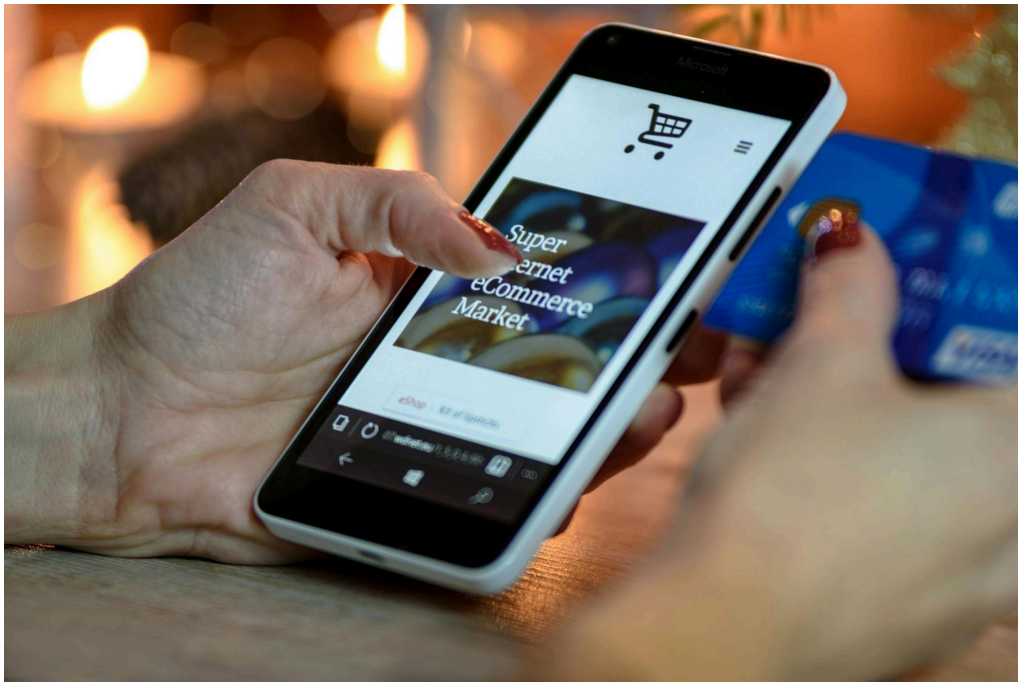


# Master's Thesis – Master Sustainable Business and Innovation

## Circular value chain changes in digital retail



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# Abstract

In recent years, the interplay of globalisation, sustainability, and digitalisation has significantly transformed the global value chain, particularly in the retail sector. This thesis investigates the environmental implications of online retail, focusing on the interactions between producers and consumers. By examining six prominent digital retailers—Bol.com, Amazon, Boohoo, ASOS, Coolblue, and Apple—this research aims to determine how these companies address the environmental impacts associated with digitalisation and whether their sustainability reports accurately reflect these impacts.

The literature review establishes a foundation by exploring the independent and collective effects of globalisation, sustainability, and digitalisation on business practices. It highlights the gap in existing research concerning the specific environmental impacts of digital retail and the effectiveness of corporate strategies in mitigating these impacts. The study employs a comprehensive Sustainable Performance Checklist (SPC) to assess the sustainability reports of the selected companies, followed by in-depth interviews with key stakeholders to contextualise the findings.

The results reveal significant variations in how companies manage and report their environmental impacts. While some companies demonstrate a strong commitment to sustainability through comprehensive reporting and proactive measures, others exhibit gaps in their approaches, particularly concerning the management of returns and attention to data centres. The study focuses on six identified problem areas of digitised retail: packaging, returns, transport, data centres energy use, digital devices production and digital devices disposal. It analyses the extent to which companies adhere to the PDCA to describe solutions for the six problem areas. The comparative analysis underscores the need for more stringent and transparent sustainability practices across the digital retail sector.

The discussion section delves into the theoretical implications of these findings, highlighting the need for integrating digitalisation into sustainability frameworks more effectively. Many companies do not utilise all the tools at their disposal in their sustainability reports such as ISO-14001, ISO-26000 and GRI. The discussion also addresses the limitations of the study, including the reliance on sustainability reports and the challenges of generalising findings across the diverse retail sector. Recommendations for future research include more information in sustainability reports on all the environmental impact of data centres and developing more standardised metrics for assessing corporate environmental performance.

In conclusion, this thesis emphasises the need for companies to adopt more comprehensive and transparent sustainability reports to mitigate the environmental impacts of their operations. By providing a detailed analysis of current practices and identifying areas for improvement, this research contributes to the broader discourse on sustainable business and innovation, offering valuable insights for academics, policymakers, and industry practitioners.

# 1. Introduction

In recent years, the global society has witnessed a deep transformation driven by three interwoven developments: globalisation (Gereffi, 2011), sustainability (MacDonald, 2005) and digitalisation (Alsufyani & Gill, 2022). The rise of globalisation has interconnected economies, cultures, and markets, creating a new era of interdependence. At the same time, a need for sustainable practices has emerged as societies grapple with the urgent need to address environmental challenges caused by human behaviour (MacDonald, 2005). Within these shifts, digitalisation has emerged as the catalyst that binds together sustainability and globalisation (Pavlidis, 2022). Circularity is one of the new sustainability strategies that can be used to implement major changes in the value chain dynamics (Reike et al., 2018). Circularity supports sustainability strategies by minimising waste, promoting resource efficiency, and reducing environmental impact through continuous material reuse and recycling (Stahel, 2013). However, over the past few decades the use of digitalisation in businesses has become increasingly apparent (Pavlidis, 2022). It has made digitalisation of circularity more common. This change has shifted the dynamics between final producers and consumers.

From the scope of global sustainability goals, this research zooms in to explore the changing interactions occurring between the final producer and consumer in digital retail compared to non-digital. The societal problem analysed in this study is that this changing dynamic has shifted the environmental impact. It is important to determine if the changing impact of digitalisation is correctly reflected in sustainability reports. There is emerging literature explaining the new environmental impacts from all three developments independently and collectively on the global value chain which is summarised in the literature review of this proposal. However, a notable gap in the literature persists. There lacks a more in-depth overview of all changed impacts of digital retail and what companies do to counteract them. More specifically, the impact that changed from digital retail due to the changing interactions between the final producer and the consumer. For example, there is no in-depth literature analysing the impact associated with returns in online retail. The existing academic literature forms a foundation of understanding, but further in-depth exploration is required.

This research aim is to determine the extent to which companies are knowledgeable and act on the different added impacts associated with digitalisation. To do this this research focuses on six fully digital or originally fully digital retail companies: Bol.com, Amazon, Boohoo, ASOS, Coolblue and Apple. With all this considered a research question and sub questions can be formulated:

- **What are the environmental implications of online retail, specifically examining the interactions between consumers and producers and how do companies deal with it?**
  - What are the most prominent sources of environmental impact change due to digitising retail?
  - How much effort do companies put in to counteract these environmental changes?
  - Do retail companies take all factors of the environmental impact of digitalisation into account when creating their sustainability reports?

- Are there significant differences between sectors?

Scientifically, the study delves into the dynamics of the global value chain, exploring how sustainability, globalisation, and digitalisation have individually and collectively influenced business practices and how the global value chain has shifted into a more digitised form. Changing interactions between final producer and consumer can have both positive and negative environmental effects. Assessing the overall impact of digitising the value chain on resource efficiency, waste reduction, and greenhouse gas emissions, while also considering potential drawbacks and unintended consequences is essential to accurately describe all the positive and negative effects of this transition. Furthermore, this research has societal relevance since it helps understand the new global value chain brought forth by the three developments. By understanding and proposing solutions for the changing interactions between final producers and consumers, the study seeks to inform and guide more sustainable business practices.

## 2. Literature review

### 2.1. Three major developments

The first major development over the past couple decades is the surge in globalisation of the value chain. Over the past few decades, globalisation has significantly influenced the way businesses operate, reshaping global production processes, supply chain dynamics, and sustainability considerations. Globalisation has come forth as a consequence of lower production costs in LIC's as well as weak regulation and enforcement in those countries (Feenstra & Hanson, 1996). This has enabled LIC's to avoid costly environmental measures that made them be able to sell at lower prices than local production. The emergence of globalisation implies the emergence of more complex global value chains, where various stages of production are distributed across different countries.

The second major development is the increasing importance of sustainability in decision-making (MacDonald & Gibson, 2005). Sustainability refers to the capacity to endure or maintain certain practices or behaviour over time. However, sustainability is a concept too broad to discuss in this paper. This paper therefore focuses on the circular economy (CE). CE helps reduce environmental impact by minimising waste and closing material loops (Yang et al., 2021).

The third major development in the past decades is the increasing use of digitalisation (Alsufyani & Gill, 2022). Digitalisation refers to the integration and adoption of digital technologies, data, and processes into various aspects of business and society (Wang et al., 2023). It involves utilising digital tools to make production more efficient, increase supply chain flexibility, and reduce errors. In the business context, digitalisation often encompasses the use of technologies such as the Internet of Things (IoT), artificial intelligence (AI), data analytics, and automation.

Existing literature, however, fails to provide a comprehensive analysis of the opportunities and risks of integrating digitalisation in the current value chain. Research on the so-called 'digital' or 'smart' circular economy has mostly focused on investigating the role of digital technologies as an enabler for circular strategies (Cagno et al., 2021) (Bressanelli et al., 2022). While most papers can be classified as empirical research, the impact they identify generally comes from cited literature or anecdotal evidence, and is rarely measured or quantified (Piscicelli, 2023). The impact of a digital circular economy is often only described at the firm or supply chain level, for example (Tang et al., 2022).

### 2.2. Connecting the three developments

The interconnectedness between sustainability, globalisation, and digitalisation can be observed through the evolution of value chains. Value chains were historically confined within national borders, globalisation has extended them to a global level (Gereffi et al., 2005). This has connected suppliers, manufacturers, and consumers across far-off regions that previously had little contact. Sustainability research recognized the environmental and social impacts of these extended chains and made sustainability governance essential to value chain management. The push for sustainable practices entails practices such as: responsible sourcing, eco-friendly production processes, and the reduction of carbon

footprints. If the world wants to transition towards a circular economy, where waste is minimised, the importance of sustainability within value chains needs to be intensified. Digitalisation can be used as a complementary asset to circularity, potentially transforming traditional value chains into data-driven networks. Digital value chains leverage technologies such as IoT, AI, and blockchain to enhance transparency, traceability, and efficiency (Piscicelli, 2023). This digital revolution not only helps in monitoring and optimising resource use but also enables the integration of sustainability into every stage of the value chain. However, this changing dynamic also changed the interactions between the final producer and consumer as well as the environmental impact. Due to products being bought online in the rise of digitalisation new environmental impacts are created along the value chain. Additional, e-waste generation, energy consumption, manufacturing impact are the most prominent examples of new environmental impacts caused by the use of digital technologies (Piscicelli, 2023). Furthermore, the transport and downgrading of products due to increasing returns is also cause for concern (Piscicelli, 2023). It should be noted that while digitalisation has the potential to bring about positive environmental impacts by enabling more efficient and sustainable practices, it can also contribute to environmental challenges in several ways. It is essential to recognize and address these potential negative environmental impacts to ensure that the benefits of digitalisation are actually worthwhile.

### 2.3. Circular value chains before digitalisation

Before the widespread adoption of sustainability practices in value chains, the focus was primarily on cost efficiency and speed, often neglecting environmental and social considerations (Reike et al., 2018). Linear and resource-intensive, traditional supply chains prioritised rapid production and disposal, contributing to excessive waste and pollution. Suppliers were selected primarily based on cost, with little emphasis on ethical or eco-friendly practices. The lack of transparency and accountability meant that environmental and social impacts were often overlooked as can be seen in Figure 1.



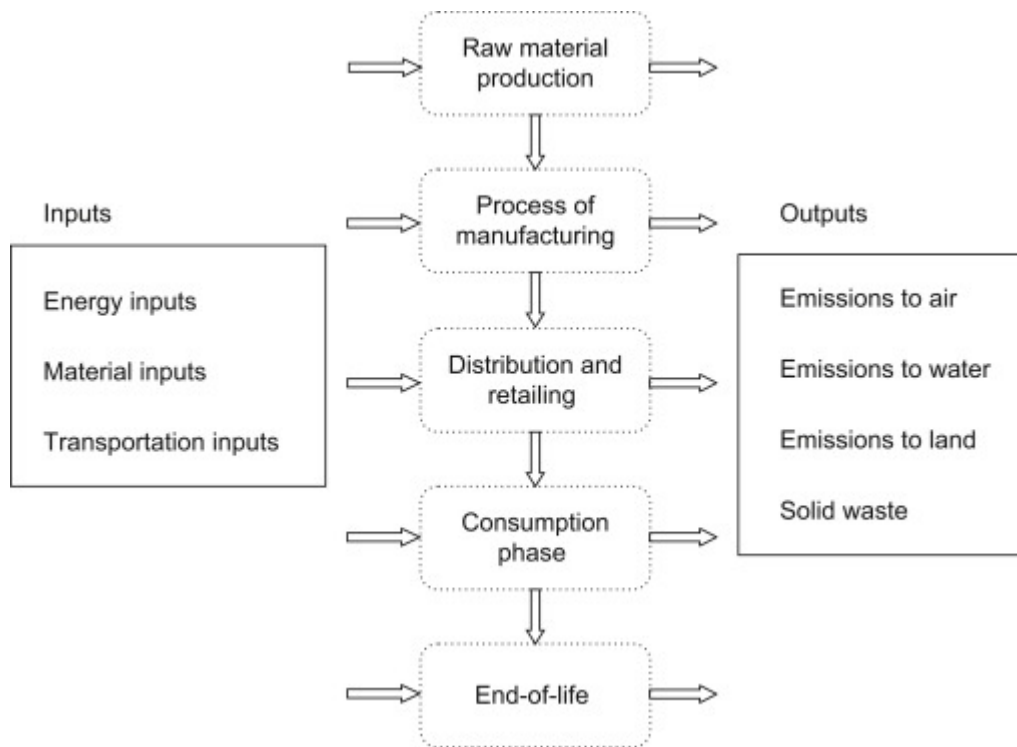


Figure 1. Generalised unit process flow diagram (Muthu, 2014)

However, the shift towards sustainability has transformed this model, connecting the various parts of the value chain as can be seen in Figure 2. This new model encourages businesses to adopt circular models, closing the loops and putting resources back into it avoiding waste and fostering a more responsible and environmentally conscious approach to supply chain management.

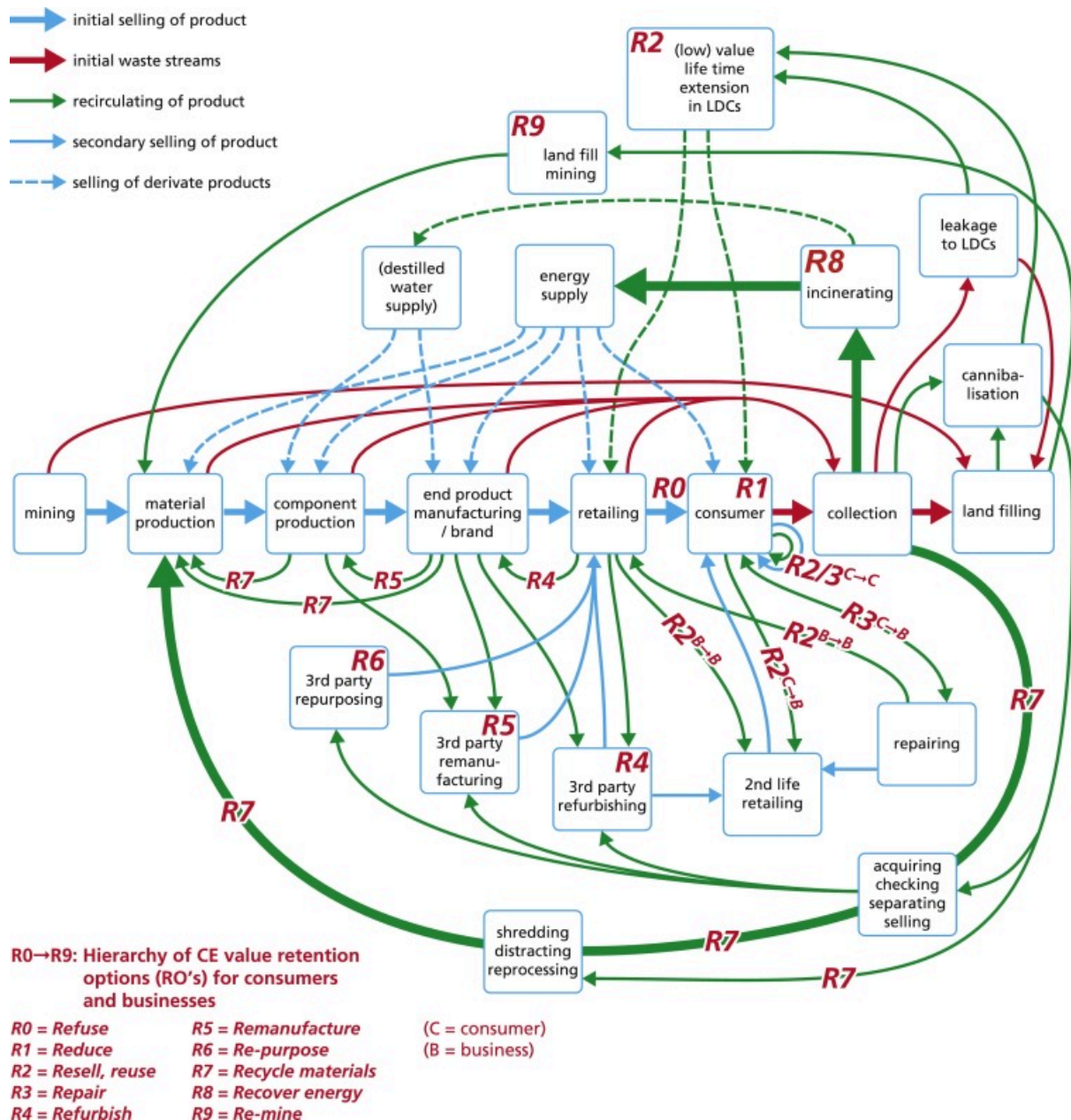


Figure 2. Circular Economy Retention Options (Reike et al., 2018)

One of the methods to evaluate the circularity of a product is to utilise the 10 R's (Figure 2) which can be used to identify the length of the loops involved when putting the product back into the value chain as well as their effectiveness. (Reike et al., 2018). These loops are categorised as short, medium or long loops depending on the part of the value chain the product is put back to (Stahel, 2013). The shorter the loop the more profitable and efficient in resource use. That means that there is a hierarchy regarding the circularity of goods: from reusing, repairing, remanufacturing to recycling. The selection of loops and the extent that they are used, is used as a grading tool to determine the effort of digital retail towards circularity.

