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Decarbonization of Global Value Chains: case studies within the food industry

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Decarbonizzazione delle Catene del Valore Globale: casi di studio nell'industria alimentare

ABSTRACT

This thesis examines how companies in the food industry integrate decarbonization and circular economy principles into their global value chains (GVCs). The food sector accounts for approximately one-third of total global greenhouse gas emissions, yet remains understudied in the sustainability literature compared to sectors such as energy and shipping, which justifies the focus of this research. The theoretical framework draws on GVC theory, covering governance typologies, recent dynamics such as slowbalization and reshoring, and Industry 4.0 technologies, and on circular economy literature, with particular attention to the ecosystem-level transformation required for meaningful circularity and the orchestrating role of the lead firm. The study adopts a qualitative, multiple case study approach based on thematic analysis of sustainability reports published in 2023–2024 by six Italian food companies: three manufacturers (Icam, Alce Nero, Valsoia) and three retailers (Esselunga, Conad, Eurospin). Analysis is organized around five themes: circularity integration into the business model, value chain governance and orchestration, decarbonization measures, technology and data, and drivers and barriers. Findings reveal significant variation across companies in the depth of circularity integration. Manufacturers show more differentiated approaches, ranging from strategic embeddedness to peripheral acknowledgement, while retailers tend to converge on a similar conception of circularity. Across both company types, however, the transition toward a fully integrated circular approach remains incomplete. In particular, the ecosystemic orchestration of all actors involved along the value chain, from farm to fork, is still not completely integrated, even though some of the analyzed companies (like Icam, Alce Nero and Esselunga) companies engaged in several partnerships to enhance company's practices and operations.

ABSTRACT ITA

La presente tesi esamina il modo in cui le aziende del settore alimentare integrano i principi della decarbonizzazione e dell'economia circolare nelle loro catene del valore globali (GVC). Il settore alimentare è responsabile di circa un terzo delle emissioni globali totali di gas serra, ma rimane poco studiato nella letteratura sulla sostenibilità rispetto a settori quali l'energia e il trasporto marittimo, il che giustifica l'attenzione dedicata a questo tema nella presente ricerca. Il quadro teorico attinge alla teoria delle GVC, che copre le tipologie di governance, le dinamiche recenti come la slowbalizzazione e il reshoring, e le tecnologie dell'Industria 4.0, e alla letteratura sull'economia circolare, con particolare attenzione alla trasformazione a livello di ecosistema necessaria per una circolarità significativa e al ruolo di coordinamento dell'azienda leader. Lo studio adotta un approccio qualitativo basato su casi multipli, fondato sull'analisi tematica dei bilanci di sostenibilità pubblicati nel 2023–2024 da sei aziende alimentari italiane: tre produttori (Icam, Alce Nero, Valsoia) e tre distributori (Esselunga, Conad, Eurospin). L'analisi è strutturata attorno a cinque temi: integrazione della circolarità nel modello di business, governance e coordinamento della catena del valore, misure di decarbonizzazione, tecnologia e dati, nonché fattori trainanti e ostacoli. I risultati evidenziano notevoli differenze tra le aziende per quanto riguarda il grado di integrazione della circolarità. I produttori mostrano approcci più diversificati, che vanno dall'integrazione strategica al semplice riconoscimento marginale, mentre i rivenditori tendono a convergere su una concezione simile della circolarità. In entrambi i tipi di aziende, tuttavia, la transizione verso un approccio circolare pienamente integrato rimane incompleta. In particolare, l'orchestrazione ecosistemica di tutti gli attori coinvolti lungo la catena del valore, dal campo alla tavola, non è ancora completamente integrata, anche se alcune delle aziende analizzate

(come Icam, Alce Nero ed Esselunga) hanno avviato diverse partnership per migliorare le pratiche e le operazioni aziendali.

CONTENTS

1 INTRODUCTION

The global economy has undergone profound transformations over recent decades, driven by the deepening integration of production systems across borders. Starting from the 1980s, significant technological, institutional, and political changes brought people and economies closer together, giving rise to the phenomenon known as globalization.[1] The emergence and expansion of global value chains (GVCs) have reshaped how goods are produced, distributed, and consumed, enabling firms to fragment production internationally and allocate activities where they can be performed most efficiently.[2] While this model has generated significant economic gains, it has also contributed to mounting environmental pressures. The spatial dispersion of production activities requires extensive transportation and shipping, increasing greenhouse gas emissions, while rising levels of consumption have accelerated the depletion of finite natural resources and the generation of excessive amounts of waste.[3]

Among the industries most exposed to these dynamics, the food sector stands out for both its scale and its environmental significance. It accounts for approximately one-third of total global greenhouse gas emissions, driven by crop production and other activities distributed across complex, multi-tiered supply chains. Despite this relevance, the food industry remains comparatively understudied in the sustainability and decarbonization literature, which has so far concentrated primarily on the energy and shipping sectors.[4] The fashion industry, for instance, has received comparatively more

[1] (Jones et al., 2019)
[2] (Gereffi et al., 2005)
[3] (*World Development Report 2020: Trading for Development in the Age of Global Value Chains*, 2020)
[4] (Sharma et al., 2024)

attention despite accounting for approximately 10% of global carbon emissions,[5] leaving the food sector as a critical yet underexplored domain.

At the same time, growing regulatory pressure, evolving consumer expectations, and increasing urgency of climate commitments are pushing food companies to reassess their business models and supply chain practices. Consumers and society more broadly are demanding greater transparency in areas such as input sourcing, waste management, energy consumption, and labour conditions, and their purchasing decisions ultimately shape firms' strategic choices.[6] In this context, decarbonization — understood as the systematic reduction of greenhouse gas emissions across the value chain — and circular economy principles have emerged as central strategic priorities. Unlike the linear economic model based on a "take, make and dispose" logic, the circular economy emphasizes the reuse of existing materials, aiming to establish a closed-loop system capable of preserving rather than degrading the external environment.[7] Yet the transition toward more sustainable and circular value chains is far from straightforward. Circularity is a property of a system[8], meaning that the commitment of a single business is not sufficient to bring about real change; instead, joint collaboration across multiple actors is required to achieve a meaningful transformation toward the circular economy paradigm.[9]

This systemic nature of circularity is particularly relevant in the context of GVCs, where the decisions and strategic choices made by lead firms in developed countries also affect activities carried out by firms embedded in

[5] (Li et al., 2024)
[6] (De Backer & Flaig, 2017)
[7] (Ellen MacArthur Foundation, 2015)
[8] (Konietzko et al., 2020)
[9] (Parida et al., 2019)

the same network across developing countries.[10] Meaningful and systemic change is more likely to occur when the lead firm is able to influence or coordinate the entire value chain, making closer collaboration and reorganization among all involved actors necessary. [11] This implies redesigning not only production processes but also the way businesses create and capture value, involving a profound transformation of the business model.[12]

This thesis addresses this gap by investigating how companies operating in the food industry integrate decarbonization strategies and circular economy principles into their value chains. The central research question guiding the study is: *"How do food industry value chains implement decarbonization and circular economy into their business?"*

To answer this question, the thesis draws on two interconnected bodies of literature. The first concerns global value chain theory, which provides a framework for understanding how production is organized, governed, and coordinated across borders[13], as well as how value chains are evolving in response to technological change, geopolitical uncertainty, and sustainability pressures.[14] The second concerns circular economy theory, with particular attention to the ecosystem-level transformation required for meaningful circularity[15] and the orchestrating role played by lead firms in coordinating actors around shared sustainability objectives.[16]

[10] (Kogg & Mont, 2012)
[11] (De Backer & Flaig, 2017)
[12] (Ellen MacArthur Foundation, 2015)
[13] (Gereffi et al., 2005);(Kano et al., 2020)
[14] (Antràs, 2020b); (De Backer & Flaig, 2017); (Smorodinskaya et al., 2021)
[15] (Trevisan et al., 2022)
[16] (Parida et al., 2019); (Zucchella & Previtali, 2019)

Empirically, the study adopts a qualitative, multiple case study approach based on thematic analysis of sustainability reports published between 2023 and 2024 by six Italian food companies — three manufacturers (Icam, Alce Nero, and Valsoia) and three retailers (Esselunga, Conad, and Eurospin). This design allows for an in-depth examination of how different types of companies, occupying different positions along the supply chain, approach the decarbonization and circularity challenge, and how they coordinate — or fail to coordinate — the actors involved in their value chains.[17]

The thesis is structured as follows. Chapter 2 presents the theoretical framework, reviewing the literature on global value chains, their governance and dynamics, and the circular economy perspective. Chapter 3 describes the methodological approach, including the research strategy, data collection, sampling criteria, and analytical framework. Chapter 4 presents the findings from the thematic analysis, organized around five core themes. Chapter 5 discusses the results, draws conclusions, and outlines the limitations of the study and directions for future research.

[17] (Lim, 2025)

2 LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Global Value Chains

Starting from the 1980s, the world economy began to change at a faster pace than in the past, bringing people and economies around the globe closer together. Significant transformations have led to increasingly integrated and interdependent economies, while several dimensions of society have been affected by rapid development, namely technological, institutional, and political ones. These changes have given rise to a new phenomenon known as globalization, resulting in transformations at multiple levels, from the global to the national and, eventually, to the firm level.[18]

Thanks to the promotion of gradual liberalization, achieved through the substantial reduction of trade barriers, the diffusion of information and communication technologies (ICT), and increased investments, firms gained the opportunity to enhance their activities and processes. This enabled them to expand their operational scope, fragmenting production processes into different stages. (39). Such fragmentation allows firms to allocate resources where they can be managed more efficiently, thereby increasing business profitability. These outcomes are further reinforced by gains derived from improved specialization and input-seeking strategies.[19]

As a result, companies began to offshore and outsource parts or entire stages of goods production by establishing relationships and connections with third parties located outside firm boundaries, yet dispersed across different

[18] (Jones et al., 2019)
[19] (Gereffi et al., 2005)

countries. The reallocation of business activities opened up opportunities to redistribute financial resources within firms, strengthening and deepening core competencies. As noted by Gereffi et al. (2005), this process is referred to as the vertical disintegration of corporations.

Consequently, a new pattern of trade emerged, characterized by components and intermediate goods crossing multiple borders and countries. Each segment or activity within the fragmented production process adds value to the final product, increasing its overall worth. For this reason, scholars and researchers recognized that key features traditionally associated with international trade were undergoing profound changes, rendering conventional trade theories insufficient to fully analyze the contemporary context. Despite former conceptualizations, all these new characteristics collectively define what is known as global value chain theory, which has been the subject of extensive debate and analysis since before the beginning of the twentieth century.[20]

In general, Michael Porter was the first scholar to introduce a conceptualization of the value chain in 1985.[21] In recent decades, following the emergence of this phenomenon, researchers have increasingly focused on defining and discussing the concept of global value chains (GVCs). Nevertheless, there is no unanimous consensus within the literature. For instance, (Antràs, 2020a)defines it as follows:

"A global value chain or *GVC* consists of a series of stages involved in producing a product or service that is sold to consumers, with each stage

[20] (Antràs, 2020a)
[21] (Jones et al., 2019)

adding value, and with at least two stages being produced in different countries".

Accordingly, a firm is considered to participate in a GVC when it is involved in one or more stages of the value chain. Firms located in different countries are interrelated, and their exchanges are governed by relationships that range from formal to informal arrangements. Most value chains are coordinated by lead firms, typically multinational enterprises (MNEs), which design and manage—with varying degrees of control—the structure and organization of the value chain. In this sense, GVCs resemble networks through which raw materials, components, intermediate inputs, and tasks are transferred across production sites and delivered to different destination countries.[22]

Compared to traditional trade patterns, components and intermediate goods are increasingly traded rather than only final goods. As a result, it frequently occurs that the same good, assembled progressively "along the way," crosses the same border multiple times before reaching the final consumer. This process leads to an increase in foreign value added embodied in production, which accumulates at each stage. Consequently, this dynamic poses significant challenges for scholars in accurately measuring the value added of final goods without incurring double counting. Overall, participation in GVCs entails a range of opportunities and outcomes, while simultaneously raising methodological complications related to the measurement of GVC activities.[23]

(Kano et al., 2020) define GVCs as follows:

[22] (Antràs, 2020a)
[23] Ibidem

"A GVC is the nexus of interconnected functions and operations through which goods and services are produced, distributed, and consumed on a global basis."

