressure typically encourages firms to reorganize production networks through relocation strategies. However, Volkswagen Group presents an anomaly, as its production network remains highly centralized in Europe despite increasing regulatory pressure in the region. To address this gap, the study analyzes how governance structures within Volkswagen's value chain under regulatory requirements. The research uses a qualitative design based on content analysis of secondary data, which includes company reports, sustainability reports, press releases, and academic publications. The Global Value Chain governance framework guides the assessment of transaction complexity, codification capability, and supplier capability. Findings indicate that Volkswagen's value chain governance is best characterized as modular. This is reflected in high transaction complexity through JIT systems and product differentiation, strong codification capability via standardized supplier requirements and digital communication systems, and high supplier capability among technologically advanced suppliers.

Keywords: European Automotive Industry; Global Value Chain; Governance; Modular Governance; Volkswagen Group

| Submited January 11 2026 | Reviewed February 24 2026 | Revised March 16 2026 | Accepted April 15 2026
| DOI: http://dx.doi.org 10.18860/mec-j.v10i1.40373

INTRODUCTION

The European automotive industry has faced structural pressure over the past decade due to disruptions to the global supply chain, particularly after the pandemic and the conflict between Russia and Ukraine. These disruptions have affected the production capacity and stability of the manufacturing networks of major European automotive

companies, including the Volkswagen Group. Although several initial studies showed the resilience of European companies' supply chains in the early stages of the pandemic, medium to long-term dynamics have revealed adjustments and contractions in production networks that warrant further study (Allam et al., 2022; Ivanov, 2020; Veselovská, 2020).

As the largest automotive manufacturer in Europe, the Volkswagen Group has a highly centralized production network across Europe and is integrated with cross-border suppliers, as shown in Figure 1. The characteristics of this network cannot be separated from European Union policies, particularly the implementation of Regulation (EU) 2019/631 on vehicle carbon emission limits. The regulation sets strict emission-reduction targets that manufacturers must meet. If the emissions exceed its specific target, the manufacturer is required to pay a hefty fine of 95 euros per gram/km of excess emissions for each new car registered. To achieve its targets, the EU introduces a credit system to encourage manufacturers to switch to electric vehicles. This regulation prompts vehicle manufacturers to implement strategies for their suppliers, which directly affect the relationship patterns and control mechanisms within the company's value chain (Regulation (EU) 2019/631 Of The European Parliament And Of The Council, 2019).

Gereffi (2021) describes how regulatory pressure forces companies to reorganize their global value chains through relocation strategy. Production switching and supplier switching are forms of a company's relocation strategy. Production switching is a strategy in which companies relocate production to countries unaffected by regulations to avoid barriers. Supplier switching is a strategy in which companies reorganize their networks by replacing supplier partners to comply with or avoid regulatory restrictions (Gereffi et al., 2021). However, this does not apply to Volkswagen, which is increasingly centralizing its value chain through the expansion of its production locations, predominantly in Europe, where regulatory pressure is applied. Production data show an anomaly in Volkswagen's expansion of production locations, which peaked in 2019 and then declined after the pandemic, yet remained concentrated in Europe, as shown in Figures 1 and 2. This situation raises questions about how Volkswagen governs its global value chain amid policy pressures, supply disruptions, and changes in the European automotive industry during the 2019–2025 period.

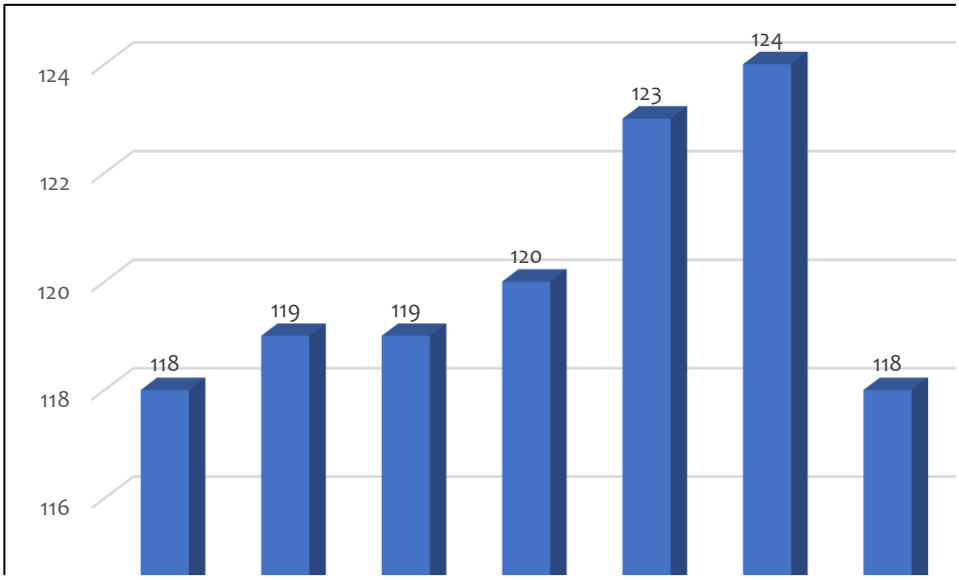

Figure 1. Volkswagen's Global Production Locations
Source: compiled from various sources by the author (Volkswagen AG, 2016a, 2017a, 2018a, 2019a, 2020, 2021, 2022, 2023, 2024; Volkswagen Group, 2025e, 2025b)

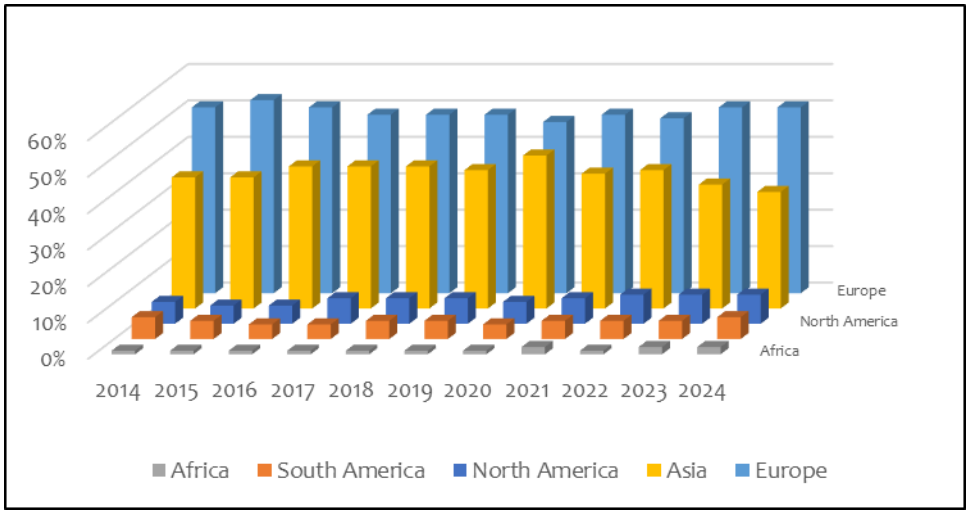

Figure 2. Percentage of Volkswagen Production Locations by Region
Source: compiled from various sources by the author (Volkswagen AG, 2016b, 2017b, 2018b, 2019b, 2020, 2021, 2022, 2023, 2024; Volkswagen Group, 2025b, 2025e)

Research on the Volkswagen Group and its supply chain generally focuses on operational efficiency, technological innovation, and production cost optimization. Rodrigues' (2016) study emphasizes reducing logistics and inventory costs through transportation optimization, while Csizmazia (2014) highlights the role of production modularization (MQB) in improving efficiency and cross-brand coordination. More recent research, such as Gaultier and Marcello (2021), examines Volkswagen's strategy in responding to sustainability demands and changing consumer preferences by emphasizing innovation and long-term relationships with suppliers (Csizmazia, 2014; Gaultier & Marcello, 2021; Rodrigues, 2016).

Although it makes an important contribution, the literature tends to view the Volkswagen supply chain as a relatively stable and managerially oriented system. These studies have not explicitly analyzed how value chain governance mechanisms operate under the pressure of EU environmental policies, particularly after the enactment of Regulation (EU) 2019/631 after 2019. Furthermore, the governance of the global value chain approach is still rarely used to examine the dynamics of Volkswagen's relationship with its suppliers in the context of emissions regulations.