## 2.4. Corporate sustainability management

Companies are complex entities, characterised by a dual nature that encompasses both physical and social dynamics according to Vermeulen and Witjes (2016).

One tool commonly used to comprehend these physical dynamics is Life Cycle Assessment (LCA). LCA provides a structured approach to evaluating the environmental impacts associated with a product, process, or service throughout its entire life cycle. From the extraction of raw materials to production, distribution, use, and disposal. By analysing factors such as resource consumption, emissions, and waste generation at each stage, organisations can identify opportunities for improvement and implement strategies to minimise their environmental impact.

However, alongside these physical dynamics, companies also operate within a social framework that encompasses internal and external dimensions. Internally, social dynamics are often managed through methodologies such as Plan-Do-Check-Act (PDCA) and due diligence. PDCA involves planning a change or improvement, implementing it, evaluating its effectiveness, and making adjustments as necessary to drive ongoing progress (Isniah et al., 2020). At the same time, due diligence ensures that sustainability programs consider potential environmental and social impacts that the change can have. It involves assessing supply chain practices, evaluating the environmental footprint, and ensuring compliance with ethical standards. By combining the PDCA cycle's improvement process with due diligence's risk assessment, corporations can improve the sustainability in their operations with very little risk of overlooking potential leaks of impact.

Externally, social dynamics are influenced by various factors, including interactions within the interorganizational governance chain and the global value chain governance. The interorganizational governance chain refers to the relationships and interactions between different entities involved in a company's supply chain or value network.

Understanding the dual nature of a company, encompassing both physical dynamics and social dynamics, aids in assessing the efficacy of its environmental impact reduction efforts amid digitising retail. LCA evaluates the environmental footprint across a product's life cycle, shedding light on material sourcing, manufacturing, and disposal. PDCA, on the other hand, emphasises continuous improvement through systematic planning, execution, evaluation, and adjustment. Integrating both approaches enables a comprehensive evaluation of a company's endeavours and the lengths that were taken to reduce environmental impacts. PDCA can be used as a tool to evaluate the progress of companies at implementing their sustainability solutions.

Lastly, according to Gereffi et al. (2005) there are five types of global value chain governance: hierarchy, captive, relational, modular, and market as can be seen in Figure 3. These types describe the range from high to low levels of explicit coordination and power asymmetry between actors in the value chain. It can be used as a guide as to which actor to address for interviews when wanting to make a change to the value chain or gain valuable information as to how stakeholders relate.

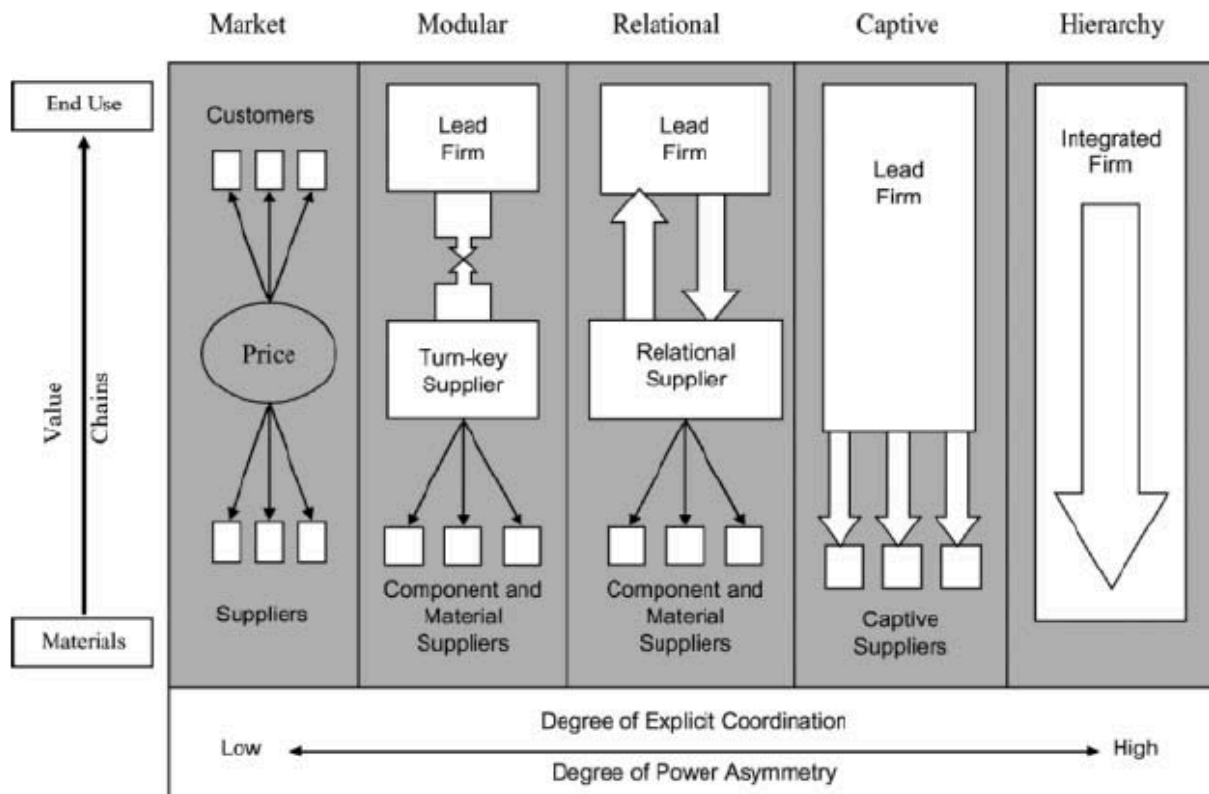


Figure 3: Five types of global value chain governance. (Gereffi et al., 2005)

## 2.5. Value chain shifts due to digitalisation

In Figure 4 the simplified value chain shifts before the digitalisation of retail shops can be observed, this is further expanded upon in Figure 2 from Reike which closes the loop in different parts of the value chain. The Figure is a simplified version of the most relevant actors in the value chain in terms of sources of environmental impact. The square shows the scope of this research. In yellow are the main actors in the value chain. The value chain with the main actors of online retail can be seen in Figure 5.

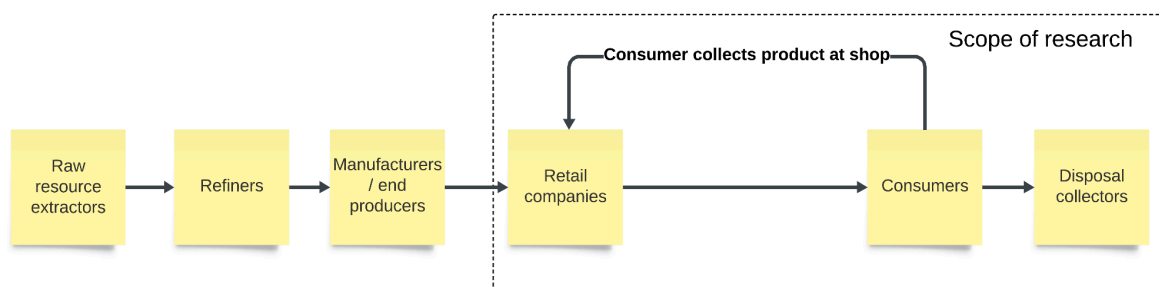


Figure 4. Simplified value chain of retail shops with all the relevant actors

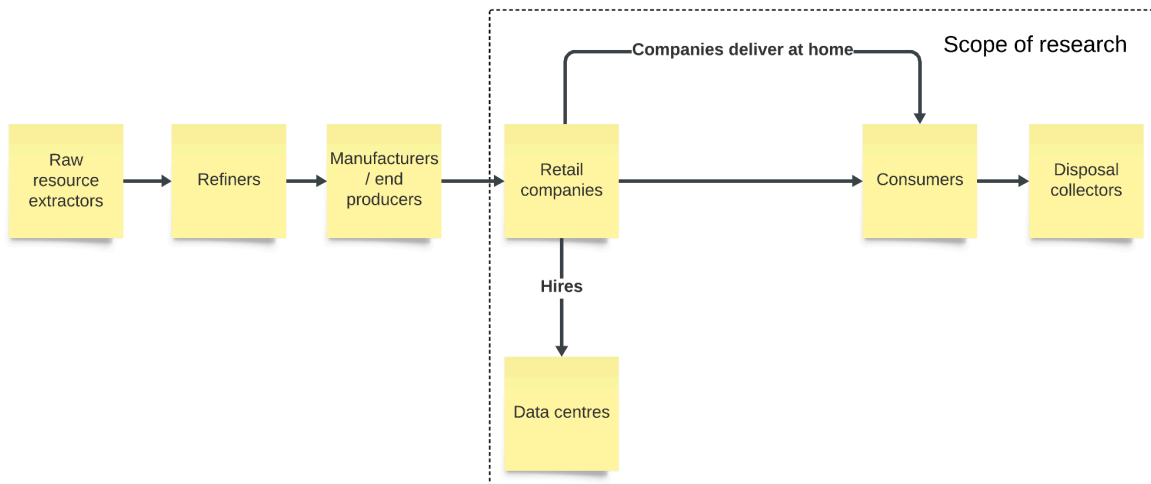


Figure 5. Simplified value chain of digitised retail shops with all the relevant actors

### 2.5.1. First-second-third order effects

Piscicelli (2023) has identified three main effects that are used to differentiate the different impacts within the value chain model based on where it is found in the value chain. First-order effects are all impacts involving direct environmental (social or economic) effects associated with the production, transportation, use and disposal of digital technologies and devices. Second-order effects are indirect environmental, social or economic impact related to changes in products and production processes caused by the deployment of digital technologies. Lastly, third order effects are indirect impacts on the environment caused by the stimulation of more consumption or higher economic growth resulting from the use of digital technologies such as rebound effects (Warmington-Lundström & Laurenti, 2020).

This research mostly focuses on first-order effects. The second-order effects that affect the zoomed-in value chain are also taken into account but only as a possible mitigation solution to first-order effects, not as a source of impact.

### 2.5.2. 1st order effects

1st order effects are impacts directly related to the production, use and disposal of the digital tools used for the digitalisation. Digital retail leverages digital services companies for various functions, such as e-commerce platforms, data analytics, and cloud services. However, e-waste generation, energy consumption, manufacturing impact are the most prominent sources of new environmental impacts caused by the use of digital technologies. Electric and electronic waste (e-waste) is one of the world's fastest growing waste streams (Widmer et al., 2005). There is also minimal focus on reuse and repair within e-waste research (Islam & Huda, 2018). Furthermore, the resources required to produce this digital technology as well as the energy consumption for utilising it is often excluded from sustainability reports utilising digital technologies for optimising their value chain.

Secondly, more frequent returns due to online retail is also a large source of environmental impact. These returns cause more transport to be required for further deliveries as well as a downgrade of the product making the producer have to sell it as 'second-hand'. The

literature on an increase of returns hasn't found any concrete numbers due to the return rate highly depending on the sector and the products sold.

Furthermore, as retail moves online, packaging becomes a growing concern due to increased emphasis on presentation, leading to excessive packaging. Individual shipments create more waste compared to bulk deliveries to physical stores. Protective materials further contribute to environmental strain. Online shopping's convenience encourages impulse buys and returns, exacerbating the issue. Additionally, global shipping increases carbon footprint and necessitates additional packaging. This is even more accentuated when taking in account the more frequent returns which enhances the environmental impact.

An overview of all the actors and impacts can be found in Figure 6. It describes all relevant actors in the digital retail value chain as well as their sources of impact compared to a non-digitised value chain. These sources of impact or problem areas were determined based on academic literature, which is further explained in 2.5.4. Solutions that companies can adopt to mitigate these problem areas are discussed in the next two chapters.

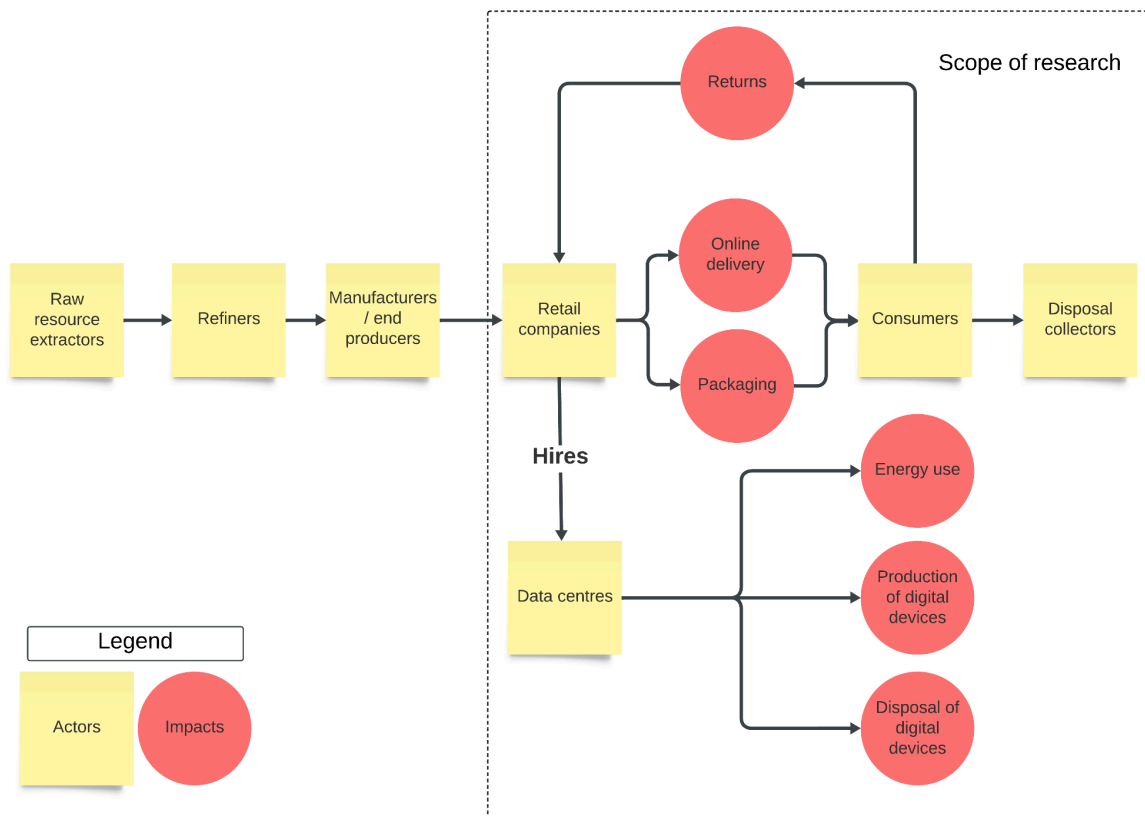


Figure 6: Graphical representation of digitised value chains with their actors and their six sources of impact

### 2.5.3. Possible mitigation strategies for companies

Companies face several challenges that demand innovative solutions for sustainable business practices due to digitalisation changing the value chain. The most important issues and some existing solutions are discussed here.

One prevalent issue is the surge in product returns, impacting the environment through increased transportation emissions. To address this, companies can implement mitigation strategies such as establishing local return centres and pick-up points. These localised solutions not only reduce the carbon footprint associated with transportation but also enhance convenience for customers. Additionally, optimising transportation routes and adopting reusable packaging contribute to minimising the negative environmental impact of increased returns.

Furthermore, digital retail can employ proactive product information, including detailed descriptions, images, and size guides, to reduce return rates. Implementing virtual try-on technologies and leveraging customer reviews aids in setting accurate expectations, minimising the need for returns.

Another challenge arises when products are returned in a downgraded condition, posing potential financial and environmental concerns. To counteract this, companies can explore the option of reselling downgraded products at slightly lower prices. This not only recovers some value from returned items but also aligns with the principles of the circular economy by extending the lifespan of products.

The production of digital devices used for online information gathering also contributes to environmental concerns. Mitigating the negative impact involves transitioning towards greener practices, such as the establishment of green data centres. These environmentally friendly facilities ensure that the manufacturing and operation of digital devices are conducted with a reduced ecological footprint. These facilities focus on energy efficiency, renewable energy sources, and eco-friendly technologies to reduce carbon footprints

Energy consumption of digital devices also remains a critical consideration in the lifecycle of digital devices. By shifting towards energy-efficient sources, companies can significantly mitigate the environmental impact associated with the production and usage of digital devices.

Participation in events such as the EPE (European Conference on Power Electronics and Applications) can be a source of innovative new ideas for companies. It serves as a platform for researchers, engineers, and practitioners to exchange knowledge, present research findings, and discuss advancements in power electronics.

Finally, the disposal of digital devices presents yet another challenge, contributing to electronic waste. To address this issue, companies can implement repair programs that encourage the fixing and refurbishing of devices rather than immediate disposal. This not only reduces electronic waste but also promotes a circular approach to product life cycles.

#### 2.5.4. Existing academic sources

In order to find academic documents on the environmental impact of digital retail, SCOPUS was used with targeted search terms to retrieve relevant documents. In this case, the terms "digital retail" or "online retail" needed a match with either "environmental impact" or "sustainab\*". Furthermore, the search was restricted to academic documents. The search took place on the 13th of February 2024 and yielded 63 documents pertinent to the research

topic. All these articles have been used to identify the most prominent impact sources of online retail as well as the most recurring solutions to them.

However, according to Piscicelli (2023), data centres are also a major new source of environmental impact. There are three main sources of impacts, production of digital devices, use of digital devices (in terms of energy) and disposal of digital devices. These three problem areas are not well documented in the first SCOPUS search but are still relevant for this study. Hence a second SCOPUS search was performed to get academic problem and solutions description for data centres. The results needed to include the terms "digital retail" OR "online retail". The articles also needed to include "Data centre" and either "environmental impact" or "sustainab\*". This resulted in a total of 7 articles which were combined with the previous 63 to get to a total of 70 articles. Despite the more specific search, no new problem description or solution was given concerning data centres. Hence, the data centres were given two additional problem areas according to Piscicelli (2023). Each problem area from the data centres was given the two most prominent solutions in other academic research. This can be visualised in Table 1, which sums up all the mentions from the sources of impact and solutions for them from the 70 academic papers. A more detailed overview of all relevant articles and their sources can be found in Appendix 6. The results from table 1 serve as a crucial foundation for evaluating the solutions adopted by companies in response to the environmental challenges posed by the digitalisation of retail through the Sustainable Performance Checklist (SPC).



