# Transforming Environmental Knowledge Into Business Opportunity Through Circular Economy Practices Mediation

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**Abstract**: In conditions of increasing environmental turbulence, organisations must continuously transform environmental information into strategic and operational responses. This study examines whether circular economy (CE) practices mediate the relationship between environmental scanning and business opportunity. Drawing on dynamic capabilities and the knowledge-based view, environmental scanning is conceptualised as a sensing capability, while CE practices represent organisational mechanisms transforming knowledge into value-creating actions. The study distinguishes between Sustainable Product Design and Circular Resource Management to explain how different CE dimensions contribute to business outcomes. Quantitative data were collected from 300 medium and large enterprises operating across 19 industrial sectors in Poland. Structural Equation Modelling (SEM) was used to examine direct and indirect relationships. The results show that environmental scanning does not directly influence business opportunity. Instead, its impact is primarily indirect and mediated through CE practices. The strongest effect was identified for Circular Resource Management, indicating that operational circular practices are critical for transforming environmental knowledge into business value. The study contributes to research on environmental scanning and circular economy by demonstrating that environmental knowledge creates value only when embedded in organisational capabilities enabling resource reconfiguration and operational implementation. The findings also provide managerial implications for firms seeking to translate environmental signals into competitive advantage.

**Keywords**: Environmental scanning, Knowledge transformation, Circular economy, Business opportunity, Organizational learning

## 1. Introduction

In an environment of growing complexity and uncertainty, the ability of firms to monitor regulatory, technological, economic and social changes has become a key determinant of long-term competitiveness. Global transformations—including digitalisation, climate policies and resource volatility—require organisations not only to possess resources but to continuously reconfigure them in response to environmental signals.

Environmental scanning is widely recognised as a component of dynamic capabilities, enabling sensing, seizing and reconfiguring (Teece, 2007; Sun et al., 2021; Koparan and Aksaray, 2025). It is primarily instrumental, supporting opportunity identification, risk mitigation and strategic decision-making. Firms scan their environment not to pursue normative goals but to recognise and exploit opportunities.

At the same time, the circular economy (CE) is gaining importance as a direction of industrial transformation. Practices such as eco-design, resource loop closure and material efficiency are increasingly perceived not only as responses to regulatory pressure but also as sources of cost efficiency, innovation and new revenue models.

Importantly, firms do not scan their environment with the primary aim of implementing CE. However, many environmental signals—such as regulatory changes, increasing material costs or technological developments—relate to circular transformation. CE may therefore represent one possible strategic response, but not an automatic one.

This raises a key research question: does environmental scanning directly lead to improved business outcomes, or is its effect mediated through specific organisational practices such as CE implementation? Existing research rarely addresses this mechanism in an integrated manner. Environmental scanning studies focus on direct effects, while CE research typically treats implementation as a response to external pressures. Few studies analyse CE as a mediating mechanism or distinguish between its design and operational dimensions.

This study addresses this gap by examining whether Sustainable Product Design and Circular Resource Management mediate the relationship between environmental scanning and business development trends. Unlike previous studies that treat circular economy implementation as a single construct or as a direct response to external pressure, this research conceptualises CE practices as organisational mechanisms transforming environmental knowledge into business opportunity.

The study contributes to the literature in three ways. First, it integrates environmental scanning and circular economy research within a single analytical framework grounded in dynamic capabilities theory. Second, it distinguishes between design-oriented and operational circular practices, showing that they generate different value creation mechanisms. Third, it empirically tests the mediating role of CE practices using Structural Equation Modelling based on data from 300 firms.

The following hypotheses are proposed:

*H1: Environmental scanning positively influences the implementation of CE practices.*

*H2: CE practices positively influence business opportunity.*

*H3: CE practices mediate the relationship between environmental scanning and business opportunity.*

## 2. Literature Review

### 2.1 Environmental Scanning and Business Outcomes

Environmental scanning is defined as the systematic monitoring and interpretation of environmental signals to support strategic decision-making (Beal, 2000; Choo, 1996; Choo, 2001). It is conceptualised within dynamic capabilities as part of the sensing process (Teece, 2007).

Empirical studies show that environmental scanning supports innovation, adaptability and performance, particularly under conditions of high turbulence (Sun et al., 2021; Stelmaszczyk et al., 2023; Zhou et al., 2025). However, most research models scanning as a direct predictor of performance or as mediated by general constructs such as innovation or flexibility (Otache, 2024; Yu et al., 2022).

