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The adoption of Circular Economy practices in supply chains – An assessment of European Multi-National Enterprises

Abstract

The European Commission Circular Economy Action Plan aims at fostering a society based on sustainable production and consumption. Within this context, industrial organisations are called to implement a wide set of practices to drive this transition: manufacturing easy-to-repair and sustainable products, adopting solutions aimed at extending product lifetime, and promoting remanufacturing and materials' recycling. A major contribution is expected from Multi-National Enterprises (MNEs), as these organisations dominate the European economy and coordinate resource-intensive global supply networks.

As such, this study assesses the Circular Economy-inspired initiatives promoted by the largest European MNEs. The content of sustainability reports is scrutinised, through a template analysis technique, in order to create a database of Circular Economy practices. Key findings include the degree of implementation, the level of involvement of supply chain partners, and the drivers behind the implementation of such practices. Furthermore, a conceptual framework is proposed, in order to describe the adoption of Circular Economy practices as a supply chain process. A theoretical discussion explores the role of institutional pressures and supply chain integration to shape the transition towards the adoption of Circular Economy practices in global supply chains.

Keywords: Circular Economy, Fortune 500, Sustainability, MNEs, Supply Chain Integration, Institutional Theory

1 Introduction

Multi-National Enterprises (MNEs) dominate European free-market economies, coordinating and commanding global supply networks, actively determining what is produced and consumed. As such, they also contribute to the unsustainable use of natural resources, which

has caused severe environmental degradation. It has been reported that just a hundred MNEs are responsible for 71% of all the GHG emissions since 1988 (Griffin, 2017) .

The Circular Economy (CE) paradigm focuses on how to revise unsustainable development patterns by transforming production and consumption systems (Fitch-Roy et al., 2020). The end-of-life concept is rethought, as economic activities focus on keeping products and materials in use, so avoiding them becoming waste (Kirchherr et al., 2017). By promoting CE-solutions through their global and multi-tier supply chain networks, MNEs could enact a more efficient use of resources and contribute to the United Nations' Sustainable Development Goals (Nasr et al., 2018).

Within this context, many MNEs have publicly communicated that they have adopted CE practices (Stewart & Niero, 2018; Hofmann, 2019), including: the manufacturing of easy to repair and sustainable goods, the adoption of solutions aimed at extending product lifetimes, the promotion of remanufacturing and recycling in subsequent feedback loops, and the use of renewable energy sources throughout supply chains (Genovese et al., 2017). However, research on the circular economy has mainly explored ad-hoc case studies in specific contexts and sectors (Kirchherr & van Santen, 2019; Salmenperä et al., 2021); the adoption of CE practices has been explored mainly in small samples of companies, rather than through the investigation of large and representative samples of MNEs coordinating global supply networks (Pagell & Shevchenko, 2014; Korhonen et al., 2018; Lahane et al., 2020). Furthermore, there is a lack of discussion of the antecedents of the adoption and diffusion of CE practices. Institutional pressures and supply chain integration (SCI) have already been frequently linked to the implementation of green and sustainable supply chain practices (Wiengarten & Longoni, 2015) and could also be linked to CE issues (Jain et al., 2020).

In order to fill this gap, this study seeks to address the following research questions: (RQ1) which CE practices have been adopted by European MNEs and to what extent? (RQ2) what factors could drive or enable the bottom-up initiatives of MNEs in the context of European free-market economies?

After having determined a representative sample of organisations through the Global Fortune 500 list[1], a comprehensive database of the state-of-the-practice of CE adoption in European MNEs has been created by coding information extracted from sustainability reports. This has allowed several analyses to be performed to address the RQs.

The remainder of this document is arranged as follows. The next section provides a review of current academic work, also highlighting research gaps and the contribution of the study. Section 3 clarifies the method that will be utilised to tackle the research questions generated by the literature review. In Section 4, the results of the analysis are illustrated. The sample is presented, highlighting the evolution of interest towards the CE; CE practices are shown in relation to their type and their extent of adoption; based on institutional pressures, drivers of CE adoption are recognised. Finally, the relevance of SCI in explaining the adoption of CE practices is explained. In Section 5, managerial and theoretical implications are described. Two propositions are formulated, on the possible relationship between institutional pressures, SCI, and the adoption of CE practices in supply chains.

2 Literature Review

The CE concept has gained increasing attention in academia, policy-making, and business practice; it advocates a deep transformation of the economic system, challenging how modern industrial societies design and produce goods. Within this context, Circular Supply Chains (CSCs) represent a building block for the transition towards a CE.

The penetration of CE-related concepts in the supply chain management (SCM) literature can be traced back to distinct, but related, streams (Howard et al., 2019): Industrial Ecology (IE), Sustainable Supply Chain Management (SSCM), Reverse logistics (RL) and Closed-Loop Supply Chain Management (CLSCM). These streams have focused on how firms can interchange resources and waste streams, how to integrate environmental and social concerns into organisations, and how to recover after-use products to capture additional economic value.

[1] The Global Fortune 500 list (2019 edition) collects the Top-500 international corporations in terms of turnover generated during the 2018 year. It is prepared by the American business journal Fortune.

A first literature scan[2] looked at how firms and supply chains are adopting CE-inspired practices, along with their drivers and enabling conditions. Selected studies (Table 1) constitute the most relevant contributions that describe the process of adoption of CE practices through the analysis of large samples of companies.

Some common findings can be found across the literature: CE related practices are finding more and more relevance within organisations' sustainability agenda (Stewart & Niero, 2018). Available secondary data (e.g. companies' public Corporate Sustainability reports) have been increasingly employed to review CE adoption in the industrial practice, more frequently than primary data (e.g. surveys and questionnaires, see Table 1).

The most common CE practices concern the recycling of end-of-life materials and incremental efficiency improvements in the use of resources (Gusmerotti et al., 2019). As such, disruptive product innovations linked to product design and new business models are not so common. Findings also suggest that the involvement of supply chain partners is often marginal (Masi et al., 2018) and most companies seem to have a low level of adoption of CE principles (Masi et al., 2018; Stewart & Niero, 2018).

In addition, papers also reflect upon the process of adoption of CE practices, by identifying drivers, predictors, and contextual variables, which could help or hinder the implementation of CE practices. Economic drivers seem to be more important than regulatory ones for companies (Mathews & Tan, 2011; Gusmerotti et al., 2019). The main barriers are related to technological limitations, institutional contexts, consumers' acceptance of used products, and lack of supply chain visibility (Govindan & Hasanagic, 2018; Masi et al., 2018; Bressanelli et al., 2019).

[2] The literature was firstly screened using the following keywords string: ("circular economy" AND ("practice*" OR "driver*" OR "barrier*") AND ("compan*" OR "supply chain*")). A first sample of papers was selected; then an iterative snowballing phase (looking at papers cited in this first subset increased the sample of articles that were finally critically analysed. Two simple selection criteria were applied to abstracts. The first one concerned the unit of analysis: only papers focusing on firms and supply chain as a unit of analysis were included, while those concentrating on the macro level were excluded. The second criterion was related to the sample size: single or multiple case studies were excluded, while empirical papers based on larger samples (with n≥25) were included.

Some theoretical constructs seem to be relevant when analysing the problem of adoption of CE practices from a SCM perspective: predictors of environmental management and green practices (institutional pressures and resource dependence) are being initially tested for CE practices, with institutional environments playing a key role (De Angelis et al., 2018; Ranta et al., 2018; Gusmerotti et al., 2019; Jain et al., 2020).