Conceptually, tightening emissions through Regulation (EU) 2019/631 has the potential to shift a company's value chain governance. This is because Regulation (EU) 2019/631 demands rapid innovation, which in turn demands greater product customization. In the literature on value chain governance, Gereffi (2005) explains that product customization increases transaction complexity and raises the potential for suppliers to invest in specific assets to meet the demands of lead firms. The use of specific assets reduces supplier independence and ultimately lowers supplier capabilities. Low supplier capabilities lead to changes in value chain governance, shifting it toward a captive or hierarchical structure (Gereffi et al., 2005). This raises another question, whether innovation demands shift in Volkswagen's previously efficient and modular coordination model, as mentioned by Czismazia (2014), into a more hierarchical or captive relationship due to increased supplier dependence and lead firm control or even stay with modular value chain. Therefore, this study aims to fill the gaps by mapping how the governance of Volkswagen's value chain under regulatory pressure that may shift the value chain governance.

In summary, this study addresses a critical gap in the existing literature, which has predominantly viewed the Volkswagen supply chain as a stable, managerially oriented system focused on operational efficiency. While current studies provide insights into logistics and modular production, they fail to account for how value chain governance mechanisms operate under the dual pressure of stringent EU environmental policies. By examining the tension between Volkswagen’s centralized production network and the demands of EU Regulation, this research tries to analyze whether modular value chain models remain in the face of increasing regulatory requirements. Specifically, this study investigates whether the necessity for rapid product inovation increased asset specificity and induces a shift in Volkswagen's governance structure toward a more captive or hierarchical relationship. Ultimately, this research aims to provide more understanding of value chain governance, within one of the world's largest automotive manufacturers in Europe.

LITERATURE REVIEW

Global Value Chain

Global Value Chains (GVC) are understood as an analytical lens to explain how increasingly fragmented production across countries can still be coordinated without full

vertical integration. Within this framework, multinational companies no longer control all stages of production; instead, they focus on core competencies such as innovation, product design, and marketing, while outsourcing manufacturing and component activities to a global network of suppliers. This fragmentation of production creates a need for cross-company coordination mechanisms that do not rely solely on direct ownership, but rather on technical standards, product specifications, and contractual arrangements (Gereffi et al., 2005, 2018).

Gereffi, Humphrey, and Sturgeon (2005) formulate GVC as a conceptual framework for understanding variations in governance within global production networks through the relationship between buyers and suppliers. This framework was later reinforced in a follow-up work that positioned GVCs not only as an industrial organizational phenomenon but also as an analytical tool for understanding the dynamics of power, coordination, and development implications in the contemporary global economy (Gereffi et al., 2005, 2018).

Conceptual Framework

The author use governance of global value chains as a conceptual framework. Governance of global value chain refers to the process of organizing economic activities across cross-border value chains, including how and why companies are connected and coordinated within global production networks (Gereffi et al., 2005). In this framework, governance not only explains the existence of inter-company relationships but also the concrete mechanisms that shape the structure, coordination patterns, and distribution of power in cross-border value chains (Ponte & Sturgeon, 2014).

Coordination in GVCs refers to the manner in which inter-firm activities are interconnected, enabling transactions to occur efficiently through mechanisms such as prices, technical standards, product specifications, or direct interactions. Meanwhile, control refers to the ability of certain actors, especially lead firms, to determine key production parameters, such as design, quality, processes, and market access (Gereffi et al., 2005). Ponte and Sturgeon (2014) emphasize that this control is manifested through driving practices, whereby lead firms set the terms of participation in the value chain and influence the distribution of value among actors (Ponte & Sturgeon, 2014).

Buyer and supplier relationships in GVCs are generally asymmetrical. Global buyers or brand owners have a dominant position because they control the market, order volume, and global standards, while suppliers, especially those with limited capabilities, are often in a dependent position Thus, governance in GVCs differs from formal ownership, as control and coordination can be exercised without vertical integration, but rather through standards, norms, and relational power in global production networks (Gereffi et al., 2005; Ponte & Sturgeon, 2014).

Typologies and Determinants of GVC Governance

The governance framework in global value chains classifies relationships between companies into five main types, namely market, modular, relational, captive, and hierarchy. The market type is characterized by simple transactions that are easily replaceable and have low switching costs. In the modular type, suppliers produce goods or components based on standardized specifications, with full responsibility for the production process. The relational type is characterized by complex and interdependent relationships based on trust, reputation, and the exchange of tacit knowledge. Meanwhile, captive governance arises when suppliers with limited capabilities are highly dependent on large buyers who exercise strict control and monitoring. At the end of the spectrum, hierarchy refers to full vertical integration, where coordination is carried out through the company's internal managerial structure. The author presents the five types of value chain governance in Figure 3 (Gereffi et al., 2018).

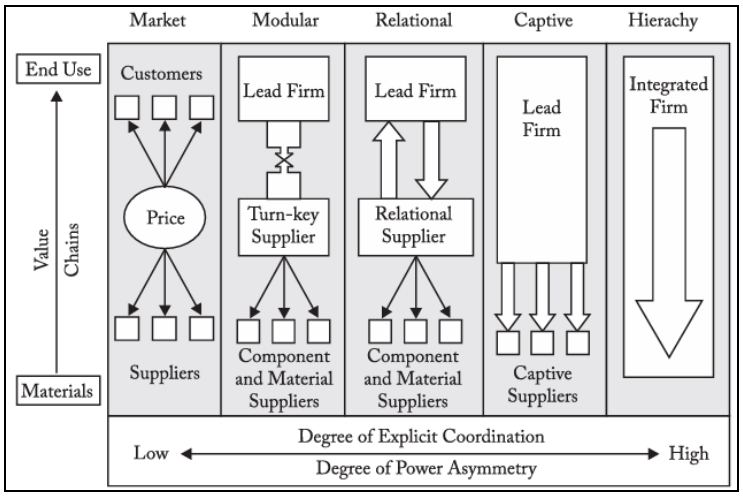

Figure 3. Five Global Value Chain Governance Types
Source: Gereffi et al. (2018)

The variation in governance types is determined by a combination of three main determinants. First, transaction complexity, which reflects the level of complexity of product specifications and processes. Second, codification capability, which is the extent to which information can be transferred efficiently through clear standards. Third, the capability of suppliers to meet the technical and organizational demands of transactions (Gereffi et al., 2018). This combination of determinants produces specific governance patterns, such as modular governance when high complexity can be codified, and suppliers have high capabilities, or captive governance when high and standardized complexity is faced by low-capability suppliers. The author presents the key determinants of Global Value Chain Governance in Table 1. In Figure 4, the author visualizes the analytical diagram of the research.

Table 1. Key Determinants of Global Value Chain Governance

Governance type	Complexity of transactions	Ability to codify transactions	Capabilities in the supply-base
Market	Low	High	High
Modular	High	High	High
Relational	High	Low	High
Captive	High	High	Low
Hierarchy	High	Low	Low

Source: Gereffi et al. (2018)

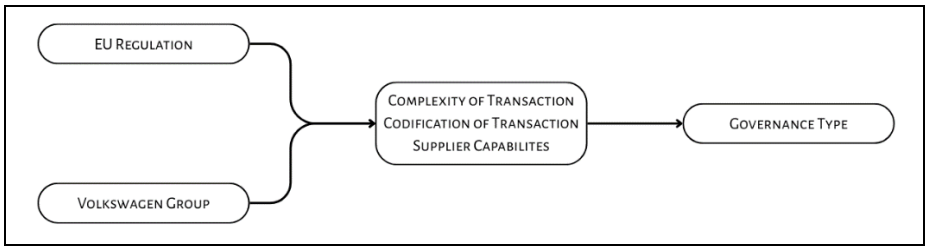

Figure 4. Analytical Diagram
Source: authors (2025)

The first determinant, complexity of transaction, is the level of complexity on information and knowledge transfer required to sustain a particular transaction, particularly with respect to product and process specifications. The high level of transaction complexity is seen in whether lead firm seeks just-in-time (JIT) supply and the existence of product differentiation. Gereffi (2018) explains that the more customized a product or service is, the higher its differentiation. This ultimately increases the likelihood of investing in specific assets in order to meet the lead firm's demands. Suppliers' involvement with these specific assets increases the lead firm's control and the suppliers' dependence on the lead firm. This control and dependence reduce the suppliers' capabilities if not accompanied by strong codification capabilities (Gereffi et al., 2018). Ding (2023) explains that product differentiation is the uniqueness of new product components or product delivery to distinguish it from competitors. In addition, product differentiation must be carried out at the core level, namely through innovation and serialization of product functions (Ding, 2023). Therefore, it is important to look at the product differentiation carried out by the lead firm and whether or not there are external factors that encourage companies to differentiate their products.