At the same time, literature reviews emphasise that studies rarely examine the specific operational mechanisms through which scanning translates into economic outcomes (Magnano et al., 2024; Nassou & Kamar, 2025). As a result, concrete organisational practices remain underexplored as intermediary links

### 2.2 Circular Economy and Firm Performance

Research on CE shows positive relationships between circular practices and financial performance, resource efficiency and organisational resilience (Centobelli et al., 2020; Khan et al., 2022). CE is also associated with business model transformation and cost reduction.

The literature identifies key drivers of CE implementation, including regulatory pressure, stakeholder expectations, environmental orientation and access to resources (Velenturf & Purnell, 2021; He et al., 2022; Aryee & Kanda, 2024). Consequently, CE is often interpreted as a response to external pressure rather than as an outcome of knowledge processes.

Moreover, many studies treat CE as a single construct, overlooking differences between design-level practices (eco-design) and operational practices (resource circulation). These dimensions may generate distinct value creation mechanisms (Aryee & Kanda, 2024).

### 2.3 Towards an Integrated Mechanism

Recent literature calls for integrating information processes with implementation mechanisms (Magnano et al., 2024). CE can be viewed not only as a response to external pressures but also as a mechanism for commercialising environmental signals.

However, there is still a lack of research that simultaneously treats environmental scanning as an antecedent of CE, distinguishes between CE dimensions, and analyses their mediating effects on business outcomes.

## 3. Materials and Methods

The study adopts a quantitative research design to examine both direct and indirect relationships between environmental scanning, CE implementation and business development trends.

The model includes two dimensions of environmental scanning: Macro-Environment Scanning (ME) and Industry Environment Scanning (IE), as well as two dimensions of CE implementation: Sustainable Product Design (CE Design) and Circular Resource Management (CE Operations). The dependent variable is Business Development Trend.

Data were collected in January 2025 from 300 medium and large enterprises operating across 19 industrial sectors in Poland. The study used a CATI survey administered to senior managers (CEOs, technical directors, financial directors).

All variables were measured using five-point Likert-type scales. The reliability of the constructs was satisfactory, with Cronbach's alpha values of 0.87 for environmental scanning and 0.78 for CE practices.

Structural Equation Modelling (SEM) was employed to analyse direct and indirect effects, enabling the simultaneous examination of mediating relationships.

Several limitations of the research design should be acknowledged. First, the use of perceptual measures may introduce common method bias, as all responses came from single respondents. To mitigate this risk, anonymity was ensured and questionnaire items were separated conceptually. Furthermore, Herman's Single-Factor Test was conducted, which showed a proportion of total variance of 31.08%. This result does not indicate a problem with common method bias. Second, the cross-sectional character of the study limits causal interpretation, as relationships were measured at a single point in time. Consequently, the findings should be interpreted as associative rather than strictly causal.

The conceptual model is presented in Figure 1.

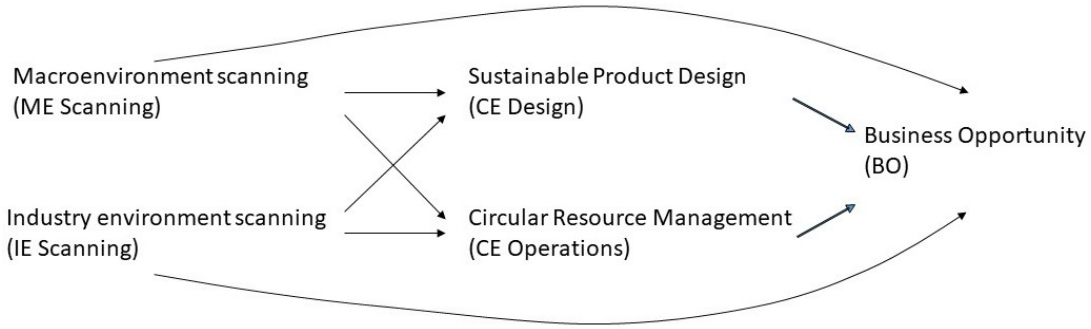


**Figure 1: Research model**

## 4. Results

### 4.1 Frequency of Responses

The descriptive analysis indicates that firms most intensively monitor technological, regulatory and customer-related environmental changes. In contrast, socio-demographic and environmental trends are scanned less frequently (Table1). Regarding CE implementation, firms more commonly adopt design-related practices, particularly environmentally friendly materials and recycling-oriented design, whereas operational practices based on internal waste reuse remain less developed (Table 2).

