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STRATEGIC INTELLECTUAL CAPITAL IN SUSTAINABLE COMPETITIVE PERFORMANCE: SMES IN THE PLASTIC MANUFACTURING SECTOR

CAPITAL INTELECTUAL ESTRATÉGICO PARA UM DESEMPENHO COMPETITIVO SUSTENTÁVEL: PMEs NO SETOR DE FABRICAÇÃO DE PLÁSTICOS

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Abstract
This study aims to analyse the role of strategic intellectual capital in Sustainable Competitive Performance among manufacturing SMEs facing pressures from foreign direct investment and the circular economy. A hypothetical-deductive approach was employed, surveying 168 SMEs in the plastic manufacturing sector within the Guadalajara Metropolitan Area. Data were analysed using Principal Component Analysis for dimensionality and ANOVA. The results demonstrate that Sustainable Competitive Performance is driven by the dynamic interaction of SIC components, supporting the development of regenerative and circular capabilities. This research empirically confirms the role of SIC as a catalyst for circular and Sustainable Competitive Performance, providing a framework that combines intangible resources within strategic responses to global and environmental challenges.

Keywords: Strategic Intellectual Capital. Sustainable Competitive Performance. SMEs. Circular Economy. Emerging Capabilities. Financial Resilience.

Resumo
Este estudo visa analisar o papel do capital intelectual estratégico no desempenho competitivo sustentável em pequenas e médias empresas (PMEs) do setor manufatureiro que enfrentam pressões do investimento estrangeiro direto e da economia circular. Foi empregada uma abordagem hipotético-dedutiva, com uma pesquisa realizada em 168 PMEs do setor de fabricação de plásticos na região metropolitana de Guadalajara. Os dados foram analisados por meio de Análise de Componentes Principais para dimensionalidade e ANOVA. Os resultados demonstram que o desempenho competitivo sustentável é impulsionado pela interação dinâmica dos componentes do capital intelectual estratégico, apoiando o desenvolvimento de capacidades regenerativas e circulares. Esta pesquisa confirma empiricamente o papel do capital intelectual estratégico como catalisador para o desempenho competitivo sustentável e circular, fornecendo uma estrutura que combina recursos intangíveis em respostas estratégicas a desafios globais e ambientais.

Palavras-chave: *Capital Intelectual Estratégico. Desempenho Competitivo Sustentável. PMEs. Economia Circular. Capacidades Emergentes. Resiliência Financeira.*

1 INTRODUCTION

The plastic industry has been pressured to adopt circular-economy practices, and industrial policies have become more restrictive. The transition to a circular model does not depend exclusively on traditional factors such as profitability, technology, or physical resources, but on the activation of intangible capabilities that enable adaptation, innovation, and organisational learning (Asgari and Asgari, 2021; Hofmann, 2019). Strategic Intellectual Capital (SIC) is a resource that must be managed with the same attention devoted to other resources (Meral et al., 2023).

This article examines the role of SIC in fostering sustainable competitiveness among plastics manufacturing SMEs in the Guadalajara Metropolitan Area. Using an empirical approach, it investigates the strategies adopted by these companies in response to environmental demands, especially those stemming from Foreign Direct Investment (FDI) and national and international regulations.

The significance of this work lies in providing evidence on how SMEs can develop emerging capabilities (Govindan, 2025) that not only facilitate their adaptation but also strengthen their competitive position in increasingly sustainability-focused Global Value Chains (GVC) (Polas et al., 2025). Additionally, an integrated explanatory framework is proposed that connects economic performance, operational efficiency, and technology with the principles of the circular economy (Digitemie et al., 2025).

The article is organised into four sections: the first introduces the theoretical and conceptual framework; the second outlines the methodology employed; the third examines the results in relation to contemporary theories of organisational learning and dynamic capabilities; and finally, the fourth section draws conclusions, highlights practical implications, and suggests directions for future research.

2 THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1 The circular economy

The circular economy, as it applies to the plastics industry, involves a transformative model of the plastics life cycle (Liu et al., 2024). In a circular system, plastic is continually reused, recycled, and reintroduced into the production chain

(Zorpas, 2024). The circular economy offers an alternative approach to reducing pollution from single-use plastics (Hahladakis et al., 2024). It also addresses the issues of the linear economy, which relies on large quantities of non-renewable resources.

The circular economy significantly diminishes the resources required to create plastic products for disposal (Zorpas, 2024). One benefit is the production of lighter plastics that remain as durable and functional (Abedsoltan, 2024). It also incorporates recycled materials or bio-based alternatives in place of fossil resources (Rani et al., 2024).

