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Structure and dynamics of business models through the implementation of circular economy strategies

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Abstract

This study aims to propose and empirically validate the application of a methodology for determining the business model (BM) dynamics associated with the implementation of selected circular economy (CE) strategies and the competitiveness of enterprises. The methodology is based on the assumptions of the attention-based view theory and legitimacy theory, which apply to the analysis of corporate communication. Key variables were identified and quantified using the verbal semantic indicators of BM and CE. The strength of the relationships between the variables was measured through correlation analysis, considering the selected moderating factors. The qualitative part of this study is based on empirical case studies of leading industrial enterprises operating in the European decorative and information systems manufacturing sectors. In the quantitative part, corporate reports were analysed and evaluated. Using the proposed I_{BMDRi} index, the dynamics exhibited by the BMs of the studied industrial enterprises in the implementation of different CE strategies were monitored. These results indicate that BM dynamics can be higher when implementing lower-level CE strategies than higher-level CE strategies. The main scientific contribution of this study is the development and application of a quantitative methodology for I_{BMDRi} determination. The methodology is applicable both in ongoing academic research in the fields of BM and CE and in the practitioner's sphere for the purpose of designing BM, determining and comparing applied BMs, and implementing CE strategies across companies and industries.

Keywords: business model, circular economy strategies, quantitative content analysis, company reports, attention-based view theory, sustainability, competitiveness

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1 INTRODUCTION

The dynamic adaptation of corporate and sectoral business models (BMs) is one of the key prerequisites for ensuring holistic, so-called 3P (people or social perspective; planet or ecological perspective; profit or economic perspective) corporate sustainability. In the context of the societal challenges of the 21st century, dynamically adapted BMs, integrating activities focused on sustainability in an ecological and social sense, have the potential to contribute to the higher competitiveness of companies and thus to their economic, holistic, 3P sustainability. As part of the sustainability concept, circular economy (CE) and its various strategies are gaining the attention of individuals, businesses, sectors, and institutions. Incorporating CE strategies into the BM of enterprises has the potential to achieve the 3Ps of corporate sustainability. Large industrial enterprises are indispensable in implementing CE strategies. Enterprises consider the expectations of their stakeholders and make efforts towards the dynamic adaptation of their BMs by implementing different CE strategies. They communicate their efforts to the stakeholders in various ways. Information on applied BMs and activities towards sustainability and CE is included in corporate reports, such as annual reports,

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sustainability reports, corporate social responsibility reports, integrated reports, and strategic reports (Michalak et al., 2017; Szewieczek et al., 2021). European Union directives 2013/34/EU (EU, 2013) and 2014/95/EU (EU, 2014) require companies to report on the non-financial aspects of the business, including the applied BMs, diverse information related to corporate social responsibility, and business sustainability. Businesses focus on communicating the environmental and social aspects associated with businesses that are considered legitimate by the public. Although corporate reports are often compiled according to harmonised methodologies and procedures, the quality and scope of the information provided by individual companies may differ from one another. Consequently, it can be difficult for less-informed stakeholders to analyse, evaluate, and compare information. This situation indicates the need and opens the space for the design and application of methodologies, enabling the discovery and quantitative evaluation of verbal and qualitative information on the BMs applied, CE strategies implemented, their internal structure, and the dynamics of their changes contained in corporate reports.

In recent years, the BM and CE fields have received increasing attention from academia and practitioners. However, quantifying the structure of both BMs and CEs and determining their individual and mutual dynamics provide ample scope for further research and pose considerable challenges (Haas, 2018). Therefore, the present study aims to use a previously developed methodology for determining the structure of applied BMs and implemented CE strategies, as presented by Krmela et al. (2022), and further elaborate on it for determining BM dynamics and finding a link to competitiveness. The methodology is based on quantifying qualitative data derived from corporate communications using the assumptions of the attention-based view theory in line with Ocasio et al. (2017) and the legitimacy theory in line with Michalak et al. (2017).

The remainder of this paper is structured as follows: Section 2 introduces the current theoretical background in the fields of BM and CE, which underpins the empirical research undertaken. Section 3 presents the research method and population used, together with the proposed methodology for determining BM dynamics. Section 4 presents the key results of the research, and Section 5 discusses them in relation to other studies. Finally, Section 6 summarises the study's conclusions and outlines possible future directions.

2 THEORETICAL BACKGROUND

2.1 Business model and its dynamics as a tool of competitiveness

BMs can exist at both enterprise and enterprise levels. The BM view, as an abstract picture of business logic, in the research conducted, is based on the structure of BMs and their elements (Gassmann et al., 2014). A BM is understood as an abstract system comprising six key building blocks or elements: WHO (customer or customer segments and customer relationships), WHAT (value proposition, usually a tangible or intangible product or service and its uniqueness), HOW1 (value creation or partners, resources, capabilities, activities, processes), HOW2 (value delivery or distribution channels), WHY (value capture or cost structure and revenue streams), and VCO (value communication). Together, these elements form an interconnected whole in their unique configurations, creating a competitive advantage for the enterprise (Koprivnjak & Oberman Peterka, 2020). Owing to the action of internal and external factors, interactions occur between the elements within a given BM as well as with the surrounding environment. Elements change (Yeger & Shenhar, 2019), both in terms of content and meaning. This leads to moderate, incremental, and adaptive BM dynamics. When individual elements change significantly, BM dynamics can be strong and radical, with strong innovation potential for both the firm and the