Other authors are looking at supply chain configurations, which could enable the implementation of CE practices. Key organizational and operational requirements include the coordination and transparency of the supply chain; shared cultural norms; communication and strategic alignment with suppliers and customers (Herczeg et al., 2018; Bressanelli et al., 2019; Howard et al., 2019). Many of these constructs can be associated to the SCI concept.

Some gaps can also be highlighted: CE practices are commonly investigated in groups of companies that are at the forefront of CE innovation (such as, the Ellen MacArthur CE100 list[3] or CONAI[4]), or that have explicitly shown at least some formal interest for CE practices (Stewart & Niero, 2018). The result is that samples tend to be *positively biased* and not adequately representative of the general population of companies.

Secondly, excluding a few studies from the IE strand (Mathews & Tan, 2011; Herczeg et al., 2018), the literature does not explore the factors behind the transition of supply chains towards the CE from a theoretical point of view. The few studies adopting any theoretical lens to understand the adoption of CE practices (Sihvonen & Partanen, 2017; Ranta et al., 2018; Gusmerotti et al., 2019) do not include a supply chain perspective. It is worth mentioning that studies in other research streams in the SCM domain (such as SSCM) have attempted to determine and test antecedents of practices adoption; many authors have started to explore relationships among such research streams in order to derive useful implications (Genovese et al., 2017; Herczeg et al., 2018; Lahane et al., 2020).

[3] Ellen MacArthur CE 100 is a global network of companies that lead the transition towards the systemic change of the circular economy (https://www.ellenmacarthurfoundation.org/our-story/our-network)

[4] CONAI is a private consortium of Italian enterprises that either produce or use packaging. The consortium aims at improving Italian waste management systems, supporting alternative strategies to landfilling, in line with policy directives.

Table 1 – Selected publications that attempted to review the adoption of CE in industrial practice. Abbreviations. IT: Institutional Theory; RBV: Resource Based View; DC: Dynamic capabilities; CS report: Corporate Sustainability report; CDP: Carbon Disclosure Program; GRI: Global Reporting Initiative.

Authors, year	**Title**	**Journal**	**Sampling technique**	**Sample size**	**Geographical context**	**Variables**	**Data Source**	**Unit of analysis**	**Theoretical lens**
Ghisellini & Ulgiati, 2020	Circular economy transition in Italy. Achievements, perspectives and constraints	*Journal of Cleaner Production*	3 different Databases	292	Italy	CE practices	Secondary sources	Firm	/
Jain et al., 2020	Institutional pressures and circular economy performance: The role of environmental management system and organizational flexibility in oil and gas sector	*Business Strategy and the Environment*	Indian Ministry National list	280	India	CE practices	Questionnaires	Firm	IT
Gusmerotti et al., 2019	Drivers and approaches to the circular economy in manufacturing firms	*Journal of Cleaner Production*	CONAI consortium list	821	Italy	CE practices, drivers	Questionnaires	Firm – supply chain	IT, RBV
Stewart & Niero, 2019	Circular economy in corporate sustainability strategies: A review of corporate sustainability reports in the fast-moving consumer goods sector	*Business Strategy and the Environment*	CE 100 directory	46	Global	CE practices	CS reports	Firm	/
Masi et al., 2018	Towards a more circular economy: exploring the awareness, practices, and barriers from a focal firm perspective	*Production Planning & Control*	LinkedIn groups professionals	77	Global	GSCM practices	Questionnaires	Firm – supply chain	/
Sihvonen & Partanen, 2017	Eco-design practices with a focus on quantitative environmental targets: An exploratory content analysis within ICT sector	*Journal of Cleaner Production*	quality disclosure requirements CDP, GRI	43	Finland	Eco-design practices	CS reports	Firm	DC, IT

In most cases, the unit of analysis is the single firm. This is problematic as the literature has recognised the involvement of supply networks as fundamental to the design and operation of circular supply chains (EMAF, 2015; Genovese et al., 2017; Batista et al., 2018; Govindan & Hasanagic, 2018) and the support of wider socio-technical systems (Kirchherr et al., 2018; Bauwens et al., 2020). In modern production and consumption systems, a single firm usually controls a limited part of the value creation process. Reuse, remanufacturing, and recycle feedback loops, usually require more actors in the same supply chain to collaborate, share information, and make decisions collaboratively.

For all these reasons, a second literature search was performed to explore the relationship between the most prominent concepts that emerged (e.g. institutional pressures and SCI) and the adoption of CE practices[5].

2.1 Institutional pressures, Supply Chain Integration and the adoption of CE practices

SSCM has already investigated the transition of global supply chains towards less impactful production and consumption paradigms, as well as the requirements at the supply chain level to make this possible; sustainable supply chains have been recently considered a unit of action for implementing the CE in supply chains (Liu et al., 2018).

2.1.1 Institutional pressures and the adoption of CE practices

Institutional theory and the concept of *isomorphism* (DiMaggio & Powell, 1983) could help understand those pressures that define organisations' practices and implementation strategies, while also taking into account the SCM dimension (Sarkis et al., 2011). *Institutional isomorphism* acts through three mechanisms: coercive, normative, and mimetic pressures (Table 2).

[5] As before, during this second literature search process keywords were chosen to select a first sample of articles, which was then enlarged through a snowballing process. The objective of this process was to investigate the possible relationship between institutional pressures, supply chain integration, and the adoption of CE practices. Research streams that have contributed to the emergence of the CE debate in the Supply Chain Management literature were considered, namely SSCM, IE, and CLSCM.

Coercive pressure acts through laws and rules: organisations make decisions based on their fear to avoid sanctions. Normative pressure originates from binding expectations of social norms: organisations are influenced not only by formal rules but also by what is viewed to be appropriate and socially accepted. Memetic pressure involves shared conceptions and beliefs: organisations follow taken-for-granted dynamics and imitate best practices from other successful social actors, which have established themselves (Scott, 2003).

According to institutional theory theoretical lenses, institutional pressures are one of the main drivers of 'sustainable' practices in organisations and their supply chains (Sarkis et al., 2011; Zhu et al., 2013; Touboulic & Walker, 2015; Ranta et al., 2018), and the most important factor behind triple-bottom-line integration in corporations strategy in every industrial sector (Tate et al., 2010). Supply chains adopt sustainable and green practices to gain legitimacy with groups of stakeholders.

Similarly, the adoption of CE practices could be interpreted as an answer to existing changing rules, norms, and beliefs (Zhu et al., 2010; Mathews & Tan, 2011). Public opinion, legislation, and competing pressures challenge the reputation of MNEs (Ranta et al., 2018; Widmer & Prior, 2019) and shape their decision-making process. Furthermore, those pressures affect the whole supply network; within the highly specialised, fragmented, and globalised production systems context, competition dynamics occur at the supply chain level rather than the single firm one (Ketchen & Hult, 2007).

Table 2 – Examples of institutional pressures in SCM literature (adapted from Zhu et al., 2013; Zeng et al., 2017; Jain et al., 2020).

Constructs	**Examples of pressures**
Coercive Pressure	National/Regional environmental regulations (such as waste emission, cleaner production etc.) National/ Regional resource-saving and conservation regulations
Normative Pressure	Environmental requirements from customers Environmental awareness of customers' organisations Media scrutiny of the industry Public environmental awareness (community, NGO etc.)
Mimetic Pressure	Competitors' adoption of 'green' practices Green strategies of direct competitors Green strategies of substitute products manufacturers

2.1.2 Supply Chain integration and adoption of CE practices

Once a firm has decided to implement CE-inspired practices, the way its supply chain is organised and configured plays an important role as to how these practices can be spread in the supply chain (Hoejmose et al., 2014).