The circular economy requires an effective system for collecting and separating plastic waste, thereby preventing it from entering landfills or the environment (Nordahl and Scown, 2024). Mechanical and chemical recycling are encouraged to convert plastic waste back into raw materials. Mechanical recycling involves shredding and melting plastic to create new products, while chemical recycling breaks down plastic into its fundamental chemical components, which can be reused to produce virgin plastic (Shen and Worrell, 2024). Plastic companies have incentives to collect their end-of-life products and recycle them for reuse in manufacturing (Helinski et al., 2024; Hassan et al., 2024).

Although there are many benefits, it is often challenging for low-income countries because, in many areas, the infrastructure for collecting, sorting, and recycling plastic is underdeveloped (Ferronato et al., 2024). Moreover, some types of plastic are difficult to recycle, and not all recycled materials match the quality of virgin plastic, which can restrict their use (Singh and Walker, 2024).

2.2 Strategic Intellectual Capital (SIC)

Strategic Intellectual Capital refers to the set of intangible resources an organization possesses that enable it to generate sustainable value over time (Prasasti et al., 2025). SIC of an SME improves as it enhances its Environmental Scanning, Organizational Knowledge Creation, and integrates Organizational Learning & Adaptive Feedback into its routine (Alharthi, 2025).

Environmental Scanning is a systematic process by which SMEs identify, analyze, and interpret relevant information from both their internal and external environments (Harris and Brooker, 2025). This scanning includes economic, technological, political, social, and competitive trends. SMEs that monitor their environment anticipate opportunities, threats, and disruptive changes.

The process definitely strengthens strategic intellectual capital by generating valuable information (Rodriguez et al., 2024) that can be transformed into practical knowledge for decision-making. In this context, the following hypothesis is proposed:

H2: Environmental Scanning significantly contributes to the development of Strategic Intellectual Capital in SMEs of the plastic manufacturing industry.

Additionally, human capital develops through enhancing employees' competencies, attitudes, and intellectual agility (Guggemos, 2024). Competence creates value via employees' knowledge, ability, talent, and technical expertise; the main components are knowledge and ability. Creating Knowledge pertains to a person's capability to solve problems (Abbas et al., 2024).

SMEs that promote spaces for sharing ideas, documenting learning, and applying knowledge to strategic projects strengthen their innovation and continuous improvement capabilities. Therefore:

H3: Organizational Knowledge Creation significantly contributes to the development of Strategic Intellectual Capital in SMEs of the plastic manufacturing industry.

Organizational learning in SMEs is evident in their ability to incorporate past experiences and use them to improve business practices (Huynh et al., 2025). Adaptive feedback allows them to identify errors, correct them, and redesign processes to cope with dynamic environments. Learning SMEs become more flexible, resilient, and able to sustain strategic processes in the long term. This process directly strengthens strategic intellectual capital.

H4: Organizational Learning & Adaptive Feedback significantly contributes to the development of Strategic Intellectual Capital in SMEs of the plastic manufacturing industry.

In short, SIC enables the development of dynamic capabilities to address industry challenges, thereby enhancing market positioning (Naoum et al., 2023). Therefore, it is essential to connect it to Sustainable Competitive Performance.

2.3 Sustainable competitive performance

Sustainable competitive performance refers to an SME's ability to maintain its competitive position over time, not only in financial results but also in innovation, relationships with key stakeholders, social responsibility, and strategic adaptation (Leon et al., 2025). Strategic intellectual capital provides the resources and capabilities that sustain long-term competitiveness.

Financial resilience refers to the ability of SMEs to maintain economic stability in the face of crises, market fluctuations, or external shocks (Aassouli and Ahmed, 2023). It involves healthy liquidity, revenue diversification, budgetary prudence, and the capacity to recover. Companies with greater strategic intellectual capital tend to develop more creative and efficient responses to economic pressures, thereby strengthening their financial resilience. The main goal of the companies is to maximise the wealth of existing shareholders. It aims to achieve economies of scale in services and supply to a growing, more demanding customer base.

H5: Financial Resilience significantly contributes to Sustainable Competitive Performance in SMEs of the plastic manufacturing industry.

Strategic Cost Management (Mpanza et al., 2025) aims to strike a balance between financial efficiency and value creation. It goes beyond simply reducing expenses; its primary task is to optimize resource allocation in line with long-term strategic objectives. Sustainable competitive performance drives innovative spending practices, the prioritization of key investments, and process improvement.

H6: Strategic Cost Management significantly contributes to Sustainable Competitive Performance in SMEs of the plastic manufacturing industry

The use of technology in SMEs activates dynamic capabilities that enhance their Sustainable Competitive Performance (Van Hoang et al., 2025). Technology is central to market improvement, creating dynamic competitive advantages and boosting productivity and income (Adama et al., 2024). However, its implementation does not automatically ensure positive outcomes, as it relies on complementary factors such as skilled human capital, infrastructure, management capacity, and customer focus (De la Mora et al., 2020; Sutrisno and Susanti, 2024).