Problem	# Mentions	Solution	# Mentions
Packaging during transport	9	Less polluting packaging	3
		Packaging reduction	5
		Educate and ban unsustainable packaging	2
		Packaging recycling	4
		Take back packaging	2
		Combined products	1
Returns	10	Second hand sale at lower price	3
		More knowledge on consumer preferences	2
		Create awareness for consumer	1
Transport	10	Efficient transport routes	6
		Low-impact transport	2
		Crowd-shipping	1
		Collection points	5
		Bundled delivery	1
Energy use of data centres	1	Renewable energy sourcing	0
		Energy efficiency	0
Production of data centre devices	0	Lower impact material	0
		Recycled materials	0
Disposal of data centre devices	0	Recycle/reuse materials	0
		Eco-friendly disposal	0

Table 1: Problem areas and solutions found from the two SCOPUS searches and how often they were mentioned

## 2.6. Integrating theory in the assessment framework

The creation of an assessment framework represents a crucial step towards evaluating a company's commitment to sustainable behaviour amidst the evolving landscape of digitalized retail. Drawing from key theoretical frameworks, including globalisation, sustainability initiatives such as Circular Economy (CE), and the impact of digitalisation, the assessment framework aims to assess the extent to which companies embrace sustainability in their operations.

Corporate sustainability governance serves as a crucial link to the assessment framework, ensuring alignment between organisational goals and sustainable practices. Through robust governance structures, companies can integrate sustainability principles into decision-making processes, resource allocation, and performance evaluation. The assessment framework, informed by theories of sustainability governance, provides a framework for assessing the attention given to these governance mechanisms in driving sustainable behaviour within organisations. By incorporating governance indicators into the

checklist, stakeholders can evaluate the extent to which companies adhere to sustainable practices.

Companies exhibit a dual nature, with their sustainability efforts evaluated through various dimensions. The physical component is assessed through methodologies like Life Cycle Assessment (LCA), which scrutinises environmental impacts across product life cycles. Meanwhile, the internal social component is managed through frameworks such as Plan-Do-Check-Act (PDCA) and due diligence processes, ensuring ethical conduct and social responsibility within organisational practices. External social interactions are governed by interorganizational governance structures, fostering accountability and collaboration across value chains. By integrating these theories, the assessment framework offers a comprehensive framework that takes into account more complex dynamics within a company in the digitised retail sector.

Afterwards, the 1st and 2nd order effects of the impacts of digitalisation in the value chain are identified, these are useful for the assessment framework since these are all points that need to be addressed and counteracted within the company's sustainability reports. Furthermore, the level of progress on the actions undertaken are determined based on PDCA progress.

## 3. Methodology

### 3.1. General

This research aims to describe the efforts of companies to reduce the environmental impact of digital technologies in digital retail. This methodology describes as accurately as possible the sources of impact or problem areas of all six companies. It also determines the extent to which companies explain their solutions. This is done by employing a four-step methodology that combines quantitative analysis and qualitative insights.

The first step involves creating a Sustainable Performance Checklist (SPC) based on academic literature. The SPC represents the effort of a company to accurately describe implemented sustainable solutions for certain problem areas within digital retail. SCOPUS was used as a search engine to find relevant articles that describe problem areas for digital retail as well as solutions for them. Within the SPC, each solution is given a score based on the number of criteria followed that describe the PDCA cycle.

The second step of this study is to apply the SPC on six different companies in the digital retail sector. The SPC is used on six different companies in the digital retail sector by assessing their sustainability reports. Each company is given a score based on the extent to which the solutions described in their sustainability report meet the nine criteria.

The third step of this study is to conduct an interview with an expert on reporting practices to give a broad and objective perspective and help identify common practices, potential biases or gaps in the sustainability reports of the companies. The results from the interview are then compared to the results of the SPC-scores to explain trends or abnormalities within the results.

The last step of this study is to compare the SPC results with the use of sustainability standards and guidelines. ISO-14001, ISO-26000, and GRI are all tools that can be used in sustainability reports to display a company's adherence to environmental standards, social responsibility guidelines, and overall sustainability practices. Assessing whether the application of these tools enhances the SPC-score of the companies adds valuable insights to this study. This step is done in the discussion section.

The research method described is a mixed-methods design, combining elements of qualitative and quantitative methodologies. The process starts with a comprehensive literature review, used for the creation of the SPC. This checklist, grading sustainable impacts, aligns with quantitative measurement. Subsequently, a qualitative interview validates and deepens the understanding gained from the SPC.

Using this method is necessary because it ensures a comprehensive evaluation of sustainability reports in digital retail. Creating a checklist (SPC) with criteria provides a structured framework for consistent grading. Applying this checklist to the reports allows for objective assessment of sustainability efforts. Interviewing a reporting expert adds qualitative insights and validates the findings. Finally, comparing SPC results with established standards like ISO-14001, ISO-26000, and GRI ensures alignment with recognized

guidelines, enhancing the credibility and relevance of the study. This systematic approach facilitates a thorough and reliable analysis of sustainability reporting practices.

### 3.2. Step 1: Creating a comprehensive Sustainable Performance Checklist (SPC)

The first phase of the methodology involves the creation of an assessment framework to identify the sustainability efforts conducted by digital retail companies. This is done through the help of a SPC. The aim of the SPC is to have a quantitative overview to check how much attention has been given by the company for each possible sustainability issue. The SPC contains a list designed to encapsulate the multifaceted dimensions of sustainability within the digital retail landscape.

The SPC addresses six problem areas that are influenced by digitisation. Each problem area has a couple of solutions linked that help to remediate the issue. These solutions are all proposed in academic documents as identified with SCOPUS search and Piscicelli's (2023) research. The problem areas and solutions for each of them can be found in Table 2.

Problem Areas	Solutions
Packaging during transport	Less polluting packaging
	Packaging reduction
	Educate and ban unsustainable packaging
	Packaging recycling
	Take back packaging
	Combined products
Returns	Second hand sale at lower price
	More knowledge on consumer preferences
	Create awareness for consumer
Transport	Efficient transport routes
	Low-impact transport
	Crowd-shipping
	Collection points
	Bundled delivery
Energy use of data centres	Renewable energy sourcing
	Energy efficiency
Production of data centre devices	Lower impact material
	Recycled materials
Disposal of data centre devices	Recycle/reuse materials
	Eco-friendly disposal

Table 2: Problem areas of SPC and their associated solutions

Each solution is given a score depending on the PDCA application of the solution by the company. This score depends on the Plan, Do and Check part of the PDCA. The Act (A) phase of the PDCA cycle is excluded from the SPC because it focuses on implementing improvements based on the evaluation results from the Check phase. While Plan, Do, and Check involve setting objectives, executing plans, and assessing outcomes, respectively, the Act phase goes a step further. It takes corrective actions to enhance processes, address deficiencies, and standardise successful practices. This falls outside the scope of this research.

The score given for each solution depends on the PDC-application in the sustainability report. The score is given depending on the number of the criteria met and can be found in Appendix 2, a summarised version of the nine criteria can be seen in Table 3. There are a total of nine criteria, three for each phase of the PDC. If one out of the three criteria of a phase criteria are met, the score for that phase would be a one. The score of all three phases together is combined in one overall score for each of the impacts in the Sustainable Performance Checklist (SPC).

Phase	Criteria
Plan	Underlying problem explained
	Target described
	Date for achieving target
Do	Results are shown
	Method of implementation is described
	Barriers described
Check	Progress checked yearly
	Development of target and achievement over time is described
	Explanation if previous target was reached

Table 3: Summarised nine criteria for SPC-score

A Sustainable Performance Checklist (SPC) serves as an academic output by consolidating research findings and methodologies into a structured tool. The digitalisation of value chains is a new field with no academic sources on how to evaluate a companies' effort and success on the impact generated from the changes brought forth from digital technologies. The SPC provides a comprehensive framework for assessing the effort of digital retail to remediate the environmental impacts caused by being digitised.

### 3.3. Step 2: Application of the SPC to sustainability reports and ranking

Building upon the SPC, the second step involves the systematic examination of sustainability reports or similar reports from prominent digital retail companies. These companies are six fully digital or originally fully digital companies: Bol.com, Amazon, Boohoo, ASOS, Coolblue and Apple. These companies were chosen since they are the biggest online companies in their sector that operate within the Netherlands (Statista, 2024). The companies were also chosen to represent three different sectors. Bol.com and Amazon represent general online

retail, Boohoo and ASOS represent fashion retail, and Coolblue and Apple represent electronics retail. These companies can be replaced with other prominent ones depending on availability of their sustainability reports.

The sustainability reports serve as a primary source of information, allowing this study to assess the actual effort of sustainable practices for each company. Within the SPC, each solution implemented is given a PDC-score depending on the number of criteria met as described in step 1. All the PDC-scores are then combined to create a comprehensive table. Through the combined PDC-score the effort of a company towards reporting their sustainability solutions is measured. Afterwards, the various SPC results of all six companies are compared providing a comparative analysis of the sustainability efforts across different companies and sectors. Furthermore, this analysis also examines the frequency of solutions usage as well as which are often overlooked. The SPC scores are based on the progress of its measures according to PDC progress.

Analysing sustainability reports through the SPC provides a grading method and standardised evaluation method of companies. However, the validity of this method is not necessarily the most accurate representation of reality. This is due to sustainability reports not always representing companies correctly. Companies may provide incomplete, incorrect or selective information on sustainability reports to enhance their public image, attract investors, and maintain customer loyalty. Greenwashing, or exaggerating environmental efforts, can create a facade of responsibility, despite inadequate practices. This misinformation allows companies to capitalise on the growing demand for sustainable practices without genuine commitment. Despite all this, step 2 remains crucial for generating a comparative ranking, facilitating a quantitative assessment of the effort towards sustainability practices implemented by digital retail entities, and identifying leaders in the sustainable landscape. To address potential inaccuracies in sustainability reports, the findings from the results are put into perspective through follow-up interviews for clarification as is described in step 3. This approach helps ensure the accuracy and validity of the SPC, enhancing the reliability of the study's conclusions.

### 3.4. Step 3: In-depth interviews

To enhance the depth of this research, the third step involves conducting in-depth interviews with representatives from the selected digital retail companies. This step would help identify any unaccounted dimensions of sustainability, understanding the rationale behind companies' practices, and refining the results' interpretation based on real-world insights and experiences. Interview candidates were identified through LinkedIn. Advanced search filters were used to pinpoint professionals occupying suitable roles for the interview such as sustainability managers or corporate responsibility officers. Personalised messages are crafted to explain the study's objectives and invite participation. Sample diversity is ensured by targeting companies across three different industries as discussed in step 2. Participants were informed that their contributions would enrich the study's findings.

Despite numerous attempts to contact various company representatives via official business emails, headquarters inquiries, and LinkedIn requests, none were available or willing to participate in interviews. In Appendix 5 all methods of contact with the six companies are shown. This lack of response posed a challenge in obtaining firsthand insights from the

companies themselves. To address this issue and ensure the study still benefited from expert knowledge, an interview was conducted with a specialist in reporting practices. This expert provided valuable perspectives on sustainability reporting, helping to fill the gap left by the unresponsive company representatives and contributing essential information to the study's overall findings.

An interview with an expert on assessing sustainability reports offers a broader perspective compared to interviews with those who authored the reports. Experts can provide critical evaluations, highlight common practices, and identify potential biases or gaps in the reports. They possess comprehensive knowledge of industry standards and best practices, enabling them to assess the credibility and accuracy of the information presented. This approach ensures a more broad and critical understanding of sustainability reporting, as experts can draw on their extensive experience across various companies and sectors, rather than being limited to a single organisation's viewpoint. The main highlights of the interview with the expert can be found in Appendix 3 and were written by the interviewee.

### 3.5. Step 4: Comparing SPC-results with common standards and guidelines use

The last step of this research involves verifying the scores from step 2 and the interview with a reporting expert from step 3 with each company's compliance to ISO-14001 standards and ISO-26000 and GRI guidelines. This is done by scoring sustainability reports and other third-party sources to find out if the companies are using these standards and guidelines within their sustainability reports. This is done to find out if adherence to these standards and guidelines would make companies have a better score on the SPC-scoring.

Furthermore, this research has also taken a look at the extent to which companies use the aspects of the GRI guidelines into account when formulating their solutions to digitalisation. Since the GRI guidelines cover a very broad scope, this research only focuses on the GRI standards relevant to it. These are GRI 301 - Materials 2016, GRI 302 - Energy 2016, GRI 305 - Emissions 2016 and GRI 306 - Waste 2020. To verify if those standards are applied, this research calculates how many topics have been discussed according to the 'Topic Disclosure' of each standard within the 'Consolidated Set of the GRI Standards'. If the requirements for the topic are met it has been counted towards the score of that standard. A summary of the standards and their associated topics can be found in Appendix 4.

### 3.6. Ethical consideration

To gather data, an interview has been conducted, and the interviewee has been provided with comprehensive information about the interview process in advance. Essential questions have been explained and sent beforehand to enable adequate preparation. At the start of the interview, the participant has been informed that their responses are utilised for scientific purposes. The interviewee retained the right to revoke consent for the use of their provided information.

The participant was notified that their data may be shared for research purposes beyond the scope of this thesis. After completion, the final version of the thesis was shared with the

interviewee. All the aforementioned procedures were formalised through the signing of an Informed Consent document in Appendix 1.



## 4. Results

### 4.1. Introduction

The first results section starts with a company description for all six companies researched separately. This description contains a short history of the company. The results then discuss whether the company follows common reporting practices namely, ISO-14001, ISO-26000 and GRI. The results then discuss the general structure and content of the report as well as on which theme it focuses. Finally the SPC results are analysed. After the data analysis for each company the highlights of the interview with a reporting expert are presented.

### 4.2. Results 1: Case descriptions

#### 4.2.1. Case 1: Bol.com

- Origins and evolution of sustainability reports

Bol.com, founded in 1999 in the Netherlands, began as an online bookstore before evolving into an e-commerce platform. Bol.com has progressively integrated sustainability into its operations, emphasising eco-friendly packaging, energy efficiency, and carbon offset initiatives (*Bol & Corporate Social Responsibility*, n.d.). They've also actively promoted sustainability brands on their web shop such as Naif and The Good Roll, reflecting a commitment to environmental responsibility throughout their evolution.

Initially, Bol.com didn't report their sustainability measures to the public. It wasn't until 2021 that Bol.com started publicly reporting its sustainability efforts through its website, marking a significant step towards greater transparency and stakeholder engagement (*News From Bol*, n.d.). Bol.com's use of sustainability reports in the form of documents began in 2022. Their latest published public sustainability report is simply called "Sustainability Report 2022". This report and their website are the only sources of information for their reporting practices.

- Management and reporting practices

Bol.com employs specific management and reporting practices that diverge from some widely recognized guidelines. Notably, Bol.com does not adhere to the ISO-14001 standards, at least not publicly. It also does not follow the ISO-26000 social responsibility guidelines. Instead, the company aligns its sustainability and corporate responsibility efforts with the Global Reporting Initiative (GRI) framework. However, it is important to note that Bol.com does not explicitly reference GRI in its reports. Its association to GRI can be found on GRI's website.

However, to be more specific four GRI standards are selected based on their relevance for the impact of digitalisation. These four standards come from the Consolidated Set of GRI Standards and can be found in Table 4. Each standard has a number of topics associated that all have different criteria. Bol.com fulfilled none of the required criteria for any topics.

GRI standard	# of topics criteria met
GRI 301 - Materials 2016	0/3
GRI 302 - Energy 2016	0/5
GRI 305 - Emissions 2016	0/7
GRI 306 - Waste 2020	0/5

Table 4: GRI application of Bol.com on GRI standard 301, 302, 305 and 306 and their topics

- Sustainability report

Bol.com's sustainability report is structured in a clear and organised manner, divided into sections that address various aspects of its sustainability initiatives. It begins with an introduction highlighting the company's commitment to sustainability. The company gives as its main goal that they aim to improve daily by optimising packaging and delivery, using 100% renewable energy, offering sustainable products, and reducing carbon emissions per package. After describing their sustainability message Bol.com describes their overarching goals and achievements.

Following this, the report delves into specific topics such as carbon footprint reduction, sustainable packaging, and social responsibility. Each section provides information on strategies, targets, and performance metrics. However, the report lacks specificity in setting explicit targets and tracking progress over time. While it addresses a range of solutions that reduces the impact of their digitised value chains, the goal they wish to reach, as well as the methodology behind it, is not properly explained. Lastly, the company does not explicitly highlight the specific impacts of digitalization in its reports.

- Focus areas in sustainability reports

Bol.com's sustainability reports have solutions that address all relevant problems of digitalization that influences their product and services. Bol.com implements many different solutions aimed at reducing packaging waste and promoting sustainable alternatives. Solutions include minimising packaging per parcel, facilitating the return of packaging materials for reuse, and consolidating shipments to reduce transportation volume. Additionally, Bol.com emphasises the use of renewable energy sources, such as local wind and solar power, to power its operations, further reducing its carbon footprint. Overall, çtheir explanation of their methodology is very basic, and it doesn't describe the solution being implemented in great detail. However, Bol.com doesn't have any solutions in place to reduce the environmental impact of data centres. There is not even a mention about data centres within their sustainability report

- Plan-Do-Check (PDC)-score

Bol.com's latest sustainability report, discussing their sustainability activities in 2022, discusses seven out of the twenty solutions that are present in academic literature aimed at addressing sustainability challenges inherent in digitised supply chains. These seven solutions are aiming to resolve the three problem areas of products and services in digital

retail. Bol.com has no solutions in place to remediate the impact of data centres as can be seen in Table 5.

Field of operation	Problem areas	SOLUTION
Product services	Packaging during transport	Less polluting packaging material
		Packaging reduction
		Educate and ban unsustainable packaging
		Packaging recycling
		Take back packaging
		Combined products
	Returns	Second hand sale at lower price
		More knowledge on consumer preferences
		Create awareness for consumer
	Transport / Delivery	Efficient transport routes
		Low-impact transport
		Crowd-shipping
Collection points		
Bundled delivery		
Data centre devices	Energy use	Renewable energy sourcing
		Energy efficiency
	Production	Lower impact material
		Recycled materials
	Disposal	Recycle/reuse materials
		Eco-friendly disposal

Table 5: Problem areas and solutions implemented by Bol.com, green is addressed, red is not addressed in sustainability report

The summarised results of the PDC scores from Bol.com can be found in Table 6. Overall, the solutions proposed are quite poorly explained resulting in a PDC-score of 3,17 out of 9. This means that only about 35% of the PDC-criteria are used to describe the solutions they have implemented. If you also count solutions that were not implemented this amounts to 9%. The sum of all their PDC-scores amounts to 24. This indicates that 24 PDC-criteria are satisfied across their four solutions. From the results it can be seen that most of these criteria are used to describe the Do-phase of the PDC with twelve criteria, followed by the Plan-phase with seven criteria and finally the Check-phase with five criteria.

