Business Performance Effects of Circular Economy Implementation in Core and Non-core Activities



André Podleisek, Nicolas Hofer, Roman Hänggi, and Katharina Luban

Abstract This article analyzes how the organizational context of Circular Economy implementation is related to perceived business performance effects. Using a comparative analytical approach, the study distinguishes between companies that integrate Circular Economy practices into their core business activities and those that implement such practices in non-core areas. The results show that companies with core integration report positive effects more frequently across most business performance factors when compared to companies with non-core implementation. These differences are particularly evident for market-related, capability-oriented, and risk-related dimensions. A notable exception concerns cost-related performance dimensions. In comparison to other business performance factors, cost-related effects show a less pronounced dominance of positive effects and instead display a more balanced distribution of positive, neutral, and negative effects.

Keywords Circular business performance · Circular economy practice · Lean digital green · Survey

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1 Circular Economy in Companies: Research Background and Focus

Research on Circular Economy (CE) has expanded considerably in recent years, reflecting a growing body of academic work addressing alternative production and consumption models [1]. The existing literature covers a wide range of perspectives, from the definition and conceptualization [2] to the analysis of drivers and barriers to CE adoption at the firm level, as well as policy frameworks and institutional mechanisms intended to promote CE principles at national and international levels [3–8]. Several studies examine the extent to which CE principles are adopted in practice. In 2018, the OECD reported that adoption by companies remained limited and often partial, with only a small share of firms having implemented CE-related principles or business models [9]. At the same time, other studies indicate that a substantial number of companies were not familiar with the CE concept [10]. More recent research suggests that both, familiarity and adoption, have increased with time [11].

The decision to integrate CE practices into a company's business model is strongly influenced by economic considerations and can affect both strategic direction and operational processes. At the same time, external factors, such as institutional requirements or customer pressure, can also influence companies to adopt circular practices. However, when adoption is primarily reactive, initiatives are often implemented in a project-based manner and remain confined to non-core business activities. By contrast, when companies perceive clear value creation through CE, they are more likely to deliberately integrate it into their core business activities as part of a wider strategic commitment aligned with economic objectives and long-term value creation [12, 13]

Against this background, the present study examines whether the organizational integration of CE makes a difference for business performance factors. Specifically, it compares business performance effects between companies that integrated CE into their core business activities and those that implemented them in non-core activities. By focusing on this distinction, the study aims to clarify how different integration contexts can shape the direction of business performance outcomes and to support companies in assessing the strategic implications of CE implementation.

1.1 Study Design and Sample Characteristics

The empirical basis of this study is a Europe-wide survey conducted in December 2022, targeting companies from the industrial sector, with a particular focus on manufacturing companies. The survey was sent mainly to decision-makers and individuals in leadership positions. While the questionnaire includes a broad range of topics related to CE, the analysis presented in this paper draws on a subset of questions that focus specifically on items capturing perceived effects on business performance factors (BPF). Details on the entire set of questions, study design, methodology used for the questionnaire, and technical aspects of the survey are described in [11].

In total, 512 valid responses were collected. For the purpose of the analysis presented in this paper, attention is restricted to companies that reported an active implementation of CE. This includes respondents who indicated CE implementation either within their core business activities or within non-core activities. Companies that reported no implementation or expressed uncertainty or unfamiliarity with the concept are not considered further. This analytical focus results in a subsample of 351 companies with headquarters located in 28 different European countries. For the breakdown of the subsample, refer to Tables 1 and 2.