Supply chain actors can be involved through integration and collaboration, using a cooperative approach in reducing risk, sustaining costs and investments, and sharing information and knowledge. The ability to work together with supply chain partners supports the development of inter-organisational resources, which could bring a competitive advantage (Gold et al., 2010), enable radical and incremental innovation (Soosay et al., 2008), and reduce uncertain outcomes of green product and process innovation (Wong et al., 2020).

Cooperating with first-tier or second-tier suppliers can mitigate their difficulties in responding to environmental pressures and enable the diffusion of practices throughout the supply chain (Seles et al., 2016; Bressanelli et al., 2019). SCI (Table 3) is considered as an enabling capability in global supply chains. No study has been developed to date about the role played by SCI in the adoption process of CE practices, whether at the single firm or at the supply chain levels.

Table 3 – Supply chain integration dimensions (adapted from Frohlich & Westbrook, 2001; Schoenherr & Swink, 2012; Wiengarten & Longoni, 2015; Wiengarten et al., 2019)

SCI dimension	**Examples**
Sharing information with key suppliers/customers	- sales forecast - production plans - order tracking and tracing - stock levels
Developing collaborative approaches with key suppliers/customers	- supplier development - risk/ revenue sharing - long-term agreements
Joint decision-making with key suppliers/customers	- product design/modifications - process design/ modifications - quality improvement - cost control
System coupling with key suppliers/customers	- vendor-managed inventory - just-in-time systems - Kanban systems - continuous replenishment

2.2 Key findings

While providing interesting perspectives and mentioning important concepts, the current CE literature exhibits some gaps which have inspired this work and shaped the research questions. In synthesis, the CE literature struggles to assess the real state-of-the practice of the adoption of the CE, as well as of the involvement of global supply chains, within a context that is still dominated by a linear paradigm of production and consumption. Despite MNEs having a key role in promoting more circular and sustainable production and consumption systems in their supply chains, their adoption of CE practices has not been assessed in a systematic way.

Additionally, there is little discussion of the antecedents to the adoption of CE practices in MNEs and of how practices are spread across supply chain networks. The literature on the CE topic often neglects the supply chain level of analysis. The SSCM literature has already explored the process of the adoption of sustainable and green practices in global supply chains as well as its antecedents; however, these aspects are not explicitly discussed in the CE literature.

On the basis of the identified gaps, the following research questions will be addressed in this study:

- RQ1: Which CE practices have been adopted by European MNEs and to what extent?
- RQ2: What factors can drive or enable bottom-up initiatives of MNEs in the context of European free-market economies?

The next section details the research method which has been designed in order to address such research questions.

3 Method

This paper reviews the adoption of CE practices, and related antecedents and drivers, in a large sample of European MNEs using secondary data from Corporate Sustainability (CS) reports.

In the SCM discipline, many authors have called for new methods and research strategies (Ellram & Tate, 2016; Roth & Rosenzweig, 2020) as an alternative to classical questionnaire surveys, given their serious issues with data dependability and reliability: firm-level answers might be provided by single respondents; respondents might lack an overview of processes

(Ketokivi, 2019) and find difficulties in being accurate about abstract constructs (Flynn et al., 2018).

In parallel, the amount and the quality of data that organisations publish has been enhanced. 80% of the largest 250 MNEs publish CS reports (KPMG, 2020) using standardised formats (e.g. the Global Reporting Initiative – GRI - framework[6]), which have also improved the comparability of results. MNEs share more and more information concerning their sustainability practices and their impacts. Not only are they required to do so by pressure from their stakeholders, but they also have a strong interest to increase customers' trust, improve brand value, and gain legitimacy (Hofmann et al., 2019).

Even though self-reported information is often presented in a favourable light (Hahn & Kühnen, 2013), using already available and validated information provides a number of advantages to address the RQs of this paper, such as the possibility of pre-defining a sample of relevant MNEs. Based on this rationale, CS reports were systematically analysed, using content analysis and a mapping approach (Figure 1), in a similar way to recent studies (Stewart & Niero, 2018; Mejías et al., 2019). An *abductive* approach was adopted, where multiple waves of coding were preferred to the employment of previously selected keywords. A similar technique has been described by King and Brooks (2018) as the *template analysis* technique, where deductive and inductive phases are alternated and initial classification categories are modified and adapted.

While most of the constructs of interest (e.g. CE practices, institutional pressures, SCI) were coded with reference to 2018 reports, a longitudinal approach was adopted, in order to highlight how the interpretation of the CE concept has evolved in the 2016, 2017, and 2018 financial years.

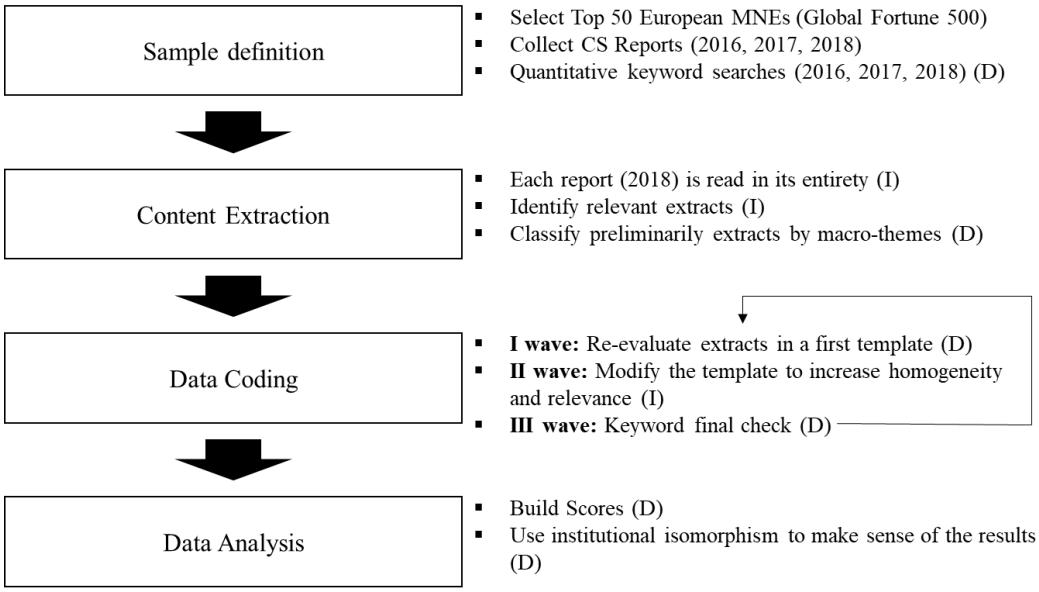
The review consisted of four main phases: (i) sample definition, (ii) content extraction, (iii) data coding, and (vi) data analysis. The following sub-sections describe these steps in detail.

[6] https://www.globalreporting.org/standards/

3.1 Sample Definition

The Global Fortune 500 list (2019 edition) was used to select a representative sample of MNEs – which includes the Top-50 European[7] companies in the list. CS Reports for the 2016, 2017, and 2018 financial years were retrieved for all the companies in the subset. In the absence of a dedicated sustainability report, sustainability information was analysed in annual reports and company websites. Documents – the vast majority of which were in English, with a few notable exceptions in French – have been reviewed regardless of language. A first exploratory search assessed the presence of specific keywords ("circular economy", "circularity", "closed-loop") in all the reports. This phase had purely a quantitative nature, aimed at performing some preliminary analysis prior to the extraction and qualitative analysis of content.