Overview table	
Variable name	bol.com score
# Problems addressed (out of 6)	3
# Solutions used (out of 20)	7
Combined P-score	7
Combined D-score	12
Combined C-score	5
Combined PDC-score	24
Average score per solution (1-9)	1,2
Average score per solution (%)	13,33%
Average score per problem (1-9)	0,78
Average score per problem (%)	8,64%
Average score per active problem (1-9)	3,17
Average score per active problem (%)	35,19%

Table 6: Overview table of Bol.com's SPC results

#### 4.2.2. Case 2: Coolblue

- Origins and evolution of sustainability reports

Coolblue, founded in 1999 in the Netherlands, began as an online electronics retailer before expanding its product range and services. It is now a leading online retailer committed to achieving net-zero emissions by 2030. Coolblue prioritises energy efficiency, sustainable packaging, and product recycling programs.

Moreover, Coolblue optimises cardboard packaging with box-to-size machines and reduces plastic use to minimise waste. The company's commitment to sustainability is evident in its dynamic energy contracts, which help customers reduce their energy consumption. It also stimulates customers to use electricity when renewable energy supply is high. By actively engaging customers in its sustainability journey, Coolblue demonstrates its willingness to actively participate in sustainability. These activities are clearly described in its sustainability reports. Coolblue started its report in 2016, and the last report was about their 2023 activities, titled "Yearbook 2023".

- Management and reporting practices

Coolblue's management and reporting practices show a selective adoption of international standards as can be found in Table 7. Despite the widespread use of ISO-14001 standards and ISO-26000 guidelines for environmental and social responsibility reporting, there is no evidence to suggest Coolblue utilises these in its sustainability efforts. Instead, Coolblue only aligns with the Global Reporting Initiative (GRI) framework, though this affiliation is not explicitly disclosed in their reports. Information about its association with GRI is available on the GRI website.

GRI standard	# of topics criteria met
GRI 301 - Materials 2016	0/3
GRI 302 - Energy 2016	0/5
GRI 305 - Emissions 2016	0/7
GRI 306 - Waste 2020	0/5

Table 7: GRI application of Coolblue on GRI standard 301, 302, 305 and 306

- Sustainability report

Coolblue's sustainability report is called "Yearbook 2023", meaning that the main aim of the report is to report about the company itself and not specifically about sustainability actions taken. The report is designed in a colourful and engaging format, making it accessible to the general public. The report has large background images of Coolblue workers with textboxes describing the various chapters of their report. The report starts with an introduction of the company followed by some general statistics about Coolblue compared to last year, such as their overall revenue, their staff and the number of stores they operate. Coolblue then describes their story and what they have achieved so far. The report describes their "Go Green" initiative. This initiative states that Coolblue is committed to sustainability by implementing green initiatives, like the largest solar roof in the Netherlands, bike deliveries, and electric vans, while also helping customers achieve their own green goals through Coolblue Energy and promoting product longevity and recycling. The "Go Green" chapter is followed by a couple of chapters less relevant for this research.

This report is very superficial and like the name indicates, it is not oriented towards sustainability. The "Go Green" chapter does give some numbers and actions taken by the company; but it is very broad, and it doesn't go into detail how those numbers were achieved. There is also no explicit mention in the company's documentation regarding special attention to the impacts of digitalization.

- Focus areas in sustainability reports

Coolblue's report focuses mostly on common practices to reduce their environmental impact of digitalising value chains. Their initiatives are mostly aimed at reducing packaging waste, dealing with returns and reducing the impact of transport. Coolblue does this by reducing the number of packaging used as well as using less polluting materials. In order to reduce the environmental impact of returns, Coolblue offers the returned product at a discounted price. It also makes sure that the product is something the customer desires before selling it, by getting advice from experts on which product would be best suited for their needs, avoiding unnecessary returns. Finally, to reduce the environmental impact of transport, Coolblue makes use of low-impact transportation methods. However, the sustainability report does not discuss any solutions to reduce the environmental impact of data centres. Data centres are not mentioned at all in the report.

- Plan-Do-Check (PDC)-score

Coolblue's last sustainability report is about their 2023 sustainability activities, and it has four solutions out of the twenty solutions that are present in academic literature aimed at addressing sustainability challenges inherent in digitised supply chains. The solutions address all three problem areas of the product and services that have changed in impact within digital retail, but have no solutions aimed at reducing the environmental impact of data centres as can be seen in Table 8.

Field of operation	Problem areas	SOLUTION
Product services	Packaging during transport	Less polluting packaging material
		Packaging reduction
		Educate and ban unsustainable packaging
		Packaging recycling
		Take back packaging
	Combined products	
	Returns	Second hand sale at lower price
		More knowledge on consumer preferences
		Create awareness for consumer
	Transport / Delivery	Efficient transport routes
		Low-impact transport
Crowd-shipping		
Collection points		
Bundled delivery		
Data centre devices	Energy use	Renewable energy sourcing
		Energy efficiency
	Production	Lower impact material
		Recycled materials
	Disposal	Recycle/reuse materials
		Eco-friendly disposal

Table 8: Problem areas and solutions implemented by Coolblue, green is addressed, red is not addressed in sustainability report

The summarised results of the PDC scores from Coolblue can be found in Table 9. Overall, the solutions which Coolblue has implemented are moderately well explained according to PDCA guidelines. It has a PDC-score of 4.17. This means that 46% of the PDC criteria are present to describe their implemented solutions. If you also count solutions that were not implemented this amounts to 6%. Coolblue's combined PDC-score is 15. This indicates that 15 PDC criteria are satisfied across their four solutions. Detailed information on the results shows that the majority of these criteria pertain to the Do phase of the PDC cycle, which covers seven criteria. The Plan phase follows with six criteria, and the Check phase only has two criteria.

Overview table	
Variable name	Coolblue score
# Problems addressed (out of 6)	3
# Solutions used (out of 20)	4
Combined P-score	6
Combined D-score	7
Combined C-score	2
Combined PDC-score	15
Average score per solution (1-9)	0,75
Average score per solution (%)	8,33%
Average score per problem (1-9)	0,59
Average score per problem (%)	6,54%
Average score per active problem (1-9)	4,17
Average score per active problem (%)	46,30%

Table 9: Overview table of Coolblue's SPC results

#### 4.2.3. Case 3: ASOS

- Origins and evolution of sustainability reports

ASOS, founded in 2000 in the United Kingdom, began as an online fashion retailer before expanding its offerings and global reach. It is now a global online fashion retailer that integrates digitalization and sustainability across its value chain. Committed to achieving net-zero emissions by 2030, ASOS prioritises circular systems, sustainable materials, and product recovery programs. Utilising digital platforms, ASOS educates customers about sustainability, offering insights into consumption and promoting responsible choices.

ASOS began its sustainability reporting in 2019, with the latest sustainability report being about their 2022 activities. It has published sustainability reports aimed towards the general audience through sustainability reports called "Fashion with Integrity".

- Management and reporting practices

Although ASOS does not explicitly state its use of ISO-14001 standards in its sustainability report, outside sources show that it has an ISO-14001 verification. The company does not implement ISO-26000 guidelines; however, it follows the Global Reporting Initiative (GRI) guidelines and can be found in Table 10. This use of GRI is explicitly mentioned in its sustainability reports. Its affiliation with GRI is also available on the GRI website.

GRI standard	# of topics criteria met
GRI 301 - Materials 2016	0/3
GRI 302 - Energy 2016	0/5
GRI 305 - Emissions 2016	0/7
GRI 306 - Waste 2020	0/5

Table 10: GRI application of ASOS on GRI standard 301, 302, 305 and 306

- Sustainability report

ASOS's sustainability report is designed in a colourful and engaging format, making it accessible to the general public. The report features large images to highlight its achievements, goals, and key statistics, ensuring the information is easy to read and visually appealing. Their report begins with a foreword explaining their overarching goals and priorities within those goals. The four main goals of ASOS described in the report is to 'Be Net Zero', 'Be More Circular', 'Be Transparent' and 'Be Diverse'. Afterwards, the report has a chapter on Planet, People and Governance. Only the Planet chapter is relevant and is analysed. The Planet chapter discusses two main methodologies: "Be Net Zero" and "Be More Circular" which are further explained in the chapter.

ASOS's 'Fashion with Integrity' report doesn't go into detail how those numbers were achieved and lacks crucial elements that are required to make a valid claim of sustainability. Another element of particular note is that the company's reports do not provide explicit details about addressing the impacts of digitalization.

- Focus areas in sustainability reports

ASOS's sustainability reports discuss very few solutions to reduce their environmental impact of digitalised value chains. Their initiatives are mostly aimed at reducing packaging waste and reducing impact of transport. ASOS does this by recycling their packages, as well as by using less polluting materials. In order to reduce the environmental impact of transport, ASOS uses some low-impact transport methods. However, the company is not very clear on how much this has led to reduced emissions. Furthermore, ASOS also doesn't have any solutions to reduce the environmental impact of data centres. The sustainability report does not address data centres at all.

- Plan-Do-Check (PDC)-score

ASOS's latest sustainability report about their 2022 activities incorporates only three out of twenty solutions that are present in academic literature aimed at addressing sustainability challenges inherent in digitised supply chains. These solutions cover all three problem areas related to the impact of products and services in digital retail, but they do not include measures to reduce the environmental impact of data centres as can be seen in Table 11.



Field of operation	Problem areas	SOLUTION
Product services	Packaging during transport	Less polluting packaging material
		Packaging reduction
		Educate and ban unsustainable packaging
		Packaging recycling
		Take back packaging
		Combined products
	Returns	Second hand sale at lower price
		More knowledge on consumer preferences
		Create awareness for consumer
	Transport / Delivery	Efficient transport routes
		Low-impact transport
		Crowd-shipping
Collection points		
Bundled delivery		
Data centre devices	Energy use	Renewable energy sourcing
		Energy efficiency
	Production	Lower impact material
		Recycled materials
	Disposal	Recycle/reuse materials
		Eco-friendly disposal

Table 11: Problem areas and solutions implemented by ASOS, green is addressed, red is not addressed in sustainability report

The summarised results of the PDC scores from ASOS can be found in Table 12. Overall, ASOS's implemented solutions are moderately well-explained according to PDCA guidelines, having a PDC-score of 4.00 out of 9, indicating that 44% of the criteria are met to describe their implemented solutions. If you include solutions that were not implemented this amounts to 8%. ASOS's combined PDC-score is 14, meaning that 14 PDC criteria are satisfied across their three solutions. Detailed analysis shows that the majority of these criteria are in the Plan- and Do-phase of the PDC cycle, covering five criteria each, followed by the Check phase with four criteria.

Overview table	
Variable name	ASOS score
# Problems addressed (out of 6)	2
# Solutions used (out of 20)	3
Combined P-score	5
Combined D-score	5
Combined C-score	4
Combined PDC-score	14
Average score per solution (1-9)	0,7
Average score per solution (%)	7,78%
Average score per problem (1-9)	0,40
Average score per problem (%)	4,44%
Average score per active problem (1-9)	4,00
Average score per active problem (%)	44,44%

Table 12: Overview table of ASOS's SPC results

#### 4.2.4. Case 4: Boohoo

- Origins and evolution of sustainability reports

Boohoo, founded in 2006 in the United Kingdom, began as an online fashion retailer before expanding its offerings and global reach. Boohoo aims to make all garments more sustainably sourced by 2030, promoting circular fashion through initiatives like offering vintage items and extending product lifespans.

Boohoo maintains transparency and accountability by publishing annual sustainability reports, providing a fair assessment of its progress and challenges. The company actively involves customers, colleagues, and shareholders in its sustainability journey, fostering a culture of responsibility and engagement. Boohoo began its sustainability report in 2021, with the last sustainability report being about 2023, called "Sustainability Report 2023".

- Management and reporting practices

Boohoo's management and reporting practices reveal a selective approach to standard frameworks as can be found in Table 13. Notably, Boohoo does not adhere to ISO-14001, which sets out criteria for environmental management systems, nor does it follow ISO-26000 guidelines, which provides guidance on social responsibility. However, Boohoo employs the Global Reporting Initiative (GRI) guidelines for its reporting. The use of GRI is not explicitly mentioned in Boohoo's report, leaving it implicit that GRI guidelines inform their disclosures. Its relationship with GRI is accessible through the GRI website.

GRI standard	# of topics criteria met
GRI 301 - Materials 2016	0/3
GRI 302 - Energy 2016	0/5
GRI 305 - Emissions 2016	0/7
GRI 306 - Waste 2020	0/5

Table 13: GRI application of Boohoo on GRI standard 301, 302, 305 and 306

- Sustainability report

Boohoo's sustainability report is structured in a very colourful manner that makes it 'fun' for the general public to read. It makes use of big pictures to showcase its achievements, goals and numbers. Their report begins with a short explanation on their targets and what they have done so far. Boohoo also describes their sustainability goal which is to make *"tangible progress on our journey to decarbonise our business. Reducing our emissions in every area of our business and supply chain is central to achieving this aim."* The introduction is then followed up by an overview on how change was made throughout their value chain and a summary explanation on how it was implemented. The rest of the chapters are less relevant for this research, since they mostly discuss how the company handles social aspects, which falls outside the scope of this research.

This report is very short and doesn't go into detail how the numbers showcased in the achievements were achieved. Overall, the report lacks crucial elements that are required to make a valid claim of sustainability. Furthermore, the impacts of digitalization are not given special attention in the company's official communications.

- Focus areas in sustainability reports

Boohoo's sustainability reports offer limited solutions for minimising the environmental impact of their digitised value chains. Their initiatives primarily focus on reducing packaging waste and transportation impacts. Boohoo aims to address packaging waste by recycling materials and utilising fewer polluting options. For transportation, they employ some low-impact methods, though the effectiveness of these measures remains unclear. Additionally, Boohoo lacks solutions to mitigate the environmental footprint of their data centres, as their sustainability report omits any mention of data centre impacts.

- Plan-Do-Check (PDC)-score

Boohoo's latest sustainability report, about their 2023 activities, incorporates three out of the twenty solutions that are present in academic literature aimed at addressing sustainability challenges inherent in digitised supply chains. These solutions tackle two out of three problem areas related to the impact of products and services within digital retail, but none target reducing the environmental impact of data centres as can be seen in Table 14.

Field of operation	Problem areas	SOLUTION
Product services	Packaging during transport	Less polluting packaging material
		Packaging reduction
		Educate and ban unsustainable packaging
		Packaging recycling
		Take back packaging
		Combined products
	Returns	Second hand sale at lower price
	More knowledge on consumer preferences	
	Create awareness for consumer	
	Transport / Delivery	Efficient transport routes
Low-impact transport		
Crowd-shipping		
Collection points		
Bundled delivery		
Data centre devices	Energy use	Renewable energy sourcing
		Energy efficiency
	Production	Lower impact material
		Recycled materials
	Disposal	Recycle/reuse materials
		Eco-friendly disposal

Table 14: Problem areas and solutions implemented by Boohoo, green is addressed, red is not addressed in sustainability report

The summarised results of the PDC scores from Boohoo can be found in Table 15. Overall, Boohoo has implemented solutions that are poorly explained according to PDCA guidelines, achieving a PDC-score of 2.50. This indicates that 28% of the PDC criteria are present in their implemented solutions. If you include solutions that were not implemented this amounts to 3%. Boohoo’s combined PDC-score is 9, meaning that only 9 PDC criteria are satisfied across their three solutions. Detailed analysis shows that most of these criteria pertain to the Do phase of the PDC cycle, which covers five criteria. The Plan phase follows with four criteria, and the Check phase has no criteria met.

Overview table	
Variable name	Boohoo score
# Problems addressed (out of 6)	2
# Solutions used (out of 20)	3
Combined P-score	4
Combined D-score	5
Combined C-score	0
Combined PDC-score	9
Average score per solution (1-9)	0,45
Average score per solution (%)	5,00%
Average score per problem (1-9)	0,26
Average score per problem (%)	2,84%
Average score per active problem (1-9)	2,50
Average score per active problem (%)	27,78%

Table 15: Overview table of Boohoo's SPC results

#### 4.2.5. Case 5: Apple

- Origins and evolution of sustainability reports

Apple, founded in 1976 in the United States, began as a computer company before evolving into a global leader in consumer electronics and technology. Apple has been a pioneer in sustainability reporting. The company initiated its Environmental Progress Report in 2012, setting a high standard for transparency and accountability in the industry. Apple's latest report, about their 2023 sustainable activities, is called "Environmental Progress Report", showcases its progress towards achieving carbon neutrality across its entire value chain by 2030. Through initiatives like renewable energy adoption and supply chain transformation, Apple demonstrates its commitment to environmental stewardship and positive change.

In addition to carbon neutrality, Apple is committed to a 100% closed-loop supply chain, encouraging the mindful production and use of recycled materials. Transparency and accountability are central to Apple's sustainability approach, as evidenced by the publication of Environmental Progress Reports to track progress and participation in global initiatives, like RE100.

Furthermore, Apple actively engages in community impact initiatives, such as forestry restoration projects and recycling programs, to promote climate action and responsible device disposal. By extending its commitment beyond products to emphasise environmental stewardship and positive change, Apple seeks to lead by example in the tech industry.

- Management and reporting practices

Apple adheres to ISO-14001 standards for environmental management, explicitly mentioning this compliance in its annual reports as can be seen in Table 16. However, Apple does not utilise the ISO-26000 guidelines. Despite this, Apple employs the Global Reporting Initiative (GRI) guidelines for its sustainability reporting. The use of GRI helps Apple ensure

comprehensive and transparent reporting, although this adherence is not explicitly stated in its reports. Proof of its use of GRI is accessible through the GRI website.