Lai et al (2003) explains that the JIT system is designed to produce and deliver goods or services as needed using minimal inventory. The basic concept of JIT is to only provide the necessary products, at the necessary time, and in the necessary quantities. Molet (2013) characterizes the JIT system as delivering the right product, at the right time, to the right customer. Therefore, it is important to see whether the lead firm uses the

principle of delivering the right product, at the right time, to the right customer. The use of JIT increases complexity because, as mentioned by Broek et al. (2020), a delay in one part disrupts the entire production chain (Broek et al., 2020; Lai et al., 2003; Molet, 2013).

The second determinant, codification capability, is the extent to which information can be transferred efficiently through clear standards. High codification capability can be measured by whether the company implements technical standards and the existence of computerized non-price information flows in the lead firm's value chain. These technical standards can be explicitly seen from whether the lead firm implements process standards, as well as quality, labor, and environmental certifications. In addition to technical standards, it is important to see whether or not there is computerization in the communication process between the lead firm and its suppliers, which also increases the lead firm's codification capability. These things are important because they enable a clean handover and avoid the possibility of investment in specific assets (Gereffi et al., 2018).

The third determinant is the supplier's capability in relation to transaction requirements. Gereffi et al (2018) depict the characteristics of suppliers in the value chain with high and low supplier capabilities. In a value chain with low supplier capabilities, such as captive, suppliers are depicted as using specific assets that create transactional dependence and high control from the lead firm. Meanwhile, in value chains with high supplier capabilities, such as modular and market, high-capability suppliers are described as using generic machinery or technology that limits investment in the use of specific assets. The use of these generic assets allows for a high degree of supplier independence and, ultimately, high capabilities. Therefore, it is important to see whether suppliers use generic or specific assets in the lead firm's value chain (Gereffi et al., 2018).

To understand whether suppliers use generic or specific assets, we need to understand the definition of each asset. In transaction cost economics, it is explained that asset specificity takes various forms, such as physical, human, location, special, and trademark, which, when transferred, reduce the value of the product and ultimately make it less likely to redeploy. Thus, as opposed to specific assets, generic assets are assets that are easily transferred or reused in various transactions without causing bilateral dependence (redeployability) (Williamson, 2025). Therefore, it is important to see whether suppliers have technology or machinery that is also used to serve companies other than the lead firm. This illustrates the high degree of independence and capability of suppliers.

In addition to seeing whether suppliers have high or low capabilities, it is important to examine the type of relationship between the lead firm and suppliers in order to classify governance types more specifically. Sturgeon et al. (2001) explain that there are three types of supply relationships, which are commodity suppliers, turn-key suppliers, and captive suppliers. Captive suppliers are suppliers that depend on specific assets and serve only one company. Commodity suppliers are suppliers that depend on generic assets and only interact with customers through the market. Turn-key suppliers are

suppliers with high independence and competence due to their ability to utilize generic assets for many customers. In Gereffi's (2018) description of supplier characteristics, only captive suppliers have low capabilities, while turn-key and commodity suppliers have high capabilities. Therefore, when a supplier is identified with high capabilities, it is important to see whether they are turn-key or commodity suppliers (Gereffi et al., 2018; Sturgeon & Lee, 2001).

Studies on GVC Governance and Related SCM Studies

Empirical studies on GVC governance show the diversity of ways in which governance is operationalized in cross-sectoral and market contexts. Kano (2018) positions governance not primarily as a formal structure, but rather as relational orchestration within asymmetrical GVC networks, where orchestrating firms manage coordination, knowledge flows, and value distribution through social mechanisms such as trust, relational capital, and joint strategizing (Kano, 2018). This approach emphasizes governance as a relational process at the network level, but relatively disregards the structural classification of governance types by Gereffi et al. (2005).

Alternatively, empirical studies in the Brazilian agrifood sector show that the GVC governance typology actually functions as an empirical classification tool, with five types of governance emerging in a mixed and dynamic manner according to the sector context and market challenges (Barros & Almeida, 2024). This confirms that governance is not static, but rather is shaped by technological conditions, supplier capabilities, and external pressures. Another study on the Kenyan leather industry reinforces the argument of governance contextuality by showing that governserves as an empirical classification tool, with five types of governance emerging in a mixed and dynamic manner, depending onance forms differ between end-markets, depending on the combination of product standards, trust, and the role of intermediaries, while still departing from the typology of Gereffi et al. (2005) (Pasquali & Alford, 2022). On the other hand, the Supply Chain Management (SCM) literature tends to focus on performance, integration, and relational mechanisms at the firm or relationship level, without discussing governance structures, power asymmetries, or the role of lead firms. This difference in focus confirms the relevance of using the GVC governance framework to analyze the governance of the Volkswagen value chain structurally and across borders (Fakhrian & Isfianadewi, 2025; Laulita, 2020).

The author realizes that although GVC typology provides a clear framework for classifying types of GVC governance, recent literature has criticized this model. Literature from Kano (2020) criticizes the static nature of the model, arguing that, in practice, there are various value chain governance models within a single value chain structure that is geographically dispersed. In addition, Mcwilliam (2023) criticizes that GVC governance is something that is "a given" driven by the market or industry. This criticism arises because Mcwilliam (2023) finds that GVC Governance studies ignore the role of lead firms in determining GVC Governance dynamics and focus only on industry.

He argues that GVC Governance should be viewed as a dynamic and collaborative strategic choice. Furthermore, Mcwilliam (2023) criticizes the lack of research examining the active role of lead firms in determining the dynamics of GVC governance (Kano et al., 2020; McWilliam, 2023).

Analytical Positioning

Based on these criticisms, the author uses the GVC Governance framework in this paper. As Mcwilliam (2023) criticizes the lack of GVC governance literature that analyzes the active role of lead firms, the author uses this framework to contribute to the literature on GVC Governance within an industry, particularly in the automotive industry. This study will also contribute to describing the active role of lead firms and their suppliers in determining the dynamics of value chain governance. Although Kano criticizes this framework, the author still uses it to identify the dominant governance of lead firms, which is Volkswagen (McWilliam, 2023).

METHODOLOGY

This study adopts a qualitative document-based research design to examine the governance structure of the Volkswagen Group's global value chain in Europe. The research is descriptive because it aims to explain how value chain governance operates rather than test causal relationships. The unit of analysis is the Volkswagen Group as the lead firm in the automotive value chain.

The study relies on secondary data obtained from publicly available documents. These include Volkswagen Group annual reports, sustainability reports, official corporate press releases, and relevant academic publications discussing Volkswagen's supplier relations. Interview material cited in the study is derived from the work of Broek et al (2020) and is used as secondary data. Documents were selected based on three criteria, which is the relevance to Volkswagen's value chain and supplier relations, the publication by official corporate or academic sources, and the availability within the 2019–2025 research period.

Table 2. Variable operationalization

Determinant	Indicator
Transaction complexity	Just-in-time supply Product differentiation
Ability to codify information	Process standard Quality certification Environmental certification
Supplier capabilities	Computerization of non-price information transfer Use of generic or specific assets

Source: Authors (2025)

Data analysis applies qualitative content analysis to systematically interpret evidence from the selected document. The analytical process is guided by the governance determinants proposed by Gary Gereffi and colleagues. As shown in Table 2, the operationalization framework consists of three determinants: transaction complexity, the ability to codify information, and supplier capability, each indicated by specific analytical indicators. Relevant textual evidence from the documents is then categorized according to these determinants and indicators. Following the categorization, the findings are matched with the governance typology framework to identify the most appropriate governance pattern within the Volkswagen value chain. To enhance reliability, this study applies source triangulation by cross-checking information across multiple document types, including corporate reports, press releases, and academic sources.