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industry in which it operates (Wirtz, 2016). BM dynamics are one of the means of sustainable innovation of BMs of business-to-business industrial enterprises and are essential for ensuring the sustainability of enterprises. Industrial enterprises have up to a 2.6 times higher scale of BM change than commercial or service enterprises (Ciechan-Kujawa & Buszko, 2020). Thus, they may be suitable objects for investigation, considering that their BMs are not only influenced by the ecosystem in which they operate but also affect it through their activities. Determining the structure and performance of BMs is difficult because it requires an understanding of BMs' configurations in terms of their elements (Montemari et al., 2019).

2.2 Circular economy strategies

The implementation of a CE is closely related to sustainability, which, in turn, is related to competitiveness (Batlles-dela Fuente et al., 2021). CE is considered a regenerative system that implies the reuse of resources in a circular manner instead of a linear use of resources, the so-called take-make-disposal. "The circular economy aims to reduce resource input, as well as waste, emissions and energy losses, through product design, maintenance, repair and reuse, regeneration, reconditioning and recycling." (Salvioni & Brondoni, 2020, p. 1). This study is based on the conceptual anchoring of the hierarchy of CE strategies presented by the RLI (2015), Potting et al. (2016), and Reike et al. (2017). This hierarchy is referred to as the CE model 9R. It consists of ten different CE strategies, referred to as R0–R9, that target different levels of waste generation and options to eliminate waste through prevention or reduction. At the highest level, strategy R0 – Refuse/Avoid – completely eliminates potential waste through the elimination of product consumption. At the lowest level, the R9 – Recover for energy strategy – the waste generated is eliminated through incineration to generate electricity or heat energy. Both strategies, along with R2 – Reduce – and R8 – Recycle – are among the most commonly implemented CE strategies (Yang & Evans, 2019). Other strategies can be considered secondary or supportive CE strategies.

CE directly influences the BM elements (Asgari & Asgari, 2021). However, the implementation of BMs focused on CE strategies is limited by firms' ability to innovate and change their BMs (Pieroni et al., 2021), whereas BM change is inevitable for successful CE implementation (Awan & Sroufe, 2022). Potting et al. (2016) and Reike et al. (2017) posit that the implementation of higher-level CE strategies (i.e., R0, R1, etc.) requires a greater extent of BM change, possibly bordering radical BM innovation. Conversely, implementations of lower-level CE strategies (e.g., R8 and R9) require a lower extent of BM change, which may be more incremental in nature. Quantification of the levels of change, adaptation, and innovation, which can be understood as forms of BM dynamics in the implementation of selected CE strategies, has so far lacked sufficient attention from the academic community. It has its place not only in understanding the impacts of CE implementation on the BM of a particular firm but also in comparing the impacts of CE implementation on BM dynamics across firms and sectors. In particular, it considers current societal challenges, such as the European Green Deal and the associated Circular Economy Action Plan, formalised by European Commission Communication No. 52020DC0098.

2.3 Focus of attention and legitimacy in corporate communication about BMs and CEs

Corporate reports mediate financial and non-financial information about a firm (Bini et al., 2016; Di Tullio et al., 2021; Di Tullio et al., 2022). They are intended to serve the company's shareholders in assessing the performance of the company, its applied BM, and its sustainability activities, including CE. However, companies do not yet use a clear, harmonised, and established language in their communication with stakeholders, neither in the area of BMs nor

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CE. An inconsistent understanding of the BMs and CE is also a problem. A BM is often semantically confused with corporate strategy or business logic (Williamsson et al., 2019). Although closely related (Strakova et al., 2021), they differ in content and meaning. BMs and their changes, as an understanding of value creation and capture, as well as the connections between the elements and their interaction with the environment, are the result of managers' ideas and thinking (Reuter & Krauspe, 2022). The applied BM reflects the intended strategy; thus, it is a tool for implementing the corporate strategy. Therefore, adapting or changing the corporate strategy logically leads to adapting or changing the BM and, thus, its dynamics. According to the attention-based view theory, strategy is the object of management attention (Ocasio et al., 2017). Therefore, changes in the BM require the management of the enterprise as well as its other stakeholders. In line with legitimacy theory (Michalak et al., 2017) and considering the applicable European Union directives (EU, 2013; EU, 2014), it is not only in the interest but also the duty of large companies to communicate and inform them about their CE and BM strategies and their legitimate changes, although some information may be intentionally hidden (Michalak et al., 2017) and thus difficult to discover, read, and analyse.