<b>GRI standard</b>	<b># of topics criteria met</b>
GRI 301 - Materials 2016	0/3
GRI 302 - Energy 2016	0/5
GRI 305 - Emissions 2016	0/7
GRI 306 - Waste 2020	0/5

Table 16: GRI application of Apple on GRI standard 301, 302, 305 and 306

- Sustainability report

Apple's sustainability report is structured in a clear and organised manner, divided into sections that address various aspects of its sustainability initiatives. It makes use of many graphs and pictures to accentuate their numbers, goals and results. Their report begins with a foreword explaining the company's goal which is called 'Apple 2030' and is their commitment to be carbon neutral for their entire footprint by the end of the decade. Afterwards, there is an introduction highlighting the company's overarching goals and achievements. Following this, the report delves into specific topics such as their Environmental Initiatives, Engagement and Advocacy, and Data. However, for this research, only the Environmental Initiatives is relevant.

While the report is very well written and easy to read, it lacks depth. It doesn't indicate where the numbers came from or how they fare compared to previous years. While it addresses a range of solutions that reduces the impact of their digitised value chains, the goal they wish to reach as well as the methodology behind is not very well explained. The company also does not explicitly state that digitalization is cause for environmental impact and that it is giving it any attention.

- Focus areas in sustainability reports

Apple's sustainability reports address many solutions, each bettering different aspects of its operations and supply chain management. Overall, the solutions described are well documented and explained. In terms of environmental sustainability, Apple prioritises initiatives aimed at reducing packaging waste and reducing emissions of transport. The solutions implemented to deal with packages are to use less-polluting materials, use less packaging per parcel and to recycle the parcels. Apple also uses low-impact transports to reduce the environmental impact of transportation. Furthermore, Apple also has solutions implemented to deal with the impact of their data centres. Apple makes sure that the energy used for data centres comes from renewable sources and also optimises their data centres to consume less energy. It however, doesn't have any solutions in place to deal with the production and disposal of the aperture used in data centres.

- Plan-Do-Check (PDC)-score

Apple's most recent sustainability report, about their 2023 activities, includes six out of the twenty solutions that are present in academic literature aimed at addressing sustainability challenges inherent in digitised supply chains. These solutions address all two out of the three problem areas related to the impact of products and services in digital retail and provide two solutions for reducing the environmental impact of data centres as can be seen in Table 17.

Field of operation	Problem areas	SOLUTION
Product services	Packaging during transport	Less polluting packaging material
		Packaging reduction
		Educate and ban unsustainable packaging
		Packaging recycling
		Take back packaging
		Combined products
	Returns	Second hand sale at lower price
		More knowledge on consumer preferences
		Create awareness for consumer
	Transport / Delivery	Efficient transport routes
		Low-impact transport
Crowd-shipping		
Collection points		
Data centre devices	Energy use	Renewable energy sourcing
		Energy efficiency
	Production	Lower impact material
		Recycled materials
	Disposal	Recycle/reuse materials
		Eco-friendly disposal

Table 17: Problem areas and solutions implemented by Apple, green is addressed, red is not addressed in sustainability report

The summarised results of the PDC scores from Apple can be found in Table 18. In general, Apple has implemented solutions that are relatively well explained according to PDCA guidelines, with a PDC-score of 5.06. This indicates that 56% of the PDC-criteria are covered in their implemented solutions. If you also count solutions that were not implemented this amounts to 18%. Apple's combined PDC score is 31, meaning 31 PDC criteria are fulfilled across their four solutions. Detailed analysis reveals that the majority of these criteria are related to the Plan-phase of the PDC cycle, which includes twelve criteria. The Do-phase covers eleven criteria, while the Check-phase includes eight criteria.

Overview table	
Variable name	Apple score
# Problem areas addressed (out of 6)	3
# Solutions used (out of 20)	6
Combined P-score	12
Combined D-score	11
Combined C-score	8
Combined PDC-score	31
Average score per solution (1-9)	1,55
Average score per solution (%)	17,22%
Average score per problem (1-9)	1,61
Average score per problem (%)	17,84%
Average score per active problem (1-9)	5,06
Average score per active problem (%)	56,17%

Table 18: Overview table of Apple's SPC results

#### 4.2.6. Case 6: Amazon

- Origins and evolution of sustainability reports

Amazon, founded in 1994 in the United States, began as an online bookstore before evolving into a global e-commerce giant. Central to Amazon's sustainability efforts is its commitment to achieving net-zero carbon emissions by 2040 through its Climate Pledge. This commitment is reflected in various initiatives, including investments in renewable energy, reduction of packaging waste, and innovation across its businesses to enhance sustainability throughout the customer journey.

Amazon was among the first online retail companies to start reporting their sustainability measures to the public. The company started its sustainability report in 2018, and the last sustainability report was about their sustainability activities in 2022. Amazon's use of sustainability reports in the form of documents began in 2020. Their latest published public sustainability report is simply called "Sustainability Report 2022".

- Management and reporting practices

Amazon employs ISO-14001 standards to guide its environmental management practices, ensuring compliance with internationally recognized criteria for reducing environmental impacts as can be found in Table 19. However, the company notably omits any mention of this standard in its sustainability report. In contrast, Amazon does not adopt the ISO-26000 guidelines, which provide guidance on social responsibility. On the other hand, Amazon actively utilises the Global Reporting Initiative (GRI) and prominently features them in its sustainability report. This can also be seen on the official GRI website.



GRI standard	# of topics criteria met
GRI 301 - Materials 2016	0/3
GRI 302 - Energy 2016	0/5
GRI 305 - Emissions 2016	0/7
GRI 306 - Waste 2020	0/5

Table 19: GRI application of Amazon on GRI standard 301, 302, 305 and 306

- Sustainability report

Amazon's sustainability report is structured in a clear and organised manner that makes it easy for the general public to understand. It begins with an introduction giving a brief history of Amazon and explaining their business, their previous achievements as well as their goals. Amazon also describes several company goals towards sustainability, the main being to *“ensure the next great climate solutions can scale fast to help set our planet back on the right track, and that all future generations can live in healthy, thriving communities”*. Afterwards, the sustainability report describes their efforts towards sustainability in five sections, the most notable ones for this review are their efforts towards driving climate solutions and how they achieve the reduction of packaging and waste. Afterwards, Amazon has some chapters on “People”, which is less relevant for this study.

This report is quite specific in setting explicit targets and tracking progress over time. Amazon clearly explains what they have achieved so far, what they want to achieve in the future and have set clear goals. However, there are less pathways explored on tackling the issues caused by digitised value chains. However, the pathways that are discussed are done so in great detail. Despite all this, explicit references to the impacts of digitalization are absent from the company's reports.

- Focus areas in sustainability reports

Amazon's sustainability reports discuss many different solutions to deal with the environmental impacts of digitalisation. Their initiatives are aimed at reducing the impact of their packages, returns, transport and energy use of data centres. It reduces the impact of packaging by reducing the number of packaging used and recycling used packages. Furthermore, Amazon also resells returned products at a lower price to deal with the issue of increasing returns due to digitalisation. Additionally, Amazon makes use of low-impact transports and efficient supply routes to reduce the environmental impact of their shipments. Finally, Amazon emphasises the use of renewable energy sources to power its operations, like their data centres, further reducing its carbon footprint. It also makes sure that the data centres are energy efficient. Overall, the solutions being implemented are well described and backed by data.

- Plan-Do-Check (PDC)-score

Amazon's latest sustainability report, discussing their sustainability activities in 2022, integrates seven out of the twenty solutions that are present in academic literature aimed at

addressing sustainability challenges inherent in digitised supply chains. These solutions address the three problem areas regarding the impact of products and services in digital retail. Furthermore, Amazon also has two solutions in place that aim to reduce the environmental impact of data centres as can be seen in Table 20.

Field of operation	Problem areas	SOLUTION
Product services	Packaging during transport	Less polluting packaging material
		Packaging reduction
		Educate and ban unsustainable packaging
		Packaging recycling
		Take back packaging
	Combined products	
	Returns	Second hand sale at lower price
		More knowledge on consumer preferences
		Create awareness for consumer
	Transport / Delivery	Efficient transport routes
Low-impact transport		
Crowd-shipping		
Collection points		
Bundled delivery		
Data centre devices	Energy use	Renewable energy sourcing
		Energy efficiency
	Production	Lower impact material
		Recycled materials
	Disposal	Recycle/reuse materials
		Eco-friendly disposal

Table 20: Problem areas and solutions implemented by Amazon, green is addressed, red is not addressed in sustainability report

The summarised results of the PDC scores from Amazon can be found in Table 21. Overall, Amazon’s solutions are quite well explained according to PDCA guidelines, with a score of 5.63 out of nine, indicating that 63% of the PDC criteria are met in their implemented solutions. If you also count solutions that were not implemented this amounts to 20%. The combined PDC-score for Amazon is 41, meaning that 41 PDC criteria are satisfied across their four solutions. Detailed analysis shows that most of these criteria are related to the Do phase of the PDC cycle, covering sixteen criteria. The Plan phase follows with thirteen criteria, and the Check phase includes twelve criteria.

Overview table	
Variable name	Amazon score
# Problems addressed (out of 6)	4
# Solutions used (out of 20)	7
Combined P-score	13
Combined D-score	16
Combined C-score	12
Combined PDC-score	41
Average score per solution (1-9)	2,05
Average score per solution (%)	22,78%
Average score per problem (1-9)	1,83
Average score per problem (%)	20,31%
Average score per active problem (1-9)	5,63
Average score per active problem (%)	62,50%

Table 21: Overview table of Amazon's SPC results

#### 4.2.7. External expert interview

To get more insights on the inner workings of sustainability reports all six companies were contacted to discuss the findings. However, none of the companies indicated to have time for interviews. The candidates were contacted through official business emails, headquarters inquiries, and LinkedIn requests, none were available or willing to participate in interviews as can be seen in Appendix 5. However, all of the respondents indicated to not having time available for an interview.

In order to still get more insight into sustainability reports, a reporting expert was interviewed instead. An interview with the former CEO of CDP (Carbon Disclosure Project Europe) and CEO of GFN (Global Footprint Network), with over two decades of experience in sustainability reporting and environmental metrics, highlighted several recurring issues in corporate sustainability reports. These issues are pivotal in understanding the current landscape and the challenges faced by organisations in this domain. The highlights of the interview are described below. The summarised transcript can be found in Appendix 3.

The CEO stated that a significant challenge lies in the inconsistencies in data quality and the lack of standardisation across different reporting frameworks. This disparity makes it difficult to compare and assess the sustainability performance of various companies accurately. Additionally, many companies resist disclosing sensitive information, citing competitive sensitivity, confidentiality concerns, and the perceived risk of negative publicity. This resistance often results in incomplete or polished public sustainability reports that highlight positive achievements while omitting critical areas needing improvement.

Common inaccuracies in sustainability reports include the underreporting of greenhouse gas emissions, inconsistent accounting of scope 3 emissions, and discrepancies in data year-on-year due to changes in reporting boundaries or methodologies. These inaccuracies

often stem from a lack of robust data collection processes or deliberate attempts to present a more favourable environmental performance.

To address these challenges, the CEO emphasised the importance of clear and standardised reporting frameworks, technical assistance, and capacity-building programs. Providing platforms for peer learning and best practice sharing can also encourage companies to improve their reporting accuracy and transparency. Engaging in dialogues to build trust and demonstrating the value of transparency in mitigating reputational risks have proven effective. For instance, when a major retailer was resistant to disclosing their supply chain emissions data, a series of dialogues, technical support, and a secure platform for data sharing eventually persuaded them to disclose the necessary information.

The CEO's organisations focus on driving transparency and accountability in corporate environmental reporting, aiming to catalyse action on climate change by providing a comprehensive platform for companies to disclose their environmental impact. However, despite these efforts, not all sectors fully account for the environmental impact of digitalization in their sustainability reports. The retail sector often overlooks the full scope of digitalization impacts, such as the carbon footprint of digital infrastructure and consumer use-phase impacts.

Technological advancements, such as data analytics, blockchain technology for supply chain transparency, and AI-driven tools for automated data collection and analysis, have significantly improved data accuracy and transparency. These technologies help streamline reporting processes, reduce human error, and enhance the traceability of environmental impacts across complex supply chains.

Regulatory pressure also plays a crucial role in ensuring accurate and transparent reports. Robust regulatory frameworks set clear expectations and create a level playing field, ensuring that all companies adhere to consistent standards. Regulatory oversight provides accountability and incentivizes companies to invest in better data collection and reporting practices.

In conclusion, addressing the challenges of obtaining accurate and transparent sustainability reports requires a collaborative effort across all stakeholders, continuous improvement in reporting standards, and technological innovation. The commitment to transparency and accountability remains essential in advancing corporate sustainability reporting and driving meaningful environmental action.

## 4.3. Results 2: Comparative analysis of the cases

### 4.3.1. Introduction

The second part of the results involves comparing the individual findings of each company with one another. Each company has also been assessed based on the SPC-criteria. Additionally, the results of these comparisons are examined considering the expert interview highlights to verify their accuracy.

### 4.3.2. SPC comparison

The analysis of sustainability reports from six companies reveals distinct trends and variances in the adoption and explanation of implemented solutions based on academic research. The following sections highlight these trends, focusing on the quantity and quality of the solutions, the phases of the PDC cycle they address, and the overall comprehensiveness of their sustainability efforts.

The combined PDC-score, which sums the criteria met across all implemented solutions, offers a perspective on the comprehensiveness of each company's sustainability efforts. As can be seen in Figure 7, Amazon leads with a total score of 41, followed by Apple with 31, Bol.com with 24, Coolblue with 15, ASOS with 14, and Boohoo with 9. These scores reinforce the observation that Amazon and Apple are more thorough in their sustainability reporting.

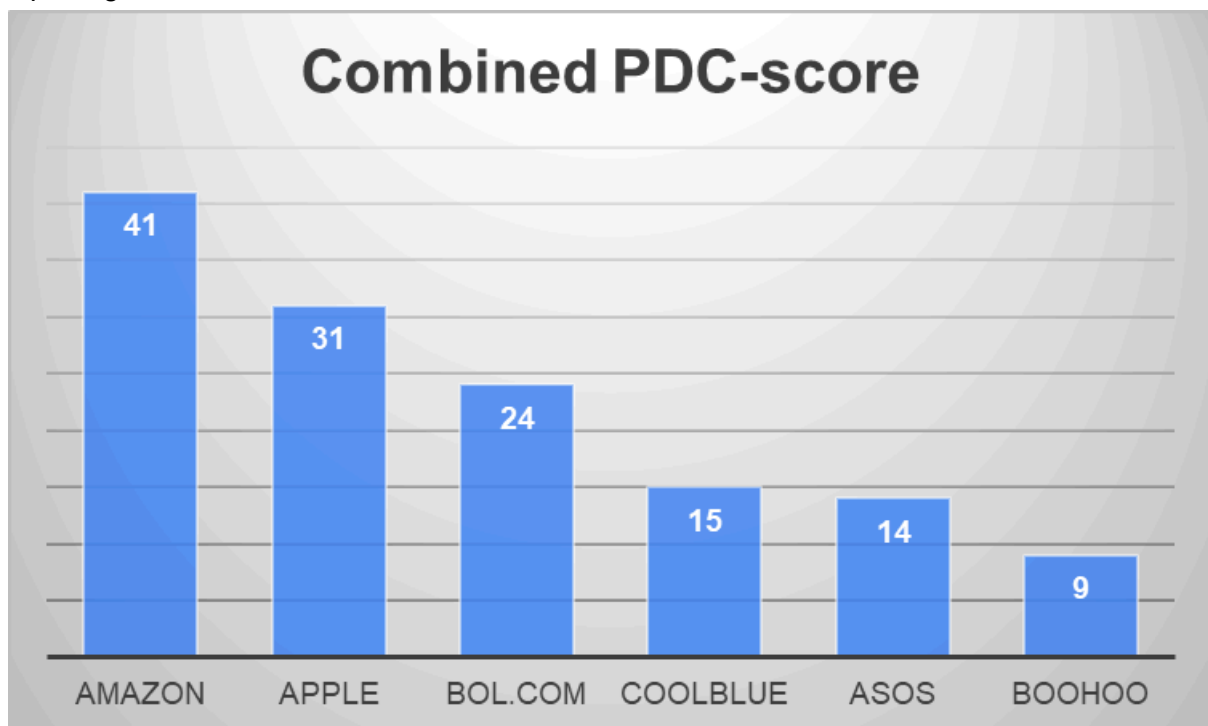


Figure 7: PDC-score of each company out of 180

Apple's distribution is more balanced with twelve criteria in the Plan phase, eleven in the Do phase, and eight in the Check phase, indicating a well-rounded approach. Amazon exhibits the highest numbers across all phases: sixteen criteria in the Do phase, thirteen in the Plan phase, and twelve in the Check phase, reflecting a comprehensive application of the PDC cycle. The distribution of these scores in all three phases of the PDC can be found in Figure 8.

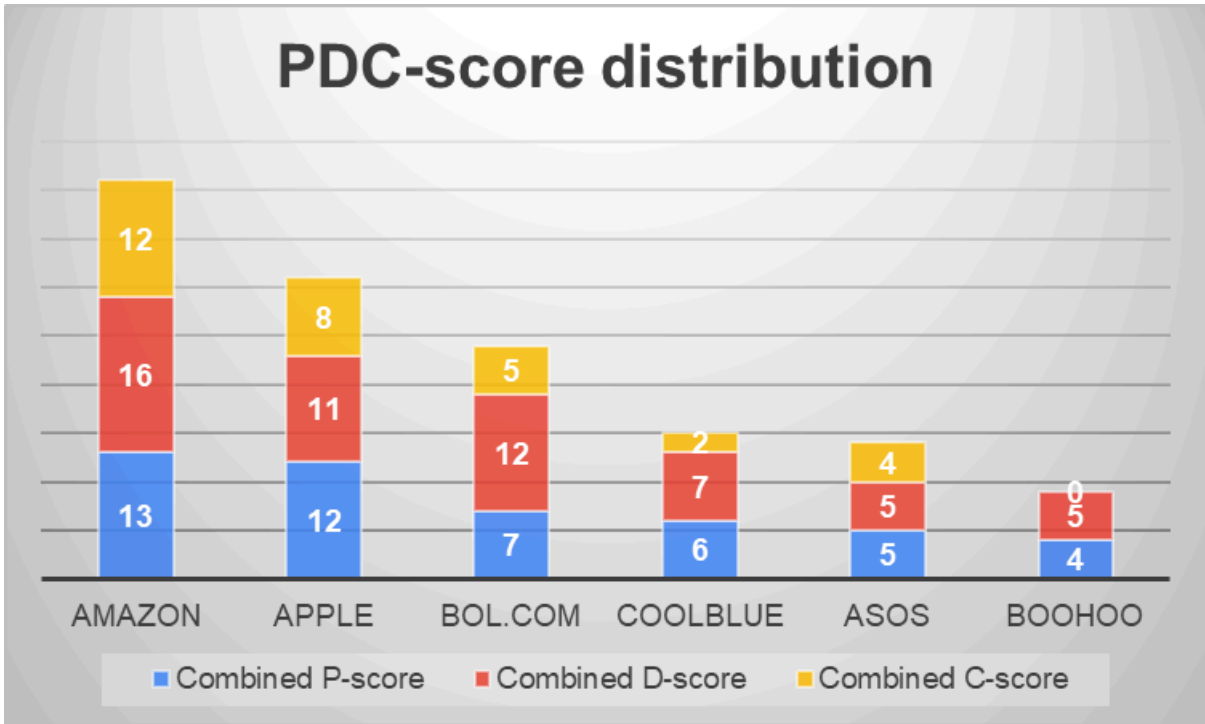


Figure 8: PDC-score distribution of each company out of 180

A common trend is the focus on addressing the three primary impacts of products and services in digital retail. All companies, except Boohoo and ASOS, target the three problem areas of their product and services as can be seen in Table 22. Additionally, Apple and Amazon are the only companies that also implement solutions aimed at reducing the environmental impact of data centres, indicating a broader scope of environmental considerations in their sustainability efforts.