Table 1 Characteristics of the subsample

Attribute	Variable	n
Position	CEO/business owner	142
	Other C-suite officers	28
	Environmental/sustainability/ governance manager	54
	Business development manager	49
	Other managerial positions	36
	Technical staff	23
	Other	18
	N/A	1
Economic activity	Manufacturer of durable products	142
	Manufacturer of non-durable products	71
	Manufacturer of parts or components	26
	Manufacturer of convenience products	4
	Repair and installation of machinery and equipment	7
	Retail/wholesale	22
	Service	49
	Other	30
Employee count	<10	79
	10–49	68
	50–249	57
	250–999	50
	1000–10,000	52
	>10,000	45
CE in	Core activity	216
	Non-core activity	135
Total (N)		351

Table 2 Company headquarter location

Country	n	Country	n
Germany	46	Spain	15
Switzerland	46	France	12
Netherlands	44	Austria	11
Italy	43	Belgium	10
Sweden	32	Denmark	8
United Kingdom	26	Other Europe	36
Finland	17	Others	5
		Total (N)	351

In the subset of questions related to BPF, respondents were asked to assess the direction of perceived effects rather than their magnitude. The effects were classified as positive, neutral, negative, and uncertain. This approach allows the analysis to focus on whether CE implementation in core versus non-core business activities is associated with favorable, unfavorable, or neutral business performance outcomes, rather than on the perceived strength of these effects.

2 Empirical Findings on Business Performance

The respondents that reported CE implementation were asked to evaluate its perceived impact on eight BPF. These factors capture key dimensions of economic and operational performance, including cost-related, market-related, technological, and resilience-oriented outcomes. The following sections present and discuss the empirical findings, with a particular emphasis on differences between CE implemented in core business activities versus non-core activities.

2.1 Material and Manufacturing Costs

Material and manufacturing costs represent a critical component of overall production expenses. These cost components may be influenced by CE-related changes such as shifts from primary to secondary materials, product design choices, and adaptations to manufacturing processes required to enable reuse, repair, or remanufacturing. Such changes affect material and manufacturing costs through altered input prices, additional processing requirements, or efforts related to redesign, testing, certification, and process adaptation. The perceived effects of CE integration on material costs are illustrated in Fig. 1.

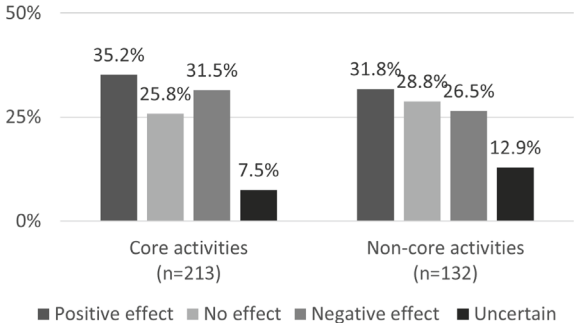


Fig. 1 Effects of CE on material costs

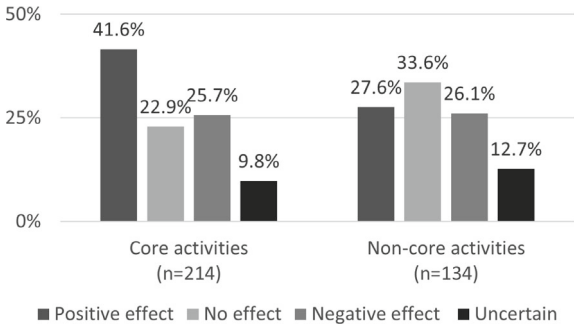


Fig. 2 Effects of CE on manufacturing costs

In the core business group, positive effects are reported by 35.2% of respondents, compared to 31.8% in the non-core group (difference: +3.4 percentage points). At the same time, negative effects are also reported on a slighty higher rate in the core group (31.5%) than in the non-core group (26.5%; difference: +5.0 percentage points).

A clearer distinction emerges with regard to manufacturing costs (see Fig. 2). Companies with CE integrated into core business activities reported positive impacts on a much higher rate than those with non-core implementation. In the core group, 41.6% of respondents report positive effects, compared to 27.6% in the non-core group (difference: +14.0 percentage points). At the same time, negative effects are reported by approximately one quarter of respondents in both groups. Neutral effects are reported more frequently in the non-core group, where 33.6% of the respondents also represent the largest share.