In this perspective, GVCs can be interpreted as governance arrangements that may be organized in different modes and are used to produce final goods whose stages are spatially dispersed on a global scale.

Before the diffusion of the GVC concept, scholars mainly relied on the notion of Global Commodity Chains (GCC), which is still frequently compared with the GVC perspective. Kano et al. report the definition of GCC originally provided by Gereffi:

"Sets of interorganizational networks clustered around one commodity or product, linking households, enterprises, and states to one another within the world economy. […]".[24]

The GCC framework primarily focuses on the organization of production around a specific commodity, as suggested by the acronym. Its analytical emphasis lies on the network of actors involved in the production and distribution of a given good, highlighting power relations and coordination mechanisms across countries. However, compared to the GVC approach, GCCs place less emphasis on the sequential fragmentation of production activities and on the value added generated at each stage of the production process. By contrast, the GVC perspective explicitly conceptualizes production as a value chain composed of distinct stages, involving both primary and support activities that are spatially dispersed across countries. This shift in focus allows for a more detailed analysis of how value is created, distributed, and captured along the chain, as well as of firms'

[24] (Kano et al., 2020)

positioning within global production networks. In this sense, while GCCs provide a useful foundation for understanding global production linkages, the GVC framework offers a more comprehensive and analytically refined approach to studying contemporary patterns of international production and trade. [25]

Many researchers have attempted to define the architecture of global value chains by identifying linkages and embedding the concept of value added. Mapping GVCs makes it possible to give a "shape" to this phenomenon, in the sense of providing a structured representation that allows comparability over time and across space and industries. By attributing such a structure, it becomes possible to develop metrics to track participation and evolution, thereby creating opportunities to measure GVC activities. Consequently, policymakers can more effectively take into account the impacts of GVCs and better manage their outcomes, leading to more appropriate and informed policy decisions. The GVC framework is composed of two main components. The first is value chain mapping, which encompasses the elements involved in the realization of a product, from conceptualization through production to final consumption. These elements include firms, activities, stakeholders, products, and geographic locations. Since these activities are carried out by multiple firms located in different parts of the world, the value chain is also characterized as 'global'. The second component is value chain analysis, which focuses on the linkages among the aforementioned elements. These linkages are shaped by governance structures, institutional contexts, and inter-firm relationships, all of which influence the location of activities, competitiveness, and development outcomes. Together, value chain mapping and analysis make it

[25] Ividem

possible to understand how, where, and by whom value is created and distributed, thereby enabling policymakers and economic developers to design targeted interventions and identify leverage points.[26] (Frederick, 2019)formalizes a visual representation of the global value chain that identifies its structural components and is industry-neutral. This representation is divided into four parts: (1) value-adding activities; (2) supply chain stages; (3) end markets; and (4) supporting environments.

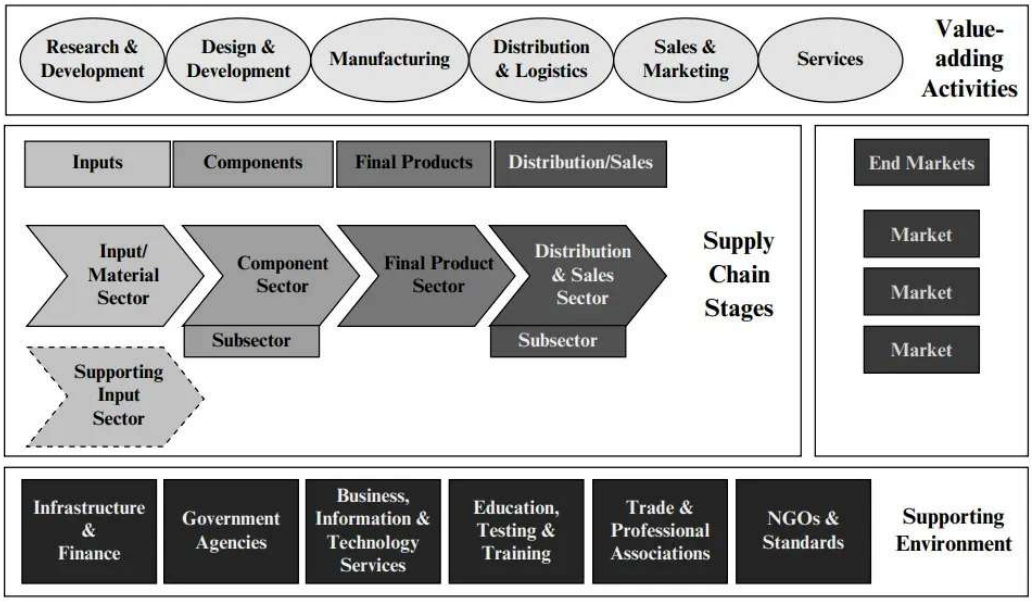

Figure 1: source Frederick (2019)

1. **Value-adding activities** are those that enable the realization of the final product, from its initial conceptualization to its delivery to customers. These activities play a crucial role in enhancing firms' competitiveness and increasing the overall value of the product. They include: (1) research and development, which relates to the ideation, improvement, and innovation of products or production processes, as well as to market and customer analysis; (2) design, which concerns the experimentation and

[26] (Frederick, 2019)

development of new products; (3) manufacturing, which refers to the locations and facilities where products are produced; (4) logistics, which involves the distribution and storage of both final and intermediate goods and includes actors such as wholesalers, distribution centres, and warehouses; (5) sales and marketing, which relate to the promotion and retailing of the final product; and (6) services, which encompass customer support, repair, and maintenance activities.

2. **Supply chain stages** represent the most tangible activities required to realize the product. They begin with the procurement of raw materials, inputs, and components, which are then combined through manufacturing processes to produce the final good, subsequently distributed and sold to the end user.

3. **End markets** refer to the segments to which the product is addressed, which may be defined by geographic areas or by specific customer characteristics.

4. **Supporting environment** encompasses the social, economic, and political actors that influence the conduct and scope of actions within the value chain. This environment includes infrastructure and finance, government agencies, businesses, information technologies, education and training systems, trade and professional associations, non-governmental organizations, and standards.

Industrial revolutions, together with the development of information and communication technologies (ICT), have facilitated the manufacturing of goods in locations that are geographically distant from their points of consumption. Improvements in transportation have eased the movement of goods, reducing both costs and delivery times. At the same time, significant

advances in communication technologies have enhanced coordination by eliminating the need for geographical proximity, which had previously required face-to-face interactions. These changes have led to the unbundling of production stages, allowing activities to be located where greater efficiency can be achieved. Enhanced coordination capabilities have enabled firms to specialize in their core activities while outsourcing others to more competent firms, even when these are located in different countries. This finer division of labour has given rise to new phenomena in international trade—namely outsourcing and offshoring—which have also facilitated the emergence and expansion of global value chains.[27]

As explained by (Jones et al., 2019), the two phenomena are distinct and should not be considered synonymous. **Offshoring** refers to the relocation of a business activity or facility to another country, while ownership of the activity could still remain within the same firm. **Outsourcing**, by contrast, involves the externalization of a business activity to another firm or organization. Outsourcing may include offshoring when the external provider is located in a foreign country.

In this context, offshoring and outsourcing represent the organizational mechanisms through which global value chains are structured, allowing firms to fragment production internationally and to position themselves in those stages of the chain where higher value added can be generated.

The decision to offshore activities is not driven by a single factor but rather results from a multifaceted decision-making process. With the reduction of trade barriers and improvements in communication and technology, manufacturing activities have increasingly shifted from

[27] (Baldwin & Venables, 2013)

developed to developing countries, particularly to China and other Asian economies. However, not all types of activities have been outsourced: manufacturing tasks account for the largest share, while others—such as research and development or services—are still predominantly carried out in-house. A widely held assumption is that firms from developed countries tend to outsource lower-paid activities or tasks subject to less stringent regulations in developing countries. By doing so, companies can enhance profitability by reducing costs and by concentrating on core competencies that significantly increase the value added of the final product. This dynamic is formalized in the so-called "smile curve," according to which pre- and post-manufacturing activities generate relatively more value added than manufacturing itself compared to the past. A plausible explanation for this pattern is the increasing commoditization of production processes.[28] When activities are outsourced, the more standardized the product, the easier coordination becomes; therefore, lead firms are more likely to outsource production stages to third parties. Conversely, when products are more customized, coordination becomes more complex due to the higher number of variables to be managed, and firms may prefer to keep certain activities in-house. Nevertheless, there is no strict correlation between the complexity of operations and outsourcing decisions. In some cases, the establishment of close and trust-based relationships enables firms to cooperate effectively and facilitates more complex divisions of labour, allowing for greater interdependence.[29] Overall, there are both "centripetal forces" and "centrifugal forces" that, respectively, encourage the concentration or dispersion of activities.[30] Moreover, it is not always feasible for firms to acquire, learn, or develop all the capabilities required for

[28] (Baldwin & Ito, 2021)
[29] (Gereffi et al., 2005)
[30] (Baldwin & Venables, 2013)

production, as this may be difficult, time-consuming, and costly. Allocating resources across too many competencies and owning every single production asset does not necessarily enhance competitiveness. On the contrary, relying on complementary competences and external resources often leads to superior performance. For this reason, asset ownership has been substantially reduced, representing another key feature of GVCs, which are characterized by cross-border activities and production. Control and coordination can be achieved without direct ownership of activities and assets, thereby reducing fixed costs related to property. Coordination may take different forms and involve varying degrees of control over activities, resulting in different types of governance, ranging from vertically integrated hierarchical structures to loosely organized market-based arrangements, as will be discussed later.[31] Within GVCs, the involvement of multiple actors sharing intermediate goods and products gives rise to production networks. The way these networks are structured affects inter-firm relationships as well as the geographical location of production activities. Researchers have identified two main configurations of global production networks: **"spider" and "snake"**. The "spider" configuration occurs when multiple components originating from different locations are assembled or combined in a single place, resulting in value being added at once. By contrast, the "snake" configuration refers to a sequential process in which the good is produced by adding components step by step, with value being added at each stage. In practice, production networks are often more complex than these two ideal types and may combine elements of both configurations, giving rise to the so-called "sniker".[32]

[31] (Gereffi et al., 2005)
[32] (Jones et al., 2019)

With the rise of global value chains, the dispersed stages of the value chain, scattered across different countries, require accurate coordination in order to ensure the effectiveness of business activities.

In their article, (McWilliam et al., 2020) define GVC governance as the organization and control of a GVC. Organization refers to the structure and characteristics of the relationships among firms participating in the chain, while control relates to the power exerted by lead firms or by institutional and market forces that shape and influence firms' operations. In simple terms, governance can be described as "the process by which economic activity is coordinated across the various nodes of a value chain". [33] Similarly, (Humphrey & Schmitz, 2002)refer to governance as the coordination of economic activities through non-market relationships. There is no single way to coordinate activities, and specific combinations of organization and control give rise to distinct types of governance. For this reason, the literature has devoted significant attention to classifying and identifying governance modes, also in order to derive analytical implications and economic consequences.[34]

One of the most influential classifications in the literature is provided by Gereffi, who developed governance frameworks for both Global Commodity Chains (GCCs) and Global Value Chains (GVCs).[35]

(Gereffi, 1994) defined governance as "authority and power relationships that determine how financial, material, and human resources are allocated and flow within a chain". Within the global commodity chain approach, Gereffi formulated a governance framework focused on power relationships among actors within the value chain. This framework is

[33] (MAHUTGA, 2012)
[34] (McWilliam et al., 2020)
[35] (MAHUTGA, 2012); (Jones et al., 2019)

industry-specific, meaning that industries are classified as either buyer-driven or producer-driven, each characterized by a lead firm positioned at a specific point in the chain. **Buyer-driven** commodity chains are typical of non-durable, labour-intensive industries, such as apparel, footwear, and toys. In these chains, the lead firm specializes in activities such as design, marketing, and retailing of the final product, while it is not directly involved in manufacturing, yet in deciding where to decentralize the production, and lead firms are typically large retailers or brand-name companies. By contrast, **producer-driven** commodity chains are typical of durable, capital-intensive industries, such as automotive, computers, and aircraft. In these chains, the lead firm is usually a multinational enterprise or an integrated industrial firm, whose core activity is manufacturing and which exercises control over actors along both backward and forward linkages. This does not imply, however, that producer-driven firms are not involved in activities such as R&D, marketing, and design, which remain fundamental for innovation and the development of products and processes.[36]

However, as previously mentioned, this approach is strongly industry-influenced, implying that the same governance pattern tends to emerge across value chains within the same industry. This assumption is unlikely to hold universally, which explains why an industry-neutral approach proves particularly useful.