RESULTS

Transaction Complexity in Volkswagen Group's European Value Chain

To determine whether a lead firm has high or low transaction complexity, one must examine whether it implements a time-sensitive supply system and adds product differentiation. An example of a time-sensitive supply system is the JIT supply system, because a delay in a single component can hinder or even halt the entire production process. JIT supply is a concept that essentially involves providing only the necessary products, at the necessary time, and in the necessary quantities, and at minimal cost. In addition to the definition of JIT, product differentiation is the uniqueness of product components that distinguishes them from similar competing products. One of these unique aspects is achieved through innovation at the core, which is at the technical and functional levels. Therefore, it is important to determine whether this principle is present in Volkswagen's value chain (Broek et al., 2020; Ding, 2023; Gereffi et al., 2018; Lai et al., 2003; Molet, 2013).

This study found that Volkswagen employs a JIT system across its value chain, as evidenced by official company statements. For instance, Volkswagen's website in Slovakia states, "At Volkswagen Slovakia, we use the JIT principle, which directs the flow of materials and information along the entire process chain." Additionally, Volkswagen in Belgium confirmed in an interview that it uses a JIT system in its value chain. This information officially confirms the use of the JIT system in the Volkswagen value chain (Broek et al., 2020; Volkswagen Slovakia, 2021).

This evidence is further supported by statements from suppliers who do indeed supply Volkswagen using the JIT system. For example, Thyssenkrupp Materials Processing Europe, a German supplier of steel and aluminum, supplies Volkswagen based on the JIT principle. They state, "we have automated almost all our assembly and delivery processes to match Volkswagen's requirements," so that Volkswagen in Portugal "can focus fully on its core activities while we provide tailored logistics and JIT deliveries." This is clear evidence from both sides that Volkswagen does indeed implement a JIT

system, which adds complexity to the transactions (Thyssenkrupp Materials Services GmbH, 2019).

This study found that product differentiation is both accelerated and regulated by European Union regulations. For example, Regulation 2019/631 stipulates that "... the manufacturer (lead firm) shall ensure that its average specific emissions of CO2 do not exceed... 95 g CO2/km for the average emissions of the new passenger car fleet, and 147 g CO2/km for the average emissions of the new light commercial vehicle fleet." Failure to comply results in the imposition of "an excess emissions premium... where a manufacturer's average specific emissions of CO2 exceed its specific emissions target." When lead firms and their suppliers introduce technological or product innovations that reduce CO2 emissions, the European Union offers incentives, such as a CO2 excess allowance of up to 7 g CO2/km, to "promote the deployment of zero- and low-emission vehicles on the Union market". Therefore, this regulation requires lead firms to innovate, thereby leading to product differentiation (Regulation (EU) 2019/631 Of The European Parliament And Of The Council, 2019).

Volkswagen acknowledges that this regulation represents a tightening of standards and impacts its technology. For example, they state, "The tightening of fleet-based CO_2 emissions… makes it necessary to use the latest mobility technologies." Consequently, "The Volkswagen Group closely coordinates technology and product planning with its brands to avoid… failure to meet fleet-level targets, which would result in significant financial penalties." They are addressing these regulations through their decarbonization and electrification program called Way to Zero. Through this program, "the production, including supply chains, and operation of electric cars are to be made net carbon neutral" to help "reduce CO_2 fleet emissions and fulfill the EU target". Therefore, it is important to examine the form of product differentiation by Volkswagen. (Volkswagen Group, 2022, 2025c).

The introduction of the VW ID.3 exemplifies product differentiation within Volkswagen's broader decarbonization and electrification strategy. The ID.3 is distinguished as "the world's first electric car with a CO_2-neutral footprint," and incorporates several technological advancements that establish new industry benchmarks. Specifically, the ID.3 utilizes the new MEB platform for electric vehicles, integrates the world's first high-performance vehicle server developed by Continental, and adopts the automotive industry's first thermal battery technology from TI Fluid Systems. These features illustrate how Volkswagen is responding to regulatory pressures by implementing leading product innovations (Continental AG, 2020; TI Fluid System, 2020; Volkswagen AG, 2019c; Volkswagen Group, 2019b).

This section concludes that Volkswagen demonstrates a high level of transaction complexity, as evidenced by the integration of JIT practices within its value chain and the implementation of product differentiation strategies. Volkswagen has officially confirmed its use of JIT, a claim further supported by suppliers that have automated

their systems to meet these requirements. Furthermore, the company advances product differentiation through the introduction of the ID.3, a model recognized for its technological innovations and competitive advantages in the automotive sector. The acceleration of this differentiation is driven by EU regulatory mandates requiring lead firms to manufacture low-carbon vehicles or face financial penalties.

Codification Capability in Volkswagen Group's Value Chain

Assessing the level of information codification in a lead firm requires examining the implementation of process standards, quality certifications, environmental certifications, and the computerization of non-price information transfer. Such implementation can be identified in the initial contract between the supplier and the lead firm, particularly through specific requirements. Additionally, evidence of digitalization in interactions between the company and its suppliers further indicates the extent of information codification. Consequently, it is necessary to investigate the presence of these requirements and the extent of digitalization at Volkswagen (Gereffi et al., 2018).

This study found that Volkswagen applies stringent process standards to its supplier selection due to decarbonization strategy implemented. In 2019, Volkswagen introduced the Sustainability Rating (S-Rating), a Group-wide tool developed to measure and assess direct suppliers' compliance with Volkswagen Group's sustainability requirements and to evaluate their environmental performance. According to Volkswagen, "If a supplier does not meet our requirements for compliance with sustainability standards, it is in principle not eligible for the award of contracts." This process standards underscores the stringency of Volkswagen's standards for prospective business partners (Volkswagen Group, 2025d).

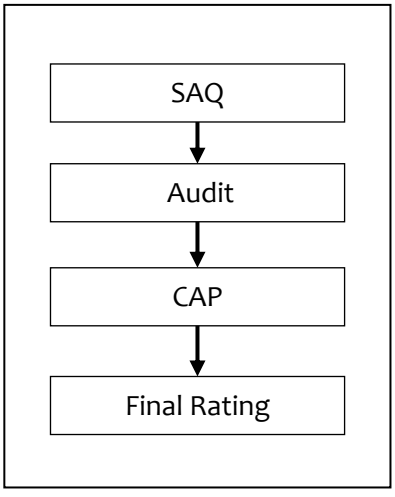

Figure 5. Volkswagen's Sustainability Rating Mechanism
Source: Compiled by the author from various sources (Volkswagen Group, 2025d, 2025g, 2025f).

The stringency of the selection and evaluation standards is demonstrated by the structured implementation of the S-rating system, which consists of four distinct stages,

as shown in figure 5. The first stage involves a Self-Assessment Questionnaire (SAQ) to assess compliance; in 2024, 19,094 suppliers completed this questionnaire. The second stage comprises an audit to verify the accuracy of the SAQ responses and evaluate supplier performance, conducted either by Volkswagen or an independent third-party auditor. For example, in 2023, 89, and in 2024, 85 audits were conducted. The third stage introduces a Corrective Action Plan (CAP) for suppliers whose ratings fall below 80 percent. The final stage is assigning the Final Rating, which determines supplier eligibility. Suppliers receiving an A or B rating are accepted, while those with a C rating are deemed ineligible for contracts. In 2024, 14,709 suppliers received an S-Rating; of these, 14,682 obtained a positive rating, and 28 received a C rating, rendering them ineligible for contracts. Thus, this finding contributes to the codification of information within the Volkswagen value chain (Volkswagen Group, 2025d, 2025g, 2025f).