Technological development in SMEs within the plastics sector cannot be fully understood without its link to emerging capabilities that, together, facilitate the shift towards sustainable competitiveness. This form of competitiveness isn’t based solely on financial outcomes but also on the interplay among technology, knowledge, efficiency, and environmental commitment—key elements for creating regenerative models within the circular economy framework.

H7: Technological Innovation Capacity significantly contributes to Sustainable Competitive Performance in SMEs of the plastic manufacturing sector

Environmental scanning, Organizational Knowledge Creation, and Organizational Learning processes build and strengthen SIC. This capital, in turn, serves as the foundation for achieving sustainable competitive performance. Sustained competitive performance strengthens financial resilience, strategic cost management, and technological innovation capacity, ensuring the organization's long-term survival and success.

Furthermore, based on the context of the SMEs studied, dynamic capabilities and intellectual capital have developed in response to the pressure or influence of the productive environment dominated by companies receiving FDI (Figure 1).

General Hypothesis

Null Hypothesis (H0): There is no statistically significant relationship between knowledge-based capabilities—including environmental scanning, organizational learning, knowledge creation, cost management, and technology—and sustainable competitive performance in SMEs of the plastic manufacturing sector.

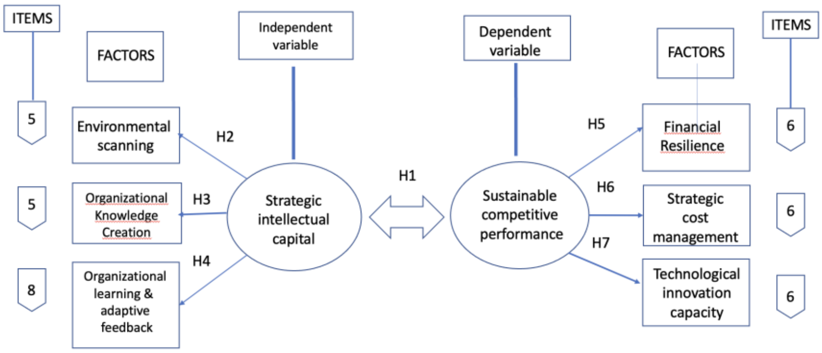
Alternative Hypothesis (H1): Knowledge-based capabilities—including environmental scanning, organizational learning, knowledge creation, cost management, and technology—significantly contribute to sustainable competitive performance in SMEs of the plastic manufacturing sector.

3 METHODOLOGY

The formulation of clear and measurable hypotheses reflects the neopositivist tradition in the social sciences (Contini, 2024), which prioritises objectivity, replicability, and control of bias through representative samples and statistical inference techniques. (Figure 1)

Figure 1

Research model



Source: Own elaboration.

This study uses a hypothetical-deductive approach, a characteristic of quantitative research that seeks to verify relationships between observable variables. In this instance, the relationship between SIC and Sustainable Competitive Performance in manufacturing SMEs is empirically tested by evaluating previously formulated hypotheses.

Jalisco is one of Mexico's primary recipients of foreign direct investment (FDI). Within this framework, small and medium-sized enterprises (SMEs) in the plastics industry play a vital role as suppliers integrated into GVCs, meeting international standards of quality, innovation, and sustainability. Consequently, this business group was selected to examine the relationship between strategic intellectual capital, Sustainable Competitive Performance, and the shift towards the circular economy, considering its crucial part in regional development and its vulnerability to external pressures for productive transformation. To determine the appropriate sample size for a study involving a finite population of 299 small and medium-sized enterprises (SMEs), we use the following formula:

$$n = (Z^2 * p * q * N) / ((e^2 * (N - 1)) + (Z^2 * p * q)) \qquad (1)$$

Where:

Z = Z-score (1.96 for 95% confidence level)

p = estimated proportion of population (0.5 for maximum variability)

q = 1 - p

e = margin of error (0.05 or 5%)

N = population size (299 SMEs, micro is excluded)

By substituting the values into the formula, we obtain a required sample size of approximately 169 respondents. This ensures statistical validity at the 95% confidence level with a 5% margin of error.

These companies are part of GVCs because they establish direct or indirect commercial relationships with transnational corporations that receive FDI. This includes supplying components or packaging to foreign companies operating in Mexico (assembly plants, pharmaceutical companies, automotive companies, etc.). It also involves complying with international quality, traceability, and certification standards required by foreign partners. Even if they do not receive FDI directly, their operations depend on or are influenced by companies that do.