Figure 1 – Method flowchart. The activities for each phase are specified together with their nature: (D) indicates a deductive approach, (I) an inductive one.



[7] European Economic Area (EEA) was considered, which includes EU countries and also Iceland, Liechtenstein, and Norway. The list of companies was compiled on the 1st of January 2019; it reflects, then, EU membership at that date.

3.2 Content Extraction

During the data extraction phase, each report (2018) was read in its entirety. Relevant text for each of the RQs was identified, extracted, collected through the NVivo software package, and then organised using an Excel spreadsheet. A deductive preliminary template was initially employed to classify content according to macro-themes and their classifications: CE practices, SCI, and institutional pressures.

3.3 Data Coding

In this phase, the extracted content was interpreted across multiple waves of coding and classified into modified templates. During the *first wave of coding,*[8] all the collected content for each macro-theme was evaluated and the information was classified into predefined sub-categories, namely the type of practice according to the 4-Rs Waste Hierarchy Framework (e.g. reduce, reuse, recycle, recover), the type of SCI dimension according to the research database International Manufacturing Strategy Survey (e.g. sharing information with key suppliers/customers, joint decision making, collaborative approaches, system coupling), and the type of institutional pressure (coercive, normative, memetic). Since organisations sometimes referred to the same CE practice using different terminologies, which could also depend on industrial and geographical contexts (Ellram & Tate, 2016), CE practices were re-classified in *reduce*, *reuse*, *recycle* and *recover* actions, independently of the original classification provided in the surveyed reports.

During the *second wave of coding,* the template was inductively enriched with some details based on a detailed evaluation of the content. Each CE practice, in each firm, was evaluated (see Appendix B) according to two dimensions of classification (Table 4): its level of implementation (five incremental implementation stages) and its involvement of supply chain partners (distinguishing internal CE practices from Circular Supply Chain ones). A complete overview

[8] All the waves of coding were performed independently by all the authors; a kappa-type measure was employed in order to keep track of disagreements. The few cases of disagreements were dealt with through a collective discussion for reaching consensus.

of all the categories can be found in Appendix A. Also, a new type of practice was added to the 4-R framework: *renewable energy & resource efficiency* practices[9] include incremental improvement of the efficiency in production systems, and the adoption of renewables sources of energy, both of which are quite commonly mentioned in CS reports.

A *third wave of coding* was performed, to conduct a keyword-based final check, for making sure that all the relevant text had already been captured from all the reports[10]. Such a procedure was aimed at achieving the maximum level of replicability of the analysis.

[9] They were unbundled from *reduce* practices, which in our classification are linked to radical changes in product design and functionality, leading to a substantial reduction in the total use of resources (rather than just an increase in their productivity). This distinction had the objective of recognising, to a broader extent, the strength and the weaknesses of the currently implemented approaches.

[10] We employed both general and specific keywords that resulted from the categorisation in the second wave of coding: the former included Circular Economy, Circular Supply Chain, Closed-Loop Supply Chain, and Waste; while the latter related more specifically to CE practices or to SCI measures which are commonly applied by organisations, such as, for instance, reduce, reuse, recycle, recover, remanufacture, redesign, design for longevity, and supplier integration and customer integration. The retrieved text was further classified according to the specific sub-categories identified in the first wave of coding.

Table 4 – CE practices dimensions of classification

Dimension of classification	Value	Description	Source
Type of CE practice	Reduce	Products are innovated to make more intensive use of resources. Product functions are re-thought and re-defined.	(European Commission, 2008, 2015, 2020); (Kirchherr et al., 2017)
	Reuse	Products' life is extended through repairing, preventive maintenance, and refurbishing actions; products and components are reutilised for their original function.	
	Recycle	End-of-life products, parts, components, and materials are reprocessed to make new products, parts, components, and materials. Includes also remanufacturing and recycling.	
	Recover	Energy is recovered from by-products or waste, either directly or through the production of alternative fuels like biofuels.	
	Renewable energy & Resource efficiency	Incremental efficiency improvement of production or logistics processes, or adoption of renewables as a source of energy. Linear flows of materials are not challenged.	
Level of implementation	No mention of CE practices (0)	Absence of any practice that can be associated to the Circular Economy.	(Mejías et al., 2019); (Ancarani et al., 2019a)
	Exploratory and conceptual (1)	CE practices are just mentioned as an aspiration; the concept is mentioned symbolically with no clear link with an operational implementation.	
	Testing (2)	Presence of R&D activities, which are being conducted on the implementation of CE practices. It is the case of pilot projects in specific plants, offices, around the world. Strategic acquisitions of start-up companies were considered as being part of this level of implementation.	
	Early Implementation (3)	Evidence of CE practices adoptions can be identified in some product/service lines. Small impacts and plans for future extensions are reported.	
	Company-wide implementation (4)	The CE practice is part of company culture and is widely implemented in different geographical areas. A clear evaluation of the overall impact is provided.	
Supply chain involvement	Internal CE practice	CE practices are implemented and managed independently by the company.	(Zhu et al., 2013); (Masi et al., 2018)
	Circular Supply Chain (CSC) practice	CE practices are implemented with the involvement of at least another supply chain partner.	

3.4 Data Analysis

A critical analysis of the final database was performed to summarise relevant findings and highlight key messages to answer the RQs. The effort to organise the content in a template allowed the information to be codified and synthetic scores to be built for each MNE. In this way, textual information was transformed into numerical scores, which included both simple counting indexes (the number of internal CE practices, the number of CSC practices) and more complex ones, such as the "CE score" and the "SCI score".

"CE score" (0-20 scale) was calculated as the arithmetic sum of the level of implementation (0-4, see Table 4) of each type of practice. SCI score (0-8) was the arithmetic sum of 8 binary variables, corresponding to SCI dimensions (Table 3), derived from the literature (presence of information on a specific item was assigned 1 and its absence 0). Such scores represent descriptive measures of how each MNE is implementing CE, as well as its level of SCI. Despite not being an exhaustive evaluation, they genuinely represent the information that has been publicly shared in CS reports.

Institutional isomorphism theoretical lenses were then used to interpret the template and the scores, to identify existing descriptive relations and make sense of the results, and to derive a conceptual framework based on two propositions.

4 Results

The sample includes very well-known MNEs operating at a global level, representing four categories of industrial sectors (Table 5). More than half of all the organisations are established in France and Germany (Table 6). Other than the state-owned energy companies *Equinor* and *EDF*, all the companies can be classified as private sector organisations with a few of these including some form of state participation (e.g. *Enel*, *Volkswagen* and *Deutsche Post DHL Group*).

The majority of the companies (37 out of 50) disclosed their sustainability performance information in a dedicated sustainability report (Table 7). Despite some exceptions from the services and agri-food industries, GRI reporting standards seem to be widely accepted (Figure 2): 35 organisations either comply with these guidelines or make a clear reference to the GRI structure, while only lacking a GRI index.

Table 5 – The sample of MNEs by sector. The manufacturing industry accounts for automotive companies, Aerospace, Chemical, Pharmaceutical, and FMCG sectors; the agri-food industry covers food producers, and food and drug stores; the service industry consists of financial institutions like banks and insurance companies; the energy industry involves both energy producers and distributors.