This study found that Volkswagen adopts quality certifications by joining the Leather Working Group (LWG). The company states that "the brands of the Volkswagen Group have joined the LWG" as part of its effort to promote responsible raw material procurement and improve sustainability across its value chain. Furthermore, Volkswagen emphasizes that its leather production facilities in the supply chain are expected to obtain LWG certification, reflecting the company's commitment to internationally recognized standards in leather sourcing. In addition, since April 2022, suppliers have been required to comply with tender specifications that include a leather-specific sustainability certificate, such as those issued by LWG. These measures indicate that Volkswagen integrates certification-based standards, as codified information, into its supply chain governance to ensure more sustainable leather sourcing (Volkswagen Group, 2023b).

This study finds that environmental certification requirements exist within the Volkswagen value chain. These requirements are formally embedded in the Code of Conduct for Business Partners. They rely on recognized environmental management standards, such as ISO 14001 and EMAS. Volkswagen expects suppliers to implement certified environmental management systems as part of its sustainability governance. For example, Volkswagen states that "a certified and/or validated environmental management system is mandatory for all suppliers with a production site and a site size of 100 employees or more." Compliance with this certification is integrated into the supplier evaluation mechanism. Since 2022, "proof of this has been required for the S-rating." Based on sales revenues, more than 80% of suppliers in scope have met this requirement. These provisions show that environmental certifications, such as ISO 14001 or EMAS, are formal compliance tools that Volkswagen uses to enforce environmental standards across its global value chain (Volkswagen Group, 2023a).

This study finds that a computerized transfer of non-price information between suppliers and the lead firm enables efficient information exchange within Volkswagen's value chain. For example, the DISCOVERY (Digital Supply Chain Communication) platform operates as a web-based system that connects suppliers, logistics providers,

and Volkswagen plants. It "provides all transport-related information to suppliers, forwarders, and group plants," and allows suppliers to submit pickup notifications and logistics data digitally (Volkswagen Group, 2024). Volkswagen also uses standardized Electronic Data Interchange (EDI) messages to transmit operational information, including material call-offs, dispatch advice, and transport status messages (e.g., VDA 4984, VDA 4987, and VDA 4945), thereby supporting structured data exchange throughout the logistics supply chain (Volkswagen Group, 2021). In addition to logistics communication, Volkswagen enhances upstream transparency through blockchain initiatives. For instance, a pilot project with Minespider involves suppliers and sub-suppliers responsible for "more than two-thirds of the Group's total lead starter battery requirements," enabling digital traceability of raw materials from the mine to the factory (Volkswagen Group, 2019a). Collectively, these digital systems illustrate that computerized information exchange increases the codification of information between Volkswagen and its suppliers (Volkswagen Group, 2019a, 2021, 2024).

This section concludes that Volkswagen has a high level of codification of information with its supplier. Its decarbonization strategy has led Volkswagen to implement a phased standardization process through S-rating, which rigorously selects suppliers based on their sustainability ratings. In addition to these process standards, Volkswagen also requires its suppliers to comply with leather and environmental certifications. Non-compliance with these requirements results in contract termination, demonstrating Volkswagen's commitment. To ensure the smooth flow of non-price information, Volkswagen has digitized its value chain using both web-based and blockchain-based systems. This evidence underscores Volkswagen's high level of codification within its value chain.

Supplier Capability within Volkswagen's Value Chain

Assessing the level of information codification in a lead firm requires examining the use of supplier's asset. The use of specific assets indicates low supplier capability, while the use of generic assets indicates high supplier capability. According to transaction cost theory, specific assets are those that lose their value if used to serve other demands, thereby fostering dependence on a single lead firm. Consequently, the use of generic assets does not allow for redeployability. Generic assets, on the other hand, are the opposite; they allow for redeployment and do not result in dependence on a single firm. Therefore, it is important to determine whether the assets used by suppliers are generic or specific (Gereffi et al., 2018; Williamson, 2025).

This study found that EU regulations also influence the capabilities of the lead firm's suppliers. EU regulations give suppliers an active role in recognizing innovative CO_2-saving technologies, which can serve as an incentive for firms. Furthermore, suppliers and firms "must be accountable for the CO_2 savings achieved through the use of innovative technologies." Under this provision, the EU grants suppliers, by virtue of their

assets, the right to contribute to CO2 emission reductions (Regulation (EU) 2019/631 Of The European Parliament And Of The Council, 2019).

The EU provides recognition and incentives to companies or suppliers with innovative technologies so they can supply various companies in need. For example, "The EU Commission has granted state aid approval… for thyssenkrupp Steel's tkH2Steel decarbonization project," which is a "technological pioneer for the further decarbonization of the steel value chain." Through this project, the EU is providing an incentive of €2 billion and has been recognized by the European Center for Industrial Transformation and Emissions. This demonstrates that, in addition to tightening regulations, the EU also provides flexibility through incentive-based tolerance and cost assistance for development (European Commission, 2025; Thyssenkrupp AG, 2023b).

The Direct Reduction (DR) plant technology is part of Thyssenkrupp's broader steel industry transformation program, tkH2Steel®, which aims to decarbonize steel production while responding to increasing market demand for low-carbon materials and European climate policy targets. Thyssenkrupp explicitly links the development of the DR plant to this transformation agenda, noting that "the plant will have a capacity of 2.5 million metric tons of directly reduced iron… as part of the tkH2Steel® transformation concept." The company also emphasizes that this investment contributes to wider policy objectives, stating that it "makes an important contribution to achieving national and European climate targets." In addition, Thyssenkrupp acknowledges the market driver behind the project, explaining that "the increasing demand for climate-friendly steel is being taken into account with the expansion of the plant capacity." Therefore, the establishment of the DR plant reflects not only a technological shift within Thyssenkrupp's decarbonization strategy but also a response to rising demand for low-CO_2 steel and the need to align with European climate commitments (Thyssenkrupp AG, 2022, 2023a; Thyssenkrupp Steel Europe, 2023a).

This study indicates that Thyssenkrupp's low-CO_2 steel production serves as a generic asset, as the underlying technology and product can be supplied to multiple industries and customers beyond a single buyer. This redeployability is evidenced by the broad range of companies utilizing the material. For instance, Thyssenkrupp supplies bluemint® steel to sectors such as packaging and manufacturing, where "Sika Deutschland GmbH now uses CO_2-reduced bluemint® steel for its tinplate pails." Comparable applications are found in metal packaging, bathroom product manufacturing, and the automotive sector, including collaborations with companies such as BMW and Mercedes-Benz. The diversity of these buyers demonstrates that Thyssenkrupp's decarbonized steel technology is not tailored to a single firm but can be redeployed across various markets and industries, reinforcing its status as a generic, widely applicable production asset (Thyssenkrupp Steel Europe, 2021, 2022, 2023b, 2025a, 2025b).

This section concludes that suppliers within Volkswagen's value chain demonstrate high capability, as evidenced by firms such as Thyssenkrupp, which develop and deploy advanced decarbonization technologies while serving multiple markets. EU regulatory frameworks not only impose emission-reduction requirements but also provide incentives that encourage suppliers to innovate and develop technological solutions for CO_2 reduction. In response, Thyssenkrupp has implemented the tkH2Steel® transformation program and direct-reduction (DR) plant technology to produce low-CO_2 steel, reflecting strong technological capabilities and alignment with European climate targets. Additionally, the production of bluemint® steel indicates that Thyssenkrupp's assets are generic and redeployable, since the same technology and materials can be supplied to various industries beyond Volkswagen. Therefore, the capacity of suppliers to innovate, comply with regulatory demands, and redeploy assets across multiple buyers suggests that Volkswagen's value chain is supported by highly capable suppliers rather than by dependence on firm-specific assets.

Classification of Volkswagen Group's Value Chain Governance

Based on three main determinants, namely high transaction complexity, high codification capability, and high supplier capability, the Volkswagen Group's value chain governance in Europe is classified as modular governance. This classification was obtained by matching the empirical characteristics of the Volkswagen value chain with the indicators of each type of governance in the analytical framework used. In this study, a summary of the relevant evidence and indicators can be found in Table 3.