According to the attention-based view theory, communication at the strategic level of enterprises can be interpreted in different ways. Ocasio et al. (2017, p. 163) acknowledge the specificity of the attention-based view theory in that ”it can, more so than other related approaches, focus on the strategic agenda of an organization.” For further research, they recommend ”to develop new methods to elucidate the communicative dynamics in strategic change.” (ibid., p. 164). Corporate external communication is one tool used to express both strategy and BM. Therefore, by applying an appropriate analytical method, it is possible to quantify and statistically evaluate the relevant variables associated with both BM and CE to capture and compare the strength of their relationships as well as their mutual dynamics.

2.4 Summary of the theoretical framework of the research

Synthesising the theoretical background in Sections 2.1–2.3, it can be concluded that there is still an underutilised research space for understanding and quantifying BM dynamics caused by implementing different CE strategies. Therefore, it is necessary to determine the relationships between BM elements as well as the relationships between the elements with external factors. BMs are complex units of analysis, and the relationships between their elements and subsystems must be addressed (Cosenz & Bivona, 2021). In the present research context, individual CE strategies can be considered as a specific form of subsystem or external factor influencing BMs. If the different BM elements are not equally affected when implementing CE strategies (Aarikka-Stenroos et al., 2022), different levels of BM dynamics of the different BM elements associated with the implementation of each CE strategy can be expected, with a varied impact on a company´s competitiveness.

3 STUDY OBJECTIVE, METHODOLOGY, AND DATA

This study is based on the works of Potting et al. (2016) and Reike et al. (2017) and the underlying assumption that higher-level CE strategies lead to a higher complexity of change and, thus, to higher levels of BM dynamics, and vice versa. The main objective of this study is to determine the BM dynamics that occur when selected CE strategies are implemented in the industry under study, understand their relationship with competitiveness, compare them, and validate them using both qualitative and quantitative methods. The primary research question (RQ_M) is:

RQ_M: What are the dynamics of BMs in implementing selected CE strategies?

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To determine BM dynamics, it is necessary to quantify both the structure of the BMs implemented in terms of the existence and relative importance of each BM's element and to quantify the relative importance of each CE strategy implemented. A sub-objective of this study is to determine the interrelationships between BMs' elements and CE strategies. Finally, this study aims to determine how the elements of the BM and CE strategies relate to BM dynamics and competitiveness. Therefore, the sub-research questions are (RQx):

RQ1: How are the elements of BMs, from the perspective of attention-based view theory and legitimacy theory, associated with BM dynamics?

RQ2: How are elements of BMs, from the perspective of attention-based view theory and legitimacy theory, associated with competitiveness?

RQ3: How are CE strategies, from an attention-based view theory and legitimacy theory perspective, associated with BM dynamics?

RQ4: How are CE strategies, from an attention-based view theory and legitimacy theory perspective, associated with competitiveness?

The concept of BM cannot be studied without understanding its context (Atkova & Ahokangas, 2020). Therefore, a mixed qualitative and quantitative research strategy is used. First, field-based empirical research was conducted, and the participant observation method was applied. The purposefully selected research population included 18 large business-to-business industrial enterprises operating in the European decorative and information systems industry. The enterprises produce physical products of a composite materials nature, fulfilling informative, decorative, and protective purposes for the products of which they are a part. The industry considers implementing appropriate CE strategies in the subject industry a priority until 2025. The research population covers a majority, empirically estimated to be around 85–90%, of the European market in the subject industry in the relevant part of the supply chain and can therefore be considered highly relevant and exhaustive for the purpose of the study, following the chosen method of analysis evaluation. The study includes a quantitative analysis of 41 corporate reports published by the set of companies under study covering the financial years 2019 (23 published in 2020) and 2020 (18 published in 2021).

For the quantitative content analyses of corporate reports (Jindřichovská et al., 2020), auto coding was used with a set of so-called verbal semantic indicators of the BM elements and the CE strategies as defined by Krmela et al. (2022). Application of the autocoding method to the analysis of communication using verbal semantic indicators can be considered appropriate for triangulating research and its results. It can complement other subjective research methods, such as questionnaires completed directly by respondents (Ibarra et al., 2020). This was used to quantify the BM structure and CE strategies of individual firms. The set of verbal semantic indicators was further extended for the purposes of the ongoing research to include 39 indicators of dynamics (see Appendix A) and 20 competitiveness indicators (see Appendix B). The verbal semantic indicators of dynamics were derived based on critical searches of the BM dynamics literature, particularly those of Achtenhagen et al. (2013), Krmela et al. (2022), Krumeich et al. (2015), Saebi (2014), Saebi et al. (2017), Schaffer et al. (2019), Wirtz (2016), and previous empirical research by the authors. Verbal semantic indicators of competitiveness were established as synonyms of the term competitiveness, as proposed by Merriam-Webster (2022) and Thesaurus (2022): The indicators were lemmatised in English.

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The MAXQDA 2020 Analytics Pro software was used for quantitative content analysis. The JASP software was used for descriptive statistics, network, and correlation analyses. For the correlation analyses of the relationships between variables (Urbinati et al., 2021), a significance level of $\alpha = 0.05$ was considered, and the moderating variable of the number of words contained in the analysed corporate reports, called *words*, was considered, too.