In 2005, within the GVC perspective, Gereffi et al. introduced a new governance framework by expanding the traditional governance modes identified in international trade—namely market and hierarchy. These two represent extreme and opposing forms of governance, yet they are part of a

[36] Ividem

broader spectrum of intermediate arrangements. Gereffi's framework is built around three key variables: (1) the complexity of transactions, (2) the codifiability of information, and (3) the capabilities of suppliers. The specific combination of these variables determines the resulting governance pattern. The complexity of transactions refers to the degree of difficulty involved in carrying out operations and the level of knowledge required, for instance in the case of highly customized products or time-sensitive production processes. Firms may nevertheless reduce transaction complexity by introducing standards or technical specifications. Together with the ability to effectively transmit such information, this determines the degree of codifiability. However, not all operations can be easily standardized. When information can be codified and shared with partners in the chain—such as suppliers or customers outside firm boundaries—it becomes possible to establish modular networks, in which information is exchanged without explicit pricing for it, even though interactions may resemble market-based relations. The third variable concerns the capabilities of suppliers, namely the extent to which they possess the skills and knowledge required to perform specific tasks independently. Based on the characterization of these three variables, the value chain tends to assume a particular form of governance. Each variable can take only two values—high or low—leading to eight theoretical combinations. For analytical consistency, however, only five governance types are identified within the framework, as shown in **Figure 2**: market, modular, relational, captive, and hierarchical (vertically integrated). [37]

[37] (Gereffi et al., 2005)

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

Figure 2: source Gereffi et. al (2005)

Market governance is the traditional form governing relationships between firms in the context of international trade. Transaction complexity is low and this governance type typically applies to highly standardized products that are easy to produce. For this reason, codifiability is high, as standards can be easily defined and specifications are not particularly demanding, allowing suppliers to meet requirements with limited complexity. In this governance mode, relationships between buyers and suppliers are arm's length and primarily price-based; consequently, suppliers are easily replaceable when better price conditions emerge. In other words, switching costs for both parties are low. Market governance therefore requires limited coordination, as interactions are based on repeated and relatively unchanged transactions. **Modular governance** characterizes inter-firm relationships in which transaction complexity is high, typically associated with products that exhibit a certain degree of differentiation. This complexity is managed through the formulation of technical standards, which simplify interactions between firms. Suppliers receive detailed specifications regarding product and process requirements, resulting in flows of information and knowledge that create inter-firm linkages and a degree of implicit coordination and control. However, because information is largely codified and coordination needs remain limited, switching costs for suppliers are relatively low, allowing firms to substitute one supplier for another. Modular governance thus represents a form of coordination based solely on codified information

flows. **Relational governance** is typical of inter-firm relationships characterized by strong interaction based on trust, reputation, and mutual dependence. Transaction complexity is high due to the sophisticated nature of products or processes, and the associated knowledge cannot be easily codified. At the same time, suppliers possess high levels of competence and are able to provide complementary capabilities to lead firms. This results in a form of mutual dependence between buyers and suppliers, sustained through reputation, trust, social or cultural proximity, and continuous interaction. As a consequence, a high degree of coordination is required, and switching costs are high, implying greater effort in managing and maintaining these relationships effectively. **Captive governance** can be seen as a variant of modular governance in which supplier capabilities are relatively low. Also in this case, transaction complexity is high, but operations and processes can be codified and simplified through the development of standards. However, because suppliers are not fully capable of meeting specifications independently, lead firms must exert a high degree of control and coordination over production processes. Suppliers become highly dependent on the lead firm and often maintain exclusive relationships with it, resulting in high switching costs for suppliers. Accordingly, interactions are strongly governed by the lead firm, which provides resources and support to captive suppliers while limiting their ability or incentive to exit the relationship. **Hierarchical governance** refers to vertically integrated firms and is based on direct control and authority exercised by the entity responsible for decision-making. Transaction complexity is high and information cannot be effectively codified. Moreover, when capable suppliers are unavailable, firms are compelled to develop required capabilities and production processes internally. This governance form entails substantial investments and the allocation of significant resources to efficiently manage complex activities

within firm boundaries. As can be readily inferred, power is exerted differently across governance types. Strong power asymmetries characterize hierarchical value chains, where top management issues directives to offshore facilities, as well as captive value chains, in which lead firms exert tight control over suppliers. At the opposite end of the spectrum, market and modular governance structures are associated with relatively low power asymmetry, as firms interact with partners that can be easily replaced. The most balanced configuration emerges in relational value chains, where both parties engage in continuous interaction and exchange valuable information. In general, power is closely linked to coordination: where power is greatest, coordination is also strongest, reaching its maximum in hierarchical governance and being almost absent in market-based relationships. Visually, Gereffi provides also a graphic representation as shown in **Figure 3**. [38]

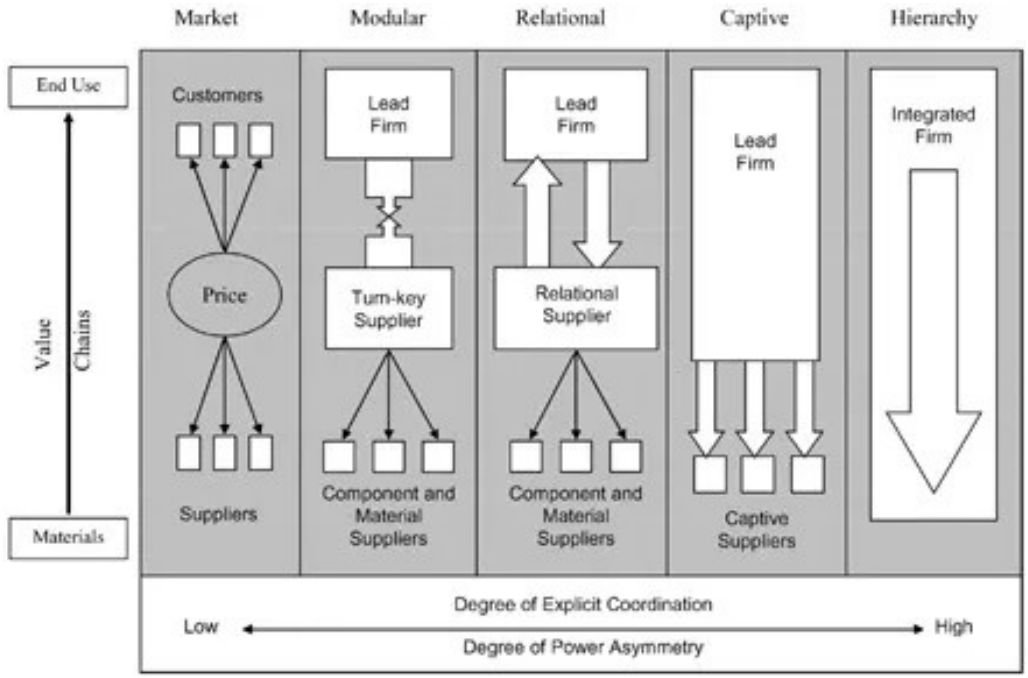

Figure 3: source Gereffi et. al (2005)

[38] (Gereffi et al., 2005)

The three variables are able to explain a large share of value chain dynamics; however, value chains are neither static nor fixed. Consequently, governance patterns cannot be rigidly fall into just these five types. A given value chain may shift from one governance form to another as transaction complexity, codifiability of information, or supplier capabilities change. For instance, when firms pursue innovation, transaction complexity tends to increase, and newly generated knowledge may initially be difficult to codify. Similarly, supplier capabilities may prove insufficient when new technologies or production requirements are introduced. Moreover, there is no single governance pattern that applies uniformly across all industries. Instead, governance structures vary according to several factors, including the type of knowledge required, the level of innovation, the technologies employed, supplier capabilities, institutional support, the power held by value chain actors, the degree of production fragmentation, economic competitiveness, financial investments, and regulatory frameworks. Each of these parameters influences industry evolution and shapes distinct value chain dynamics. In recent decades, the modular form of governance has increased its presence in the global economy, as standards have progressively improved and supplier capabilities have expanded, enabling more fluid value chains and lower coordination costs. By contrast, relational governance, although more balanced in terms of power distribution, requires high coordination capabilities and may be less suitable for the extensive production fragmentation observed in recent decades. Overall, each governance form entails specific advantages and risks, particularly in relation to outsourcing and fragmentation. None of these governance types represents a universally optimal solution; rather, each global value chain must consider the prevailing conditions and relevant variables in order to identify the governance structure that best aligns with firm objectives. In some cases, for example, a

hierarchical approach may be the most effective in enhancing competitiveness for particular products. [39]

Nevertheless, according to (MAHUTGA, 2012), neither the GCC nor the GVC governance frameworks fully achieve the objective of explaining global value chain governance, as such a framework should be able to "explain how lead firms determine which activities to exclude from within their formal boundaries, and where to locate externalized activities globally." In his analysis, the GCC framework helps explain the expansion of manufacturing in the Global South, particularly in labour-intensive industries. This dynamic is associated with buyer-driven chains, in which lead firms outsource production to offshore locations characterized by lower entry barriers. In this sense, MAHUTGA argues that the GVC governance approach does not predict "which types of linkages are more likely to diffuse to the global South" and does not sufficiently emphasize the central role of the lead firm. In practice, lead firms play a crucial role in managing and organizing the entire chain, as emphasized in GCC theory, where they decide which activities to externalize and where to locate them. As a result, the lead firm is regarded as the primary driver of value creation and distribution, an aspect that the GVC governance approach does not fully capture. The make-or-buy dilemma is therefore fundamental for firms, both in terms of value creation and the broader economic development implications associated with outsourcing decisions. Accordingly, a firm qualifies as a lead firm when it is able to decide which stages, activities, or tasks to retain within its organizational boundaries and which to externalize, as well as to whom these externalized activities are entrusted. The fragmentation of value chains across borders has highlighted the uneven distribution of manufacturing capabilities

[39] Ividem

between the Global North and the Global South. In this context, the **height of entry barriers** to manufacturing plays a crucial role, as it is determined by factors such as labour skills, capital requirements, compliance with standards, and related constraints. Given that buyer-driven chains are typical of labour-intensive industries, they generally do not require high investments in advanced technological facilities. As a result, entry barriers to manufacturing are relatively low, leading firms to externalize production. Offshoring production is convenient primarily due to lower costs, even though suppliers located in the lead firm's home country—usually in the Global North—may initially possess higher capabilities. By starting with activities characterized by low entry barriers, suppliers can gradually upgrade their capabilities and subsequently become able to perform more complex tasks that they were initially unable to undertake. [40]