Volkswagen's value chain governance is not relational, as the company relies on formalized standards to regulate supplier participation. For example, the Sustainability Rating (S-Rating) is a component of Volkswagen's decarbonization strategy and requires suppliers to meet specific environmental and sustainability criteria before they become contract-eligible. Suppliers must adhere to defined procedures, audits, and corrective mechanisms rather than informal coordination or trust-based exchanges, which typically characterize relational governance. Additionally, the European regulatory environment, particularly stringent emissions policies, compels automotive manufacturers to accelerate technological innovation to avoid financial penalties. This regulatory pressure increases transaction complexity within the supply chain, as suppliers are required to develop advanced technologies and meet demanding technical standards. Consequently, many suppliers in Volkswagen's network possess high technological capabilities and respond to sophisticated product and process requirements, rather than relying on close relational ties. The combination of strict entry standards such as the S-Rating, regulatory-driven innovation, and technologically capable suppliers indicates that Volkswagen's value chain governance cannot be interpreted as relational.

Table 3. Synthesis of Value Chain Governance Determinants and Empirical Evidence for Volkswagen Group.

Determinant	Indicator	Evidence	Classification
Complexity of Transaction	JIT Supply	Through its official website, interviews, press releases, and Volkswagen in Slovakia and Belgium, it is stated that VW uses JIT supply, which is confirmed by suppliers who supply Volkswagen in Portugal using the JIT system (Broek et al., 2020; Thyssenkrupp Materials Services GmbH, 2019; Volkswagen Group, 2025a; Volkswagen Slovakia, 2021).	High
	Product differentiation	Regulation 2019/631 requires the fulfillment of emission targets of 95 g CO_2/km for passenger cars and 174 g CO_2/km for commercial vehicles. Failure to meet these targets will result in financial penalties for each g CO_2/km of excess emissions. To encourage innovation, the regulation provides incentives for companies who implement new technologies. Therefore, Volkswagen launches the world's first electric car innovation with a neutral carbon dioxide footprint, the ID.3. The vehicle uses world-first innovative technologies, including: a new underbody structure specifically for electric vehicles, MEB; the world's first high-performance server and computer from Continental; and the industry's first thermal technology from TI Fluid System	
Codification Capability	Process standard	Volkswagen codifies information across its value chain through strict supplier selection standards, especially through the Sustainability Rating (S-Rating) to assess compliance with sustainability and environmental requirements. This structured mechanism includes self-assessments, audits, corrective action plans, and final ratings that determine contract eligibility, demonstrating a formal, standardized exchange of information with suppliers.	High

	Quality certification	Volkswagen joins the Leather Working Group to certify leather manufacturers' facilities in order to maintain the quality of its leather.	
	Environmental certification	Volkswagen sets a target for most suppliers to have environmental certifications such as ISO 14001 or EMAS.	
	Computerization of non-price information transfer	This study finds that Volkswagen enhances the codification of information within its value chain through computerized information transfer systems that facilitate structured and efficient communication with suppliers. Platforms such as DISCOVERY, standardized EDI messages, and blockchain initiatives enable digital exchange of logistics data and upstream traceability across the supply chain	
Supplier capabilities	Use of generic or specific assets	This study finds that suppliers within Volkswagen's value chain demonstrate high capability, as shown by firms such as Thyssenkrupp that develop decarbonization technologies supported by EU regulatory incentives and climate policy frameworks. The use of redeployable technologies, such as tkH2Steel® and bluemint® steel, supplied to multiple industries, indicates that these suppliers rely on generic rather than firm-specific assets, enabling them to serve buyers beyond Volkswagen.	High

Source: Authors (2025)

Thyssenkrupp as a Turn-Key Suppliers in Volkswagen Group's Value Chain

A core competence of turn-key suppliers lies in their ability to provide customer service through structured project management that translates OEM requirements into coordinated production processes (Sturgeon & Lee, 2001). In the supply chain relationship between Thyssenkrupp and the Volkswagen Group, collaboration is typically organized through cross-functional project teams that are involved from the early stages of vehicle development. Company documentation indicates that suppliers participate in pre-series and product development phases alongside the automaker, ensuring that production planning aligns with vehicle specifications. As one source notes, "the project

teams include experts from quality, logistics, production, and procurement," illustrating how multidisciplinary teams coordinate with OEMs to translate technical requirements into production processes and supply chain coordination. Therefore, the presence of cross-functional project teams reflects the customer interface capability that characterizes turnkey suppliers in the automotive industry (Thyssenkrupp AG, 2025a, 2025d).

Another key competence of turn-key suppliers is the ability to translate diverse customer requirements into standardized procedures while scanning demand to improve procurement efficiency (Sturgeon & Lee, 2001). In practice, thyssenkrupp converts automotive customer specifications into structured operational standards through quality management systems aligned with industry standards such as ISO 9001:2015 and IATF 16949:2016. These standards enable specific requirements from automakers, such as the Volkswagen Group, to be incorporated into production processes, quality documentation, and supplier coordination frameworks. In addition, the company employs demand management mechanisms that allow digital modeling and consolidation of customer forecasts to enhance procurement efficiency. Internal documentation describes the capability to "electronically upload, manipulate and model customer forecasts item-by-item" and to perform the "aggregation of full material demand… to buy materials economically." This demonstrates how customer demand analysis is used to combine material requirements and reduce input costs in the supply chain, reinforcing the operational competencies expected from turn-key suppliers (Thyssenkrupp AG, 2025c, 2025b).

DISCUSSION

This study argues that the governance structure within the Global Value Chain of the Volkswagen Group can be understood as a form of modular coordination that has gradually become more regulated under external institutional pressures. In a conventional modular arrangement, suppliers can produce components according to detailed technical specifications provided by the lead firm while maintaining a degree of operational autonomy. Yet the introduction of stricter environmental policies in the European Union, particularly those targeting reductions in automotive emissions, such as Regulation (EU) 2019/631, appears to be reshaping how coordination occurs between Volkswagen and its suppliers. Rather than relying solely on technical product specifications, the governance structure increasingly incorporates environmental compliance, sustainability metrics, and decarbonization requirements that suppliers must meet to remain integrated into the value chain.

Against this background, the analysis suggests that regulatory pressure indirectly strengthens the lead firm's control dimension. Volkswagen translates regulatory expectations into internal supplier requirements, sustainability ratings, and procurement standards that guide supplier behavior across the production network. Although suppliers retain responsibility for meeting the specified technical solutions, their

discretion narrows as compliance with environmental standards becomes a prerequisite for participation. In this sense, modular governance does not disappear but evolves into a more regulated form of modular coordination. The evidence also points to a significant power asymmetry within the relationship. As a lead firm with substantial purchasing power and technological influence, Volkswagen holds the capacity to define production standards, determine acceptable environmental practices, and ultimately decide which suppliers remain within its supply network. Such dynamics indicate that regulatory pressures do not simply affect individual firms; they also reinforce the structural authority of the lead firm over suppliers within the value chain.

CONCLUSIONS

This study analyzes the governance of the Volkswagen Group's global value chain in Europe between 2019 and 2025. The findings indicate that Volkswagen's value chain governance is best characterized as modular, reflected in a combination of high transaction complexity, high codification capability, and high supplier capability. Transaction complexity emerges through the implementation of just-in-time supply and product differentiation driven by low-emission vehicle innovation. At the same time, Volkswagen relies on structured coordination mechanisms such as the Sustainability Rating system, environmental certifications, and digital communication platforms to codify interactions with suppliers. These mechanisms allow the company to coordinate complex production activities while maintaining a network of technologically capable suppliers that operate with a significant degree of operational autonomy.

From a theoretical perspective, this study contributes to the literature on global value chain governance by providing empirical evidence that modular governance remains relevant in advanced-economy manufacturing sectors, such as the European automotive industry. The findings also demonstrate the growing importance of digital governance tools in supporting modular coordination. Systems for electronic data exchange, logistics platforms, and blockchain-based traceability enable structured communication between the lead firm and suppliers without requiring vertical integration. In this sense, modular governance in contemporary manufacturing appears increasingly structured through standardized digital systems and formalized sustainability requirements.

The findings also generate managerial and policy implications. For firms, the case of Volkswagen illustrates how governance stability in complex value chains can be maintained through the combination of standardized supplier requirements and investment in supplier capability. Digital traceability and evaluation mechanisms function as governance instruments that allow the lead firm to coordinate technologically advanced suppliers while ensuring compliance with sustainability objectives. From a policy perspective, the analysis suggests that carbon-emission regulations in the European Union indirectly strengthen the codification of value-chain governance. Regulatory pressure encourages firms to translate environmental standards into internal

supplier requirements, thereby reinforcing structured coordination across the production network.