The use of 5-point Likert scales and analyses such as Cronbach's Alpha, Principal Component Analysis (PCA), and ANOVA aligns with modern standards of empirical validation and with efforts to reduce phenomenological complexity. PCA reveals underlying patterns, and ANOVA evaluates the significance of differences in those patterns between groups.

The dependent variables (components of Sustainable Competitive Performance and SIC) were measured using ordinal Likert-scaled items. When aggregated and checked for internal consistency (using Cronbach's alpha), they can be regarded as continuous variables for analytical purposes.

The independent variables (such as categories of Environmental Scanning performance, Organizational Knowledge Creation, Financial Resilience, and others) were categorised into groups or levels, enabling comparisons of means across multiple categories. ANOVA is used to compare the means of a continuous variable across three or more independent groups, which is precisely the case in this study.

The goal of ANOVA in this context is to assess whether observed differences in Sustainable Competitive Performance (and its components) can be significantly attributed to variations in levels of Strategic Intellectual Capital (and vice versa).

This method not only enables empirical testing of the formulated hypotheses but also helps develop intermediate theories on the link between intangible assets (SIC) and organisational outcomes (Sustainable Competitive Performance), especially relevant in the context of industrial SMEs in emerging economies.

4 RESULTS

The Cronbach's alpha between SIC and Sustainable Competitive Performance is highly consistent (.941; 36 items), as it is close to 1. It can be observed that the variables considered in the questionnaire, using Likert scale questions, were applied consistently.

The KMO value of 0.856 indicates excellent sampling adequacy, making it suitable to proceed with a factor analysis of the data. The results (Table 1) show that the data meet the necessary assumptions for conducting a Principal Component Analysis (PCA).

Table 1

KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of the adequacy of sampling		.856
Sphericity test of Bartlett	Chi-square	2603.377
	gl	630
	Sig.	.000

Source: Own elaboration.

Examining the commonality values helps determine how well the factors account for each variable (Table 2). The closer the commonality is to 1, the better the factors explain the variable. For low values (< 0.4), the item has little relation to the extracted factors and could be removed (e.g., product costs).

The ability to innovate, adapt to change, and transfer knowledge is crucial for Sustainable Competitive Performance within the circular economy (Köhler et al., 2022). The following elements demonstrate this: “Financial results”, “Development of products and/or services”, “Project planning”, and “Knowledge exchange with society”.

“Sales”, “Process/Service development”, and “Technology development” illustrate the application of knowledge in productive and technological processes, which are vital for operational efficiency. (Cobbinah et al., 2025)

The practical and codified know-how characteristic of action-oriented Strategic Intellectual Capital management (Husain and Ermine, 2025) is supported by the "Uses instruction guide and orders" (0.684), "Procedures for applying knowledge" (0.682), and "Adapt quickly" (0.678).

"Consulting" (0.576), "Raw materials and inputs" (0.570), and "Production costs" (0.568) are cost structure factors related to circular economy practices such as energy efficiency, recycling, and waste reduction.

Table 2

Commonalities

Group	1	2	3	4	5	6
Financial results	0.822					
Sales		0.793				
Processes Services/Products		0.786				
Technology development		0.785				
Product/Service Development		0.782				
Upgrading machinery and equipment		0.771				
New opportunities		0.766				
Knowledge Exchange with the Society		0.765				
Crises and unexpected events		0.759				
Development of products and/or services		0.747				
Project planning		0.746				
Knowledge exchange with partners		0.738				
Browse information		0.735				
Coordinate development efforts		0.735				
Locate and apply knowledge to changing conditions		0.726				
Information technology development		0.723				
Product delivery costs		0.709				
Transportation costs		0.704				
Anticipate potential opportunities for the Market		0.703				
Profits have been good.			0.693			
Uses instruction guide and orders			0.684			
It has procedures for applying the knowledge			0.682			
Adapt quickly			0.678			
League sources of knowledge			0.672			
Information from technologies			0.646			
Performs feedback			0.644			
Debts have decreased.			0.629			
Uses the knowledge			0.621			
The investment has been very good			0.620			
Consulting				0.576		
Low raw materials and inputs				0.570		
Production costs				0.568		

Supported by documented material				0.533		
Loans contracted				0.516		
Order costs					0.480	
Product costs						0.354

Source: Own elaboration.

According to Table 3 from the Environmental Scanning factor, the most critical item, "generation of a guide of instructions and orders from managers," has the highest quadratic mean. Companies that document processes and organise internal knowledge are better positioned to redesign processes towards sustainable and circular approaches. This practice supports the standardisation of best practices in reverse logistics, traceability, and clean production. This item not only has high statistical significance but also substantial strategic value for the circular transition. Therefore, the results empirically support

H2, Environmental Scanning significantly contributes to the development of Strategic Intellectual Capital in SMEs of the plastic manufacturing industry.