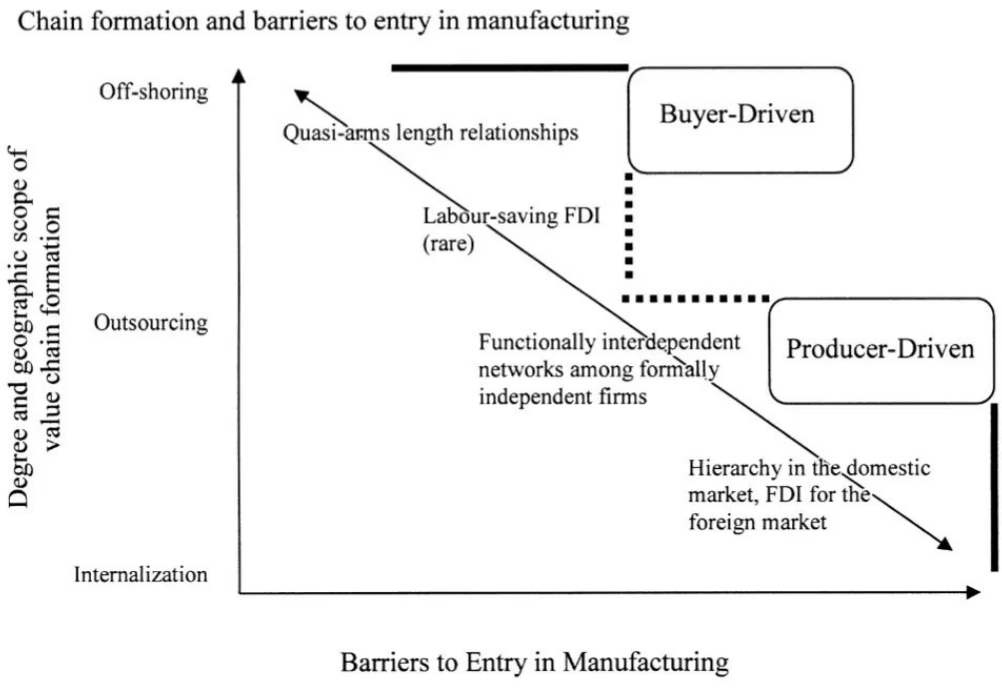

Figure 4: source Mahutga (2012)

[40] (MAHUTGA, 2012)

When the **entry barriers** to manufacturing are **highest**, the lead firm has little incentive to outsource production and instead tends to internalize manufacturing activities in order to better serve local consumers. Alternatively, production may also be carried out in foreign markets through foreign direct investment (FDI). This scenario is relatively less common and typically corresponds to producer-driven chains, which are usually dominated by multinational corporations. When entry barriers to manufacturing are higher than intermediate, several firms possessing adequate capabilities engage with one another and operate in a functionally interdependent manner, while remaining formally independent. When entry barriers to manufacturing are lower than intermediate, the lead firm may decide to undertake FDI to produce abroad and subsequently import goods either to the home market or to other foreign markets. When the **entry barriers** to manufacturing are **lowest**, the lead firm has strong incentives to outsource production to offshore locations. In this case, the lead firm focuses on its core activities and provides only basic product specifications that suppliers are required to meet, such as size, quality, design, and standard requirements, without extensive mutual interaction. This configuration characterizes a large share of global value chains and is typical of buyer-driven chains. By linking the concept of entry barriers to Gereffi's governance typology, different scenarios can be identified. First, when **entry barriers are low**, transactions tend to be relatively simple and highly standardized, making codification straightforward. Given the low complexity of operations, both Northern and Southern suppliers are generally capable of performing the required tasks. Consequently, lead firms tend to choose suppliers located in the Global South in order to reduce production costs, thereby offshoring manufacturing activities. Second, when **entry barriers are high**, operations are more complex and demanding. In this case, suppliers located in the Global North

are typically more capable of carrying out such activities, leading lead firms either to internalize production or to outsource to local suppliers. The first scenario, characterized by low complexity and high supplier capabilities, is associated primarily with market governance and, in some cases, modular governance. In these cases, operations are outsourced to offshore locations and inter-firm relationships are largely driven by cost considerations. The second scenario, characterized by high complexity, is associated with modular and relational governance when supplier capabilities are high, with production activities predominantly located in the Global North. Conversely, when supplier capabilities are low, this scenario corresponds to hierarchical and captive governance structures, in which operations are more likely to be located offshore in the Global South, often through FDI. Overall, this combination of theoretical perspectives allows for a more precise formulation of the spatialization of global value chains. It highlights how supplier capabilities across the North–South divide constitute a key determinant of the degree of offshoring, and how the geographical location of activities—whether in the Global North or the Global South—shapes the type of linkages governing inter-firm interactions.[41]

Table 2: GVC types by GCC types across the North–South divide

		Global value chain categories according to location of potential supplier	
		Global North	**Global South**
Global commodity chains dichotomy	**Producer driven**: High entry barriers to manufacturing	Modular, Relational	Captive, Hierarchy (FDI is most likely)
	Buyer driven: Low entry barriers to manufacturing	Unlikely	Quasi-Market/ Modular

Figure 5: source Mahutga (2012)

[41] Ividem

Companies continuously strive to enhance their capabilities and are therefore constantly required to make decisions aimed at improving efficiency and performance, with the ultimate objective of increasing their competitiveness in the market. Within the literature, the process of innovation related to products, operations, and activities is referred to as ***upgrading***. As reported by (Humphrey & Schmitz, 2002), upgrading is necessary in order to maintain stable incomes or achieve income growth. To this end, firms are required to regularly "increase the skill content of their activities or move into market niches excluded from pressures". A crucial role in this process is played by the governance structure adopted by firms. As previously discussed, governance acts as a key driver of knowledge sharing, thereby facilitating the transfer of capabilities, valuable resources, expertise, and experience that enable improvements in the performance of all actors involved in the value chain. While governance can foster innovation and upgrading, it may also inhibit or fail to encourage upgrading among other nodes of the chain. Upgrading within global value chains specifically considers inter-firm relationships with the external environment, in contrast to upgrading in industrial clusters, which primarily focuses on linkages within a local industrial context. In this perspective, upgrading opportunities are not evenly distributed across firms, but are strongly influenced by the governance structure of the global value chain. Different governance modes shape the extent to which knowledge, capabilities, and strategic functions are transferred or retained by lead firms, thereby affecting the possibility for suppliers to engage in upgrading processes. In this framework, global buyers provide important feedback regarding which aspects of production processes

should be modified and how quality standards can be achieved. The literature identifies four main types of upgrading[42]:

1. **Product upgrading**, which involves improving product features, quality, and functionality, or introducing innovations that result in more sophisticated products. This may also include targeting new market segments or introducing new product lines.
2. **Process upgrading**, which refers to improving production processes by increasing efficiency, optimizing resource flows, better allocating competences, reorganizing tasks and workflows, and developing or acquiring new technologies.
3. **Functional upgrading**, which entails enhancing the organizational structure of the firm by creating new functions or improving the allocation of resources among existing ones.
4. **Inter-sectoral upgrading**, which consists of leveraging existing capabilities to enter new markets, for example by producing new types of products.

The feasibility of each upgrading trajectory depends largely on the governance mode of the value chain. Market and modular governance structures tend to facilitate process and product upgrading, as codified information and standardized requirements allow suppliers to improve efficiency and quality. By contrast, functional upgrading is more difficult to achieve in captive and hierarchical chains, where lead firms often retain higher-value functions and limit suppliers' access to strategic knowledge. Relational governance, based on trust and intensive interaction, offers the

[42] (Humphrey & Schmitz, 2002)

greatest potential for more advanced forms of upgrading, including functional and inter-sectoral upgrading. [43]

Generally speaking, process and functional upgrading are primarily associated with improvements in productivity, whereas product and inter-sectoral upgrading are related to vertical and horizontal movements along the value chain, respectively.[44]

The consequences of global value chains are multifaceted. Hyper-specialization and long-term inter-firm relationships have enhanced firm performance and facilitated the diffusion of knowledge, thereby increasing productivity and income growth at the country level. These outcomes stem from a deeper division of labour and broader access to inputs. Such effects are particularly pronounced in GVCs characterized by network-based structures, as in the case of relational governance. Overall, GVCs generate impacts at multiple levels, most notably at the social, macroeconomic, and environmental levels. By increasing income and fostering economic growth, GVCs can contribute to the reduction of poverty and unemployment. However, the gains generated are not evenly distributed across countries or within them, particularly between capital and labour, skilled and unskilled workers, and male and female workers. This uneven distribution contributes to wage inequality across income levels. Moreover, many workers are employed informally and therefore lack social protection or receive lower wages than formally employed counterparts. Poor working conditions—such as unsafe environments, excessive working hours, and violations of labour standards—are especially prevalent in labour-intensive manufacturing activities in developing countries, where labour costs and regulatory

[43] Ividem
[44] (Jones et al., 2019)

requirements are relatively low and firms are therefore more inclined to locate production. Women, in particular, tend to be disproportionately affected by these conditions. Outsourcing has enabled large corporations to increase their markups by exploiting lower labour and input costs. At the same time, in some value chains, knowledge transfer remains limited, thereby constraining innovation and preventing firms from fully exploiting growth opportunities. Furthermore, the geographical fragmentation of activities, combined with a highly integrated global economic system, has created challenges for national tax systems, as firms may take advantage of cross-country differences in taxation by shifting operations to lower-tax jurisdictions. At the macroeconomic level, the increasing interconnectedness and integration of the global economy have heightened countries' exposure to external shocks, even when these originate in distant regions. As a result, inflationary dynamics tend to become more synchronized across countries. In this context, political measures such as protectionism are likely to have more severe negative effects on the global economy than in the past. Conversely, trade agreements and trade liberalization can promote international exchange and support a more efficient allocation of resources across countries. Environmental consequences of GVCs encompass both negative and positive effects. On the one hand, the expansion of economic activity at the global level has increased demand for inputs and natural resources, accelerating the depletion of finite global reserves. Rising levels of consumption have also led to the generation of excessive amounts of waste, often exceeding existing waste management capacities. Moreover, the spatial dispersion of production activities requires extensive transportation and shipping, thereby increasing greenhouse gas emissions. These effects are particularly pronounced when production is relocated to countries with less stringent environmental regulations, where activities may generate higher levels of pollution and

hazardous waste, causing significant environmental damage. On the other hand, these concerns may be offset or cut down by the positive effects of GVCs related to knowledge diffusion and innovation. Technological progress fostered within GVCs can enable waste reduction, more efficient resource use, lower emissions, and the design of more environmentally friendly products.[45]

Since their initial phase, global value chains have grown continuously and at an accelerating pace. Their expansion has also reached developing countries, enabling higher growth rates compared to the past. Most firms entered already existing GVCs, which facilitated this rapid expansion by allowing them to specialize in specific tasks and activities, thereby increasing the overall competitiveness of markets. Prior to 2008, the share of firms participating in GVCs reached its peak, accounting for approximately 52 percent of global trade. However, the 2008 financial crisis marked a turning point and led to a slowdown in GVC growth, as illustrated in **Figure 6**. The underlying reasons for this deceleration are complex and multifaceted. For instance, China has increasingly expanded its domestic economy, reducing its dependence on foreign suppliers. In addition, the financial crisis generated uncertainty, resulting in a contraction of foreign direct investment and a decline in investor confidence. More recently, the pattern of GVC development has begun to change. The emergence of new, and particularly disruptive, technologies is reshaping the opportunities for achieving efficiency gains in production processes, thereby establishing a new equilibrium that challenges previous assumptions. Technologies such as 3D printing and artificial intelligence are creating new market paradigms by reducing the reliance on large labour forces, lowering production costs, and

[45] (*World Development Report 2020: Trading for Development in the Age of Global Value Chains*, 2020)

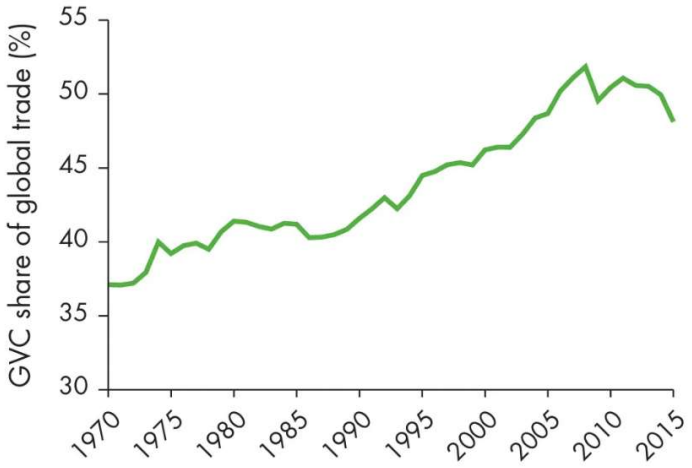

Figure 6: source World Development Report 2020: Trading for Development in the Age of Global Value Chains, 2020

diminishing the need to relocate manufacturing to low-cost countries. This technological transformation is not the only factor influencing GVCs. Risks associated with climate change are also reshaping how firms organize production and structure their value chains. Moreover, growing ethical concerns and increasingly stringent standards are requiring firms to adopt more responsible and attentive business practices.[46] As a consequence of these transformations, firms are increasingly reassessing the geographical organization of their value chains. Rather than pursuing further fragmentation on a global scale, companies are progressively considering strategies aimed at relocating or shortening parts of production. This trend has contributed to the growing relevance of reshoring and nearshoring practices, through which firms bring activities back to the home country or relocate them to geographically closer regions. These strategies are not necessarily in contrast with the global value chain framework, but rather represent an adaptation to new technological, environmental, and geopolitical constraints. In this sense,

[46] Ividem

GVCs are not disappearing; instead, they are undergoing a process of reconfiguration toward more regionalized and resilient structures.