Limitations and recommendations

This study also acknowledges several limitations. One limitation concerns the potential for corporate reporting bias, as part of the empirical evidence relies on publicly available corporate documents produced by Volkswagen and its partners. Such sources may emphasize successful initiatives or selectively present information that aligns with corporate communication strategies, which could limit the completeness of the governance dynamics captured in this study. In addition, the research also faces a potential generalization bias, since the analysis primarily identifies turnkey suppliers within Volkswagen's value chain. As a result, the governance pattern observed in this research may not fully capture the diversity of supplier relationships within the broader network. Future research is therefore needed to identify whether other types of suppliers exist within Volkswagen's value chain in Europe. If additional supplier types are identified, this would support Kano's (2020) argument that value chains may operate through multiple governance modes simultaneously, forming a hybrid governance structure rather than a single dominant model.

REFERENCES

Allam, Z., Bibri, S. E., & Sharpe, S. A. (2022). *The Rising Impacts of the COVID-19 Pandemic and the Russia–Ukraine War: Energy Transition, Climate Justice, Global Inequality, and Supply Chain Disruption*. Environmental Science, Political Science, Economics.

Barros, R. da S. de C., & Almeida, L. F. de. (2024). Triple-A approach and global value chain governance (GVC): The case of Brazilian beef. *Journal of Rural Studies*, *107*. https://www.sciencedirect.com/science/article/abs/pii/S0743016724000457?via%3Dihub

Broek, K. v, Beer, F. d, Amelsvoort, G. v, Vanhaverbeke, C., & Nugteren, J. (2020). The Covid-19 Effects on the Volkswagen Supply Chain. In eds. (Ed.), *COVID19 & the Digital Transformation. K.J.M.G. Meesters*.

Continental AG. (2020, October 7). *Start of the Electric Era: New VW ID.3 E-model Equipped with Continental Technologies*. https://www.continental.com/en/press/press-releases/volkswagen-id3/

Csizmazia, R. A. (2014). Reconfiguration of Supply Chain at Volkswagen Group to Develop Global. *International Journal of Academic Research in Business and Social Sciences*, *4*(12), 294–305.

Ding, X. (2023). Product Differentiation. *Proceedings of the 2nd International Conference on Business and Policy Studies* .

European Commission. (2025). *tkH2Steel | INCITE*. https://innovation-centre-for-industrial-transformation.ec.europa.eu/node/822569

Fakhrian, M. B., & Isfianadewi, D. (2025). Collaboration and Integration Role in Mediating the Effect of Trust and Commitment on Supply Chain Performance. *MEC-J (Management and Economics Journal)*, *9*(1), 17–36. https://doi.org/https://doi.org/10.18860/mec-j.v9i1.29838

Gaultier, C., & Marcello, K. (2021). Volkswagen Group Supply Chain Analysis In Europe. *African Journal of Emerging Issues*, *3*(8), 1–10.

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, 78–104.

Gereffi, G., Humphrey, J., & Sturgeon, T. J. (2018). The Governance of Global Value Chains. In *Global Value Chains and Development* (pp. 108–134). Cambridge University Press. https://doi.org/10.1017/9781108559423.005

Gereffi, G., Lim, H., & Lee, J. (2021). *Trade policies, firm strategies, and adaptive reconfigurations of global value chains*.

Ivanov, D. (2020). Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case. *Transportation Research Part E: Logistics and Transportation Review*, *136*.

Kano, L. (2018). Global value chain governance: A relational perspective. *Journal of International Business Studies*, *49*(6), 684–705. https://doi.org/10.1057/s41267-017-0086-8

Kano, L., Tsang, E. W. K., & Yeung, H. W. (2020). Global value chains: A review of the multi-disciplinary literature. *Journal of International Business Studies*, *51*(4), 577–622. https://doi.org/10.1057/s41267-020-00304-2

Lai, C. L., Lee, W. B., & Ip, W. H. (2003). A study of system dynamics in just-in-time logistics. *Journal of Material Processing Technology*. https://www.sciencedirect.com/science/article/abs/pii/S0924013603000839

Laulita, N. B. (2020). The Effect of Organizational Culture and Supplier Integration to Supply Chain Performance. *MEC-J (Management and Economic Journal)*, *4*(3), 295–306. https://doi.org/10.18860/mec-j.v4i3.8896

McWilliam, S. E. (2023). Global Value Chain Governance Dynamics: A Co-Evolutionary Perspective on the Transition from Relational to Modular Governance in Construction. *AIB Insights*, *23*(5). https://doi.org/10.46697/001c.88528

Molet, H. (2013). Production Systems. In P. Wieser, F.-L. Perret, & C. Jaffeux (Eds.), *Essentials Of Logistics & Management: The Global Supply Chain* (3rd ed.). EPFL Press.

Pasquali, G., & Alford, M. (2022). Global value chains, private governance and multiple end-markets: insights from Kenyan leather. *Journal of Economic Geography*, *22*(1), 129–157. https://doi.org/10.1093/jeg/lbab018

Ponte, S., & Sturgeon, T. (2014). Explaining governance in global value chains: A modular theory-building effort. *Review of International Political Economy*, *21*(1), 195–223. https://doi.org/10.1080/09692290.2013.809596

Purbantina, A. P., & Perbawani, F. C. (2023). *Buku Ajar Metode Penelitian Sosial untuk Hubungan Internasional*. Penerbit Nas Media Pustaka.

Regulation (EU) 2019/631 Of The European Parliament And Of The Council, Pub. L. 2019/631, 13 (2019). https://eur-lex.europa.eu/eli/reg/2019/631/oj/eng

Rodrigues, E. A. (2016). *Supply Chain & Transports Optimization Volkswagen Autoeuropa Case Study*. Department of Engineering and Management, Instituto Superior Técnico.

Sturgeon, T., & Lee, J.-R. (2001). *Industry Co-Evolution and the Rise of a Shared Supply-base for Electronics Manufacturing*. https://www.researchgate.net/publication/241269620_Industry_Co-Evolution_and_the_Rise_of_a_Shared_Supply-base_for_Electronics_Manufacturing

Thyssenkrupp AG. (2022, August 9). *thyssenkrupp is accelerating the green transformation: Decision taken on the construction of Germany's largest direct reduction plant for low-CO2 steel*. https://www.thyssenkrupp.com/en/newsroom/press-releases/pressdetailpage/thyssenkrupp-is-accelerating-the-green-transformation--decision-taken-on-the-construction-of-germanys-largest-direct-reduction-plant-for-low-co2-steel-146809

Thyssenkrupp AG. (2023a, January 3). *thyssenkrupp Steel awards a contract worth billions of euros to SMS group for a direct reduction plant: one of the world's largest industrial decarbonization projects gets underway*. https://www.thyssenkrupp.com/en/newsroom/press-releases/pressdetailpage/thyssenkrupp-steel-awards-a-contract-worth-billions-of-euros-to-sms-group-for-a-direct-reduction-plant:-one-of-the-world's-largest-industrial-decarbonization-projects-gets-underway-163184?trk=public_post_comment-text

Thyssenkrupp AG. (2023b, July 20). *EU Commission approves German federal and state government fund-ing for thyssenkrupp Steel's "tkH2Steel" decarbonization project*. https://www.thyssenkrupp.com/en/newsroom/press-releases/pressdetailpage/eu-commission-approves-german-federal-and-state-government-fund-ing-for-thyssenkrupp-steels-tkh2steel-decarbonization-project-228875

Thyssenkrupp AG. (2025a). *Automobilproduktion sekundengenau steuert*. https://www.thyssenkrupp-automotive-technology.com/en/innovation/automotive_production_down_to_the_second

Thyssenkrupp AG. (2025b). *Procurement & Delivery*. https://www.thyssenkrupp-aerospace.com/en/materials/procurement-and-delivery