2.2 Resilience Against Resource Related Risks

Resilience against resource-related risks refers to a company's ability to cope with disruptions in the availability, price, or reliability of materials and resources. Such disruptions may arise from regulatory changes, geopolitical developments, increasing

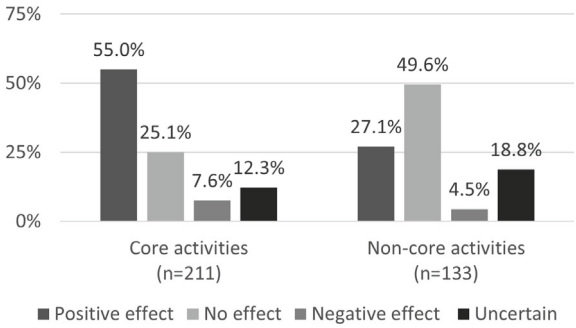


Fig. 3 Effects of CE on a company's resilience against resource-related risks

resource scarcity, or supply chain interruptions, as experienced during the COVID-19 pandemic [14].

The perceived effects of CE on this BPF are shown in Fig. 3. The comparison highlights clear differences between the two groups, primarily reflected in the relative distribution of positive and neutral effects. In the core business group, 55.0% of respondents report positive effects, compared to 27.1% in the non-core group (difference: +27.9 percentage points). By contrast, no percieved effect account for 25.1% in the core group, whereas they represent almost half of the responses in the non-core group (49.6%; difference: +24.5 percentage points). Negative effects on the company's resilience are reported by only a small share of respondents in both groups.

2.3 Sales

Sales performance reflects changes in revenue generation which can be associated with market acceptance, customer demand, and the commercial positioning of products and services. CE implementation can affect sales performance through product characteristics, service offerings, or communication related to circular attributes.

The perceived effects of CE on sales performance differ clearly between core and non-core implementation contexts, as shown in Fig. 4. Among companies implementing CE in core business activities, 73.4% report a positive effect on sales performance, while 15.0% indicate no effect and 2.3% report negative effects. In contrast, companies implementing CE in non-core activities report positive effects less frequently (39.6%), while neutral effects account for 47.8% of responses and negative effects for 1.5%. The distribution of effects indicate that positive effects on sales performance are much more likely when CE is implemented in core business activities than when it is limited to non-core activities.

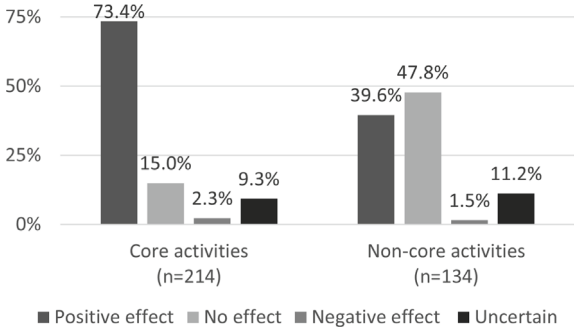


Fig. 4 Effects of CE on sales

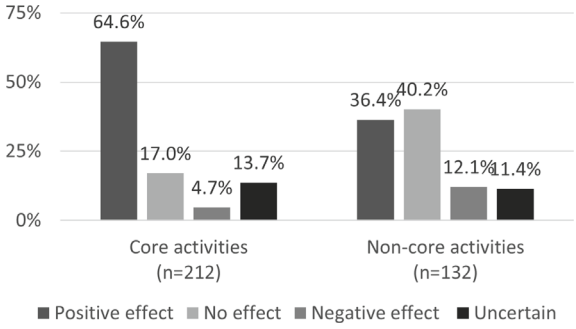


Fig. 5 Effects of CE on profits

2.4 Profit

Profitability reflects a company's financial success and captures whether revenues exceed costs over a given period. Figure 5 illustrates the perceived effects of CE on profitability. In the core business group, 64.6% of respondents report a positive effect on profitability, compared to 36.4% in the non-core group (difference: +28.2 percentage points). Neutral effects are reported by 17.0% of respondents in the core group, while this share increases to 40.2% in the non-core group (difference: +23.2 percentage points). Negative effects are reported by 4.7% of respondents in the core group and by 12.1% in the non-core group (difference: +7.4 percentage points).