2.1.2 GVCs dynamics

As introduced in the previous paragraph, the growth of Global Value Chains has not been constant over time; in recent years, in particular, a slowdown has been observed. After the Great Recession, the typical functioning of GVCs has been affected by emerging trends that have altered some of their distinguishing and predominant features. Firms operating on a global scale are resorting less to offshoring and are increasingly implementing new strategies aimed at enhancing their resilience to shocks.[47]

It has often been argued that the world economy is experiencing a phase of de-globalization, in which firms that were previously embedded in dense international production networks are reducing the geographical dispersion of their activities and relocating them to their country of origin. Conversely, as argued by (Antràs, 2020b), there is no clear evidence of an actual de-globalization process; rather, the current phase can be described as slowbalization, referring to a slowdown in the growth rate of globalization rather than a reversal of it. A combination of factors has contributed to this slackening of the world economy, particularly with regard to the global production system. In the past, the presence of trade organizations and international agreements fostered cooperation among countries and facilitated the cross-border movement of goods. In the current context, however, there appears to be less willingness to pursue the same path of trade liberalization and multilateral openness.

While trade liberalization and openness have historically supported the expansion of globalization, recent years have witnessed a partial reversal of this trend, with major economies adopting more protectionist policies aimed

[47] (De Backer & Flaig, 2017)

at safeguarding domestic production, thereby increasing trade costs, as in the case of the United States. Higher trade barriers raise costs for importers and, consequently, reduce domestic demand for foreign products.[48]

Protectionist measures may also be interpreted as a response to rising wage inequality associated with the large-scale relocation of production to emerging economies offering cost advantages. This dynamic has led to a concentration of low-skilled employment in manufacturing facilities abroad, contributing to job losses and higher unemployment in the domestic economy. Since the 1990s, China—more than other emerging economies—has significantly increased its economic, technological, and innovative capabilities, progressively narrowing the gap with advanced countries. Its growing competitiveness and ability to supply a wide range of products at comparatively low prices have strengthened its position in the global economy. From an economic perspective, China's rise has challenged the longstanding leadership of the United States. In response, the United States has adopted a more protectionist stance and intensified its trade tensions with China.[49] As already mentioned, China has progressively eroded a significant share of global manufacturing activities. In the decades following the 1980s and 1990s, it became the primary destination for production relocation. As a result, the workforce expanded considerably and, particularly in labour-intensive industries, both labour productivity and wages increased. The rise in average income levels in countries that were previously highly underdeveloped contributed to the expansion of the middle class, thereby stimulating domestic demand for consumer goods and other products. This dynamic supported further growth in production and GDP. Consequently, for

[48] Ividem
[49] (Antràs, 2020b)

many firms, China and similar economies are no longer as attractive as low-cost offshoring locations; instead, they have become central actors reshaping the global economic balance.

Another factor that may discourage excessive fragmentation is the presence of substantial transportation costs, especially when goods are shipped over long distances and multiple times, as is typical in highly fragmented production systems.[50] Similarly, organizing a global value chain across geographically distant locations entails fixed costs for firms, which tend to increase with greater distance between nodes. These costs are often sunk, as they relate to relationship-specific physical assets or capital that cannot be easily redeployed. Investments in reputational capital represent a clear example of how global value chain relationships can become "sticky."[51]

Globalization has made the world more interconnected, interdependent, and, at the same time, more vulnerable. The dispersed configuration of production networks and the high degree of fragmentation of value chain stages increase the need for coordination and precision, making the system more sensitive even to minor disruptions.[52] When these elements are considered together, the overall level of criticality rises, generating new challenges. In this context, one relevant phenomenon is the **ripple effect**, which occurs when a disruptive event triggers consequences that propagate widely across the network. The ripple effect should not be confused with the bullwhip effect. The former arises when a disruption is not confined to a single stage of the supply chain but spreads downstream, affecting multiple nodes. The longer the disruption persists, the more stages are involved,

[50] (De Backer & Flaig, 2017)
[51] (Antràs, 2020b)
[52] (Smorodinskaya et al., 2021)

potentially leading to severe production stoppages. The bullwhip effect, by contrast, refers to demand and supply fluctuations caused by uncertainty and operational variability. These effects are generally more contained and can be addressed without fundamentally compromising the overall structure of the chain. Recent events, most notably the COVID-19 pandemic, have drawn significant attention to the vulnerability of GVCs, given the extensive consequences experienced worldwide. The health crisis abruptly halted production activities, slowed consumption, and disrupted the global economy. Such a disruption revealed that modern and highly efficient production systems may not always represent "the best choice," as they often lack the flexibility required to respond promptly to sudden shocks. For example, while a "just-in-time" system is highly efficient under stable conditions, it proves less suitable in the presence of delays and supply inconsistencies.[53] [54]

More broadly, geopolitical uncertainty, political risks, cybersecurity threats, natural disasters, climate change, and pandemics all pose significant challenges to the stability of value chains. These risks become particularly critical when they are unpredictable. Consequently, firms are increasingly required to rethink and reorganize how activities are structured and geographically distributed within global networks in order to mitigate undesirable effects. This implies revising the underlying logic and principles guiding production and adopting long-term objectives that prioritize economic sustainability and resilience, rather than focusing solely on short-term profitability.[55] [56]

[53] (Miroudot, 2020)
[54] (Smorodinskaya et al., 2021)
[55] (De Backer & Flaig, 2017)
[56] (Miroudot, 2020)

The rise and development of new technologies represent another key factor potentially driving the paradigm shift currently observed in the context of global value chains. As technological change continues to transform society and remains in constant evolution, researchers are increasingly investigating both the positive and negative implications of the adoption of different technologies across industries. This new wave of innovation primarily concerns information technologies, rather than communication technologies, which previously fuelled hyperglobalization.[57] It includes automation through robotics and advanced machinery, 3D printing, digital platforms, the Internet of Things, Big Data, machine learning, Cloud computing, Blockchain, and Artificial Intelligence.[58]

Collectively, these technologies are commonly referred to as Industry 4.0 and have been progressively adopted by firms, permeating virtually every aspect of business activity. Automation and robotics enhance production processes by increasing efficiency and optimization, while enabling the manufacture of more sophisticated and highly customized products tailored to specific customer requirements. The Internet of Things facilitates the monitoring of production processes, improving organization, traceability, coordination, and control, particularly in areas such as inventory management and logistics. 3D printing and additive manufacturing allow for further product customization, while machine learning, supported by Big Data, refines market analysis and helps identify and satisfy emerging customer needs. These examples illustrate only a fraction of the broad range of possible applications. The effects of Industry 4.0 are ambivalent, as they depend both

[57] (De Backer & Flaig, 2017)
[58] (Antràs, 2020b)

on how these technologies are implemented and on the structural transformations they induce. Several key implications can be identified.[59]

First, automation enables firms to perform more complex operations at lower cost while achieving higher quality standards, even in developed countries. This reduces the need to import intermediate goods from abroad. Second, for similar reasons, production fragmentation aimed at exploiting low labour costs in developing countries becomes less attractive. Moreover, technological adoption reduces the overall demand for labour. As a consequence, wage inequality may intensify, as low-skilled jobs are displaced while demand increases for high-skilled workers in both developed and emerging economies. At the same time, emerging economies such as China, Indonesia, and Thailand are investing heavily in digital technologies, progressively narrowing the competitiveness gap with advanced countries. The adoption of these technologies enhances efficiency and flexibility by reducing waste and production time. However, such investments require substantial financial resources and high fixed costs, meaning that only a limited number of well-established firms are able to implement them fully. This dynamic may further increase disparities and contribute to market concentration. Finally, technologies such as the Internet of Things and Artificial Intelligence enhance transparency along value chains—for example, by allowing consumers to trace the sourcing of primary inputs—thereby strengthening firms' reputation and reliability. However, the extensive collection of user and customer data also raises significant privacy concerns and risks of opportunistic behaviour. This creates new challenges for

[59] (Ancarani et al., 2019)

regulators and policymakers, who must ensure fair competition and the proper protection of personal data. [60] [61] [62]

As discussed in the previous paragraph, the high fragmentation of activities and increasing product diversification have intensified the production and global movement of goods. As a result, greenhouse gas emissions, waste generation, natural resource depletion, and biodiversity loss have significantly increased. Freight transport alone accounts for approximately 30% of CO_2 emissions generated by the transport sector and around 7% of total global emissions. [63] Furthermore, due to production fragmentation, the decisions and strategic choices made by lead firms in developed countries also affect activities carried out in developing countries by firms embedded in the same network.[64]

Societies are increasingly witnessing the environmental consequences of such an intensive and insufficiently regulated production system, raising concerns about the sustainability of the prevailing economic model. Consumers, and society more broadly, are demanding more responsible behaviour from companies, calling for greater transparency in areas such as input sourcing, waste management, use of materials and natural resources, energy consumption and sourcing, product design, as well as health and labour conditions. Individuals are able to influence corporate conduct, as their purchasing decisions ultimately shape firms' strategic choices, including product design and production methods. In this sense, consumers represent a primary source of pressure toward more responsible business practices.

[60] (Antràs, 2020b)
[61] (De Backer & Flaig, 2017)
[62] (Ancarani et al., 2019)
[63] (De Backer & Flaig, 2017)
[64] (Kogg & Mont, 2012)

Sustainability has therefore become a strategic priority for a growing number of firms, which are implementing new measures and procedures, as well as for governments and industry associations that are introducing standards and regulations to guide corporate behaviour. Companies are increasingly required to invest in innovative solutions capable of transforming production systems and products in ways that reduce their environmental and social impact. However, innovation in the field of sustainability is not always easy or feasible for every firm or industry. Criticisms of sustainability practices often highlight the high costs involved, potential reductions in profitability, internal organizational resistance, and practical constraints. For instance, certain sustainable solutions may not be applicable to specific products where strict standards related to health, safety, or durability must be maintained. Moreover, meaningful and systemic change is more likely to occur when the lead firm is able to influence or coordinate the entire value chain, making closer collaboration and reorganization among involved actors necessary. The practices and solutions adopted are typically aligned with the objectives and strategies defined within a company's Corporate Social Responsibility framework, whose strategic relevance continues to grow. Such actions are not limited to the lead firm alone but are increasingly extended to the entire value chain in order to make it more environmentally sustainable.[65] [66]

Corporate Social Responsibility is a relatively recent concept and is defined as "the responsibility of entreprises for their impacts on society." It entails the incorporation of "social, environmental, ethical, and human rights, as well as consumers concerns into the core business practices."[67]

[65] (De Backer & Flaig, 2017)
[66] (Kogg & Mont, 2012)
[67] (Gereffi & Lee, 2016)

A more comprehensive and transformative approach to sustainability is represented by the circular economy. Unlike the linear economic model—based on a "take, make and dispose" logic—the circular economy does not rely on the extraction of virgin resources from the environment but instead emphasizes the reuse of existing materials. Its ultimate objective is not waste generation but the reintegration of materials into the production cycle through maintenance, reuse, refurbishment, remanufacturing, recycling, and composting.[68] It aims to establish a closed-loop system capable of preserving, rather than degrading, the external environment. Implementing such a system requires a profound transformation within firms, as it implies redesigning the way businesses create and capture value.[69]

All these factors above are reshaping the organization of global value chains and influencing the strategies companies adopt to maintain stable performance over time. As previously discussed, the ripple effect can generate widespread and cascading disruptions, potentially leading to production stoppages.[70]