**Table 1: Environmental Scanning (N = 300)**

| Segment | | LOW (1;2) | LOW (%) | HIGH (4;5) | HIGH (%) |
|---|---|---|---|---|---|
| ME Scanning | E1 | 77 | 25,7% | 118 | 39,3% |
| | E2 | 55 | 18,3% | 143 | 47,7% |
| | E3 | 79 | 26,3% | 88 | 29,3% |
| | E4 | 61 | 20,3% | 147 | 49,0% |
| | E5 | 56 | 18,7% | 179 | 59,7% |
| IE Scanning | E6 | 34 | 11,3% | 191 | 63,7% |
| | E7 | 46 | 15,3% | 170 | 56,7% |
| | E8 | 74 | 24,7% | 130 | 43,3% |

**Table 2: Circular Economy Practices (N = 300)**

| Principle | | LOW (1;2) | LOW (%) | HIGH (4;5) | HIGH (%) |
|---|---|---|---|---|---|
| CE Design | C1 | 74 | 24,7% | 147 | 49,0% |
| | C2 | 50 | 16,7% | 155 | 51,7% |
| | C3 | 91 | 30,3% | 119 | 39,7% |
| | C4 | 63 | 21,0% | 147 | 49,0% |
| | C5 | 119 | 39,7% | 100 | 33,3% |
| CE Operations | C6 | 90 | 30,0% | 118 | 39,3% |
| | C7 | 150 | 50,0% | 82 | 27,3% |
| | C8 | 96 | 32,0% | 128 | 42,7% |

Table 3 shows the distribution of assessments of business development trends (Business Opportunity – BO). A positive trend (responses 4–5) was reported by 47.3% of enterprises, whilst 13.3% indicated a negative trend (responses 1–2). This means that almost half of the surveyed companies perceive their growth dynamics as favourable.

**Table 3: Business Trend**

| Category | N | % |
|---|---|---|
| BO (1–2) | 40 | 13.3% |
| BO (4–5) | 142 | 47.3 |

In order to preliminarily identify the relationship between environmental scanning and the implementation of CE principles and the business development (BO) trend, two extreme configurations were compared (Table 4): low engagement in scanning changes in the sociodemographic segment and the use of own production waste (E3 and C7), and high engagement in scanning the customer segment and the use of environmentally friendly materials (E6 and C2).

The proportion of firms declaring a positive business development trend (BO 4–5) was significantly higher in the strong configuration (19.7%) than in the weak configuration (6.0%), indicating a link between the co-occurrence of engagement in scanning and implementing CE principles and more favourable business dynamics.

**Table 4: High and low engagement in environmental scanning and the implementation of circular economy principles versus business trend**

| Configuration | BO (1–2) % | BO (4–5) % |
|---|---|---|
| Low E3 and Low C7 | 3.0% | 6.0% |
| High E6 and High C2 | 3.7% | 19.7% |

### 4.2 Correlation Analysis

To determine whether there is a correlation between the variables: environmental scanning (E1–E5; E6–E8), application of Circular Economy principles (C1–C5; C6–C8) and business development trends (BO), a Spearman's rank correlation test was conducted (Table 5).

Correlation analysis revealed statistically significant positive relationships among environmental scanning variables, CE practices and business opportunity. Strong correlations within the scanning and CE dimensions suggest that firms tend to apply these practices systematically rather than selectively.