The BM dynamics are expressed using the proposed BM dynamics index when implementing the selected CE strategy, I_{BMDRi}. The proposed methodology for determining BM dynamics using I_{BDMRi} is novel and has not been applied previously. Heuristic inference and analytical induction are essential for this formulation. Assumptions for the application of correlation analysis to the quantification of qualitative data and their evaluation have also been considered (Hendl, 2014, 2015, 2016). The work and approaches of selected authors in the field of BMs, their dynamics, and innovation, particularly Clauss (2017), Gassmann et al. (2014), Wirtz (2016), and Yeger and Shenhar (2019), were simultaneously interpreted and synthesised. The methodology and its applications are based on the results of our empirical research. The starting points for determining BM dynamics using I_{BMDRi} are presented below:

- The tightness of the relationships between the individual BM elements and individual CE strategies, as expressed by Pearson's correlation coefficients r (or partial correlation coefficients), indicates the extent to which the $_j$-th BM element is potentially affected by a particular R_i-th strategy in the 9R CE model. A higher degree of tightness potentially leads to a higher degree of influence on the BM element and vice versa. The direction of tightness (positive or negative) was not relevant for determining the level of BM dynamics.
- Only relationships demonstrated at the chosen significance level $\alpha = 0.05$, meeting the condition of $p < 0.05$, are considered.
- The significance of the $_j$-th element of a BM is expressed as the % relative representation of the $_j$-th element in the BM. The higher the % significance of an element, the more the overall BM will, ceteris paribus, be potentially affected by a change in that element.
- The BM dynamics are given by the sum of the levels of change in all individual elements of the BM for a particular chosen R_i-th CE strategy.
- An overall higher level of change in all individual BM elements causes a higher level of BM dynamics and vice versa. A higher level of BM dynamics implies a higher level of BM change complexity.
- The BM dynamics cannot assume negative values. However, it can be zero (the BM does not change).
- The BM dynamics are expressed by the BM dynamics index (I_{BMDRi}), a unitless quantity that can take values from 0 (no BM dynamics; BM does not change as a whole) to 4 (maximum BM dynamics; radical BM innovation) when applying the selected R_i-th CE strategy:

$$I_{BMDRi} = \langle 0; 4 \rangle$$

To determine the BM dynamics, the transformed Pearson correlation coefficient of the R_i-th CE strategy and the $_j$-th BM element $\boldsymbol{r_{tRij}}$, inspired by Yeger and Shenhar (2019), is proposed as

$|r| = \quad \langle 0{,}00;0{,}20 \rangle \vee p > 0{,}05 \Rightarrow r_{tRij} = 0$ (no correlation)
$|r| = \quad (0{,}20;0{,}35 \rangle \wedge p < 0{,}05 \Rightarrow r_{tRij} = 1$ (weak correlation)
$|r| = \quad (0{,}35;0{,}60 \rangle \wedge p < 0{,}05 \Rightarrow r_{tRij} = 2$ (moderate correlation)
$|r| = \quad (0{,}60;0{,}80 \rangle \wedge p < 0{,}05 \Rightarrow r_{tRij} = 3$ (strong correlation)

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$|r| =$ $\langle 0{,}80;1{,}00\rangle$ $\wedge\ p < 0{,}05 \Rightarrow r_{tRij} = 4$ (very strong correlation)

and I_{BDMRi} determination is proposed as follows:

$$I_{BMDRi} = \sum_{j=1}^{6} \left(\frac{rtRij \times BMELwj}{100} \right) \quad (1)$$

- $BMEL_j$ is the $_j$-th element of the monitored BM. The model presented herein considers six BM elements: WHO, WHAT, HOW1, HOW2, WHY, and VCO ($BM_j = 6$).

- $BMEL_{wj}$ is the relative % significance of the BM of the $_j$-th element of the monitored BM, expressed in the interval (0; 100) when

$$\sum_{j=1}^{6} (\text{BMELwj}) = 100, \quad (2)$$

- where R_i is the $_i$-th strategy of the 9R CE implemented in the monitored BM ($R_i = 10$).
- r_{tRij} is the transformed Pearson correlation coefficient of the R_i-th strategy of the CE and the $_j$-th element of the BM.
- $r_{tRij} \times BMEL_{wj}$ is the product of the transformed Pearson correlation coefficient of r_{tRij} and $BMEL_{wj}$ of the significance of the $_j$-th BM element in the monitored BM in hundreds and can take values in the interval:

$$\left(\frac{rtRij \times BMELwj}{100} \right) = \langle 0; 4 \rangle \quad (3)$$

The BM dynamics level expression, interpreted according to Wirtz (2016), via I_{BMDRi}:

$I_{BMDRi} = \langle 0 \rangle$	zero BM dynamics	(BM does not change)
$I_{BMDRi} = (0; 1\rangle$	slight BM dynamics	(incremental change of BM)
$I_{BMDRi} = (1; 2\rangle$	moderate BM dynamics	(moderate change of BM)
$I_{BMDRi} = (2; 3\rangle$	strong BM dynamics	(strong change of BM)
$I_{BMDRi} = (3; 4\rangle$	very strong BM dynamics	(radical BM change with strong BM innovation potential).