Variable name	Amazon	Apple	ASOS	Boohoo	Coolblue	bol.com	Best of all cases	Average of all cases
# Problem areas addressed (out of 6)	4	3	2	2	3	3	4	2,83
# Solutions used (out of 20)	7	6	3	3	4	7	7	5,00
Combined P-score	13	12	5	4	6	7	13	7,83
Combined D-score	16	11	5	5	7	12	16	9,33
Combined C-score	12	8	4	0	2	5	12	5,17
Combined PDC-score	41	31	14	9	15	24	41	22,33
Average score per solution (1-9)	2,05	1,55	0,7	0,45	0,75	1,2	2,05	1,12
Average score per solution (%)	22,78%	17,22%	7,78%	5,00%	8,33%	13,33%	22,78%	12,41%
Average score per problem (1-9)	1,83	1,61	0,40	0,26	0,59	0,78	1,83	0,91
Average score per problem (%)	20,31%	17,84%	4,44%	2,84%	6,54%	8,64%	20,31%	10,10%
Average score per implemented problem (1-9)	5,63	5,06	4,00	2,50	4,17	3,17	5,63	4,09
Average score per implemented problem (%)	62,50%	56,17%	44,44%	27,78%	46,30%	35,19%	62,50%	45,40%

Table 22: Overview table of PDC-scoring for all six companies, companies with the highest score of a variable are coloured

ISO-14001 standards, ISO-26000 guidelines and GRI are all (widely supported) tools that can be used by companies to further deepen and structure the content of their sustainability

reports. However, while Amazon, Apple and ASOS all use ISO-14001, only Amazon and Apple score high on the PDC-scoring of Table 22. ASOS on the other scores amongst the lowest of all six companies.

The quality of the explanations for the implemented solutions, measured by the PDC-score, also varies among the companies as can be seen in Table 22 and Figure 9. Amazon leads with a PDC-score of 5.63, meaning 63% of the criteria are met, followed by Apple with 5.06 (56%), Coolblue with 4.17 (46%), ASOS with 4.00 (44%), Bol.com with 3.17 (35%), and Boohoo with 2.50 (28%). This suggests that Amazon and Apple not only adopt a higher number of solutions, but also explain them more comprehensively according to PDC criteria of this research.

Examining the distribution of criteria met across the PDC phases provides insight into which aspects of the sustainability cycle each company emphasises. As can be seen in Table 22, for Bol.com, the Do phase is most prominent with twelve criteria, followed by the Plan phase with seven, and the Check phase with five. Coolblue similarly focuses on the Do phase with seven criteria, followed by the Plan phase with six, and the Check phase with two. ASOS shows a more balanced approach with five criteria each for the Plan and Do phases, and four for the Check phase. Boohoo, however, focuses primarily on the Do phase with five criteria and four in the Plan phase, with no criteria met in the Check phase.

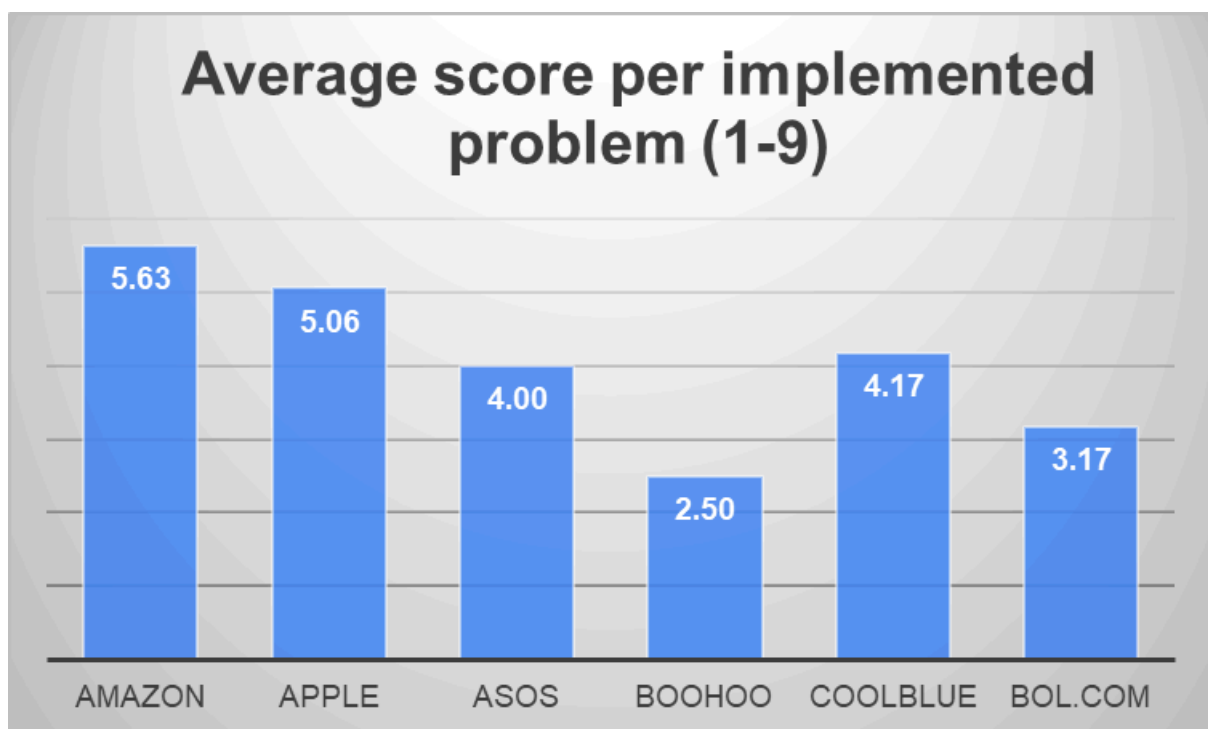


Figure 9: Average PDC-score of each company per implemented problem

The number of solutions (as identified in academic literature) implemented by each company varies significantly. As can be seen in Figure 10, Bol.com and Amazon each incorporate seven solutions, the highest among the six companies. Apple follows with six solutions, Coolblue with four, and both ASOS and Boohoo implement three solutions each. This indicates a range of commitment levels towards integrating academic insights into sustainability practices, with Bol.com and Amazon leading in quantity.

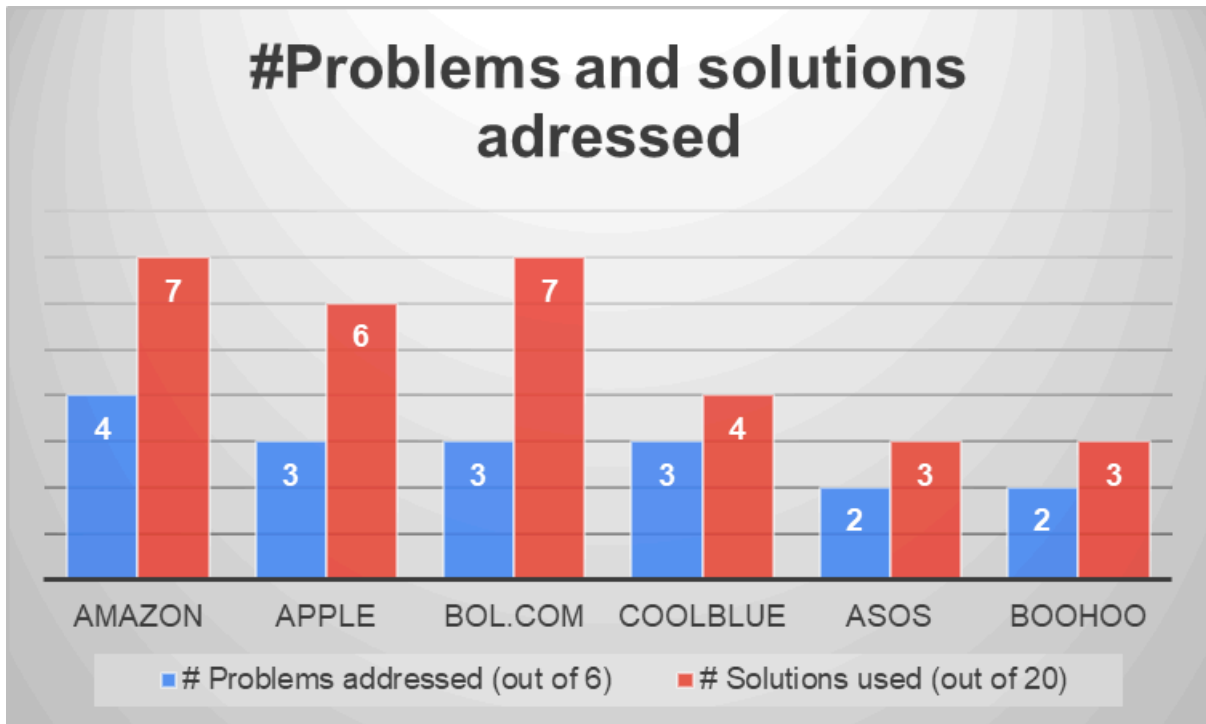


Figure 10: Number of problems and solutions addressed by each company

One other notable key finding is that none of the six companies researched seemed to apply GRI standards disclosure to their sustainability reports. While some companies like Amazon and ASOS mention the use of GRI guidelines and all six companies are members on the official GRI website, none seem to be willing to share the GRI standards numbers. This is further accentuated by the fact that no companies were willing to have an interview discussing these findings. This might be a common trend among digital retail since other sectors do seem to publish this kind of information.

Overall, the data indicates several key trends in the sustainability efforts of these companies. There is a clear variance in the number of academic solutions adopted, with Bol.com and Amazon at the forefront. Most companies focus on addressing the primary impacts of digital retail, but only a few tackle the environmental impacts of data centres. The quality of solution explanations and the thoroughness of the sustainability efforts, as indicated by PDC-scores, show that Amazon and Apple lead in both respects. Lastly, the distribution of criteria across PDC phases highlights varying emphases, with a general trend towards prioritising the Do phase, except for Apple and Amazon, which demonstrate a more balanced approach across all phases.

#### 4.3.3. Explaining the gaps using the interview

The analysis of sustainability reports from six companies highlights significant trends and variances in the adoption and explanation of implemented solutions. The interview with the CEO of CDP Europe and Global Footprint Network offers valuable insights that further underscore the significance of these findings.

One of the primary observations from the analysis is the disparity in the number of solutions adopted by different companies. Bol.com and Amazon lead with seven solutions each,



followed by Apple with six, Coolblue with four, and ASOS and Boohoo with three each. This variance indicates different levels of commitment to integrating academic insights into sustainability practices. The CEO's insights about the challenges in obtaining accurate reports, including inconsistencies in data quality and lack of standardisation, help explain why some companies may adopt fewer solutions. Companies with better internal capacity and expertise, like Amazon and Apple, are likely more equipped to integrate and report on a higher number of solutions comprehensively.

The focus on which type of problem areas to address in digital retail is another key trend. All companies, except Boohoo, address the three problem areas of their product and services, with Apple and Amazon extending their efforts to also address the environmental impact of data centres. The CEO mentions that not all retail companies fully account for the environmental impact of digitalisation, often overlooking aspects like the carbon footprint of digital infrastructure. This aligns with the finding that only Apple and Amazon address data centre impacts, reflecting their broader scope of environmental considerations.

The quality of explanations for the implemented solutions, measured by the PDC-score, varies, with Amazon leading at 5.63 and Boohoo trailing at 2.50. The CEO's emphasis on the importance of regulatory pressure and standardised reporting frameworks is pertinent here. Companies with higher PDC-scores likely benefit from robust internal systems and external regulatory pressures that drive comprehensive and transparent reporting. Amazon and Apple's high scores suggest they are more thorough in their approach, aligning with the CEO's point about the role of stakeholder pressure in enhancing transparency and accuracy.

The combined PDC score, summing criteria met across all implemented solutions, further supports the observation that Amazon and Apple lead in comprehensiveness, scoring 41 and 31, respectively. This aligns with the CEO's mention of effective solutions like technical assistance and capacity-building programs, which likely contribute to these companies' thorough sustainability efforts. Both companies are also non-European which can be the cause of these results and will be further discussed in the discussion.

The distribution of criteria across the PDC phases reveals varying emphases among companies. Bol.com and Coolblue focus more on the Do phase, while Apple and Amazon show a balanced approach across all phases, reflecting a comprehensive application of the PDC cycle. The CEO's insights on the challenges of tracking digital impacts, such as emissions from logistics and data centres, explain why companies might focus differently on PDC phases based on their capabilities and focus areas.

In conclusion, the interview with the CEO enriches the understanding of the sustainability report analysis by providing context to the observed trends and variances. The challenges of data accuracy, the importance of regulatory frameworks, and the need for comprehensive solutions are critical factors that influence how companies report and implement sustainability practices. The insights help elucidate why certain companies lead in both the quantity and quality of their sustainability efforts, highlighting the interplay between internal capabilities, external pressures, and strategic focus.

## 5. Discussion

### 5.1. Theoretical Implications

Table 23 reveals a strong correlation between academic mentions and sustainability report mentions for problem areas. This indicates that issues highlighted in academic literature are similarly emphasised in sustainability reports. The correlation between academic mentions and sustainability report mentions for implemented solutions is a lot lower, suggesting a lesser degree of alignment between academic discussions and sustainability reporting on proposed solutions. An example of this is the solution "Collection points" which has five academic mentions but not one mention in sustainability reports. This discrepancy suggests that this solution is more prominently featured in academic research than in practical sustainability efforts. Conversely, "Low-impact transport" has few academic mentions and many practical applications.

Overall, the findings indicate a general alignment between academic research and sustainability reporting for problem areas, while the low correlation for solutions and the presence of outliers highlight areas where practical sustainability efforts may be advancing ahead of academic research or vice versa. The discrepancy between academic mentions and practical implementation might be due to practical feasibility of certain solutions. While the solutions are useful on paper, practical implementation makes it difficult and vice-versa.

Overall, solutions that have more consumer involvement or require certain actions to be taken by them are less used in sustainability reports. Some examples of this are "Collection points", "More knowledge on customer preference" and "Create awareness for customers". These more social solutions are also more difficult to describe, in terms of applications and results, quantitatively in sustainability reports. The dual nature of a company is not very well integrated as of yet, while the physical dynamics are well documented and applied, the social dynamics are lacking and require more attention.

Lastly, Table 23 clearly shows that both academic and practical focus on the third major development of recent decades, digitalization, and specifically the effects of data centres, is very limited. Only Apple and Amazon give it some attention and it is only focussed on energy use. Other impacts such as "Production of digital devices" and "Disposal of digital devices" are not addressed, and no solutions are implemented either. Circular actions are more discussed in literature and practical application, but some solutions, such as "Take back packaging" are not commonly used yet.

PROBLEM AREAS	#Academic mentions	#Sus. report mentions (out of 6)	SOLUTION	#Academic mentions	#Sus. report mentions (out of 6)
Packaging during transport	9	6	Less polluting packaging	3	4
			Packaging reduction	5	4
			Educate and ban unsustainable packaging	2	0
			Packaging recycling	4	4
			Take back packaging	2	1
			Combined products	1	1
Returns	10	3	Second hand sale at lower price	3	3
			More knowledge on consumer preferences	2	1
			Create awareness for consumer	1	0
Transport	10	6	Efficient transport routes	6	1
			Low-impact transport	2	6
			Crowd-shipping	1	0
			Collection points	5	0
			Bundled delivery	1	1
Energy use of data centres	1	2	Renewable energy sourcing	0	2
			Energy efficiency	0	2
Production of data centre devices	0	0	Lower impact material	0	0
			Recycled materials	0	0
Disposal of data centre devices	0	0	Recycle/reuse materials	0	0
			Eco-friendly disposal	0	0

Table 23: Number of SCOPUS mentions for each problem areas and their associated solutions and Number of problems and solutions addressed by all six companies

In Table 24 the use of standards and guidelines is shown for all six companies researched. By comparing Table 24 and Table 22. The correlation between the use of standards and guidelines and the SPC-score for the six companies highlights an interesting pattern. Companies that incorporate more standards and guidelines generally achieve higher SPC scores. However, there are notable exceptions.

Amazon and Apple, which use various standards and guidelines (as indicated by multiple green cells in Table 24, show strong SPC performance with a combined PDC score of 41 and 31 respectively. This suggests a positive correlation between the use of standards and higher SPC scores. Conversely, bol.com, which only has a GRI account, still achieves a relatively high combined PDC-score of 24. This indicates that while the use of standards is generally beneficial, other factors may also contribute significantly to SPC performance.

Another outlier is ASOS which like Amazon and Apple utilises various standards and guidelines but only has a combined PDC-score of 14. However, this outlier can be attributed to the clothing sector since Boohoo, which is in the same sector as ASOS, only uses one standard and scores lower than ASOS with a combined PDC-score of 9.

The fact that companies have a GRI account but have very limited application of it in their sustainability reports seems to indicate that there is a gap between their commitment to sustainability frameworks and their actual reporting practices. This discrepancy may suggest that companies are either not fully integrating these guidelines into their operations or are possibly using the GRI account for symbolic purposes rather than substantive reporting. Conversely, the fact that companies have an ISO-14001 certification but do not include it in their sustainability reports shows that there may be a lack of transparency or recognition of their environmental management achievements in their public disclosures.