In line with the pattern observed for sales performance, a distinct shift can be observed in the distribution of profitability-related effects attributed to CE between the two groups. Positive effects clearly dominate when CE is integrated into core business activities, whereas the non-core group is characterized by a substantially higher share of neutral effects. In addition negative effects occur more than twice as frequently in the non-core group compared to the core group.

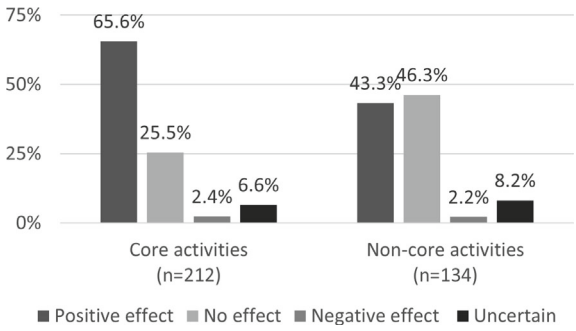


Fig. 6 Effects of CE on technological progress

2.5 Technological Progress

Technological progress focuses on changes in technological capabilities. It is treated as a BPF because it reflects whether and to what extent companies develop or adapt technological capabilities in response to CE integration. This can directly affect their ability to operate, compete, and scale circular activities. Examples from practice, such as DESSO, illustrate how CE integration can be associated with technological adaptations in areas such as material recovery and product redesign [15]. On the other hand, negative effects can occur when necessary CE-related technological changes are perceived as less suitable, less efficient, or more constraining than other existing technologies.

The results on this BPF are illustrated in Fig. 6. In the core business group, 65.6% of respondents indicate positive technological effects, whereas this share decreases to 43.3% when CE is implemented in non-core activities (difference: +21.7 percentage points). By contrast, the perception of no effect is stronger in the non-core group, where neutral assessments account for a substantially larger share of responses compared to the core group. Negative effects remain marginal in both implementation contexts.

2.6 Waste Reduction

As waste prevention and reduction are core elements of CE principles, and because they reflect operational efficiency outcomes that affect material use, process performance, and resource handling at the company level, waste reduction is treated as a business performance factor. As such, it captures a company's ability to manage resources efficiently and translate circular practices into measurable operational outcomes.

Figure 7 shows the distribution of perceived waste-related effects associated with CE implementation in core and non-core activities. In both groups, positive effects account for the majority of the responses, indicating that waste reduction is widely

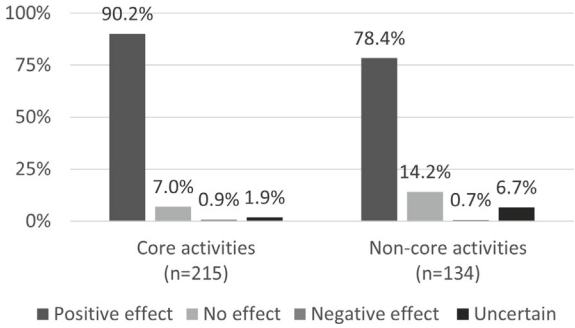


Fig. 7 Effects of CE on waste reduction

perceived as an outcome related to CE practices. The share of positive responses reaches 90.2% in the core business group and remains high at 78.4% in the non-core group. Differences between the two contexts are primarily reflected in the proportion of neutral effects (7.0% in the core group versus 14.2% in the non-core group] difference: +7.2 percentage points). Negative effects remain marginal in both groups (below 1%). A share of 6,7% of respondets in the non-core group reports uncertain effects, this suggests that waste-related effects are not systematically captured or assessed, for instance because corresponding data are not collected or not available in this implementation context.