4 RESULTS

The analysed set of corporate reports contained almost 3.3 million words. The total number of verbal semantic indicators retrieved was 166,511, of which 120,845 were *BM element* indicators (clustered as *ALL BM*), 13,272 were *CE strategy* indicators (clustered as *ALL CE*), 31,445 were *dynamics* indicators, and 949 were *competitiveness* indicators.

Figure 1 shows the tightness values of the relationships among the *BM elements*, the *dynamics* variable, and the *competitiveness* variable. Values are expressed as partial correlation coefficients considering the moderating variable *words*, representing the total number of words in corporate reports. By considering the moderating variable *words*, the potential undesirable effect of extensive communication by firms on the relationships between the key observed variables was eliminated (Hendl, 2015).

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Pearson's Partial Correlations

Variable		WHO	WHAT	HOW1	HOW2	WHY	VCO	Dynamics	Competitiveness
1. WHO	Pearson's r	—							
	p-value	—							
2. WHAT	Pearson's r	−0.137	—						
	p-value	0.401	—						
3. HOW1	Pearson's r	−0.284	0.894***	—					
	p-value	0.075	< .001	—					
4. HOW2	Pearson's r	−0.441**	0.521***	0.569***	—				
	p-value	0.004	< .001	< .001	—				
5. WHY	Pearson's r	0.249	−0.533***	−0.594***	−0.427**	—			
	p-value	0.121	< .001	< .001	0.006	—			
6. VCO	Pearson's r	−0.558***	0.564***	0.641***	0.609***	−0.546***	—		
	p-value	< .001	< .001	< .001	< .001	< .001	—		
7. Dynamics	Pearson's r	−0.004	0.452**	0.517***	0.018	−0.329*	0.525***	—	
	p-value	0.982	0.003	< .001	0.910	0.038	< .001	—	
8. Competitiveness	Pearson's r	0.086	0.433**	0.266	−0.013	−0.132	0.252	0.693***	—
	p-value	0.599	0.005	0.097	0.938	0.415	0.116	< .001	—

* p < .05, ** p < .01, *** p < .001
Conditioned on variables: Words

Fig. 1 – Relationships among elements of the BM, *dynamics* and *competitiveness*. Source: own research & JASP Team (2020).

Analogous to Figure 1, Figure 2 shows the tightness of the relationship among CE strategies, *dynamics*, and *competitiveness*.

Pearson's Partial Correlations

Variable		R0	R2	R8	R9	Dynamics	Competitiveness
1. R0	Pearson's r	—					
	p-value	—					
2. R2	Pearson's r	0.124	—				
	p-value	0.444	—				
3. R8	Pearson's r	0.723***	0.469**	—			
	p-value	< .001	0.002	—			
4. R9	Pearson's r	0.098	−0.083	−0.072	—		
	p-value	0.547	0.613	0.660	—		
5. Dynamics	Pearson's r	0.564***	−0.212	0.387*	−0.058	—	
	p-value	< .001	0.189	0.014	0.723	—	
6. Competitiveness	Pearson's r	0.465**	−0.299	0.223	0.397*	0.693***	—
	p-value	0.003	0.061	0.167	0.011	< .001	—

* p < .05, ** p < .01, *** p < .001
Conditioned on variables: Words

Fig. 2 – Relationships among elements of the CE model, *dynamics* and *competitiveness*. Source: own research & JASP Team (2020).

The tightness of the relationships of the aggregated variables of higher order, *ALL BM* = $\sum BMELj$ and *ALL CE* = $\sum Ri$, and the variables created by aggregating all identified indicators of both variables are shown in Figure 3. Note: For the *ALL CE* variable, All identified CE indicators were considered, including those that are not clearly attributable to a specific CE strategy but are closely related to CE. When the moderating variable *words* were excluded, a positive correlation between all the variables was evident. The variable *competitiveness* showed a weak positive correlation with *ALL BM* at the chosen level of significance.

The next step in this investigation was to determine the I_{BMDRi}. Using descriptive statistics, $BMEL_{wj}$ was determined (rounded to two decimal places in Table 1). Next, the values of the partial correlation coefficient *r*, excluding the effect of the moderating variable *words*, of the individual elements of $BMEL_j$ and individual CE strategies R_i were determined. These were then transformed into r_{tRij} coefficients. Finally, the values of $r_{tRij} \times BMEL_{wj}$ were determined, from which the I_{BMDRi} values were derived according to Formula (1). The obtained values are listed in Table 1.

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Pearson's Partial Correlations

Variable		ALL BM	All CE	Dynamics	Competitiveness
1. ALL BM	Pearson's r	—			
	p-value	—			
2. All CE	Pearson's r	0.805***	—		
	p-value	< .001	—		
3. Dynamics	Pearson's r	0.446**	0.427**	—	
	p-value	0.004	0.006	—	
4. Competitiveness	Pearson's r	0.338*	0.307	0.693***	—
	p-value	0.033	0.054	< .001	—

Conditioned on variables: Words
* p < .05, ** p < .01, *** p < .001

Fig. 3 – Relationships between higher-order variables. Source: own research & JASP Team (2020).