	Amazon	Apple	ASOS	Boohoo	Coolblue	bol.com
ISO-14001 certified	Green	Green	Green	Red	Red	Red
ISO-14001 mention in sustainability report	Red	Green	Red	Red	Red	Red
ISO-26000 mention in sustainability report	Red	Red	Red	Red	Red	Red
GRI account	Green	Green	Green	Green	Green	Green
GRI in sustainability report	Green	Red	Green	Red	Red	Red
"Digital impact" mention in sustainability report	Red	Red	Red	Red	Red	Red

Table 24: Use of standards and guidelines of companies

Comparing the results from Table 24 with Figure 11 and 12 shows that a vast more number of organisations are ISO-14001 certified compared to utilising GRI. This trend is not the same in Table 24 where both GRI and ISO-14001 are not put at the forefront of sustainability reports. While all six companies researched have an GRI account, the use of GRI standards and guidelines within their reports is very limited and only performed to a certain degree by few companies. None of the companies have described any GRI topic fully within their public sustainability reports as can be seen in “Results 1”.

Number of ISO 14001 certified organisations

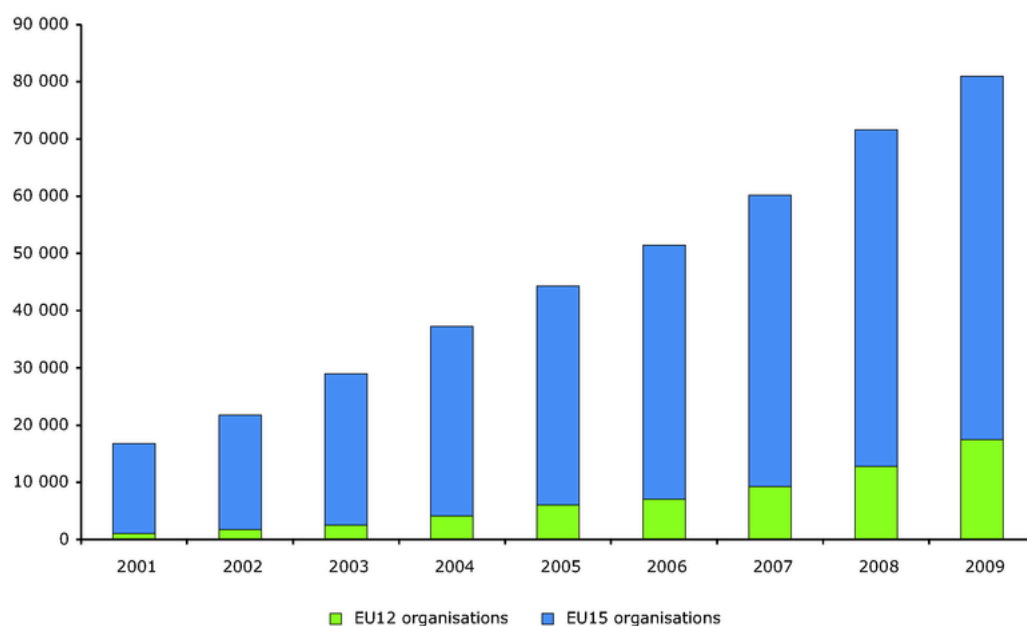


Figure 11: Number of organisations with registered environmental management system according to ISO 14001 within EU member countries (European Environment Agency, n.d.)

Number of organisations publishing reports according to the Global Reporting initiative (GRI) standard

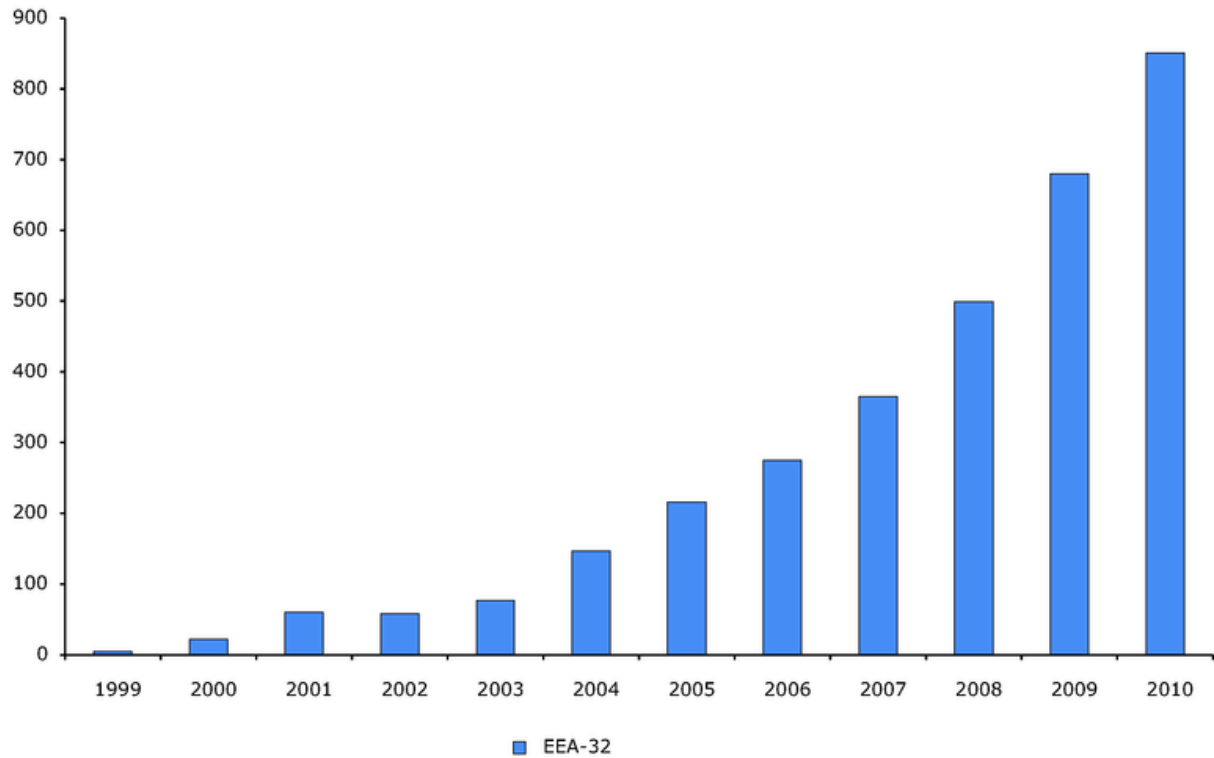


Figure 12: Number of organisations publishing environment and sustainability reports according to the Global Reporting initiative (GRI) standard (European Environment Agency, n.d.)

This study extends current theoretical insights into corporate sustainability by providing a detailed examination of how companies integrate academic research into their sustainability practices. It highlights the variability in both the quantity and quality of solutions adopted by different companies. The findings suggest that while some companies, such as Amazon and Bol.com, are more proactive in adopting multiple academic solutions, others like Boohoo lag behind. This disparity can be linked to theoretical models of corporate behaviour, which suggest that organisational commitment to sustainability varies widely and is influenced by factors such as company size, market pressure, and leadership priorities.

The research findings indicate that among the three key developments in the value chain—globalisation, sustainability, and digitization—digitalization has not been fully integrated into current business practices. Companies tend to focus on the impacts of their products and services rather than the impacts of their data centres. While larger companies like Apple and Amazon consider the energy consumption of their data centres, they do not currently address the environmental impacts associated with the production and disposal of the digital devices used in these centres. This oversight represents a significant environmental concern.

Overall, in terms of efforts towards circularity, according to Reike, most of the options used by companies have low CE value retention. Options to reduce unnecessary use of their products are not put forward and seen as a priority. Most companies mostly reduce the stress with lower impact CE value retention such as recycling and refurbishing. The results show that no companies actively try to encourage their consumers to be certain about their product choices to reduce unnecessary transport, packaging and product waste.

One of the notable findings in this study is that Apple and Amazon have the best score to report their sustainability solutions. One key difference between those two companies and the other four is that both are significantly larger and are both located in the US. Hence the difference in results might be explained by the size of the company or that the US has more stringent reporting policies than the Netherlands or Europe in general.

The analysis also underscores the importance of the PDC cycle in evaluating the comprehensiveness of implemented solutions. Companies that achieve higher PDC-scores, such as Amazon and Apple, not only adopt more solutions but also provide more thorough explanations, indicating a deeper integration of continuous improvement practices in their sustainability efforts. This aligns with the theory that continuous improvement frameworks, such as PDCA, are critical for effective sustainability management.

Unexpected findings, such as the limited focus on the environmental impact of data centres by most companies, could be explained by a lack of immediate regulatory pressure or awareness about the significant environmental footprint of digital infrastructure. Further research could explore the reasons behind this gap and investigate the impact of emerging regulations and technological advancements on corporate sustainability reporting.

## 5.2. Limitations

The research is limited by the reliance on publicly available sustainability reports, which may not provide a complete picture of each company's sustainability efforts. The quality and comprehensiveness of these reports can vary significantly, impacting the reliability of the analysis. While all of the results are based on the public sustainability reports of the companies researched and there was no interview with those companies to discuss the results, the results are based on reality and common practices. This is done by checking the results with various common practices used to enhance sustainability reports such as ISO-14001, ISO-26000 and GRI as well as the PDCA.

Despite using common practices to analyse the sustainability reports, the question remains if using the PDCA is the best measurement method available. The PDC-scores used in this study are based on 9 criteria used to assess the reports, which could introduce bias since these criteria are not directly cited in the PDCA but are derived from the information from it. There is a lack of transparency from the companies that disables better and more accurate methods. To improve validity, future research could incorporate interviews with company representatives or third-party audits to verify the reported data which in this study was not possible.

Another limitation of a study utilising Amazon, Apple, Boohoo, ASOS, Coolblue, and bol.com to represent the digital retail sector lies in the potential lack of accurate representation. While these companies are prominent within their respective categories—Amazon and bol.com for general online retail, Boohoo and ASOS for fashion retail, and Coolblue and Apple for electronics retail—they do not encompass the full diversity of the digital retail landscape. Their size, market dominance, and geographic focus might not reflect the experiences and practices of smaller or regional players. Furthermore, the sustainability practices of these large corporations may differ significantly from those of smaller firms due to their extensive resources and global reach. Thus, while these six companies provide valuable insights into leading industry practices, the study's findings may not be entirely generalizable across the entire digital retail sector, potentially limiting the applicability of the results to a broader range of businesses.

Moreover, while all six companies operate within the Netherlands, the geographical focus of these companies further limits their representativeness. Amazon and Apple operate globally, whereas bol.com and Coolblue primarily serve the European market, particularly the Netherlands and Belgium. Boohoo and ASOS mainly cater to the UK and international fashion markets. This geographical concentration means the study might overlook regional variations in digital retail practices and sustainability approaches, limiting the applicability of the findings to a broader, more diverse set of markets and companies worldwide.

Furthermore, these companies may not be the best suited for a sustainability-focused study, as they are not necessarily the leaders in sustainable practices within digital retail. Their sustainability efforts have often been criticised or deemed insufficient compared to other companies that prioritise eco-friendly practices and social responsibility. Consequently, the study's findings might not fully capture the best practices in sustainability, reducing its overall relevance and impact for those seeking to understand and emulate leading sustainability strategies in the digital retail sector.

Sensitivity analysis reveals that slight changes in the scoring criteria or interpretation of the PDC phases could affect the overall rankings and insights. Despite these limitations, the research adds value by highlighting key trends and providing a comparative analysis that can inform both academic research and practical applications in corporate sustainability.

### 5.3. Recommendations

Managers should focus on adopting a more comprehensive and streamlined approach to sustainability reporting by addressing all phases of the PDC. This includes not only planning and implementing solutions but also thoroughly checking and acting on the results. Companies like Amazon and Apple, which show balanced efforts across all phases, serve as models for best practices.

Managers should also prioritise the inclusion of solutions that address the environmental impact of data centres, as this is an area often overlooked but crucial for reducing the overall carbon footprint of digital retail operations.

Lastly, policymakers should consider establishing standardised reporting frameworks to enhance the comparability and consistency of sustainability reports. This could involve

mandating disclosures on specific environmental impacts, such as data centres, and providing guidelines on integrating academic research into corporate sustainability strategies.

## 5.4. Future Research

Future research should explore the barriers that prevent companies from fully addressing the environmental impacts of digital infrastructure. Additionally, investigating the role of technological advancements and regulatory changes in shaping sustainability reporting practices could provide deeper insights into how companies can improve their sustainability efforts.

In conclusion, while the research highlights significant trends and variances in corporate sustainability reporting, addressing the limitations and following the recommendations can enhance the reliability and comprehensiveness of future analyses. By adopting more rigorous and standardised reporting practices, companies can better align their sustainability efforts with academic insights and regulatory expectations, ultimately contributing to more effective environmental stewardship.



## 6. Conclusion

This study sought to answer the research question: "What are the environmental implications of online retail, specifically examining the interactions between consumers and producers, and how do companies deal with it?" To address this, the study focused on six digital retail companies: Bol.com, Amazon, Boohoo, ASOS, Coolblue, and Apple. Through an analysis of their sustainability reports, the study explored the impact of digitalisation on environmental sustainability and evaluated how these companies address these impacts in their sustainability practices.

The research revealed that most companies have solutions in place to deal with most environmental impacts of their products and services in digital retail. However, very little attention is given towards the dealing with the environmental impact from data centres, only Apple and Amazon have solutions in place, but those are only aimed at the energy use of data centres and not the production and disposal of the digital devices used.

Furthermore, the number of solutions implemented to deal with the environmental impact of digital retail and the adherence to PDCA guidelines varies per sector and the company size. Amazon and Apple, which are both very large companies, score very high on the SPC (Sustainable Performance Checklist). Companies in the general online retail sector, such as bol.com and Amazon, also score quite high. However, companies that are smaller in size and are not in the general online retail sector score overall very low.

Key findings indicate that the use of guidelines or standards within sustainability reports made the companies SPC-score higher overall. This is quite notable when comparing the scores of Boohoo and ASOS. ASOS, which uses those standards and guidelines to a higher degree, has a higher overall score than Boohoo. Apple and Amazon which both have the highest scores by far also utilise those standards and guidelines.

To enhance the environmental sustainability of digital retail, companies must prioritise transparency and standardisation in their reporting practices. This includes adopting comprehensive sustainability frameworks that cover all aspects of their operations and actively working to mitigate the unique environmental impacts of digitalisation. Policymakers also have a critical role to play in establishing mandatory reporting guidelines and incentivizing companies to adopt best practices in sustainability.

In conclusion, while the research highlights significant trends and variances in corporate sustainability reporting, addressing the limitations and following the recommendations can enhance the reliability and comprehensiveness of future analyses. By adopting more rigorous and standardised reporting practices, companies can better align their sustainability efforts with academic insights and regulatory expectations, ultimately contributing to more transparent sustainability reports.

The take-home message from this thesis is that digitalisation in the retail sector presents both opportunities and challenges for sustainability. On the one hand, digital retail can lead to more efficient use of resources and reduction in waste through better inventory management and logistics optimization. On the other hand, it also introduces new

environmental challenges such as increased environmental impacts from data centres and logistics, as well as higher return rates leading to more waste. Therefore, it is imperative for companies to adopt a holistic approach to sustainability reporting and implementation, ensuring that all phases of the PDC cycle are addressed comprehensively.

# References

- Alsufyani, N., & Gill, A. Q. (2022). *Digitalisation performance assessment: A systematic review*. *Technology in Society*, 68, 101894. <https://doi.org/10.1016/j.techsoc.2022.101894>
- Bol & Corporate Social Responsibility*. (n.d.). Bol.Newsroom. <https://pers.Bol.com/en/Bol-com-corporate-social-responsibility/>
- Bressanelli, G., Adrodegari, F., Pigosso, D. C. A., & Parida, V. (2022). Circular economy in the digital age. *Sustainability*, 14(9), 5565. <https://doi.org/10.3390/su14095565>
- Cagno, E., Neri, A., Negri, M., Bassani, C. A., & Lampertico, T. (2021). The Role of Digital Technologies in Operationalizing the Circular Economy Transition: A Systematic Literature review. *Applied Sciences*, 11(8), 3328. <https://doi.org/10.3390/app11083328>
- European Environment Agency (n.d.). *Number of organisations publishing environment and sustainability reports according to the Global Reporting initiative (GRI) standard*. <https://www.eea.europa.eu/data-and-maps/figures/number-of-organisations-publishing-environment>
- European Environment Agency. (n.d.). *Number of organisations with registered environmental management system according to ISO 14001 within EU member countries*. <https://www.eea.europa.eu/data-and-maps/figures/number-of-organisations-with-registered-1>
- Feenstra, R., & Hanson, G. (1996). *Globalization, outsourcing, and wage inequality*. <https://doi.org/10.3386/w5424>
- Gereffi, G., Humphrey, J., & Sturgeon, T. J. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1), 78–104. <https://doi.org/10.1080/09692290500049805>
- Islam, T., & Huda, N. (2018). Reverse logistics and closed-loop supply chain of Waste Electrical and Electronic Equipment (WEEE)/E-waste: A comprehensive literature review. *Resources, Conservation and Recycling*, 137, 48–75. <https://doi.org/10.1016/j.resconrec.2018.05.026>
- Isniah, S., Purba, H. H., & Debora, F. (2020). Plan do check action (PDCA) method: literature review and research issues. *Jurnal Sistem dan Manajemen Industri*, 4(1), 72-81. <https://doi.org/10.30656/jsmi.v4i1.2186>
- MacDonald, J. P. (2005). Strategic sustainable development using the ISO 14001 Standard. *Journal of Cleaner Production*, 13(6), 631–643. <https://doi.org/10.1016/j.jclepro.2003.06.001>
- Muthu, S. S. (2014). Assessing the environmental impact of textiles and the clothing supply chain. In *Elsevier eBooks*. <https://doi.org/10.1016/c2013-0-16461-6>
- News from Bol*. (n.d.). Bol.Newsroom. <https://pers.Bol.com/en/news/>
- Pavlidis, G. (2022). The digital transformation of the global green bonds market: New-fashioned international standards for a new generation of financial instruments. In *Data Governance in AI, FinTech and LegalTech* (pp. 263-278). Edward Elgar Publishing. <https://doi.org/10.4337/9781800379954.00020>
- Piscicelli, L. (2023). The sustainability impact of a digital circular economy. *Current Opinion in Environmental Sustainability*, 61, 101251. <https://doi.org/10.1016/j.cosust.2022.101251>