The sample				
Manufacturing	**Agri-food**	**Services**		**Energy**
Volkswagen AG	Carrefour	AXA	Aviva	Royal Dutch Shell
Daimler	Tesco	Allianz	BPCE	BP plc
FCA	RA Delhaize	BNP Paribas	Vodafone	Total
BMW Group	Auchan	Prudential	Telefonica	Enel
Siemens	AB InBev	Ass. Generali	ING Group	Uniper
Bosch Group	Louis Dreyfus	Banco Santander	Legal & General Group	ENI
Airbus Group	Finatis	Deutsche Telekom	Lloyds Banking Group	EDF
Peugeot		Credit Agricole	CNP Assurances	Engie
BASF		HSBC Holdings		Equinor
ArcelorMittal		D. Post DHL Gr.		
Renault		Munich Re Group		
Unilever		Societe Generale		
Bayer		Aegon		

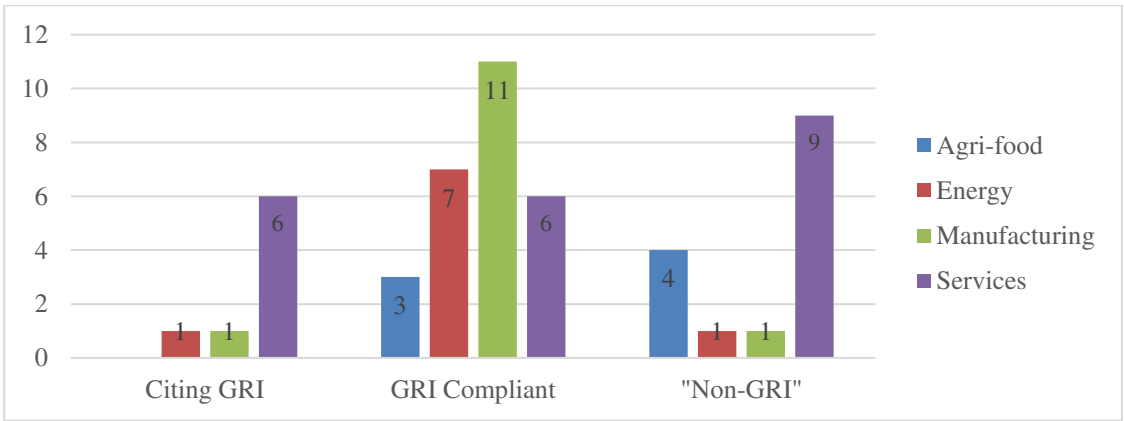
Table 6 – The sample by country

Country	**Companies**
France	14
Germany	12
UK	9
The Netherlands	6
Italy	4
Spain	2

Table 7 –Type of Report

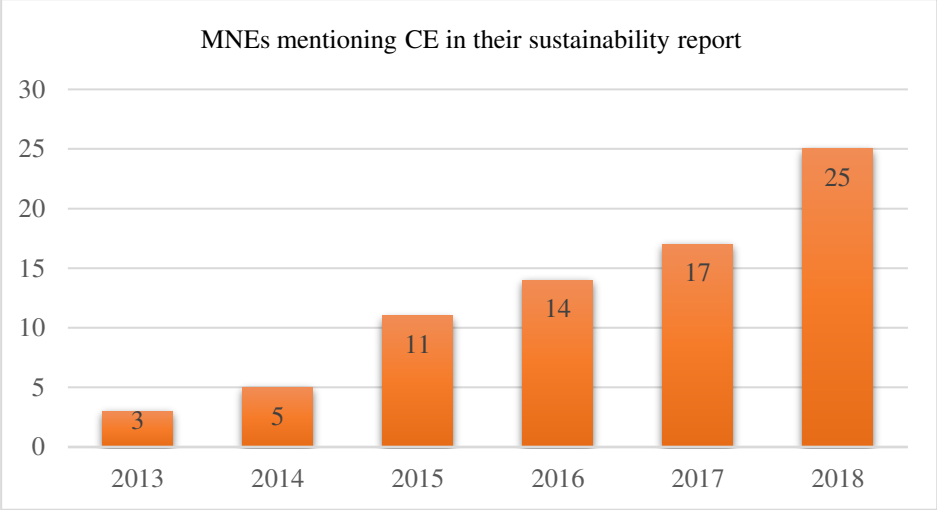
Reporting Standards	**Companies**
Dedicated Sustainability Report	37
Sustainability information in the Annual Report	13

Figure 2 – Compliance to GRI reporting by sector. Citing GRI means company mention GRI in their reports while only lacking a GRI index.



The interest of organisations towards the CE concept is recent – in 2015 just 3 out of 50 companies were citing it – and it can be interpreted as a direct consequence of the promulgation of the European directives (2015), and the emergence of a public debate about CE (Borrello et al., 2020). The highest reported level was in 2018 when 50% of the firms under investigation mentioned the CE concept at least once in their CS reports (Figure 3). However, still in 2018, only 9 organisations included a dedicated section in the report about the CE, which might suggest the lack of a structured approach to reporting CE practices.

Figure 3 – Evolution of the interest in the CE in the Top 50 EU Organisations



4.1 What kind of CE practices have been adopted in the sample?

The identified CE practices for each MNE have been classified according to their type and level of implementation, as well as for their involvement of supply chain partners; this contributes to addressing RQ1.

Practices linked to *recycling* along with *reduction* and *renewable energy & resource efficiency* are the most popular across the sample, while developments linked to product *reuse* are currently overlooked. Each company CE implementation strategy strongly depends on the focal industry and is subject to sector-specific challenges. In this sub-section, CE practices across the whole sample were aggregated and summarised per industrial sector (Table 8).

In the manufacturing industry (including companies from automotive and related industries), the identified CE practices pertain both to the ability to close the loop for valuable components

and key materials, and to the establishment of the first prototypes of product-as-a-service approaches. Remanufacturing projects have resulted in the development of specific product lines of remanufactured parts to support the aftermarket needs of customers (*FCA, Volkswagen,* and *Renault*). Design for resource recovery practices is playing an important role to operationalise a closed-loop supply chain and to recover materials (e.g. aluminium, steel, plastics, batteries, electrolytes, and graphite). However, only one company (*Bosch*) highlighted the necessity of designing products with longer life.

In the Energy sector, the concept of the CE is interpreted as closely related to waste management (with specific reference to plastic waste), as opposed to divestment from fossil fuels and a transition towards renewable energy. *Shell* and *Total* are among the founders of the *Alliance to End Plastic Waste*, committing themselves to invest $1.5 billion over 5 years to develop solutions in this field. At the same time, this problem is being addressed through integration with technological start-ups: *Total* acquired the French company *Synova*, a leader in the manufacturing of high-performance recycled polypropylene; *BP* is collaborating with *Neste* to increase the supply of sustainable fuel for aviation (the company has already worked as a supplier for *Bombardier* and *Airbus*).

The financial sector (and the service sector in general) demonstrates a general lack of clarity when dealing with CE, as well as with the potential role that banks and insurance companies could have in supporting the transition towards an economy of services rather than products. Some banks are pioneering the offer of financial instruments to finance the transition of companies – supporting vehicle leasing and renting (*Banco Santander* and *Credit Agricole)* or innovative start-ups (*BNP Paribas*) – but also consumer choices – creating solutions for *Blablacar* carpooling members (*Allianz* and *AXA*). Other common practices adopted by other companies in the financial sector include the divestment from carbon fossil fuels and the investment in sustainable solutions (mainly renewable energy for both households and firms).