The eta squared (η^2) values indicate medium to large effect sizes. These results not only demonstrate statistical significance ($p < .001$) but also substantial explanatory power, reinforcing the conclusion that Environmental Scanning practices significantly influence the development of Intellectual Capital in SMEs.

Additionally, the results empirically confirm the concept of knowledge conversion by demonstrating how Environmental Scanning, external collaboration, and document structuring support the shift from tacit to explicit knowledge in real-world organisational contexts (Oliva et al., 2025). This research, therefore, offers quantitative evidence for what has traditionally been based on case studies or qualitative methods. It affirms that the company functions as a distributed cognitive system, with processes that enable information to be transformed into innovation.

Table 3

ANOVA Environmental Scanning

		Sum of squares	gl	Media quadratic	F	Sig.	η^2 (Effect Size)
ES1	Between groups	163.002	24	6.792	10.340	.000	.70
	Within groups	69.624	106	.657			
	Total	232.626	130				
ES2	Between groups	141.721	24	5.905	7.705	.000	.63

	Within groups	81.999	107	.766			
	Total	223.720	131				
ES3	Between groups	132.996	23	5.782	9.728	.000	.68
	Within groups	63.599	107	.594			
	Total	196.595	130				
ES4	Between groups	105.082	24	4.378	8.814	.000	.67
	Within groups	52.659	106	.497			
	Total	157.740	130				
ES5	Between groups	83.417	21	3.972	5.666	.000	.54
	Within groups	71.511	102	.701			
	Total	154.927	123				

Source: Own elaboration.

The results in Table 4 confirm that

H3: Organizational Knowledge Creation significantly contributes to the development of Strategic Intellectual Capital in SMEs of the plastic manufacturing industry.

The η^2 values (ranging from 0.708 to 0.789) indicate that over 70% of the variance in Organizational Knowledge Creation is explained by group-level differences—underscoring the substantial effect of organizational factors on Knowledge Creation capacity.

The most significant item is "Anticipate crises and unexpected events." The ability to anticipate disruptive events fosters knowledge development within the SIC (Deepa and Elangovan, 2024). Within the circular economy framework, this capability is a vital emerging adaptive skill (Puerta et al., 2023). Companies that can foresee environmental, regulatory, or market disruptions are better prepared to redesign their production processes in line with regenerative principles. This is directly linked to Adaptive Organisational Learning, where knowledge is not only absorbed but also proactively generated in response to change.

The findings pertain to Adaptive Organisational Learning. Valuable knowledge resides not only in what is accumulated but also in what is anticipated, collaboratively integrated, and transformed into innovation.

Table 4

ANOVA Organizational Knowledge Creation

		Sum of squares	gl	Media quadratic	F	Sig.	η² (Effect Size)
OK1	Between groups	101.605	19	5.348	19.648	.000	0.768
	Within groups	30.756	113	.272			
	Total	132.361	132				
OK2	Between groups	89.534	19	4.712	18.178	.000	0.753
	Within groups	29.293	113	.259			
	Total	118.827	132				
OK3	Between groups	113.485	19	5.973	20.971	.000	0.779
	Within groups	32.184	113	.285			
	Total	145.669	132				
OK4	Between groups	103.906	19	5.469	14.428	.000	0.708
	Within groups	42.831	113	.379			
	Total	146.737	132				
OK5	Between groups	149.282	19	7.857	22.240	.000	0.789
	Within groups	39.921	113	.353			
	Total	189.203	132				

Source: Own elaboration.

According to Table 5, "Learning feedback for capital" is the most significant item. It emphasises that the internal feedback process is crucial for accumulating practical knowledge. Active feedback is fundamental to converting tacit knowledge into explicit knowledge. This kind of reflective learning is a vital emerging capability for redesigning processes, enhancing material flows, and adapting to changing regulatory environments.

Error systematisation and continuous redesign are processes that strengthen SCI by transforming operational knowledge into organisational knowledge. They promote the ability to adapt to circular principles, which involve redesigning the product life cycle, traceability, and reverse logistics (Rouhani et al., 2025). Circularity requires systemic innovation, not just momentary optimisation.

Empirical data support hypothesis

H4: Organizational Learning & Adaptive Feedback significantly contributes to the development of Strategic Intellectual Capital in SMEs of the plastic manufacturing industry.

It demonstrates that feedback, reflection on errors, and systematising learning are practices that enhance SIC.