Tab. 1 – Determination of I_{BMDRi}. Source: own research

Pearson's partial correlations. Conditioned on variable: *words*							
$BMEL_j$	**VCO**	**HOW1**	**HOW2**	**WHO**	**WHAT**	**WHY**	
R_i	r	r	r	r	r	r	
R0	0,794***	0,740***	0,492**	–0,423**	0,724***	–0,551***	
R2	0,125	0,452**	0,723***	–0,094	0,395*	–0,125	
R8	0,827***	0,813***	0,804***	–0,454**	0,755***	–0,548***	
R9	–0,186	0,012	–0,124	–0,080	0,147	0,073	
*** p < 0,001	** p < 0,01	* p < 0,05					
$BMEL_j$	**VCO**	**HOW1**	**HOW2**	**WHO**	**WHAT**	**WHY**	
R_i	r_{tRij}	r_{tRij}	r_{tRij}	r_{tRij}	r_{tRij}	r_{tRij}	
R0	3	3	2	2	3	2	
R2	0	2	3	0	2	0	
R8	4	4	4	2	3	2	
R9	0	0	0	0	0	0	
$BMEL_j$	**VCO**	**HOW1**	**HOW2**	**WHO**	**WHAT**	**WHY**	
$BMEL_{wj}$	8,05	35,36	3,06	10,53	20,13	22,57	
Ri	$r_{tRij} \times BMEL_{wj}$	$r_{tRij} \times BMEL_{wj}$	$r_{tRij} \times BMEL_{wj}$	$r_{tRij} \times BMEL_{wj}$	$r_{tRij} \times BMEL_{wj}$	$r_{tRij} \times BMEL_{wj}$	I_{BMDRi}
R0	0,24	1,06	0,06	0,21	0,60	0,45	**2,63**
R2	0,00	0,71	0,09	0,00	0,40	0,00	**1,20**
R8	0,32	1,41	0,12	0,21	0,60	0,45	**3,12**
R9	0,00	0,00	0,00	0,00	0,00	0,00	**0,00**

5 DISCUSSION

An analysis of corporate reports shows that the extent of communication, expressed as the number of words, is positively associated with firm turnover. In this study, the reports of larger firms are more extensive than those of smaller firms. These results correspond to those of Jindřichovská et al. (2020). This can affect the results of the quantitative content analyses. This issue was eliminated by considering the number of words as a moderating variable.

The empirical field research and analyses of corporate reports show that firms observed in the sector focus on R0, R2, R8, and R9 CE strategies. These results are consistent with those of Yang and Evans (2019). However, other CE strategies may be prioritised in other sectors. In the BM structure, the element HOW1, value creation, was the most dominant element with $BMEL_{wHOW1}$ = 35,36, while the WHO, the customer, reached $BMEL_{wWHO}$ = 10,53. Here, the results differ slightly from the findings of Gassmann et al. (2014), who considered the WHO as a central element of each BM.

The correlation analysis and partial correlation coefficients presented in Figure 1 contribute to answering *RQ_1: How are the elements of BMs, from the perspective of attention-based view theory and legitimacy theory, associated with dynamics?* The answer is that *dynamics* are positively associated with *WHAT*, *HOW1* and *VCO*, which can be considered key to BM

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dynamics. Conversely, a negative association existed with *WHY*. Businesses pay relatively less attention to the financial aspects embodied by the *WHY* element in their communication, focusing specifically on the value proposition (i.e., products and their features) and value creation (i.e., activities, resources, and partners). In contrast, both the *WHO* and *HOW2* variables showed almost zero association with *dynamics*, which is remarkable. The value delivery element is mainly associated with distribution and logistics and is clearly outside the focus of attention and communication in the sector under study. By contrast, the *WHO* element, that is, the customer, is an immediate external stakeholder of each BM (Gassmann et al., 2014). Even given the very strong correlation between the *WHAT* and *HOW1* elements, it is evident that given the industrial-production nature of the subject industry and the relatively stable, traditional customer base, the BMs of firms are specifically focused on *WHAT*, *the* value proposition, and *HOW1*, *the* value creation, which is consistent with the findings of Bini et al. (2016) and Di Tullio et al. (2021) and are comparatively more associated with BMs' dynamics than other BMs' elements.

Furthermore, the values presented in Figure 1 contribute to answering *RQ_2: How are the elements of BMs, from the perspective of attention-based view theory and legitimacy theory, associated with competitiveness? Competitiveness* correlates with *WHAT*. A weak, though unproven, relationship at the chosen level of significance also exists for *HOW1* and *VCO*. Therefore, product and value creation are related to competitiveness. Increased attention is being paid to product-related communication, which can be attributed mainly to efforts to adapt product design to better meet CE requirements and the perceived need to communicate with consumers about it, as well as educate them. Associations with other BMs' elements were weak and were not confirmed at the chosen level of significance. In contrast, the strong positive correlation between the variable *dynamics* and *competitiveness* is remarkable, as confirmed at the chosen level of significance. In other words, achieving competitiveness is associated with BM dynamics in firms' perceptions. This is consistent with Krumeich et al. (2015), who found that the dynamics of BM are crucial for ensuring a company's competitiveness and success.