The agri-food sector presents a good level of adoption of CE practices that ranges from the implementation of dynamic product pricing policies to reduce food waste, to the rejection of packaging for some product lines and of single-use plastic bags for customers.

Table 8 – CE practices aggregated view per industry across the whole sample (a high level of similarity was registered for companies in the same industry). The detail of the level of implementation in the brackets (0-4), while the involvement of supply chain partners is described by the "*" symbol.

	Manufacturing	**Energy**	**Financial & Services**	**Agri-Food**
Reduce – Prevention	(4) Design for resource recovery * (2) Modular Design * (2) Product-as-a-Service *	(1) Commitment to reduce plastic waste	(4) Disinvesting from coal energy sources (4) Investments in sustainable solutions (4) Design of "green" products*	(4) Donate unsold food * (3) Dynamic product pricing to reduce waste (2) Commitment to reduce plastic waste - Refuse packaging *
Reuse	(2) Reuse of parts and components (batteries)*	(0)	(0)	(3) Reuse of packaging
Recycle	(4) Closing the loop for some products/materials *	(3) Investments in recycling technologies	(3) Materials recycling (paper)	(4) Recycled materials utilisation
Recover Energy	(0)	(3) Energy Recovery from by-products	(0)	(0)
Renewable Energy & Resource Efficiency	(4) On-site generation of Renewable Energy (4) Improve production systems efficiency	(3) Investments in large-scale Renewable Energy generation plants (4) Improve Energy Efficiency	(3) Investments in Renewable Energy companies (3) Energy sourcing from Renewable Energy	(4) Prioritise regenerative & less impactful resources

4.2 To what extent are CE practices adopted?

This sub-section completes the answer to RQ1. MNEs have very different approaches to the CE. Some companies have adopted every type of practices at high levels of implementation, while others show a very limited level of adoption.

The 50 MNEs were assigned scores that measure their general level of implementation of CE practices. Table 9 gives an overview of how these 3 scores – the CE score, the number of internal CE (N ICE), and Circular Supply Chain (N CSC) practices – were calculated for Carrefour. The result of such a scoring process was repeated for each MNE (Table 10). Appendix B contains the full details. Companies with high CE scores can be found across each sector; the majority of the MNEs with a low score belong to the Services sector.

Table 9 – Calculation of the CE score from the CE practices for Carrefour. Max score per type represents the intermediate step of how CE score is calculated. In presence of more than one practice per a chosen type, its value is the maximum level of implementation among all the practices of that type.

	Type of practice	Code	Category score	CE score	N. of ICE practices	N. of CSC practices
Carrefour	**Reduce**	(3) Refusing the use of plastics and the sale of plastic straws by the end of 2018 removing single-use plastic straws from juice boxes*	4	18	5	5
		(4) Rethinking prices to reduce food waste, selling products with short use-by dates at low prices				
		(4) Raise customers awareness: give them access to properly designed information and tips on our product packaging so they know how to use them*				
		(4) Collaborating with local associations donating everything that can be given away: the unsold stock is donated set up to tackle poverty*				
	Renewable Energy & Resource Efficiency	(4) Utilisation of renewable energy (geothermal power, wind power, solar power). The heat generated by stores also has to be recovered and reused – such as the heat generated by refrigeration units	4			
		(4) Resource efficiency: reduce per-square-meter electricity consumption in stores by closing the cold storage units – energy savings of up to 18%, or using low-energy light bulbs – up to 50% energy savings				
	Reuse	(2) Promoting the reuse of packaging aiming at 100% reusable, recyclable or compostable packaging*	2			
	Recycle	(3) Incorporating 50% of recycled plastic in its juice, soda, and water bottles*	4			
		(4) Recycled materials utilisation Since 2017, all cardboard packaging for Carrefour brand food products are printed with vegetal-based ink (over 4,000 products)				
	Recover	(4) Energy production from bio-methane - product wastage that can no longer be consumed (withered flowers, spoilt fruit, and vegetables, etc.) is converted into biogas, and then into bio-methane.	4			

Table 10 – An evaluation of the CE scores for each MNE.

Organization	CE score	N. of ICE practices	N. of CSC practices	Organization	CE score	N. of ICE practices	N. of CSC practices
Deutsche Telekom	19	8	3	Siemens	12	3	2
Unilever	18	5	6	HSBC Holdings	12	6	1
Carrefour	18	5	5	Tesco	11	1	3
Auchan Holding	17	6	4	Airbus Group	11	2	2
Royal Dutch Shell	17	7	5	Volkswagen AG	10	1	6
FCA	16	5	8	Deutsche Post	10	3	1
Renault	16	2	6	BASF	10	5	1
Telefonica	16	5	1	Prudential	9	3	0
BNP Paribas	15	3	4	Equinor	8	2	0
ENI	15	4	2	Societe Generale	8	0	4
EDF	15	3	2	Banco Santander	8	1	3
Total	15	6	1	Aegon	8	1	3
ArcelorMittal	14	2	2	BPCE	8	0	3
Anheuser-Busch	13	2	4	Engie	8	2	2
BP plc	13	5	1	Allianz	8	3	2
Royal Ahold	12	4	3	Uniper	8	2	1
PSA	12	0	6	Finatis	8	5	1
Bosch Group	12	1	5	Bayer	8	2	0
Enel	12	2	2	CNP Assurances	7	3	0
Munich Re Group	12	4	2	Aviva	7	4	0
BMW Group	12	2	3	Louis Dreyfus	6	3	0
Vodafone	12	3	1	Assicurazioni	4	1	2
ING Group	12	0	6	Legal & General	4	0	1
Daimler	12	3	5	Lloyds Banking	4	0	1
Credit Agricole	12	1	3	AXA	4	1	1

Deutsche Telekom, *Unilever* and *Carrefour* were the companies with the highest CE scores with more than 10 practices and at high levels of implementation. Some companies adopted mostly ICE practices, without involving supply chain partners. Among the companies that have involved to a greater extent their suppliers and customers, there are *FCA,* with 8 CSC practices, and 6 other companies with 6 CSC practices each (*Unilever, Renault, PSA, ING Group, Volkswagen AG*). . *Legal & General Group* and *Lloyds Banking Group* were classified in the last position, with just one CE practice.

4.3 Why are MNEs adopting CE practices?

Companies adopt CE practices motivated by different types of benefit: economic, environmental, and social drivers. To address RQ2, the sources behind each of these drivers were classified using the institutional isomorphism theoretical lenses (Table 11).

CE practices can help in reducing waste, the consumption of virgin resources, and emissions thanks to less energy-intensive production processes that can re-use the available parts,

components, and by-products. Economic drivers are frequently mentioned in CS reports, mainly linked with increasing the amount of value that can be extracted from products by keeping resources in use and retaining the value of materials after the end of life of the products. Social drivers are generally overlooked and linked to the more traditional Corporate Social Responsibility agenda, without explicit links to the CE and the social impact of the implementation of these practices.