These results indicate that organizational learning and adaptive feedback mechanisms explain between 60% and 85% of the variance in the measured items. Specifically, OL1 ($\eta^2 = 0.846$) stands out as the item with the most significant explanatory power, suggesting that certain collective learning practices play a crucial role in structuring intellectual capital in SMEs in the plastics sector.

This evidence empirically supports the notion that organizational knowledge develops through collective experience, the sharing of lessons learned, and the ability to adapt to environmental changes.

Table 5

ANOVA Organizational Learning & Adaptive Feedback

		Sum of squares	gl	Media quadratic	F	Sig.	η² (Effect Size)
OL1	Between groups	445.716	33	13.507	16.286	.000	0.846
	Within groups	81.276	98	.829			
	Total	526.992	131				
OL2	Between groups	130.794	33	3.963	7.267	.000	0.710
	Within groups	53.449	98	.545			
	Total	184.242	131				
OL3	Between groups	149.412	31	4.820	7.787	.000	0.711
	Within groups	60.657	98	.619			
	Total	210.069	129				
OL4	Between groups	143.942	31	4.643	8.513	.000	0.729
	Within groups	53.450	98	.545			
	Total	197.392	129				
OL5	Between groups	106.779	32	3.337	6.174	.000	0.668
	Within groups	52.962	98	.540			
	Total	159.740	130				
OL6	Between groups	110.596	32	3.456	7.196	.000	0.701
	Within groups	47.068	98	.480			
	Total	157.664	130				
OL7	Between groups	75.108	33	2.276	4.479	.000	0.601

	Within groups	49.801	98	.508			
	Total	124.909	131				
OL8	Between groups	90.825	33	2.752	5.141	.000	0.634
	Within groups	52.470	98	.535			
	Total	143.295	131				

Source: Own elaboration.

The results in Table 6 offer strong evidence that Financial Resilience aspects (sales, access to credit, profits) are vital predictors of competitiveness in industrial SMEs.

H5: Financial Resilience significantly contributes to Sustainable Competitive Performance in SMEs of the plastic manufacturing industry.

All η^2 values exceed 0.14, which is considered a significant effect according to Cohen's conventions. This confirms that financial resilience has a substantial impact on perceived competitive sustainability. Additionally, the item FR2 ("Identifying financial opportunities to respond to economic fluctuations") stands out as the most influential financial capability for sustaining competitive advantage, with the highest η^2 (0.767) and F-value (15.31).

Strong financial structure and access to affordable financing are crucial enablers for implementing circular economy practices (Ahmed et al., 2025), thereby supporting the theory from a practical and integrative perspective that connects economic performance and sustainability.

The findings enhance our understanding of proactive financial resilience, which allows companies to keep liquidity, invest in innovation, and respond flexibly to crises or market changes.

The integration of p-values and η^2 substantiates the empirical strength of H6. This robust evidence confirms that financial resilience is not merely associated with competitiveness but is a core enabler of sustained strategic advantage, particularly in volatile economic environments.

Table 6

ANOVA Financial Resilience

		Sum of squares	gl	Media quadratic	F	Sig.	η² (Effect Size)
FR1	Between groups	82.328	24	3.430	7.546	.000	0.629
	Within groups	48.642	107	.455			
	Total	130.970	131				
FR2	Between groups	95.605	23	4.157	15.310	.000	0.767
	Within groups	29.052	107	.272			
	Total	124.656	130				
FR3	Between groups	90.941	24	3.789	14.643	.000	0.767
	Within groups	27.688	107	.259			
	Total	118.629	131				
FR4	Between groups	89.401	24	3.725	13.333	.000	0.749
	Within groups	29.895	107	.279			
	Total	119.295	131				
FR5	Between groups	86.844	24	3.618	6.059	.000	0.576
	Within groups	63.906	107	.597			
	Total	150.750	131				
FR6	Between groups	96.310	21	4.586	4.605	.000	0.474
	Within groups	106.574	107	.996			
	Total	202.884	128				

Source: Own elaboration.

Table 7 highlights two types of emerging capabilities: 1) projective capability, represented by project planning and facilitating the structuring and scaling of sustainable change; 2) adaptive and digital capability, which supports the circular transition through connectivity, data analysis, and collaborative redesign.

The results in Table 7 show that effective Strategic Cost Management—especially in raw materials, deliveries, and energy use—is a key factor in Sustainable Competitive Performance for industrial SMEs. Additionally, they provide empirical evidence that many circular-economy-oriented practices (reduction, efficiency, reuse) are also genuine sources of competitive advantage (Schöggl et al., 2024). Therefore, the analysis contributes to the theoretical integration of the circular economy as a viable strategy for boosting competitiveness through resource efficiency.