In the long term, firms aim to strengthen resilience and robustness in order to withstand shocks that may undermine performance. Although often used interchangeably, resilience and robustness refer to distinct organizational capabilities. (Miroudot, 2020) defines **resilience** as "the ability to return to normal operations over an acceptable period of time, post-disruption," whereas **robustness** is defined as "the ability to maintain operations during a crisis." The distinction clearly implies different strategic approaches. While robustness may be preferable, as it enables firms to

[68] https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
[69] https://www.ellenmacarthurfoundation.org/articles/circular-business-models-rethinking-how-value-is-created
[70] (Smorodinskaya et al., 2021)

continue operating during disruptions, it typically entails higher costs related to maintenance and risk monitoring. Consequently, some firms opt to prioritize resilience, ensuring recovery after a disruption rather than full operational continuity during it. Another difference lies in the scope of risk management: resilience focuses primarily on reducing exposure to risks, whereas robustness also involves anticipating potential threats in order to prevent severe consequences. One commonly adopted strategy is **diversification**, which involves distributing value chain stages across multiple countries. At the same time, empirical evidence suggests that establishing long-term relationships with partners is associated with faster recovery from disruptions.[71]

Another important strategy is **redundancy**, which often includes diversification and multiple sourcing of inputs. Rather than prioritizing inventory minimization and short-term profitability, firms facing uncertainty may choose to invest in buffers and backup options to strengthen long-term resilience. In practical terms, building resilience requires the implementation of both proactive and reactive strategies—measures adopted before and after a disruption occurs. These include reshoring strategies (encompassing both nearshoring and backshoring), relocation and regionalization of activities, increased operational flexibility, and the adoption of digital technologies.[72] Geography of production therefore plays a crucial role, but so do information sharing and supply chain visibility. Given the inherent complexity of production networks, the objective is not necessarily to simplify them, but

[71] (Miroudot, 2020)
[72] (Smorodinskaya et al., 2021)

rather to develop the tools and capabilities required to manage such complexity effectively and mitigate potential negative effects.[73]

Reshoring is one of the strategies currently reshaping the dynamics within GVCs. It is generally conceived as the opposite of offshoring, which has traditionally been more suitable for routinized activities, standardized products, and modular production structures. However, contemporary markets are characterized by increasing product differentiation, with consumers demanding more specific features and personalized customization. At the same time, mass consumerism entails a higher frequency of transactions and shorter product life cycles. As a consequence, firms are required to respond more rapidly to changing customer needs and preferences. Greater responsiveness often relies on locating production facilities closer to end markets, thereby enhancing geographical proximity between production and consumption. (Ancarani et al., 2019) distinguish between **nearshoring** and **backshoring**. The former refers to the relocation of activities to countries geographically close to the home country, whereas the latter indicates the relocation of previously offshored activities back to the firm's home country.

The technological dynamics discussed above, particularly those related to digitalization and automation, may favor production closer to headquarters, thereby reducing the attractiveness of offshoring. Since automation enables firms to offset part of the labour cost advantages previously associated with foreign locations, lead firms may decide to backshore specific stages of the value chain. Similar considerations apply to technologies such as 3D printing. Nevertheless, the relationship between technological change and reshoring is not entirely straightforward in the literature. Evidence also shows that some

[73] (Miroudot, 2020)

manufacturing activities continue to be relocated to emerging economies that have not yet experienced significant wage convergence. Furthermore, firms incur substantial fixed costs when establishing production facilities in a given location. These investments are often sunk, which limits the feasibility of relocating activities even when alternative locations might appear more attractive. Similar considerations apply in the presence of shocks and disruptions, as well as changes in political or regulatory frameworks (e.g., trade wars) or exposure to local natural hazards.[74] [75] Another related strategy is **relocation**, understood as the change of suppliers in search of more suitable partners. Firms may adopt this approach to identify suppliers that comply with higher environmental and social standards, thereby aligning production with evolving consumer preferences. [76] The literature does not suggest that domestic production or shorter supply chains necessarily represent the optimal solution in all cases. Rather, the effectiveness of such strategies depends on industry characteristics and the specific requirements firms must address.[77] Closely related is the concept of **regionalization**, which refers to the reconfiguration of supply chain nodes in a way that reduces their geographical dispersion, resulting in a more spatially concentrated production network.[78]

[74] (Antràs, 2020b)
[75] (De Backer & Flaig, 2017)
[76] (Kogg & Mont, 2012)
[77] (Miroudot, 2020)
[78] (Smorodinskaya et al., 2021)

2.1.3 Value chains orchestration in the perspective of Circular Economy

As explained in the previous paragraph, one variable of change within the Global Value Chain is represented by sustainability, fostered by environmental and social concerns. In this sense, circular economy represents the most radical approach to reverse the course the earth is heading in.[79] The Circular economy concept has its roots in 1990 from the studies of Pearce and Turner, who emphasized the possibility for waste to not remain as such.[80] Circular economy emerges from the push to limit resources consumption and environmental-related problems, because it looks differently at the resources and materials use, compare to the linear economy. It encompasses a new perspective that close material flows through "reduce, reuse and recycle" loop (or so-called 3Rs). However, to be really effective, efforts towards circularity could not be isolated but requires a systemic approach that involves design, development, manufacturing, servicing use and recycle.[81] In another words, circularity "is a property of a system".[82] This means that the commitment of a single business is not sufficient to bring a real change, instead a joint collaboration of several business can achieve transformation toward circular economy paradigm.[83] Transformation requires innovation, and specifically regarding the business model, the product and ecosystem.[84] Transformation, to be meaningful, implies to rethink and revise the business model. A change in the business model of a single business requires changes at all nodes of value chain, which would otherwise be inconsistent and result in futile efforts.[85] It means also to haul the value proposition, therefore how value is

[79] (Parida et al., 2019)
[80] (Pearce & Turner, 1991)
[81] (Parida et al., 2019)
[82] (Konietzko et al., 2020)
[83] (Parida et al., 2019)
[84] (Konietzko et al., 2020)
[85] (Parida et al., 2019)

created, delivered and captured. And lastly, it means to innovate products, making new ones or finding new markets.[86] This mutual commitment toward a circular transition leads to the formation of an industrial ecosystem with companies taking part of it.[87] However, the organization of an ecosystem is not an easy task, and requires greater capabilities than traditional ones, in order to be able to a implement circular practices, and because they involve interactions with a wider range of stakeholders, to which are associated higher costs. Besides coordination-related costs, other are associated with the implementation of innovative solutions that require some disruptive technologies, but also assuming greater risks and responsibilities, the definition of a shared vision, the objectives and interests alignment and a clear definition of roles and tasks.[88] The circular nature of the process does not preclude the generation of profits. Conversely, the implementation of a circular business model entails the execution of activities that yield profits in a sustainable manner. The distinction lies in the approach: rather than prioritizing personal business interests over societal and environmental concerns, a more balanced and inclusive stance is adopted, aligning with these interests. [89] Moreover, two additional features are unique of a circular ecosystem, compared to a linear one, namely, it need to be restorative and regenerative, which entails "*preserves and enhances natural environment conditions reducing the finite resources use and incrementing the renewable sources*".[90]

Within literature, Trevisan et al. (2022) identified the lack of comprehensive definition of what a circular ecosystem might be, they

[86] (Konietzko et al., 2020)
[87] (Jensen et al., 2024)
[88] (Parida et al., 2019)
[89] (Zucchella & Previtali, 2019)
[90] (Ellen MacArthur Foundation, 2015)

criticized previous studies which attempted and failied. Trevisan et al. (2022) says that circular ecosystem is "*a system of interdependent and heterogeneous actors that go beyond industrial boundaries and direct the collective efforts towards a circular value proposition, providing opportunities for economic and environmental sustainability".* This definition encompasses two characteristics, not correctly acknowledged in the literature, namely, the interdependence between actors, which is clearly essential when it comes to ecosystems, and heterogeneity, from which thrives innovation by merging diverse perspective, yet at the same time posing challenges to alignment.[91]

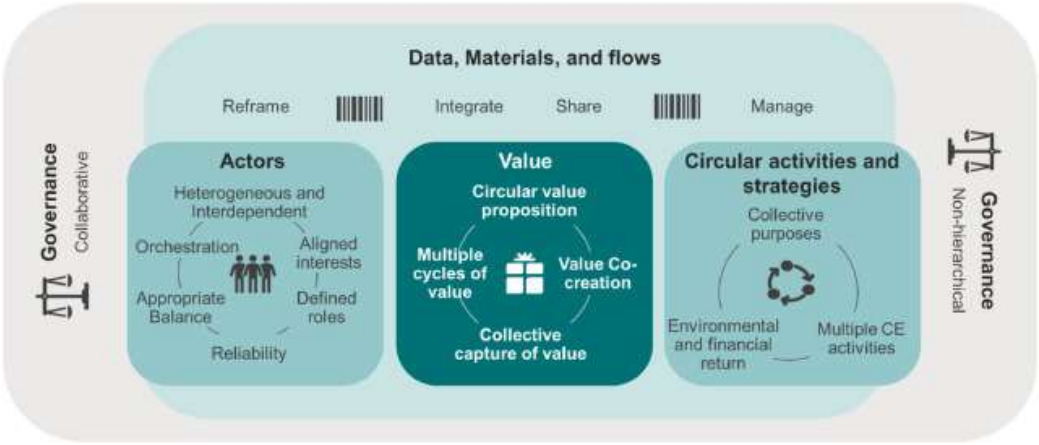

Figure 7: Source Trevisan et al (2022)

Trevisan et al. (2022) proposed a framework with the objective of providing an optimal configuration for a circular ecosystem, one that incorporate all the fundamental components as showed in **Figure 7**.

These **elements** are value, actors, data materials and flows, circular activities and strategies and governance.

1. **Value**: contains concepts as circular value proposition, value co-creation, collective capture of value, multiple circle of value. The

[91] (Trevisan et al., 2022)

whole ecosystem revolves around its value, it maintains actors committed and engaged.[92]

2. **Actors**: they are external firms or entities outside the focal business which cooperate together and allow to achieve circularity since it can be reached only through collective efforts. For this reason, the selection of partners cannot fall upon anyone, but must be conducted following precise principles that enable collaboration and the fulfilment of established objectives.[93] The types of actors differs according to the industry, but generally speaking they are suppliers and customers, associations and institution, research center and universities, third-part and service companies.[94] In this way circularity innovations can permeate every aspect and it is not restricted to a business operations. This is a peculiarity that emphasizes heterogeneity among members, which sometimes leads to conflicts.[95] Along with interdependence and heterogeneity, partners should be joined by the definition of aligned interests, reliability, role and responsibilities, appropriate balanced. All these properties together are orchestrated by the focal company, whose role is crucial to support all the structure.[96]

3. **Data, materials and flows**: concerns the set of all kinds of resources that flow around the ecosystem. With technological development, data integration can support the existence of the ecosystem, data generated by technology can give accurate insights for new circular

[92] (Trevisan et al., 2022); (Konietzko et al., 2020)
[93] (Trevisan et al., 2022)
[94] (Zucchella & Previtali, 2019); (Jensen et al., 2024)
[95] (Zucchella & Previtali, 2019)
[96] (Trevisan et al., 2022)

improvements. Another aspect of data is sharing, because the exchange of resources and knowledge enriches capabilities of involved parts. Overall, the orchestrator shall rethink at how the resources are managed, to convey more value co-creation.

4. **Circular activities and strategies**: not only the final product is thought as circular, but all activities have to be aligned with circular principles, from all actors of the ecosystem. The strategies are based on collective purposes, as ecosystem works on shared vision and purposes.