Sources of drivers can be associated with isomorphic mechanisms. The high level of similarity within the same sector of type practices and levels of implementation and degree of involvement of supply chain partners is a first evidence of isomorphism. *Coercive isomorphism* can be associated with the presence of regulations and legislation imposing fines or bans. For instance, many organisations have taken action to fight waste deriving from the consumption of plastics (*Unilever, Carrefour, ING, BASF, Shell, Total, ENI*) pressured by current regulation (EU Directive 2018/852/EC), as well as by the fear in the future of more stringent ones. The French law on food waste (law 138 of 2016) bans supermarkets from throwing away or destroying unsold food. Accordingly, companies (*Carrefour, Auchan, Finatis*) were forced to act on the root of the problem, to reduce systematically waste streams leveraging on multiple strategies: donating surplus food (to charitable trusts, food banks, and other types of organisations which provide redistribution services), establishing dynamic pricing in their sale points, reducing packaging waste.

Changing industry norms are another driver: new standards have been developed to use materials more efficiently, for example recovering end-of-life products, and closing material loops (e.g. aluminium, steel, plastic). The *Global Battery*, *Aluminium Stewardship,* and *Responsible Steel* initiatives are all powerful examples of current attempts, which are defining norms and standards for a transparent and sustainable supply chain, promoting the adoption of CE practices. In the financial sector, banks are cooperating to create standards to finance the

transition to the CE (*ING* and others) and reach climate goals[11] (*BNP Paribas, ING, Société Générale,* and others).

Table 11 – Types, sources, and examples of CE drivers.

Type / Source	Economic	Environmental	Social
Coercive pressures	Meet future law requirements for a more circular economy ○ *Start integrating recycled materials as an input*	follow European Commission Directives ○ *2000/53/EC (end-of-life vehicles)* ○ *2018/852/EC (Packaging Waste)* follow National laws ○ *French law 2016-138 (against food waste)* Meet customer expectations ○ *Disclose reparability index*	Avoid sanctions and loss of legitimacy ○ *Anticipate future regulation on plastics waste*
Normative pressures	Reduce uncertainty and risks ○ *Aluminium Stewardship Initiative* ○ *Global Battery Alliance* ○ *Responsible Steel* Invest for future and green growth ○ *Milestone pledge for global climate goals*	Reduce products environmental footprint ○ *Life Cycle Assessments for product lines*	Reduce external costs for the Society ○ *Alliance to end plastic waste* Become a promoter for a systemic change of the economic paradigm ○ *The Circular Economy Finance guidelines* ○ *Support the local economy*
Memetic pressures	Opportunity for growth and competitiveness by following best practices ○ *Invest in renewable energy* ○ *Invest in recycling technologies capacity* Identify market gaps, innovate and try to achieve competitive advantage ○ *Mobility-as-a-service* ○ *Electric mobility*	Use regenerative resources ○ *disinvest from "carbon-intensive assets"*	Avoid wasting valuable resources ○ *Repair and reuse IT hardware*

[11] https://www.ing.com/Newsroom/News/ING-talks-climate-in-Katowice-at-COP24.htm

Even in the absence of coercive or normative pressures, a company could still adopt CE practices, for instance by following the example of industry peers or also by seeking opportunities for competitive advantages – this is described as *mimetic isomorphism.* Companies imitate each other by designing more environmentally friendly and energy-efficient products and showing responsibility when investing in assets. A representative example is an initiative, adopted by many financial institutions, related to the divestment from the coal sector. It is possible to notice, indeed, that all the surveyed companies from this sector report such a practice, while investing in renewable energy solutions and products. Companies that are experimenting *Product-as-a-Service* models are mostly motivated by identifying market gaps and exploiting market opportunities (*Bosch, Telefonica*).

4.4 Supply Chain Integration, a possible enabler of the CE

The effect of SCI was initially assessed in this sample. Also this sub-section contributes to answer to RQ2. In order to measure the level of SCI, the relevant code has been extracted from the reports for each SCI measurement item. Examples from the reports include: creating stable and long-term relationships with key suppliers and customers, involving suppliers and customers in the design of products and services, and engaging in development programs with suppliers helping them to comply with environmental and human rights standards (Table 12). Reported collaborations at a supply chain level are mainly focused on suppliers' auditing and development programmes, involving some life-cycle evaluation of the overall environmental impact of products and services.

The 50 companies were assigned a score from 0 to 8 (see the detail in Appendix C), on the basis of the presence in their report of SCI items. Three classes of companies were finally defined, based on the level of SCI. Highly integrated supply chains seem to have adopted CE practices at a higher level of implementation (higher average CE score) and to adopt a higher number of CSC practices (Table 13). Furthermore, companies with medium integration have a higher number of internal/CSC practices than companies with low integration.

Many companies in the sample also mention SCI practices and how they are related to sustainability results. This seems to strengthen the hypothesised relationship among two of the constructs (SCI and CE practices adoption).

Table 12. Examples of Supply Chain Integration from the CS Reports. The dimensions to assess the level of SCI have been derived from the literature (Frohlich & Westbrook, 2001; Wiengarten & Longoni, 2015).

SCI dimension	Examples	Company
Sharing information	"We minimize food waste in our own operations by preventing it, through optimised store replenishment and on-shelf management, and by re-directing unsold food to feed people."	Royal Ahold Delhaize
Developing collaborative approaches	"We work tirelessly with our suppliers to ensure that our quality standards are met. We run a bespoke due diligence audit programme that offers documented evidence of compliance to our standards and monitors continual improvement."	Tesco
Joint decision-making with key suppliers/customers	"Another aspect of supplier engagement focuses on fostering innovation to improve products, processes and content, often leading to sustainable solutions such as the use of recycled raw materials or weight reduction"	FCA
System coupling with key suppliers/customers	As the Company performs a strong platform prime integrator role, managing the supplier base to enable the delivery of on time and on quality product to the final customer. […] The Company's suppliers provide a large proportion of the value in our products, necessitating a robust supply-chain governance framework. This is supported by processes and tools that foster partnership, risk mitigation and supplier performance development.	Airbus

Table 13. The relation between SCI level and the adoption of CE practices; CE score was previously defined, as well as the number of internal CE practices and of CSC practices (Table 10). These values represent the average values of each score, within groups of MNEs with a similar level of SCI.

SCI class	Avg. CE score	Avg. Number of internal CE practices	Avg. Number of CSC practices	Companies
High integration (SCI score ≥4)	14	2.6	4.6	FCA, Telefonica, Royal Ahold Delhaize, Renault, Shell
Medium integration (2≤SCI score<4)	13	3.4	2.8	Bosch Group, Tesco, PSA, Carrefour, Enel, Deutsche Telekom, Other 5
Low integration (SCI score<2)	10	2.6	2.0	Auchan Holding, BNP Paribas, Prudential, BMW Group, Vodafone, Other 30

5 Implications

This work contributes to advance both practice and knowledge, by providing insights on the dynamics of the transition towards the CE in MNEs, along with initial evidence about where the adoption has been successful and where it has not. In the following sub-sections, managerial and theoretical implications are discussed.

5.1 Managerial implications

Results show how the adoption of CE practices is taking place in industrial organisations and their global supply chains: the CE is acquiring a growing relevance in corporate sustainability strategies. MNEs often recognise the necessity of closing material loops and all of them had clear evidence of at least one implemented CE practice. However, the CE remains for the moment a peripheral topic: half of the companies do not even mention the term "circular economy", and the adoption of CE practices seems linked to a few sporadic initiatives. CE does not seem to have a prominent role in the process of value creation for organisations. The level of implementation is either still at a conceptual stage with no evidence of an implementation, or at an early one. In most cases, the expected results and impacts of CE practices are not disclosed, and when reported, they are negligible and far from affecting the overall business performance. MNEs show a clear preference for recycling practices, where current linear business models are not challenged, but rather integrated with value recovery activities.