The correlation analysis and partial correlation coefficients presented in Figure 2 contribute to answering *RQ_3: How are CE strategies, from the perspective of attention-based view theory and legitimacy theory, associated with dynamics?* The answer is that *dynamics* correlated with *R0* and *R8*. Heuristically, the CE strategy R0 implies a significant change in business logic. As Potting et al. (2016) and Reike et al. (2017) reported, there are radical changes in virtually all elements of BM. Simultaneously, the empirical analysis shows that CE strategy R8 is also associated with intense BM changes in the studied industry, whether it is product design for recycling, investment in recycling technologies, logistics solutions, or consumer education and communication.

Figure 2 presents the answer to *RQ4: How are CE strategies, from an attention-based view theory perspective, associated with competitiveness? Competitiveness* was correlated with *R0* and *R9*. In the case of the CE strategy R0, new and even revolutionary product solutions are introduced. Despite the considerable risks, companies see them as tools for competitiveness. Conversely, the unconfirmed weak correlation between *competitiveness* and *R8* is explained by the empirical finding that the complexity and risks associated with the introduction of R8 partially limit competitiveness; firms do not clearly perceive R8 as either a threat or an opportunity in terms of competitiveness. Conversely, the potential ease of implementation of the R9 strategy, with its perceived minimal impact on BM, may paradoxically support competitiveness, at least in the short term, especially in the form of relatively low implementation costs mainly associated with waste collection and waste disposal fees.

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The results presented in Figure 3 contribute to answering RQ_1–RQ_4, and it can be concluded that *ALL BM* and *ALL CE* are strongly and positively associated. Simultaneously, both variables are moderately strongly associated with *dynamics*. Clearly, the CE strategy and the BM dynamics are closely related. Thus, it can be inferred that the implementation of CE strategies is closely associated with the BM and will require its adaptation or innovation. The implementation of the CE must be reflected in the BM. Without changing the BM, the CE cannot be implemented. The variable *competitiveness* showed a weak degree of association with *ALL BM*. Changing a BM is not simple; it is associated with risks and costs that can affect competitiveness. The weak association between *competitiveness* and the *ALL CE* variable may indicate that the surveyed firms respect CE implementation, which seems to stem from the uncertainty and costs associated with CE implementation. However, the *p*-value obtained missed the chosen level of significance.

This study considers the hierarchy of CE strategies introduced by RLI (2015), Potting et al. (2016), and Reike et al. (2017). All these authors posit a higher-level complexity, and thus higher potential BMs' dynamics, as the pyramid goes up from CE strategy R9 to R0. However, a remarkable result of the study is that, although the CE strategy R8 – Recycle – is considered a lower-level strategy than strategy R0 – Refuse/Avoid – the observed value of $I_{BMDR8} = 3.12$ is higher than the value of I_{BMDR0} (2.63). Both indicate strong BM dynamics (R0) to very strong BM dynamics (R8), that is, the level of a BM's change attributable to the implementation of both CE strategies. Conversely, $I_{BMDR2} = 1.20$ indicates moderate BM dynamics; that is, moderate BM change attributable to CE strategy R2. The CE strategy R9 – Recover for energy – shows $I_{BMDR9} = 0$, that is, no BM dynamics and, therefore, no BMs change. This result is not surprising. The qualitative and empirical findings supported the measured I_{BMDRi} values. The CE strategy R2 – Reduction in terms of reducing the number of materials used – is often rather incremental in the sector under study without the need for a significant change in the BM. Owing to the technological complexity of products in the subject industry, it is more easily promoted and without a significant need or even willingness to communicate, compared to strategies R0 and R8, respectively, compared to the radical version of R2. However, the radical version of R2 is not easily executed and is not the main focus of attention, unlike R0 or R8. Strategy R9 does not seem to be the focus of attention and communication of businesses because of its nature, and at the same time, according to the results, it does not lead to a significant change in BM. The collection of unsorted waste for incineration is associated with costs and, therefore with an element of *WHY*, but does not require increased effort, affecting BM.

The I_{BMDRi} and its values contribute to answering the RQ_M*: What are the dynamics of BMs in implementing selected CE strategies?* The answer is that the BM dynamics are very strong for strategy R8 in the sector under study, followed by strong BM dynamics for R0 and moderate BM dynamics for R2. However, there are no BM dynamics for strategy R9. Thus, similar to Aarikka-Stenroos et al. (2022), different levels of influence of BM and its elements on CE strategies were found through I_{BMDRi}.

The proposed I_{BMDRi}, its assumptions, and logic were inspired primarily by Krumeich et al. (2015), Clauss (2017), Yeger and Shenhar (2019), Urbinati et al. (2021), and Krmela et al. (2022). These authors studied BMs, the interdependencies between their elements, and their changes both qualitatively and quantitatively. Other authors have focused on the dynamics of the BM through other lenses, for example, from a system dynamics perspective (e.g., Cosenz & Bivona, 2021). The I_{BMDRi}-related methodology builds on these approaches by offering a simple quantitative method that can be applied by both researchers and practitioners, even when using freely accessible sources of data, publishing corporate reports, applying relatively simple

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means for quantitative content analyses, and statistical evaluations to make inferences. In particular, it focuses on CE-related aspects, an emerging research field (Aarikka-Stenroos, 2022; Asgari & Asgari, 2021). This topic is relevant for practitioners in view of the European Green Deal and the E.U.'s Circular Economy Action Plan.