H6: Strategic Cost Management significantly contributes to Sustainable Competitive Performance in SMEs of the plastic manufacturing industry.

The effect sizes (η^2) range from 0.28 to 0.57, demonstrating medium to large practical impact. The consistency of high effect sizes aligns with recent studies showing that cost transparency and real-time performance monitoring enhance resource allocation, adaptive decision-making, and long-term value creation, particularly in sectors facing international competitive pressure.

The most essential items are "The costs of raw materials and inputs with our suppliers are low" and "The costs of product deliveries with our suppliers are low," as these two factors are the most influential on production costs, thereby enhancing competitiveness.

This analysis relates to circular efficiency, defined as the capacity to minimise waste, optimise resources, and redesign production processes with a focus on sustainability and cost savings.

Clear points of alignment with the principles of the circular economy are identified, particularly in terms of traceability, resource efficiency, and sustainable technological innovation (Zhou et al., 2023). The study thus contributes to integrating the theory of capability-based competitiveness with contemporary approaches to the circular transition (Supriadi et al., 2025), reaffirming that technology not only enhances business performance but also acts as a lever for sustainability. Strategic digital innovation is evident, along with the ability to incorporate digital tools to redesign business models, processes, and relationships with the environment.

Table 7

ANOVA Strategic Cost Management (Sustainable Competitive Performance)

		Sum of squares	gl	Media quadratic	F	Sig.	η^2 (Effect Size)
PC1	Between groups	53.383	19	2.810	2.252	.005	0.28
	Within groups	137.240	110	1.248			
	Total	190.623	129				
PC2	Between groups	44.547	18	2.475	5.415	.000	0.47
	Within groups	49.820	109	.457			
	Total	94.367	127				
PC3	Between groups	64.920	18	3.607	6.489	.000	0.52

	Within groups	60.580	109	.556			
	Total	125.500	127				
PC4	Between groups	66.533	17	3.914	8.417	.000	0.57
	Within groups	50.680	109	.465			
	Total	117.213	126				
PC5	Between groups	74.946	19	3.945	6.149	.000	0.52
	Within groups	70.562	110	.641			
	Total	145.508	129				
PC6	Between groups	54.436	19	2.865	5.863	.000	0.50
	Within groups	53.756	110	.489			
	Total	108.192	129				

Source: Own elaboration.

Circularity involves redesigning processes, managing extended lifecycles, and optimising resources. All of these elements require strategic planning—an emerging key capability for handling circular complexity—making it a crucial skill for advancing sustainability from a technological perspective. Followed by "Information technology development." These two are the most influential in advancing technology for greater Sustainable Competitive Performance.

All p-values are significant ($p < 0.001$), and η^2 values are significant, indicating a strong effect of technology variables on performance. It can empirically support the hypothesis (H7) that

Technological Innovation Capacity significantly contributes to Sustainable Competitive Performance in SMEs of the plastic manufacturing industry.

Table 8

Technological Innovation Capacity

		Sum of squares	gl	Media quadratic	F	Sig.	η² (Effect Size)
TE1	Between groups	168.519	25	6.741	16.132	.000	0.792
	Within groups	44.292	106	.418			
	Total	212.811	131				
TE2	Between groups	171.936	25	6.877	18.677	.000	0.815
	Within groups	39.033	106	.368			
	Total	210.970	131				

TE3	Between groups	171.822	24	7.159	20.620	.000	0.824
	Within groups	36.804	106	.347			
	Total	208.626	130				
TE4	Between groups	141.411	25	5.656	11.650	.000	0.733
	Within groups	51.468	106	.486			
	Total	192.879	131				
TE5	Between groups	185.198	25	7.408	17.955	.000	0.809
	Within groups	43.733	106	.413			
	Total	228.932	131				
TE6	Between groups	178.470	25	7.139	15.050	.000	0.780
	Within groups	50.280	106	.474			
	Total	228.750	131				

Source: Own elaboration.

Exploratory factor analysis using Principal Component Analysis (PCA) revealed six components with eigenvalues greater than 1, accounting for 76.35% of the total variance, indicating a robust factor structure. The Kaiser-Meyer-Olkin (KMO) test of sampling adequacy (KMO = 0.856) and the significance of Bartlett's test of sphericity ($p < 0.001$) confirmed the suitability of the data for this type of analysis. The internal consistency of the items used was excellent, as evidenced by a Cronbach's alpha coefficient of 0.941. Subsequently, one-way analysis of variance (ANOVA) was performed to test the hypotheses. The results showed statistically significant differences ($p < 0.05$) between Strategic Intellectual Capital and Sustainable Competitive Performance variables. Therefore, the null hypothesis is rejected and the alternative hypothesis (H1) is accepted.