**Table 5: Spearman's rank correlation**

| Variable | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | BO | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1 | 1,000 | 0,561 | 0,421 | 0,494 | 0,451 | 0,440 | 0,413 | 0,440 | 0,289 | 0,121 | 0,198 | 0,163 | 0,166 | 0,169 | 0,092 | 0,146 | 0,079 |
| E2 | 0,561 | 1,000 | 0,422 | 0,493 | 0,477 | 0,464 | 0,517 | 0,365 | 0,211 | 0,181 | 0,187 | 0,188 | 0,199 | 0,249 | 0,182 | 0,098 | 0,130 |
| E3 | 0,421 | 0,422 | 1,000 | 0,544 | 0,349 | 0,297 | 0,288 | 0,333 | 0,228 | 0,239 | 0,174 | 0,360 | 0,140 | 0,287 | 0,122 | 0,299 | 0,250 |
| E4 | 0,494 | 0,493 | 0,544 | 1,000 | 0,379 | 0,408 | 0,371 | 0,304 | 0,201 | 0,283 | 0,235 | 0,368 | 0,223 | 0,274 | 0,249 | 0,218 | 0,197 |
| E5 | 0,451 | 0,477 | 0,349 | 0,379 | 1,000 | 0,535 | 0,605 | 0,481 | 0,250 | 0,150 | 0,214 | 0,122 | 0,268 | 0,206 | 0,154 | 0,035 | 0,248 |
| E6 | 0,440 | 0,464 | 0,297 | 0,408 | 0,535 | 1,000 | 0,643 | 0,497 | 0,135 | 0,143 | 0,081 | 0,108 | 0,085 | 0,169 | 0,132 | 0,073 | 0,150 |
| E7 | 0,413 | 0,517 | 0,288 | 0,371 | 0,605 | 0,643 | 1,000 | 0,486 | 0,171 | 0,070 | 0,097 | 0,048 | 0,126 | 0,186 | 0,096 | 0,032 | 0,134 |
| E8 | 0,440 | 0,365 | 0,333 | 0,304 | 0,481 | 0,497 | 0,486 | 1,000 | 0,183 | 0,165 | 0,128 | 0,111 | 0,091 | 0,134 | 0,064 | 0,119 | 0,141 |
| BO | 0,289 | 0,211 | 0,228 | 0,201 | 0,250 | 0,135 | 0,171 | 0,183 | 1,000 | 0,242 | 0,176 | 0,150 | 0,224 | 0,220 | 0,226 | 0,189 | 0,290 |
| C1 | 0,121 | 0,181 | 0,239 | 0,283 | 0,150 | 0,143 | 0,070 | 0,165 | 0,242 | 1,000 | 0,428 | 0,488 | 0,397 | 0,310 | 0,420 | 0,192 | 0,234 |
| C2 | 0,198 | 0,187 | 0,174 | 0,235 | 0,214 | 0,081 | 0,097 | 0,128 | 0,176 | 0,428 | 1,000 | 0,388 | 0,331 | 0,330 | 0,306 | 0,148 | 0,244 |
| C3 | 0,163 | 0,188 | 0,360 | 0,368 | 0,122 | 0,108 | 0,048 | 0,111 | 0,150 | 0,488 | 0,388 | 1,000 | 0,319 | 0,358 | 0,360 | 0,358 | 0,275 |
| C4 | 0,166 | 0,199 | 0,140 | 0,223 | 0,268 | 0,085 | 0,126 | 0,091 | 0,224 | 0,397 | 0,331 | 0,319 | 1,000 | 0,317 | 0,287 | 0,111 | 0,283 |
| C5 | 0,169 | 0,249 | 0,287 | 0,274 | 0,206 | 0,169 | 0,186 | 0,134 | 0,220 | 0,310 | 0,330 | 0,358 | 0,317 | 1,000 | 0,242 | 0,240 | 0,256 |
| C6 | 0,092 | 0,182 | 0,122 | 0,249 | 0,154 | 0,132 | 0,096 | 0,064 | 0,226 | 0,420 | 0,306 | 0,360 | 0,287 | 0,242 | 1,000 | 0,347 | 0,253 |
| C7 | 0,146 | 0,098 | 0,299 | 0,218 | 0,035 | 0,073 | 0,032 | 0,119 | 0,189 | 0,192 | 0,148 | 0,358 | 0,111 | 0,240 | 0,347 | 1,000 | 0,295 |
| C8 | 0,079 | 0,130 | 0,250 | 0,197 | 0,248 | 0,150 | 0,134 | 0,141 | 0,290 | 0,234 | 0,244 | 0,275 | 0,283 | 0,256 | 0,253 | 0,295 | 1,000 |

### 4.3 Results of Structural Equation Modelling (SEM)

The SEM analysis provides the most important findings of the study (Figure 2). The direct effects of environmental scanning on business opportunity are weak (ME → BO = 0.056; IE → BO = –0.044). By contrast, indirect effects through CE practices are substantially stronger.

The strongest relationship identified in the model is the effect of Circular Resource Management on Business Opportunity (b = 0.437). This indicates that operational circular practices constitute the principal mechanism through which environmental knowledge is transformed into economic value. Sustainable Product Design also positively influences business opportunity, although its effect is weaker and more indirect.