Compared to other business performance factors, waste reduction shows high levels of positive effects across both implementation contexts.

2.7 Company Image

The final BPF considered in this analysis, company image, reflects how a firm is perceived by external and internal stakeholders, such as customers, employees, and investors. As a BPF, company image captures perception-based outcomes that can influence trust, legitimacy, and stakeholder support. In the context of CE implementation, this BPF focuses on whether CE-related activities are perceived as shaping a company's reputation and credibility.

Across both implementation contexts, CE is widely perceived as having a positive influence on company image (see Fig. 8). In the core business group, 93.0% of respondents report a positive effect on company image. A similarly positive assessment is also evident in the non-core group, where 76.9% of respondents indicate a positive effect. Notably, no negative effects on company image are reported in either group. Differences between the two contexts are therefore primarily reflected in the share of neutral assessments, which occur more frequently when CE is implemented in non-core activities.

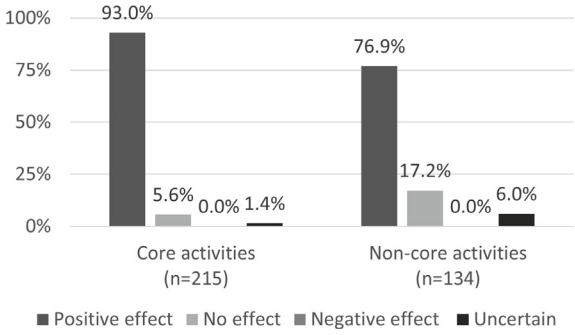


Fig. 8 Effects of CE on company image

3 Synthesis of Findings

The comparison between CE implementation in core and non-core business activities reveals distinct effect profiles that cut across cost-related, market-related, operational, and perception-based factors.

A first pattern emerges for market-oriented BPF, including sales performance and profitability. For these, CE implementation in core business activities is associated with a clear dominance of positive effects, whereas non-core implementation is characterized by a pronounced shift towards neutral assessments. Negative effects remain but occur more frequently in the non-core context. This pattern suggests that the organizational placement of CE is closely linked to whether market- and revenue-related effects are perceived as material.

A second pattern can be observed for resilience against resource-related risks and technological progress. Very, similarl to sales and profitability, these factors exhibit substantially higher shares of positive effects when CE is integrated into core business activities. The dominant contrast between the two implementation contexts also lies in the prevalence of neutral assessments in the non-core group. This indicates that CE-related contributions to resilience and technological capabilities are less clearly perceived when CE remains confined to non-core activities.

Cost-related factors show a more differentiated pattern. Material and manufacturing costs show mixed distributions of positive and negative effects in both groups, with comparatively smaller differences between core and non-core implementation. This ambivalence suggests that cost-related effects are not uniformly associated with CE integration and may depend on context-specific conditions, such as material choices, process configurations, or transition phases.

In contrast, waste reduction and company image form a distinct group of BPF. For both of them, positive effects dominate across core and non-core implementation contexts, and negative effects are either marginal or entirely absent. Differences between the two groups are primarily reflected in the share of neutral or uncertain assessments, particularly in the non-core group. This pattern indicates that some CE-related outcomes are widely perceived as positive irrespective of organizational

embedding, while differences emerge mainly in the clarity and visibility of these effects.

Across all business performance factors, a recurring feature of the empirical results is the presence of uncertainty about the effects. The existence of these responses shows that, for a subset of companies, CE-related effects are not or cannot be clearly evaluated. The assessment of BPFs presupposes the availability of relevant data or reference values. Where such data are not systematically collected or monitored, companies are unable to compare performance before and after CE implementation. Beyond internal assessment, the absence of reliable data also limits the ability to communicate CE-related performance externally, making it difficult to signal whether and to what extent CE integration has delivered measurable benefits. These observations point to measurement, data availability, and transparency as important cross-cutting issues that shape how CE-related effects are evaluated and made visible.