5. **Governance**: determines pattern of coordination and control by the orchestrator, as well as the distribution of value created among participants. As Trevisan et al. (2022) reports, it is better to have a non-hierarchical and collaborative governance, as power should be distributed equally and not detained by one organization. The ecosystem can be governed through formal contracts and agreements, as well as informal mechanisms that are established by means of cultural socialization, communication and trust. [97] The circular ecosystem allows for more flexibility, therefore actors have more autonomy. Still the orchestrator might enforce rules and standard to follow.[98]

As mentioned, a key role is played by the orchestrator, which is usually embodied by a large manufacturing company[99], however other studies, like Zucchella & Previtali (2019), have demonstrated that also small or medium enterprises can greatly fit the position if specific managerial and leadership

[97] (Zucchella & Previtali, 2019)
[98] (Trevisan et al., 2022)
[99] (Parida et al., 2019)

skills are owned. What makes the difference is not just the resource availability by the focal company, which is greater in case of a large one, but the singular attitude and transformational leadership, which comprises competencies, resources, ability and power capable of guiding the entire ecosystem. The focal company is not external to the ecosystem but at the center of the circular network, as it literally acts as a binding force and serves as an intermediary. Despite the centrality of the focal company, the presence of the actors remains essential. Otherwise, the ecosystem would be unable to survive, given that its functionality depends on network presence. The orchestrator is called as such for its role of establishing the ecosystem, deciding other participants and organizing them, setting rules and coordination mechanisms.[100] It mediated diverse points of view so that to foster collaboration, build trust and encourage participation. Furthermore, it needs to define a common vision and objectives to which everyone should agree upon, therefore everyone heads in the same direction. At the same time, it enforces the rules and oversee the adherence by the partners. It is called to provide institutional stability, imposing sanctions or imposing sanctions or excluding partners not respecting the rules.[101] The ecosystem goes through several stages, from its conception to its maintenance and renewal. To distinguish more clearly, throughout all the phases, the orchestrator put into action different mechanisms to involve and foster members participation.[102] Members are chosen by the focal company not by chance but following a specific methodology, first assessing if there are right conditions to start an ecosystem or if there are gaps that hinder its development. It allows the lead company to deepen into the readiness of the ecosystem in order to evaluate

[100] (Zucchella & Previtali, 2019)
[101] (Parida et al., 2019)
[102](Jensen et al., 2024)

which strategies to apply. Secondly, the relationships established are governed by coordination mechanisms.[103]

Parida et al. (2019) distinguishes three types of orchestration mechanisms: standardization, nurturing and negotiation. **Standardization** mechanisms regard formulation of standards and requirements to follow. **Nurturing** mechanisms regard activities aimed at fostering collaboration and involvement of participants so that there is more willingness towards innovation. This might involve baring early investment to support companies with limited resources; development of new routines to give more practical competencies to partners (e.g. cost calculation support, managing portfolios, configure product, etc); openness toward sharing core knowledge to accelerate development of circular business models. **Negotiation** mechanisms regard alignment across partners as heterogeneity might leads to conflicts. This might involve reducing conflicts through relational interdependence; setting rules of game based on give-and-take to stimulate one another; including new partners to meet new requirements.

MANCA 2.1.4 + FOOD REVIEW (?)

[103] (Parida et al., 2019)

3 METHODOLOGY

The previous chapter set forth the background and literature framework concerning the more general concept of global value chain, from the emergence to its latest structural changes and, then, the importance of an ecosystematic approach when implementing a circular business.

The rise in GHG emissions resulting from increased industrial activity is linked to population growth and related consumption trends, which have driven up demand for various goods, including food. Consequently, the food industry has also expanded, contributing significantly to environmental impact. The food industry alone accounts for one-third of total emissions. This is largely attributable to crop production and other activities within the supply chain.[104] The growing concerns over this has led companies to increase decarbonization interventions to reduce the environmental impact of their activities. However, within the research landscape most of the studies probe into the shipping sector and energy sector [105] and lack for instance in the fashion and food industry, both of which are among the most polluting industries in the world. It justifies the subject of analysis in this thesis, opting for food industry, since it accounts for a significant portion of emissions (fashion accounts for 10% of global carbon emissions[106]).

For this reason, this thesis wants to address the following research question: "**How food industry's value chains implement decarbonization and circular economy into their business?**".

The aim is to investigate the concrete measures businesses have taken to reduce the environmental impact of their activities along the value chain,

[104] (Sharma et al., 2024)
[105] Ibidem
[106] (Li et al., 2024)

identifying the factors that encourage companies to make the transition and, at the same time, the reasons—or, more accurately, the constraints—that prevent companies from implementing these measures more rapidly.

More broadly, within the context of the circular economy, the research aims at investigating whether the company approaches decarbonization in a systemic manner, involving the entire value chain rather than implementing isolated changes. As explained in the previous chapter, this involves not only the lead company but also the relationships it maintains with actors upstream and downstream the chain.

3.1 Research strategy

In order to address the research question, a **qualitative study** was conducted, as it is more appropriate to investigate phenomena in depth, thereby identifying nuances and richer reasons to occurrences, rather than performing statistical and numerical analyses. Of all the approaches considered in the qualitative study, **general inquiry** was selected as the approach to developing the research question. In contrast to grounded theory, general inquiry does not generate theories based on collected data. At most, it enables a more thorough and extensive examination of human behavior and current trends. It provides methods like narrative inquiry, historical inquiry and case study. For the purpose of this study, **multiple case study** has been considered as a suitable option to pursue, in order to investigate drivers and barriers and implemented practices regarding decarbonization. Moreover, the multiple case study approach enables the analysis of a single case in isolation as well as its comparison with other, albeit different, cases. This facilitates the understanding of how the same objective can be achieved through the use

of different strategies.[107] In our case, the aim is to examine how the same decarbonization goal is developed and effectively pursued within different companies that, although operating in the same sector, produce different goods and consequently have different impacts.

3.2 Data collection techniques

There are several techniques useful to collect proper data, such as in-depth interviews, focus group, observation and archival. In order to gather a substantial amount of data, the research draws on **existing documents**, which make it possible to track the initiatives undertaken by companies in recent years. This method was chosen because, when compared with other equally valid methods, it avoids biases that could influence the results. For example, interviews provide direct and clear answers that are therefore more easily comparable, but at the same time, the answers depend on the interviewee's honesty and memory, with the risk of overlooking important details.[108] As sustained by Bowen (2009), document analysis is not often used in qualitative research; instead, researchers tend to prefer alternative methods, such as interviews, which, however, allow for greater researcher involvement.

3.3 Data sampling

The qualitative analysis was conducted on **sustainability reports** published by companies in the food industry. This constitutes the reference population for the sample. Due to the large population, some criteria were applied to narrow down the company selection. To achieve a more comprehensive perspective, two types of companies were chosen to represent different tiers of the supply chain. This will allow us to assess whether different types of companies have different decarbonization patterns. The

[107] (Lim, 2025)
[108] Ibidem.

sampling frame therefore refers to (1) lead manufacturing companies in the food industry that are directly involved in producing the final good and (2) lead firms in the food retail sector. To select specific companies and, consequently, their reports**, purposive sampling** was employed, which allows the scope to be narrowed to elements that best address the research question. Furthermore, compared to probability sampling techniques, purposive sampling is more suitable in cases where the sample size is relatively small.[109] Additional criteria were established to narrow the sample and ensure comparability among the sources. The selected companies were chosen from the Italian market, meaning those that sell their products primarily in Italy. The companies had to have published a sustainability report in the 2023–2024 timeframe, applying GRI and/or ESRS standards. Furthermore, the selected companies could not be those that were founded with circularity as their core and founding strategy, but rather those that have undergone a transformation over the years to reduce the environmental impact of their operations. Consecutively, the reports were retrieved from the companies' official websites, and after verifying that they met the established criteria, they were selected. The final sample was selected in accordance with the aforementioned criteria, albeit without analyzing them beforehand, in order to avoid the selection of companies that have outperformed their peers.

[109] (Rai & Thapa, 2015)

As a final sample, three companies for manufacturing sector, and three for retail sector has been analysed, as reported in **Table 1**.

Table 1: source Author

Company type	Company name	Issue date of the report
Retailer	Esselunga	2023
	Conad	2024
	Eurospin	2024
Manufacturer	Icam	2024
	Alce Nero	2024
	Valsoia	2024

3.4 Data analysis

The collected reports were reviewed and analyzed to answer the research question. A **thematic analysis** was performed. This method allows information to be grouped and aggregated into previously identified patterns. Thematic analysis serves as a method for understanding the significance of experiences, viewpoints, or belief systems, all viewed through the perspective of a specific conceptual or theoretical framework. As Lochmiller (2021) stated, this method can be seen as a question-driven exercise, in which questions drive and lead to interpretation of data. Therefore, thematic analysis aims at evaluating how reported information addresses the research question.[110] To categorize and compare the reports, the concepts and terms from the literature review were used to create categories that addressed various aspects in an organized manner. The identified categories are as follows: the importance of circularity for the business; the key players

[110] (Lochmiller, 2021)

involved; the coordination of partners along the supply chain; business models; greenhouse gas (GHG) emissions; decarbonization measures; technology and data; circular key performance indicators (KPIs); drivers and barriers. In more detail, each area is accompanied by a question. The reports were analyzed by identifying information relevant to the inquiry (See APPENDIX A) and correlated results are reported in the next chapter. The results are grouped according to company type. First, the research question is addressed for Icam, Alce Nero, and Valsoia. Second, the research question is addressed for Esselunga, Conad, and Eurospin. This approach allows for a comparison within two groups.

Subsequently, in order to present the findings in a concise manner, the categories were further grouped into broader themes, as composed and illustrated in the following **Table 2**:

Table 2: Source Author

Theme	**Categories**
Circularity integration into Business model	Business model
	Circularity importance
Value chain governance & Orchestration	Main players
	Partners coordination
Tackle decarbonization & Circularity	GHG emissions
	Decarbonization measures
	Circular KPIs
Technology & Data	Technology and data
Drivers & Barriers	Drivers and barriers

3.5 Validity and limitations

As credibility refers to truthfulness of findings related to investigated phenomena, since the Sustainability reports are published by the company on online company websites, are therefore considered as valid. In addition, the content of the reports is prepared following with specific standards, namely the GRI and ESRS, which entail precise guidelines for disclosing information. For this reason, findings are referred exclusively from the collected reports.

However, this qualitative research comes with its own limitations. Firstly, in contrast to alternative approaches, general inquiry is inherently open-ended, which introduces the potential for ambiguity or the influence of personal biases associated with the researcher's individual perceptions. The process of document analysis necessitates the presence of substantial data, which may prove challenging to summarize concisely. Moreover, it may not fully capture the study scope.

4 FINDINGS

To the best of my knowledge, here are reported all the findings deriving from the thematic analysis, previously described in the methodology chapter. As mentioned earlier, the results are grouped and presented by topic, following a logical order that makes it easier to understand, compare, and read the information. As for the purpose of the study, our research question concerns “How food industry’s value chains implement decarbonization and circular economy into their business?”. In other words, the following inquiry is posed: what strategies or mechanisms have companies implemented to pursue a circular and decarbonization path? The inquiry extends to the identification of potential barriers or drivers that might impede the realization of this objective.

4.1 Circularity integration into Business Model Manufacturers

For **Alce Nero** Circularity is embedded with the business. It is part of Materiality Evaluation. Sustainability strategy and business model are paired together. Circularity represents a pillar of environmental sphere.

It is the only one manufacturer that explicitly gives a visual representation of the business model. The business model can be seen as a structure that integrate together input sources, activities and process, and outcome. The value creation is given by the realization of the so-called single brand, enabled by farmers and processors who believed in biological as a means. In fact, all products are biological. The growers and the processors are also shareholder members, which are remunerated fairly and part of the governance. The final product is a co-creation between farmers and processors and Alce Nero, who collaborate and together own and produce the final good.

For **Valsoia** Circularity is not among materiality topics, but just taken into consideration among the impact, risks and opportunity evaluation (so-called IRO). Within environmental section of the report, there is a sub-section dedicated to circularity and related interventions. Valsoia doesn't own any Circular policy or Circular explicit mention in the business model or business strategy.

For Valsoia the value creation passes through the transformation of input into output. Valsoia has a brief scheme of its business model, composed by elements like brand image and reputation; leadership perceived quality; International expansion; M&A; Product innovation and business system innovation; internal and external operational efficiency. As core activity Valsoia produces plant-based products, which are healthy, functional, nutritionally balanced and tasty.

For **Icam**, Circularity is within the materiality topics, as a main impact generated, not as a main pillar as in for Alce Nero. The company has rather a more general and strong approach to sustainability, without mentioning circularity as a core pillar, even though is an intrinsic characteristic of business operations. It speaks about a sustainability governance that should include also suppliers, customers, financial sector, institutions and third sector.