However, the limitations of this study and its methodology must be considered when interpreting the results. This study focuses on a selected sector, specifically large industrial enterprises. The focus and relevance of BMs and CE issues by enterprises operating in other sectors may differ in nature, size, or focus of activity. The research-analytical method relies on attention, legitimacy, and the resulting communication. Based on this, we derive the variables of interest. At the same time, this method has limitations in terms of the defined set of verbal semantic indicators and the applied autocoding method. The omission or inclusion of a significant indicator or its misinterpretation in terms of (multiple) meanings may bias the results. The pitfalls associated with inaccurate terminology when compiling corporate reports cannot be ignored. The terminology used evolved; therefore, the set of semantic verbal indicators must be revised and updated occasionally. The application of analytical methods, in this case, network and correlation analysis, has limitations, especially in terms of (not) considering possible moderating variables. However, by rigorously examining the documents analysed and triangulating the data collection methods, the risk of incorrect interpretations can be reduced.

Given the method applied and the sector studied, avenues for further research can be identified, particularly in the involvement of longitudinal research methods in following specific companies and sectors over a more extended period and capturing trends in BM and CE communication as well as critical political-economic-legislative milestones. In addition, there is research potential in the use of the BM dynamics determination methodology and the comparison of the I_{BDMRi} index across businesses and sectors, particularly at times of revolutionary changes in society caused by events such as the coronavirus pandemic, the implementation of measures associated with the European Green Deal and related efforts towards the transition to a CE, non-financial reporting directives, and their impact on businesses' decision-making and the scope and content of their BM communication. Events of this nature and the associated measures can have a disruptive effect on established businesses, their BMs, and their priorities in implementing CE strategies.

6 CONCLUSION

This study focuses on the content of selected large business-to-business industrial enterprises' communications about BMs and CE strategies. It aims to determine the structure of the BM, identify the BM dynamics that occur through their interactions, and identify their relationships with competitiveness. The initial in-depth qualitative empirical research was followed by quantitative analyses of published corporate reports that fulfilled the purpose of official corporate communication about BMs and CE, among other information. Thus, it is possible to quantify the structures of the BMs and CE strategies. Both stages of the study served to triangulate the data obtained and verify the conclusions and should therefore be interpreted together, especially because of the application of the chosen research method, analysis, and interpretation of the results. Both contributed to the empirical validation of the proposed method of BM dynamics determination, as well as to the validation and interpretation of the obtained I_{MBDRi} values.

The results of this study support the assumption established at the beginning of the study that companies focus their communication on issues that are legitimate in the eyes of stakeholders.

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They communicate with stakeholders but not about them. The issues of climate change and the associated challenges, particularly in reducing consumption and waste and, therefore, the need to implement CE strategies in BMs, are undoubtedly perceived as highly relevant in society. This is evidenced by the growing interest in this issue among both academia and practitioners. This is reflected in the corporate reports published by the companies. Simultaneously, however, the research results indicate no easy and quick solutions for implementing CE through BM change. Some CE strategies (e.g., R8), by assuming lower-level CE and thus potentially easier in terms of implementation, clearly involve considerable effort and lead to very strong BM dynamics, that is, radical BM change of established business-to-business enterprises.

It would be interesting to monitor the extent and form of changes in various elements of the BMs. The proposed methodology will make it easier for stakeholders to monitor these changes better and more easily, triangulate the results, and identify implicit messages in communication. It is intended to support stakeholders in independently analysing corporate reports and making inferences about both the structure and configurations of BMs and implementing CE strategies, as well as to track their dynamics over longer time horizons. It also sheds light on the strength and direction of the relationships among the BM elements and CE strategies, thus helping managers design their BMs. In this context, the research undertaken is novel and potentially beneficial to a wide group of stakeholders who have an interest in and need to better understand the behaviour of businesses embodied in their communications with the public.

APPENDIX A

Set of verbal semantic indicators of the clustered variable *dynamics*, total 39 indicators:

adapt, adopt, align, breakthrough, develop, discontin, dynamic, erod, erosion, evolution, expansion, extension, growth, improv, incorporat, innovat, invest, integrat, learn, lifecycle, migrat, modif, novel, radical, reconfigur, reevaluat, reinvent, renewal, reorgani, reorient, replicat, research, restructur, revolution, shift toward, stabilis, stabiliz, transform, transition

APPENDIX B

Set of verbal semantic indicators of the clustered variable *competitiveness*, total 20 indicators:

aggressive, aggression, ambitious, antagonistic, at odds, combative, competing, competitive advantage, competitiveness, cutthroat, determination, diligence, dog-eat-dog, emulous, killer, killer instinct, opposing, rival, streetwise, vying

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