3.1 Recommendations for Companies

The results support the view that CE is most effective when it is embedded within established operational excellence frameworks rather than pursued as a standalone sustainability initiative. Contemporary industrial operational performance is largely based on Lean principles and is increasingly enhanced through digitalization [16, 17]. Within this context, CE adds a complementary "green" dimension by extending efficiency-oriented operational models towards lifecycle-oriented and resource-focused value creation [18–20].

Implementing CE in this way requires an understanding of the entire product lifecycle and the ability to systematically use data to question and adapt existing operational routines. Combining Lean (stable processes), digitalization (data, technologies), and CE (sustainability) enhances operational performance. Based on these considerations, we propose a Lean–Digital–Green approach that integrates these three perspectives into a comprehensive operational excellence model (see Fig. 9).

The Lean–Digital–Green framework places the integration of CE practices within a broader operational excellence perspective. By combining Lean principles, digital

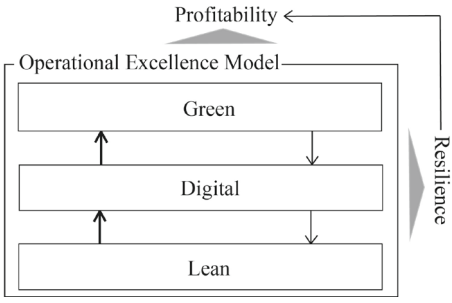


Fig. 9 Lean-digital-green framework for operational excellence

technologies, and sustainability-oriented thinking, the framework links process stability, data-driven transparency, and lifecycle-oriented resource management into a coherent approach. Lean provides the foundation for efficient and reliable processes, digitalization enables the systematic generation and use of operational data, and Circular Economy extends this foundation by introducing a lifecycle-oriented perspective on value creation. In this way, Lean–Digital–Green shifts attention from individual performance effects to the organizational conditions that enable CE implementation. The framework highlights how processes, data infrastructures, and responsibilities can be deliberately aligned to support CE initiatives and to make their effects observable, comparable over time, and communicable to internal as well as external stakeholders.

3.2 Further Research

While this study provides insights into the relationship between CE implementation and business performance, it is based on self-reported perceptions and cross-sectional data. Future research could explore causal relationships in greater depth and analyze interactions between different performance factors. Longitudinal studies and sector-specific analyses may further improve understanding of how CE contributes to sustainable competitive advantage.

References

1. Web of science, Search throughout All database using as Keyword Circular Economy from 1989 to 2022. (2022). https://www.webofscience.com/wos/woscc/analyze-results/8565a6aa-8d21-441b-81e1-e72cccb90ddf-68e87c00 (visited on 10/28/2022).
2. J. Kirchherr, D. Reike, and M. Hekkert, Conceptualizing the circular economy: An analysis of 114 definitions, Resources, Conservation and Recycling, vol. 127, pp. 221–232. (2017). https://doi.org/10.1016/j.resconrec.2017.09.005. (visited on 04/06/2022).
3. A. Podleisek, R. Hänggi, and K. Luban, Circular Economy: The Next Level of Company Success. Springer (2025).
4. J. Hart, K. Adams, J. Giesekam, D. D. Tingley, and F. Pomponi, Barriers and drivers in a circular economy: The case of the built environment, Procedia CIRP, vol. 80, pp. 619–624 (2019). https://doi.org/10.1016/j.procir.2018.12.015. (visited on 04/06/2022).
5. D. Reike, W. J. Vermeulen, and S. Witjes, The circular economy: New or refurbished as CE 3.0? Exploring controversies in the conceptualization of the circular economy through a focus on history and resource value retention options, Resources, Conservation and Recycling, vol. 135, pp. 246–264 (2018). https://doi.org/10.1016/j.resconrec.2017.08.027.
6. N. van Buren, M. Demmers, R. van der Heijden, and F. Witlox, Towards a circular economy: The role of dutch logistics industries and governments, Sustainability, vol. 8, no. 7, p. 647 (2016). https://doi.org/10.3390/su8070647. (visited on 05/10/2022).
7. T. Andersen, A comparative study of national variations of the European WEEE directive: Manufacturers view, Environmental Science and Pollution Research, vol. 29, no. 14, pp. 19920–19939 (2022). https://doi.org/10.1007/s11356-021-13206-z.