Thyssenkrupp AG. (2025c). *Quality Management*. https://www.thyssenkrupp.hu/en/quality-management

Thyssenkrupp AG. (2025d). *Volkswagen honors thyssenkrupp with award for outstanding product launches*. https://www.thyssenkrupp-automotive-technology.com/en/press/press-releases/volkswagen-honors-thyssenkrupp-with-award-for-outstanding-product-launches-390.html

Thyssenkrupp Materials Services GmbH. (2019, December 5). *thyssenkrupp Materials Processing Europe supplies Volkswagen in Portugal on a just-in-time basis*. Press Release. https://www.thyssenkrupp-materials-services.com/en/newsroom/press-releases/thyssenkrupp-materials-processing-europe-supplies-volkswagen-in-portugal-on-a-just-in-time-basis-15040.html

Thyssenkrupp Steel Europe. (2021, October 26). *bluemint® Steel: Premium steels with an environmental benefit*. https://www.thyssenkrupp-steel.com/en/newsroom/press-releases/bluemint-steel-premium-steels-with-an-environmental-benefit.html

Thyssenkrupp Steel Europe. (2022). *thyssenkrupp Steel presents high-quality flat steel with reduced CO2 intensity at the EuroBLECH*. https://www.thyssenkrupp-steel.com/en/newsroom/press-releases/thyssenkrupp-steel-presents-high-quality-flat-steel-with-reduced-co2-intensity-at-the-euroblech.html

Thyssenkrupp Steel Europe. (2023a). *Green Steel World 2023: thyssenkrupp Steel presents technologically leading concept for decarbonizing steel production*. https://www.thyssenkrupp-steel.com/en/newsroom/press-releases/green-steel-world-2023-thyssenkrupp-steel-presents-technologically-leading-concept-for-decarbonizing-steel-production.html

Thyssenkrupp Steel Europe. (2023b). *Sika now also relies on sustainable bluemint® packaging steel from thyssenkrupp Rasselstein*. https://www.thyssenkrupp-steel.com/en/newsroom/press-releases/sika-now-also-relies-on-sustainable-bluemint-packaging-steel-from-thyssenkrupp-rasselstein.html

Thyssenkrupp Steel Europe. (2025a). *bluemint® Steel: CO_2-reduced steel | thyssenkrupp Steel*. https://www.thyssenkrupp-steel.com/en/products/bluemint/bluemint.html

Thyssenkrupp Steel Europe. (2025b, February 23). *thyssenkrupp Steel supplies bluemint® Steel for series production of the BMW iX3*. https://www.thyssenkrupp.com/en/newsroom/press-releases/pressdetailpage/thyssenkrupp-steel-supplies-bluemint%28r%29-steel-for-series-production-of-the-bmw-ix3-311921

TI Fluid System. (2020, November 5). *TI Fluid Systems Supplies Volkswagen ID.3 And ID.4 Battery Electric Vehicles With Industry-First Thermal Technology*. https://www.prnewswire.com/news-releases/ti-fluid-systems-supplies-volkswagen-

id3-and-id4-battery-electric-vehicles-with-industry-first-thermal-technology-301166775.html

Veselovská, L. (2020). Supply chain disruptions in the context of early stages of the global COVID-19 outbreak. *Problems and Perspectives in Management*, *18*(ue 2), 490–500.

Volkswagen AG. (2016a). *Key Figures in 2015*. https://annualreport2015.volkswagenag.com/additional-information/key-figures.html

Volkswagen AG. (2016b). *Production*. https://annualreport2015.volkswagenag.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen AG. (2017a). *Key Figures in 2016*. https://annualreport2016.volkswagenag.com/additional-information/key-figures.html

Volkswagen AG. (2017b). *Production*. https://annualreport2016.volkswagenag.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen AG. (2018a). *Our key figures in 2017*. https://annualreport2017.volkswagenag.com/

Volkswagen AG. (2018b). *Production*. https://annualreport2017.volkswagenag.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen AG. (2019a). *Our key figures in 2018*. https://annualreport2018.volkswagenag.com/

Volkswagen AG. (2019b). *Production*. https://annualreport2018.volkswagenag.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen AG. (2019c, October 9). *IAA 2019: Volkswagen launches the breakthrough for electric vehicles with the ID.3's world premiere*. https://www.volkswagen-newsroom.com/en/press-releases/iaa-2019-volkswagen-launches-the-breakthrough-for-electric-vehicles-with-the-id3s-world-premiere-5341

Volkswagen AG. (2020). *Production*. https://annualreport2019.volkswagenag.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen AG. (2021). *Production*. https://annualreport2020.volkswagenag.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen AG. (2022). *Production*. https://annualreport2021.volkswagenag.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen AG. (2023). *Production*. https://annualreport2022.volkswagenag.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen AG. (2024). *Production*. https://annualreport2023.volkswagen-group.com/group-management-report/sustainable-value-enhancement/production.html#:~:text=At%209.31%20million%20vehicles%2C%20the,compared%20with%20the%20previous%20year.

Volkswagen Group. (2019a). *From mine to factory: Volkswagen makes supply chain transparent with blockchain*. https://www.volkswagen-group.com/en/press-releases/from-mine-to-factory-volkswagen-makes-supply-chain-transparent-with-blockchain-16623

Volkswagen Group. (2019b, November 4). *Volkswagen initiates system changeover to e-mobility – Production of the ID.3 starts in Zwickau*. https://www.volkswagen-newsroom.com/en/press-releases/volkswagen-initiates-system-changeover-to-e-mobility-production-of-the-id3-starts-in-zwickau-5529

Volkswagen Group. (2021, July 12). *Benefits for all concerned process partners*. https://www.vwgroupsupply.com/one-kbp-pub/media/kbp_public/documents_2/zusammenarbeit/discovery_4/prozessschaubild_discovery_1/discovery-prozessuebersicht-en.pdf

Volkswagen Group. (2022). *Volkswagen Passenger Cars again significantly exceeds European CO2 fleet targets for 2021*.

Volkswagen Group. (2023a). *Code of Conduct for Business Partner*. https://www.volkswagen-group.com/en/publications/more/code-of-conduct-for-business-partner-1885

Volkswagen Group. (2023b, April 14). *Volkswagen is committed to more sustainable leather sourcing*. https://www.volkswagen-group.com/en/press-releases/volkswagen-is-committed-to-more-sustainable-leather-sourcing-16158

Volkswagen Group. (2024). *DISCOVERY*. https://www.vwgroupsupply.com/one-kbp-pub/en/kbp_public/information/communication_1/discovery/discovery.html

Volkswagen Group. (2025a). *1992 to 2015 – Globalisation of the Mobility Group*. https://www.volkswagen-group.com/en/volkswagen-chronicle-17351/1992-to-2015-globalisation-of-the-mobility-group-17360#

Volkswagen Group. (2025b). *Annual Report 2014*. https://www.volkswagen-group.com/en/publications/corporate/annual-report-2014-2332

Volkswagen Group. (2025c). *Environmental and social risks - Volkswagen Group Annual Report 2024*. https://annualreport2024.volkswagen-group.com/group-management-report/report-on-risks-and-opportunities/risks-and-opportunities/environmental-and-social-risks.html

Volkswagen Group. (2025d). *Procurement*. https://annualreport2024.volkswagen-group.com/group-management-report/sustainable-value-enhancement/procurement.html

Volkswagen Group. (2025e). *Production*. https://annualreport2024.volkswagen-group.com/group-management-report/sustainable-value-enhancement/production.html

Volkswagen Group. (2025f). *Sustainability Report*. https://annualreport2024.volkswagen-group.com/_assets/downloads/esrs-sustainability-report-vw-ar24.pdf

Volkswagen Group. (2025g). *Workers in the value chain - Volkswagen Group Annual Report 2024*. https://annualreport2024.volkswagen-group.com/sustainability-report/social/workers-in-the-value-chain.html?tabc=4e3

Volkswagen Slovakia. (2021). *Logistics department*. https://en.volkswagen.sk/en/for-suppliers/logistics.html

Williamson, O. E. (2025). Transaction Cost Economics. In C. Ménard & M. M. Shirley (Eds.), *Handbook of New Institutional Economics* (2nd ed.).