Overall, the findings support the mediational role of CE practices and confirm that environmental scanning contributes to business opportunity primarily through organisational implementation mechanisms rather than through direct effects.

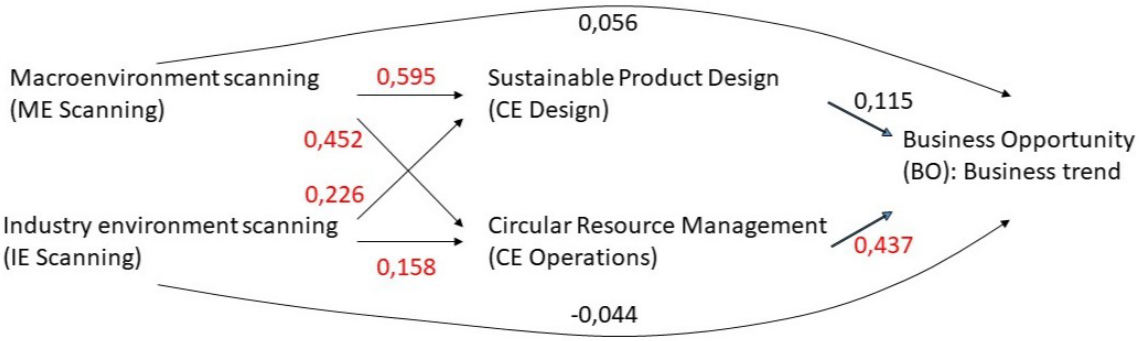


**Figure 2: Structural model with standardized coefficients**

## 5. Discussion

The aim of this study was to explain how knowledge gained through environmental scanning can be transformed into tangible business opportunities through the implementation of circular economy principles. The findings indicate that this relationship is complex and multi-stage. Neither more intensive scanning nor the mere adoption of circular practices automatically improves business performance. Instead, the results suggest a process of knowledge transformation: from selective acquisition of environmental information, through interpretation and organisational internalisation, to utilisation in project and operational activities. This interpretation places the findings at the intersection of dynamic capabilities theory, absorptive capacity, and the knowledge-based view, where competitive advantage depends not on possessing information itself, but on the

ability to integrate and translate it into value-creating actions (Teece, 2007; Cohen and Levinthal, 1990; Grant, 1996; Zirena-Bejarano et al., 2025; Agustí et al., 2022).

The results reveal clear selectivity in environmental scanning. Firms most frequently monitor technological and regulatory segments in the macro-environment, and customers and competitors in the industry environment, while socio-demographic factors and the natural environment receive less attention. Technological and regulatory signals are directly linked to innovation, productivity and compliance, whereas customer and competitor scanning supports adaptation to market dynamics. In contrast, socio-demographic and environmental signals are harder to translate into immediate business decisions because they are indirect and long-term. This supports the view that environmental scanning is a selective and interpretative process shaped by organisational cognition and existing knowledge structures (Daft and Weick, 1984; Choo, 1996; Helfat and Peteraf, 2015).

A similar selectivity appears in the implementation of circular economy practices. Firms more often adopt design-oriented practices, such as environmentally friendly materials and recycling-oriented design, together with less disruptive operational solutions like virtual prototyping and the use of external waste streams. The least frequent practice is the reuse of a firm's own production waste, which requires deeper integration of technological, process and organisational knowledge. From a knowledge-management perspective, circular design relies more on explicit knowledge, while operational circularity depends on tacit knowledge embedded in routines and organisational processes (Ranucci & Souder, 2015; Nonaka and Takeuchi, 1995). The findings therefore indicate that knowledge transformation into circular practices is gradual and asymmetric.

Another important finding is that environmental scanning alone does not significantly improve business development trends. Both macro- and industry-level scanning show weak direct effects on business opportunity, with the industry-level effect even negative. This confirms that knowledge itself does not create value. In dynamic capabilities theory, sensing is only the first stage; value emerges when organisations are able to seize opportunities and reconfigure resources accordingly (Teece, 2007; Schilke et al., 2018; Wilden & Gudergan, 2015; Amara et al., 2025). Environmental scanning therefore constitutes a source of knowledge, but not an independent source of value creation.