8. D. Vermunt, S. Negro, P. Verweij, D. Kuppens, and M. Hekkert, Exploring barriers to implementing different circular business models, Journal of Cleaner Production, vol. 222, pp. 891–902 (2019). https://doi.org/10.1016/j.jclepro.2019.03.052.
9. OECD, Business models for the circular economy: Opportunities and challenges from a policy perspective, OECD Publishing, Paris (2018).
10. D. Masi, V. Kumar, J. A. Garza-Reyes, and J. Godsell, Towards a more circular economy: Exploring the awareness, practices, and barriers from a focal firm perspective, Production Planning and Control, vol. 29, no. 6, pp. 539–550 (2018). https://doi.org/10.1080/09537287.2018.1449246.
11. N. Hofer, A. Podleisek, R. Hänggi, and K. Luban, Implementation of circular economy in European industrial companies a survey, in Circular Economy: The Next Level of Company Success, Cham: Springer, 2025, pp. 67–128.
12. K. Govindan and M. Hasanagic, A systematic review on drivers, barriers, and practices towards circular economy: A supply chain perspective, International Journal of Production Research, vol. 56, no. 1, pp. 278–311 (2018). https://doi.org/10.1080/00207543.2017.1402141.
13. M. A. Camilleri, European environment policy for the circular economy: Implications for business and industry stakeholders, Sustainable Development, vol. 28, no. 6, pp. 1804–1812 (2020). https://doi.org/10.1002/sd.2113.
14. K. Luban and R. Hänggi, Communicable Eds., Erfolgreiche Unternehmensführung durch Resilienzmanagement, Berlin, Heidelberg: Springer (2022)
15. Desso, As a cradle to cradle® company, we go beyond what most people understand by sustainability (2015). https://vloeren.projecten.tarkett.nl/nl_NL/node/onze-duurzaamheidsstrategie-omgezet-in-acties-1831 (visited on 04/14/2022).
16. R. Hänggi, A. Fimpel, and R. Siegenthaler, LEAN Production—Einfach und Umfassend: Ein Praxisorientierter Leitfaden zu Schlanken Prozessen mit Bildern Erklärt. Berlin, Heidelberg: Springer (2021)
17. L. Budde, R. Hänggi, T. Friedli, and A. Rüedy, Smart Factory Navigator: Identifying and Implementing the Most Beneficial Use Cases for Your Company—44 Use Cases That Will Drive Your Operational Performance and Digital Service Business. Cham: Springer (2023)
18. G. A. Queiroz, P. N. A. Junior, and I. C. Melo, Digitalization as an enabler to SMEs implementing lean-green? A systematic review through the topic modelling approach, Sustainability, vol. 14, no. 21, p. 14089 (2022). https://doi.org/10.3390/su142114089.
19. M. Roesch, J. Köberlein, M. Goldmanns, and A. Hohmann, Green-lean-digital als leitbild für die nachhaltige fabrik der zukunft, Zeitschrift für Wirtschaftlichen Fabrikbetrieb, vol. 116, no. 1, pp. 29–33 (2021). https://doi.org/10.1515/zwf-2021-0006.
20. A. Goelz, Green lean digital factory: Lean management trifft digitalisierung, 2020. https://industrie.de/industrie-4-0/green-lean-digital-factory-lean-management-trifft-digitalisierung/ (visited on 06/09/2023).

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