5 CONCLUSIONS

The study emphasises the changing role of SIC amid pressures from foreign direct investment and the need to adopt circular-economy principles. It concludes that the Sustainable Competitive Performance of SMEs in the plastics sector is not solely influenced by traditional factors such as profitability or technology, but also by the integration of intangible, dynamic, and systemic elements that support the transition to a circular economy. Sustainability comprises multiple interacting dimensions that give rise to emerging capabilities not previously established within organisations.

The SMEs in the Guadalajara Metropolitan Area have adapted to environmental pressures to the extent that FDI has generated opportunities for them. However, the decisions made by the strategists of these companies have been reactive, responding to the demands of their environment: international quality standards, compliance with specific units produced for sale to transnationals in the area, and adaptation to government regulations influenced by global pressures. These strategies are far from the so-called proactive approach of creating value through products and services, which is essential for enhancing competitiveness against rivals.

SIC was presented as a strategic factor that enhances adaptive capacity and encourages collaborative innovation. The results reinforce the importance of knowledge as a key regenerative resource in circular models. Knowledge facilitates process redesign, promotes collaboration to share solutions, and provides feedback on decisions made based on both environmental and economic impacts.

Strategic Cost Management—especially regarding inputs and logistics—was recognised as a crucial factor in boosting efficiency without sacrificing sustainability. The circular economy offers a strategic perspective: it is not solely about cutting costs, but also about reducing waste, selecting reusable materials, optimising logistics routes, and developing regenerative supply chains.

The technological aspect had a notable influence on Sustainable Competitive Performance, with project planning and information technology development being the most significant factors. This implies that digital transformation can facilitate circular models through traceability systems, collaborative platforms, lifecycle simulation, and repair, reuse, and remanufacturing technologies.

Overall, the results suggest that circular competitiveness depends on emerging capabilities that develop through the interaction of knowledge, technologies, and collaborative processes. These capabilities are neither innate nor fixed, but instead evolve in environments characterised by complexity and innovation, as proposed by modern theories of the dynamic firm and organisational learning.

The practical implications for companies include fostering shared knowledge ecosystems, organisational learning, and data management to redesign processes in line with circularity.

Redesigning supply chains by prioritising circular suppliers, recycled materials, and reverse logistics; investing in adaptive technologies that support the circular economy (such as traceability, environmental big data, design for disassembly, and artificial intelligence applied to the lifecycle); and including circularity indicators in the organisational performance management system.

The findings are seen as contributing to the theory of competitiveness. This is done by expanding the traditional model to include intangible, adaptive, and technological variables that reflect regenerative and collaborative competitiveness. A second contribution is to the circular economy, through empirical evidence on organisational factors—beyond the technical—that enable the shift to circular models. The latter with special attention to SMEs.

According to emergent capabilities theory, competitive capabilities for circularity do not preexist but rather develop through the interaction among knowledge, learning, technological processes, and strategic decisions in complex environments.

Overall, this study helps develop a comprehensive explanatory framework that connects SIC, economic performance, operational efficiency, and technology with the principles of the circular economy, providing concrete pathways for SMEs to shift towards a sustainable, inclusive, and regenerative competitiveness model.

Practical implications: The study advocates for a strategic focus on SIC development for SMEs in the plastic manufacturing sector. SMEs can strengthen their competitive positioning by prioritising continuous learning, incorporating feedback, and utilising industry-specific knowledge. This proactive approach aligns with current market demands and positions SMEs to capitalise on emerging opportunities driven by global economic shifts and sustainability agendas.

Social Implications: Compliance with international and government regulations often requires meeting environmental standards, thereby improving sustainability practices within the industry. However, the reactive nature of the strategies might mean that companies only do the minimum required rather than taking proactive measures to reduce their environmental impact. The competitive landscape may shift as companies that adapt more effectively to external pressures dominate the market, potentially displacing smaller or less adaptable firms. Proactive strategies that generate value and foster innovation could be vital for long-term competitiveness and market leadership.

Finally, this research has some limitations arising from the empirical work. The study focused on the strategist's perception of a specific economic environment, geographically and within a particular industry. The proposed lines of research aim to further explore the studied group (SMEs), investigating the direct relationship between reactive and proactive strategies, the circular economy, and the opportunities presented by FDI.

Furthermore, it is suggested that the study be expanded to include large companies connected to those already examined, thereby offering a more comprehensive view of the GVC and its influence on the local context. Lastly, the same research could be conducted in another region with similar FDI conditions, where companies are involved in GVCs and influenced by government regulation concerning a circular economy, but within a different business culture (for example, in an Asian region).

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Authors' Contribution

Both authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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