Results confirm that the prevalent approaches so far have had a reductionist interpretation of the CE concept, where *reduce* and *reuse* actions (which are linked to deeper revisions of business models) are still avoided, as they could compromise economic growth through ever-growing outputs or affect the release of new products (e.g. manufacturing easy to repair products might cannibalise future sales). This would confirm that despite strong societal pressures, companies seem to face a linear lock-in re-thinking deeply how value is created (Hofmann & Jaeger-Erben, 2020).

Furthermore, there is a lack of declared long-term objectives regarding strategic and structural investments in this direction. This is also reflected by the fact that companies seldom employ true circularity indicators for keeping track of their performance. Indeed, most companies adopt some environmental measures which are designed as *efficiency* metrics, and thus highly sensitive to productivity improvements (Bimpizas-Pinis et al., 2021). It must be highlighted that the usage of such indicators for measuring the success of CE practices is problematic. Figures could be manipulated to obtain better results, for example just by

increasing production volumes (for instance, through productivity improvements), rather than by implementing practices that can promote a more efficient use of resources [12].

A reductionist approach to the CE would increase the risk of a rebound effect (Zink & Geyer, 2017), where a CE practice does not bring any environmental benefits as it is not associated with a reduction and displacement of primary production. These considerations contribute to the debate on whether CE is the feasible in the current economic paradigm (Genovese & Pansera, 2020). In general, there are many doubts that individual actions are able to reduce the overall impact of entire sectors and contribute to the sustainability objectives that institutions have set, especially in an economic context that incentivises growing levels of consumption and pollution, rather than contrasting them (Hickel & Kallis, 2019).

At the same time, the analysis pointed out that SCI and institutional pressures might increase MNEs' propensity to adopt CE practices, as well as their level of implementation, their overall impact, and the extent that supply networks are involved. This constitutes an opportunity to better look at uncovering these possible relationships through quantitative statistical studies and contribute to generalisable results.

5.2 Theoretical contribution: a suggested conceptual framework

On the basis of the evidence provided, which found support in the analysed literature, two propositions on the factors (e.g. drivers and mechanisms) that drive or hinder industrial organisations to adopt CE practices can be generated. We propose a conceptual framework (Figure 4), which will be tested in future studies. The three main building blocks of the framework have been identified: CE practices adoption, SCI, and Institutional Pressures.

The first proposition finds foundation in the literature (Mathews & Tan, 2011; Sarkis et al., 2011; Zhu et al., 2013; Masi et al., 2017; De Angelis et al., 2018; Kirchherr et al., 2018; Ranta et al., 2018) according to which the institutional environment is a driver (or inhibitor) of CE practices adoption.

[12] Just one company, the Italian energy utility provider Enel, has developed a measurement system to assess the level of circularity of its solutions and products (Enel X Circular Economy Score).

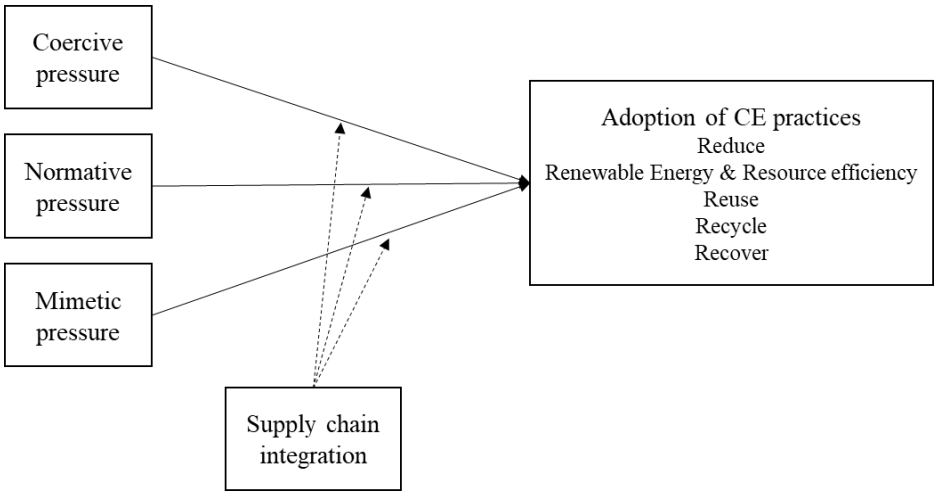
Proposition 1: *Institutional pressures drive the adoption of CE practices in supply chains*

The second proposition entails that higher levels of SCI might support the transition towards the CE in the supply chain, in the presence of institutional pressures. This second proposition finds support in the studies of Wong et al. (2020), Bressanelli et al. (2019), Herczeg et al. (2018), Sancha et al. (2015), and Wu (2013).

Proposition 2: *SCI has a moderating effect on Institutional pressures driving force on the adoption of CE practices in supply chains*

Further research could focus on the validation of the framework, for example by verifying the causal relationship between SCI, Institutional pressures and CE adoption through inferential studies using secondary data, in a similar way to what has been done by Ancarani et al. (2019a and 2019b).

Figure 4 – The conceptual model on the antecedents of CE practices adoption



5.3 Limitations

These results should be interpreted by taking into account the possible limitations of the method. The reliability of secondary data and public information that were found in CS reports might constitute a challenge. We assumed that it is in the interest of the organisations to report all the virtuous practices that contribute to their overall sustainability performance. However,

there is the risk that organisations might over report – to gain more legitimacy from its stakeholders – or under-report – not to disclose information that could be linked to competitive advantage positions (The Guardian, 2019)[13]. Future studies could explore ways to triangulate data from more than one source, so as to improve the reliability of the analysis.

6 Conclusions

This paper investigates which CE practices in the top-50 European MNEs, the extent of the adoption, the level of involvement of the supply chain, along with the drivers behind the adoption. Following empirical observations and referring to the recent literature on the topic, institutional isomorphism and the concept of SCI were employed.

The analysis reveals that the attention devoted to CE practices is generally increasing. Practices associated with *renewable energy & resource efficiency* and *reduction*, along with *recycling* are the most popular, while developments related to product *reuse* are currently overlooked. In general, an ambiguous attitude is reported towards the implementation of practices that deal with rethinking product design, product functions, and business models.

MNEs from the same industrial sector adopt very similar types of CE practices, which confirms the presence of similar institutional pressures. However, some companies have more advanced approaches, adopting many CE practices of each type and at high levels of implementation, while some other companies have only few sporadic initiatives at lower levels of implementation and without any involvement of the supply chain. The initial evidence also shows that the presence of higher levels of integration in the supply chain usually reflects in a higher propensity of having more CE practices implemented and at a higher level of implementation and with greater involvement of key suppliers and customers.

A framework is developed to explain the factors that drive or hinder industrial organisations to adopt CE practices. It is proposed that the adoption of CE practices is the result of the driving force of institutional pressures moderated by the level of SCI.

[13] https://www.theguardian.com/science/2019/sep/08/producers-keep-sustainable-practices-secret

Future research will be aimed at: (i) increasing the sample coverage, reviewing CS reports and other data for the Top-100 European companies in terms of revenues, or for other geographical areas; (ii) validating the framework in a round of interviews; (iii) testing the causal relationships conceptual framework, on the effect of the level of SCI and the institutional pressures on CE practices adoption.

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