- Reike, D., Vermeulen, W. J., & Witjes, S. (2018). The circular economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options. *Resources Conservation and Recycling*, 135, 246–264. <https://doi.org/10.1016/j.resconrec.2017.08.027>
- Stahel, W. R. (2013). Policy for material efficiency—sustainable taxation as a departure from the throwaway society. *Philosophical Transactions of the Royal Society A*, 371(1986), 20110567. <https://doi.org/10.1098/rsta.2011.0567>
- Tang, Y. M., Chau, K. Y., Fatima, A., & Waqas, M. (2022). Industry 4.0 technology and circular economy practices: business management strategies for environmental sustainability. *Environmental Science and Pollution Research*, 29(33), 49752–49769. <https://doi.org/10.1007/s11356-022-19081-6>
- Vermeulen, W. J., & Witjes, S. (2016). On addressing the dual and embedded nature of business and the route towards corporate sustainability. *Journal of Cleaner Production*, 112, 2822–2832. <https://doi.org/10.1016/j.jclepro.2015.09.132>
- Wang, H., Wu D., Zeng. Y. (2023). Digital economy, market segmentation and carbon emission performance. *Environment, Development and Sustainability*. [https://www.researchgate.net/publication/371564045\\_Digital\\_economy\\_market\\_segmentation\\_and\\_carbon\\_emission\\_performance](https://www.researchgate.net/publication/371564045_Digital_economy_market_segmentation_and_carbon_emission_performance)
- Warmington-Lundström, J., & Laurenti, R. (2020). Reviewing circular economy rebound effects: The case of online peer-to-peer boat sharing. *Resources, Conservation & Recycling: X*, 5, 100028. <https://doi.org/10.1016/j.rcrx.2019.100028>
- Widmer, R., Oswald-Krapf, H., Sinha-Khetriwal, D., Schnellmann, M., & Böni, H. (2005). Global perspectives on e-waste. *Environmental Impact Assessment Review*, 25(5), 436–458. <https://doi.org/10.1016/j.eiar.2005.04.001>
- Yang, A., Lin, R., Shi, T., Xiao, H., Shen, W., & Ren, J. (2021). Methods in sustainability science. In *Elsevier eBooks* (pp. 1–12). <https://doi.org/10.1016/b978-0-12-823987-2.00015-5>

# Appendices

## Appendix 1: Consent form for interviews

### Consent to take part in research

- I..... voluntarily agree to participate in this research study.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
- I understand that participation involves explaining the extent to which my company is involved on sustainability issues.
- I understand that I will not benefit directly from participating in this research.
- I agree to my interview being audio-recorded.
- I understand that all information I provide for this study will be treated confidentially.
- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.
- I understand that disguised extracts from my interview may be quoted in this research paper as well as an academic presentation.
- I understand that if I inform the researcher that myself or someone else is at risk of harm, they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.
- I understand that signed consent forms and original audio recordings will be retained in secure UU servers with only the researcher having access to it until the exam board of the researcher confirms the results of their dissertation.
- I understand that a transcript of my interview in which all identifying information has been removed will be retained for two years from the date of the exam board.

- I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above.
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

*Signature of research participant*

-----  
Signature of participant

-----  
Date

*Signature of researcher*

I believe the participant is giving informed consent to participate in this study

-----  
Signature of researcher

-----  
Date

## Appendix 2: Criteria for PDC-score

- **Plan**
  - What problem does it resolve
    - Is there a description of the issue being tackled, including some background and impact of the issue?
  - What is the target
    - Does the paper specify the goals or outcomes that the project aims to achieve? This description can be pretty vague as long as it is related to the issue.
  - When does it want to achieve the target
    - The company provides a clear date by which the goals have to be reached
- **Do**
  - Results are shown
    - Provide a comprehensive and clear presentation of the results with quantitative data
  - Method of implementation is described
    - Is there a description of the plan that was carried out?
  - Barriers described
    - Are specific barriers or challenges encountered during the project clearly identified and described (directly or indirectly)?
- **Check**
  - Progress checked yearly
    - Is there documentation of progress reviews or reports conducted annually or is there any data on last years' results?
  - Development of goal and achievement over time
    - The paper discusses previous goals that were achieved at earlier points in the project.
  - Was the previous goal reached
    - There is a clear statement indicating whether the goals set for the previous year were achieved or not.

## Appendix 3: Interview with an expert: main points

### Background and Experience

*Can you briefly describe your background and the mission of your company?*

As the CEO of CDP Europe (formerly Carbon Disclosure Project) and Global Footprint Network (GFN), as well as Special Advisor on Sustainability to the EU's EFRAG, I bring over two decades of expertise in sustainability reporting and environmental metrics. Both organisations are dedicated to driving transparency and accountability in corporate environmental reporting. Our mission is to catalyse action on climate change by providing a comprehensive platform for companies to disclose their environmental impact and to use this data to manage and reduce their carbon footprint effectively.

*How long have you been working in the reporting industry, and what motivated you to enter this field?*

I have been deeply involved in the reporting industry for over 20 years. My motivation to enter this field stemmed from a strong commitment to environmental sustainability and a desire to leverage data to drive meaningful change. Witnessing the gap between corporate actions and environmental accountability, I saw an opportunity to influence how businesses measure, manage, and disclose their environmental impact.

### Challenges in Obtaining Accurate Reports

*What are some of the biggest challenges your company faces when trying to obtain accurate reports from other companies?*

The primary challenges we face include inconsistencies in data quality, lack of standardisation across different reporting frameworks, and resistance from companies in disclosing sensitive information. Additionally, there is often a lack of internal capacity and expertise within companies to collect and report accurate data.

*How difficult would it be as a private researcher to get access to those reports?*

As a private researcher, accessing comprehensive and accurate reports can be quite challenging. Many companies restrict access to detailed environmental data to maintain competitive advantage or due to confidentiality concerns. While some information is available publicly, accessing the full depth of data often requires direct engagement with the companies or leveraging established relationships within the industry.

*Can you share any examples of common inaccuracies or discrepancies you encounter in company reports?*

Common inaccuracies include underreporting of greenhouse gas emissions, inconsistent accounting of scope 3 emissions, and discrepancies in data year-on-year due to changes in reporting boundaries or methodologies. These inaccuracies often arise from a lack of robust data collection processes or deliberate attempts to present a more favourable environmental performance.



*How would you rate the quality of public sustainability reports compared to private reports?*

Public sustainability reports often provide a polished and high-level overview of a company's environmental impact, focusing on positive achievements. In contrast, private reports, especially those used internally or submitted to regulatory bodies, tend to be more detailed and comprehensive, reflecting the full scope of environmental impact, including challenges and areas needing improvement.

### Transparency Issues

*What reasons do companies usually give for withholding information or not being fully transparent?*

Companies often cite competitive sensitivity, confidentiality concerns, and the perceived risk of negative publicity as reasons for withholding information. Additionally, there may be internal challenges such as inadequate data collection systems, lack of expertise, or resource constraints that hinder full transparency.

*Can you describe a situation where a company was particularly resistant to providing transparent information? How did you handle it?*

In one instance, a major retailer was resistant to disclosing their supply chain emissions data, citing competitive concerns. We addressed this by engaging in a series of dialogues to build trust, demonstrating the value of transparency in mitigating reputational risks, and highlighting industry best practices. By providing a secure platform for data sharing and offering technical support, we eventually persuaded them to disclose the necessary information.

### Impact and Consequences

How has digitalisation altered the environmental impact in the interaction between final producers and consumers in online retail shops in their reporting?

Digitalisation has significantly increased the complexity of tracking environmental impacts due to the rise of e-commerce and global supply chains. While it has enabled better data collection and analytics, it has also introduced challenges in capturing the full environmental footprint of online transactions, including emissions from logistics, packaging waste, and increased energy consumption from data centres.

Are there significant differences between sectors?

Yes, different sectors face unique challenges and opportunities in reporting environmental impacts. For example, the manufacturing sector might struggle with quantifying emissions from complex supply chains, while the technology sector might focus more on energy

efficiency and electronic waste. Retail sectors, especially online, grapple with packaging and logistics impacts.

Do retail companies take all factors of the environmental impact of digitalisation into account when creating their sustainability reports?

Not all retail companies fully account for the environmental impact of digitalisation in their sustainability reports. While some leading companies are beginning to address issues such as packaging waste and emissions from logistics, many still overlook the full scope of digitalisation impacts, such as the carbon footprint of digital infrastructure and consumer use-phase impacts.

What are common issues for companies when reporting impacts of digitalisation?

Common issues include lack of standardised metrics for digital impacts, difficulties in tracking and quantifying emissions from online activities, and the rapid pace of technological change outstripping reporting capabilities. Additionally, there is often insufficient integration of digitalisation impacts into broader sustainability strategies.

## Strategies and Solutions

What strategies have you found effective in encouraging companies to provide more accurate and transparent reports?

Effective strategies include providing clear and standardised reporting frameworks, offering technical assistance and capacity-building programs, and creating platforms for peer learning and best practice sharing. Additionally, leveraging stakeholder pressure, such as investor demands and consumer expectations, can motivate companies to enhance their transparency and accuracy.

Are there any technological tools or innovations that have helped improve data accuracy and transparency?

Yes, advancements in data analytics, blockchain technology for supply chain transparency, and AI-driven tools for automated data collection and analysis have significantly improved data accuracy and transparency. These technologies help streamline reporting processes, reduce human error, and enhance the traceability of environmental impacts across complex supply chains.

How important is regulatory pressure in ensuring companies provide accurate and transparent reports?

Regulatory pressure is crucial in driving companies to provide accurate and transparent reports. Robust regulatory frameworks set clear expectations and create a level playing field, ensuring that all companies adhere to consistent standards. Regulatory oversight also

provides accountability and can incentivise companies to invest in better data collection and reporting practices.

## Closing

Is there anything else you'd like to share about the challenges of obtaining accurate and transparent reports?

Obtaining accurate and transparent reports is an ongoing challenge that requires collaboration across all stakeholders, including companies, regulators, investors, and consumers. Continuous improvement in reporting standards, technological innovation, and fostering a culture of transparency are essential to achieving meaningful progress in corporate sustainability reporting. Thank you for your time and dedication to advancing this critical field.

## Appendix 4: GRI standards and specific topics

STANDARD	TOPIC
GRI 301: Materials 2016	Materials used by weight or volume
	Recycled input materials used
	Reclaimed products and their packaging materials
GRI 302: Energy 2016	Energy consumption within the organisation
	Energy consumption outside of the organisation
	Energy intensity
	Reduction of energy consumption
	Reduction of energy requirements of products and services
GRI 305: Emissions 2016	Direct (Scope 1) GHG emissions
	Energy indirect (Scope 2) GHG emissions
	Other indirect (Scope 3) GHG emissions
	GHG emissions intensity
	Reduction of GHG emissions
	Emissions of ozone-depleting substances
	Nitrogen oxides (NOx), sulfur oxides (SOx), and other significant air emissions
GRI 306: Waste 2020	Waste generation and significant waste-related impacts
	Management of significant waste-related impacts
	Waste generated
	Waste diverted from disposal
	Waste directed to disposal

## Appendix 5: Companies contacted for interview

	Amazon	Apple	ASOS	Boohoo	Coolblue	bol.com
Business emails of companies	<a href="mailto:amazon@bobbery.amsterdam">amazon@bobbery.amsterdam</a> (3 times contacted, no response)	<a href="mailto:media.nl@apple.com">media.nl@apple.com</a> (1 time contacted, redirected to general information website)	<a href="mailto:CR@asos.com">CR@asos.com</a> (4 times contacted, no response)		<a href="mailto:zakelijk@coolblue.nl">zakelijk@coolblue.nl</a> (2 times contacted, semi-automatic negative response)	<a href="mailto:marketing@bol.com">marketing@bol.com</a> (1 time contacted, redirected to general information website)
		<a href="mailto:jason_sisk@apple.com">jason_sisk@apple.com</a> (3 times contacted, no response)			<a href="mailto:marketing@coolblue.nl">marketing@coolblue.nl</a> (3 times contacted, semi-automatic negative response)	
		<a href="mailto:environment-report@apple.com">environment-report@apple.com</a> (4 times contacted, no response)				
Headquarters calls			0044 20 7756 1000 (1 time contacted, redirected to business e-mail)	0044 843 837 0041 (3 times contacted, no response)	010 798 8999 (1 time contacted, redirected to business e-mail)	0031 (0)30 600 8888 (1 time contacted, redirected to business e-mail)

LinkedIn requests	Brittany (Hoedemaker) Murphy (2 times contacted, no response)	Marvin Smith (2 times contacted, no response)	Aimee McDonald (2 times contacted, no response)	Sarah J. (2 times contacted, no response)		Evita Dupker (2 times contacted, no response)
	Barbara Mariani (2 times contacted, no response)	Fabian Langer (2 times contacted, no response)	Jessica Connell (2 times contacted, no response)	Canberk Akgül (2 times contacted, no response)		
Website	<a href="https://aws.amazon.com/government-education/contact/">https://aws.amazon.com/government-education/contact/</a> (2 times contacted, no response)			<a href="https://ie.boohoo.com/page/customer-service-contact-us.html">https://ie.boohoo.com/page/customer-service-contact-us.html</a> (2 times contacted, no response)		

## Appendix 6: SCOPUS search results

Problem	# Mentions	Article	Solution	# Mentions	ARTICLE
Packaging during transport	9	1,3,4,5,6,8,9,12,13	Less polluting packaging	3	1,3,5
			Packaging reduction	5	1,3,4,6,9
			Educate and ban unsustainable packaging	2	1,3
			Packaging recycling	4	1,3,4,5
			Take back packaging	2	1,3
			Combined products	1	1
Returns	10	2,3,5,7,8,10,11,12,13,15	Second hand sale at lower price	3	2,12,15
			More knowledge on consumer preferences	2	2,11
			Create awareness for consumer	1	8
Transport	10	4,6,7,8,9,10,11,13,14,15	Efficient transport routes	6	6,8,9,11,14,15
			Low-impact transport	2	6,9
			Crowd-shipping	1	9
			Collection points	5	7,9,10,12,14
			Bundled delivery	1	9
Energy use	1	8			
Production					
Disposal					

1. Frommeyer, B., Koch, J., Scagnetti, C., Lorenz, M., & Schewe, G. (2023). Recycled or reusable: A multi-method assessment of eco-friendly packaging in online retail. *Journal of Industrial Ecology*, 28(1), 100–115. <https://doi.org/10.1111/jiec.13447>
2. Zha, Y., Sun, Y., Chen, Y., & Zhao, L. (2023). Idlefish or not? Online platform's strategy of secondhand marketplace introduction in the presence of consumer's uncertain preferences and strategic behavior. *Annals of Operation Research/Annals of Operations Research*. <https://doi.org/10.1007/s10479-023-05584-z>
3. Yang, Y., Habib, K., & Wood, M. O. (2023). Establishing best practices for E-commerce transport packaging waste management in Canada: A systematic review. *Journal of Cleaner Production*, 429, 139377. <https://doi.org/10.1016/j.jclepro.2023.139377>
4. Ling, L., Anping, R., & Di, X. (2022). Proposal of a hybrid decision-making framework for the prioritization of express packaging recycling patterns. *Environment, Development and Sustainability*, 25(3), 2610–2647. <https://doi.org/10.1007/s10668-022-02145-5>
5. Koch, J., Frommeyer, B., & Schewe, G. (2022). Managing the transition to eco-friendly packaging – An investigation of consumers' motives in online retail. *Journal of Cleaner Production*, 351, 131504. <https://doi.org/10.1016/j.jclepro.2022.131504>
6. Kang, P., Song, G., Xu, M., Miller, T. R., Wang, H., Zhang, H., Liu, G., Zhou, Y., Ren, J., Zhong, R., & Duan, H. (2021). Low-carbon pathways for the booming express delivery sector in China. *Nature Communications*, 12(1). <https://doi.org/10.1038/s41467-020-20738-4>
7. Rai, H. B., Verlinde, S., & Macharis, C. (2021). Unlocking the failed delivery problem? Opportunities and challenges for smart locks from a consumer perspective. *Research in Transportation Economics*, 87, 100753. <https://doi.org/10.1016/j.retrec.2019.100753>
8. Rao, P., Balasubramanian, S., Vihari, N., Jabeen, S., Shukla, V., & Chanchaichujit, J. (2021b). The e-commerce supply chain and environmental sustainability: An empirical investigation on the online retail sector. *Cogent Business & Management*, 8(1). <https://doi.org/10.1080/23311975.2021.1938377>
9. Heshmati, S., Verstichel, J., Esprit, E., & Berghe, G. V. (2019). Alternative e-commerce delivery policies: A case study concerning the effects on carbon emissions. *EURO Journal on Transportation and Logistics*, 8(3), 217-248. <https://link.springer.com/article/10.1007/s13676-018-0120-4>
10. Kedia, A., Kusumastuti, D., & Nicholson, A. (2017). Acceptability of collection and delivery points from consumers' perspective: A qualitative case study of Christchurch city. *Case Studies on Transport Policy*, 5(4), 587–595. <https://doi.org/10.1016/j.cstp.2017.10.009>
11. Ghadge, A., Yang, Q., Caldwell, N., König, C., & Tiwari, M. K. (2016). Facility location for a closed-loop distribution network: a hybrid approach. *International Journal of Retail & Distribution Management*, 44(9), 884–902. <https://doi.org/10.1108/ijrdm-07-2015-0094>
12. Edwards, J., McKinnon, A., & Cullinane, S. (2011). Comparative carbon auditing of conventional and online retail supply chains: a review of methodological issues. *Supply Chain Management: An International Journal*, 16(1), 57-63. <https://www.emerald.com/insight/content/doi/10.1108/13598541111103502/full/html>
13. Buldeo Rai, H., Touami, S., & Dablanc, L. (2022). Not all e-commerce emits equally: Systematic quantitative review of online and store purchases' carbon footprint. *Environmental Science & Technology*, 57(1), 708-718. <https://doi.org/10.1021/acs.est.2c00299>
14. Viet, N. Q., De Leeuw, S., & Van Herpen, E. (2023). The impact of social vs environmental sustainability information disclosure on consumer choice of delivery time with varying sustainability concerns. *International Journal of Physical Distribution & Logistics Management*, 53(11), 26–52. <https://doi.org/10.1108/ijpdlm-09-2021-0392>
15. Dutta, P., Mishra, A., Khandelwal, S., & Katthawala, I. (2020). A multiobjective optimization model for sustainable reverse logistics in Indian E-commerce market. *Journal of Cleaner Production*, 249, 119348. <https://doi.org/10.1016/j.jclepro.2019.119348>



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