Icam business model is based on the realization of three business lines, each one aiming at a different target, namely own-brand product for the end consumers, products for the professionals and industry market, products being private label for large retailers. One peculiar characteristic of its business model is vertical integration, i.e. to oversee the entire process chain, from the planting to finished product, without involving intermediaries. This

high degree of vertical integration is due to the company's international strategy and approach.

Retailers

For **Conad**, Circularity is not explicitly mentioned within double materiality, even if the business strategy is strongly influenced by sustainability. Nevertheless, circularity is mainly related to the efficient management of waste and food surpluses.

It is one of the largest cooperative company in Italy, Conad's business model is based on a cooperative approach, comprising member-entrepreneurs—the retailers who manage the stores; the cooperatives, which assist the members by providing administrative and logistical support within their respective geographical areas; and the consortium, which serves as the general management of the Conad system. A key driver of value is the Conad private label, integrated with an omnichannel strategy that enables Conad to provide a wide range of services to the end consumer.

For **Esselunga**, circularity importance is very similar to the one of Conad. The business is focused on sustainability, but circularity is primarily mentioned in relation to packaging and the reduction of waste and resource use. It falls under one of the material environmental topic.

Esselunga describes itself as a "food company" as well as a retailer, thanks to the inclusion of its own products—made directly by Esselunga—in its product lineup (such as baked goods and pastries, fresh pasta, etc.). Esselunga's business model is based on offering high-quality goods at affordable prices, with quality and freshness guaranteed through centralized procurement, production, and logistics. Another value-creating activity is the

continuous innovation of products and services and—similar to Conad—the development of a multi-channel approach.

For **Eurospin**, Circularity is not explicitly mentioned in the material topics. The report does not contain a single word beginning with “circolar-” (the report is in Italian). The report does not contain a single word beginning with “circular-” (the report is in Italian), although it can be inferred that the term “circularity” refers here primarily to the management of packaging and food waste.

The business model is based on the idea of a “smart grocery” (Spesa Intelligente), offering quality goods at the most affordable prices possible. Eurospin achieves this by actively participating in product design and working with manufacturers to establish safety and quality standards. The business is built on four pillars: Italian heritage, private label products, a wide selection, and quick shopping.

4.2 Value Chain Governance & Orchestration

Generally speaking, the players upstream and downstream for company type are very similar. Same goes for the stakeholders. Each company engage with them in different ways, through surveys, focus groups, investigations, etc; to get to know stakeholders’ opinion on products quality, services and improvements area of the company.

Manufacturers

It is interesting that in this sample we encounter three different manufacturing companies, with very different coordination mechanisms of the actors distributed along the supply chain.

For **Alce Nero**, Agribusiness members (10 major members who are both owners and producers), other suppliers of goods and agri-food products, transportation service providers, testing laboratories, and Fairtrade Italia. End consumers, large-scale retailers, retail stores, e-commerce channels, wholesalers and distributors, advertising agencies. The stakeholders are financial institutions and business partners, farmers and suppliers, partners, end consumers and clients, employees, social media and influencer, universities and research centers, local community, public institutions, future generations.

As mentioned before in the business model, Alce Nero strictly collaborates with its partners, which are at the same time shareholders and farmers and producers of raw materials. The relationships are based on a system of collaboration, where strategic decisions are decided by all members. The other partners relationships are built in a strong and lasting manner. Alce Nero declared that it is still elaborating specific protocols for the evaluation of environmental and social aspects of suppliers along the chain. So far, it has "Codice di condotta per i fornitori", principles and codes of conduct that suppliers need to attain. It is based on integrity, human rights and environmental responsibility. Moreover, the products are co-created and elaborated together with suppliers in their standards and specifications, through a solid relation based on trust. Alce Nero also reported the reciprocal share of knowledge that flows with the partners (from one side productive and technological know-how, and from the other standard and quality specifications). For this reason, Alce nero outlined guidelines that direct cooperation according to principles. Specific requirements and procedures have been defined for the selection of new suppliers and control plans. Alce Nero opts for Fairtrade-certificated products of foreign origin.

Since Alce Nero is not directly involved in agricultural production, it invests resources and collaborates with research institutes to keep and reduce environmental impact of agricultural activities, still maintaining high the products quality. It has also adopted a monitoring system for agricultural sites linked to the main supply chains to assess the main impacts on soil, water and biodiversity. It is involved in a project research on biodiversity, together with Scuola Superiore Sant'Anna and involving also suppliers to track data and valuable information along the supply chain. The company has promoted the establishment of the two Bio-Districts, in collaboration with other local stakeholders, to foster the development of local communities and their agricultural biodiversity. In collaboration with other organizations, it has created a technology transfer ecosystem focused on natural resources integrated with the circular economy and agriculture.

Valsoia provides a visual representation of the production process, highlighting both in-house and outsourced activities. The main players in the supply chain include soy and oat suppliers, distributors specialized in frozen and fresh products, and retailers, HoReCa channel and e-commerce.

Valsoia is more specific when it comes to addressing stakeholders, because it highlights as such also industrial and commercial partners (i.e. co-packer and distributors), institutions like ENSA, UNIONE ITALIANA FOOD ROMA, Italia del Gusto, environmental agencies like ARPA, universities.

Valsoia declared that it establishes strong and lasting relationships with its suppliers, however it has no formalized regulations concerning environmental or ethical standards for partners audit. Selection of suppliers is based on traditional market-based conditions like quality, price, delivery

efficiency. It takes care of relations with logistics and distributors, since it is outsourced to third party. However, it is not mentioned a tight collaboration with all these actors. There is an-going evaluation with a selected partner on carbon footprint of plant-based beverages. However, the evaluation relates a "cradle-to-grave" approach. Moreover, it has fostered new partnerships with universities regarding the use of okara and byproducts in new applications.

For **Icam** upstream there are different players according to the primary source. For cocoa the main upstream players are farmers, cooperatives, local traders closer to growers), collecteurs. Cocoa is sourced across the world, in countries like Perù, Ecuador, Dominican Republic, Sierra Leone, Guinea, Togo, Nigeria, Camerun, Uganda, Sao Tomé, Madagascar. For diary and sugar, main players are farmers, cooperatives, and producers. Then for all primary sources traders and brokers are involved. Downstream the chain there are retailers, professional markets (bakeries and hotels).

Among the others, peculiar stakeholders are local governments, community authorities, farmer "leaders", private label customers, "Uganda" human resources, NGOs.

The Icam main coordination mechanism of actors along the supply chain consists of vertical integration, namely full and complete management of resources and work flows with the aim to select the best raw materials ever. This mechanism allows to create short supply chain and cooperate directly with farmers and growers of "more than 20 supply chains around the world". Total and direct control is what ensure high-quality cocoa and, therefore, final products. As for vertical integration, it establishes great and long-lasting cooperation with growing communities (local cooperatives) also to improve the quality of cocoa agriculture techniques and practices by providing them

technical skills and financial support. At the same time, Icam supports improvements in growers economic conditions by increasing their income because it is accountable also for remuneration of the very first tier of the supply chain. ICAM has established long-term partnerships with its main supply sources, signing annual purchasing agreements with cocoa suppliers. Besides direct collaboration with growers, due to high cocoa-based products, Icam is called to collaborate with local and international traders who work closely with growers. It relies on carefully selected international intermediaries. Partners are chosen according to rigorous criteria of reliability, transparency and adherence to international regulations, with particular attention to environmental and social aspects, thus ensuring high standards throughout the production chain. ICAM's supplier evaluation and qualification process considers agreement to the Code of Ethics an essential prerequisite for establishing a business relationship and, since 2024, the Code has been enriched with social and environmental criteria to ensure an increasingly responsible supply chain. Moreover, for each other raw materials sourced, like sugar, milk and diary products, hazelnut, Icam needs to track and know directly the producers location and origin. ICAM has built a traceability system along the cocoa supply chain that leverages strong, long-standing relationships.

Retailers

Retailers companies have a very broad range of stakeholders, as well as players that are involved in the value chain, since they sell products brand from other companies, and then they either engage with other companies providing them goods destined for private label and/or produce internally with owned facilities and resources their products.

For **Conad** upstream players are SMEs that develop together with Conad its private labels. pallet pooling partners, logistics. Downstream there are the cooperatives and CIA cooperative, customers.

Conad reported briefly stakeholders' categories. They comprise local community and associations, tertiary sector, academic world, institutions and media.

Conad has established a network-based cooperation model (tree-like structure) consisting of a central coordinating body—the consortium—whose decisions are made in consultation with the five cooperatives spread across the territory, which in turn are composed of all the member-entrepreneurs who manage the retail stores. The coordination structure is based on a centralized warehouse and logistics system that enables rapid delivery to retailers and ensures product quality. Conad has established strong, long-lasting relationships with its suppliers, based on mutual trust, and has also involved them in the sustainability plan to which they have committed. Conad wants to support suppliers in their sustainability and ecological transition. By working together in a synergistic manner, Conad offer a wide range of high-quality products that are affordable and carefully monitored at every stage of the supply chain. Conad stands alongside its suppliers, offering practical tools, technical support, and opportunities for growth. It guides them in adopting innovative and sustainable practices. It is also part of companies network to establish new partnerships to enhance and implement sustainability practices. It collaborates also with clients to foster and achieve projects on local territories.

For **Esselunga**, since it is also food company, it entertains relations with farmers and raw materials suppliers, logistics. Downstream the company main players are customers, local communities, agencies.

Esselunga reported stakeholders' categories. These include also associations, institutions, social community, universities.

When it comes to producing its own products (such as fresh seafood, baked goods, pastries, and meat products), Esselunga oversees the entire production chain, from the careful selection of raw material suppliers to the management of the production departments responsible for manufacturing the goods, and the centralized logistics system that distributes the finished products to stores. Therefore, it is sort like of a vertical integration and control of the supply chain. Centralization of procurement, production and logistics allows to maintain the cold chain and the freshness of products at every stage. Esselunga engages also with stakeholders to share opinions on sustainability path and improvements areas. To manage its relationships with suppliers, the company has a code of ethics and conduct, as well as a supplier code of conduct. It collaborates extensively with universities to ensure the safety, quality, and health standards of its products.

For **Eurospin**, upstream players are represented by farmers, suppliers, logistics. Downstream there are consumers and clients, public institutions, local communities,

Eurospin is directly involved in product design, establishing safety criteria and specific features, selecting suppliers, and negotiating with them. Eurospin manages its relationships with suppliers in accordance with its code of ethics. Suppliers selection is based on traditional criteria, like quality, competencies, timeliness, fairness and ethics. It keeps solid and long-lasting

relationships, especially with private label suppliers. Eurospin also mentions its relationships with non-raw-material partners, such as transport companies, waste disposal firms, testing laboratories, maintenance contractors, and demolition and remediation contractors, for whom it establishes specific selection criteria.

4.3 Tackle Decarbonization & Circularity

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4.4 Technology and Data

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4.5 Drivers & Barriers

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5 CONCLUSIONS

5.1 Discussions

5.2 Limitations and Future research

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APPENDIX A

1. Importance of circularity for the business → How does circularity result important for the business and, more broadly, for the whole value chain?
2. Key players involved → Are indicated the main players, both upstream and downstream? Who are they? Are there also important stakeholders?
3. Coordination of partners along the supply chain → Is there any indication of how relationships along the value chain are coordinated?
4. Business models → What is the business model based on, and how is it structured? Is it explicitly described and explained, with a breakdown of the activities that create value along the value chain?
5. Greenhouse gas (GHG) emissions → Where greatest GHG emissions happens? Are all the emissions scope calculated?
6. Decarbonization measures → Which specific measures has the business implemented to reduce ghg emissions or increase circularity?
7. Technology and data → Which and how disruptive technologies — such as AI, blockchain, IoT, or 3D manufacturing — support decarbonization and circularity pathway? Is there any indication of how the data generated throughout the process is used?
8. Circular key performance indicators (KPIs) → Which KPIs are mentioned that track circularity and decarbonization progress?
9. Drivers and barriers → What are the main barriers that prevent a fuller transition toward circularity or decarbonization in the value chain — and what are the main drivers that push forward?