The importance of this distinction becomes clear in the analysis of indirect effects. The strongest relationship in the model is between Circular Resource Management and Business Opportunity, while indirect paths from scanning to business outcomes through circular practices—especially operational ones—are substantially stronger than direct effects. This indicates that circular economy practices are not secondary contextual variables but central mechanisms transforming knowledge into value. Environmental information gains economic significance only when translated into changes in resource use, operational processes and organisational routines. This interpretation is consistent with the knowledge-based view and prior research emphasising that circular practices contribute to performance only when integrated into organisational value-creation processes (Grant, 1996; Centobelli et al., 2020; Magnano et al., 2024; Khan et al., 2022).

A particularly important distinction emerges between circular design and operational circular practices. Although both dimensions positively influence business opportunity, the operational dimension is considerably stronger. Circular design primarily prepares the organisation for future opportunities by supporting compliance and long-term adaptability. Operational practices, however, directly influence efficiency, costs and resource utilisation, translating more rapidly into visible business outcomes. In this sense, circular design can be interpreted as "capability enabling", whereas operational circularity is "opportunity realising".

The comparison of extreme configurations provides additional insight. Firms characterised by low socio-demographic scanning and limited reuse of internal waste report substantially lower levels of positive business trends than firms combining intensive customer scanning with the use of environmentally friendly materials. This confirms that the co-occurrence of intensive scanning and circular implementation supports stronger business dynamics. However, some firms in the "weak" configuration still achieve positive results, suggesting that opportunities may also emerge through intuition, managerial experience or favourable market conditions. According to organisational learning theory, opportunity recognition may initially rely on intuition before becoming institutionalised within organisational routines (Crossan et al., 1999; Pidduck & Clark, 2025). Conversely, some firms with intensive scanning and strong circular implementation still report negative trends, indicating an implementation gap between recognising opportunities and effectively exploiting them.

The distinction between macro- and industry-level environments is equally significant. Macro-environmental scanning shows stronger relationships with business outcomes than industry-level scanning, suggesting that

systemic knowledge concerning regulation, technology and environmental trends has greater transformative potential than knowledge about current competitors or customers. The macro-environment generates exploratory knowledge capable of reshaping business models, whereas the industry environment more often reinforces adaptation and imitation.

Overall, the findings support viewing the model as a structured process of knowledge transformation. Organisations first selectively acquire environmental knowledge, then interpret it through existing competencies and business models, and finally translate it into project and operational activities. Only when these stages are successfully connected does environmental knowledge become a sustainable business opportunity. In this context, the circular economy is not merely a response to environmental pressures, but a key mechanism linking environmental knowledge with strategic and economic outcomes through operational reconfiguration and opportunity capture.

## 6. Conclusion

This study examined whether circular economy practices mediate the relationship between environmental scanning and business opportunity. The findings show that environmental scanning alone does not directly generate business value. Instead, its influence is realised through organisational capabilities that translate environmental knowledge into operational and strategic activities.

The study makes three main contributions. First, it integrates environmental scanning and circular economy research within a single dynamic capabilities framework. Second, it demonstrates that CE practices mediate the relationship between environmental scanning and business opportunity. Third, it shows that different CE dimensions generate different value creation mechanisms, with Circular Resource Management exerting the strongest effect on business outcomes.

From a practical perspective, the results suggest that firms should treat environmental scanning as a starting point for capability development rather than as an isolated information activity. Managers should invest in operational circular capabilities, cross-functional coordination and resource reconfiguration processes enabling the practical use of environmental knowledge. Particular attention should be paid to resource circulation practices, as these provide the strongest link between environmental information and economic value.

The study has several limitations. First, the use of perceptual measures may introduce subjective bias. Second, the cross-sectional nature of the data limits the ability to infer causality. Third, the research was conducted in a single country, which may affect the generalisability of the findings.

Future research could explore longitudinal designs to better capture dynamic relationships over time, as well as examine additional mediating mechanisms linking environmental scanning with business performance. Further studies could also investigate sector-specific differences and extend the analysis to different institutional contexts.

**Ethics Declaration:** The study complied with institutional ethical standards. Participation was voluntary and anonymous. No personal or sensitive data were collected. Because the data concerned organizational and technological aspects, formal ethics committee approval was not required.

**AI Declaration:** ChatGPT was used to support the search for scientific literature and to edit and format the bibliography according to Harvard style. All sources used were independently reviewed and critically used by the author, who takes full responsibility for the reliability, accuracy, and originality of the content.

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