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Artificial Intelligence Capabilities and Business Model Transformation in Manufacturing Smes: An Exploratory Study

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Abstract

This study examines the relationships between artificial intelligence capabilities, organisational culture, scalability, resilience, and business model transformation in manufacturing SMEs participating in the automotive cluster of Nuevo León, Mexico. A quantitative, cross-sectional, and exploratory design was employed using a convenience sample of 30 firms. Data were obtained from one managerial informant per company, drawn from operations, production, or quality functions because of their broad knowledge of organisational and manufacturing processes. The proposed relationships were assessed through multiple linear regression using heteroscedasticity-consistent HC3 standard errors, complemented by bias-corrected and accelerated (BCa) 95% bootstrap confidence intervals based on 10,000 resamples and leave-one-out cross-validation. The model explained 71.3% of the variance in business model transformation. Resilience showed the strongest positive association, followed closely by artificial intelligence capabilities and then scalability, providing support for three of the four hypotheses. Organisational culture was positively correlated with business model transformation but did not retain a statistically robust independent association when the remaining predictors were considered simultaneously. The findings suggest that AI-related business model transformation in SMEs is associated not only with technological capability but also with complementary organisational factors that support adaptation and scalability. The study provides exploratory evidence from an internationally integrated manufacturing context and offers practical implications for SME managers seeking to translate AI adoption into meaningful business model transformation.

Keywords: Artificial intelligence capabilities; business model transformation; SMEs; resilience; scalability; organisational culture; automotive industry.

1. Introduction

Artificial intelligence (AI) is increasingly reshaping how small and medium-sized enterprises (SMEs) organise activities, process information, respond to environmental changes, and reconsider the way they create and deliver value. For smaller firms, however, the strategic relevance of AI extends beyond the acquisition of new technologies. Limited resources, restricted access to specialised talent, organisational inertia, and uncertainty regarding returns on digital investments can constrain the ability of SMEs to translate emerging technologies into meaningful strategic change. Recent research has therefore shifted attention from technology adoption alone toward the organisational capabilities required to convert digital technologies into sustained competitive and strategic outcomes (McIlveene et al., 2026; Oldemeyer et al., 2026).

This distinction is particularly relevant when AI is considered in relation to business model transformation. Business models describe the configuration through which firms organise activities, create value, interact with markets, and capture economic returns (Morris et al., 2006). Consequently, business model transformation involves more than incremental process improvement or isolated digitalisation initiatives. It implies changes in how resources, technologies, processes, relationships, and value propositions are combined. For SMEs, such transformation may be especially demanding because modifications to the business model often require

simultaneous changes in organisational routines, technological infrastructure, managerial decision making, and resource allocation.

The growing literature on digital transformation in SMEs has identified several factors associated with technological adoption and organisational change. Studies have highlighted the relevance of digital capabilities, managerial orientation, strategic flexibility, organisational resources, and leadership in determining whether SMEs can successfully incorporate new technologies into their operations (Bouncken & Schmitt, 2022; Kessler et al., 2026; Rojas-Berrio et al., 2022). Research conducted in Latin American contexts similarly suggests that AI and digitalisation can contribute to competitiveness and managerial decision making, but their effective use depends on the organisational capacity to integrate technological tools into existing structures and practices (Guatemala et al., 2025; Porras Sandoval et al., 2025).

Nevertheless, an important gap remains. Much of the current SME literature examines AI adoption, digital readiness, innovation, technological acceptance, or firm performance as separate outcomes. Comparatively less attention has been devoted to understanding how technological and organisational capabilities operate simultaneously in relation to business model transformation. This gap is relevant because firms do not transform their business models through technology alone. They must also be capable of adapting to disruption, scaling successful initiatives, and sustaining organisational conditions that support change.

Resilience represents one such capability. Rather than referring exclusively to recovery after an adverse event, resilience can be understood as the capacity of an organisation to adapt, reorganise, and continue functioning under changing or uncertain conditions. Recent SME research has connected resilience with technology adoption, strategic flexibility, and organisational adaptation (Pereira Ribeiro et al., 2026; Sudirman et al., 2025; White & Gillis, 2026). This suggests that firms capable of responding effectively to disruption may also be better prepared to modify processes and resource configurations associated with their business models.

Scalability constitutes another potentially relevant capability. Digital and AI-based initiatives can generate strategic value when firms are able to move beyond isolated applications and extend new solutions across processes, functions, or market activities. In this sense, scalability reflects the firm's ability to expand or replicate organisational practices without proportional increases in resources. Although scalability is frequently associated with growth and digital business models, its direct relationship with business model transformation in established SMEs remains comparatively underexplored.

Organisational culture may also influence the transformation process. Innovation-oriented environments can support experimentation, openness to technological change, organisational learning, and the adoption of new managerial practices. Yet culture may not necessarily operate as an independent driver. Its influence may overlap with more proximal organisational capabilities or create the conditions under which resilience, technological capabilities, and scalability develop. This distinction deserves empirical attention, particularly in industrial SMEs where technological adoption is embedded in established operating routines.

The manufacturing context provides a particularly useful setting in which to examine these relationships. Firms participating in automotive supply networks operate under continuous pressures related to technological upgrading, productivity, customer requirements, operational flexibility, and supply-chain coordination. The automotive cluster of Nuevo León, Mexico, therefore offers an appropriate empirical context for exploring how technological and organisational capabilities are associated with business model transformation.

Against this background, the present study addresses the following research question: How are artificial intelligence capabilities, organisational culture, scalability, and resilience associated with business model transformation in firms within the automotive cluster of Nuevo León, Mexico? Accordingly, the objective is to empirically explore the relationship between these four capabilities and business model transformation through a quantitative, cross-sectional study involving 30 companies and senior managerial informants.

The study makes three main contributions. First, it integrates AI capabilities with resilience, scalability, and organisational culture within a single explanatory model of business model transformation. Second, it extends the emerging literature on AI and SME strategy by moving the discussion beyond technology adoption toward the organisational capabilities associated with transforming how firms create and deliver value. Third, it provides exploratory evidence from the Mexican automotive context, contributing to a geographical and industrial setting that remains less represented in the international SME literature. By examining these capabilities simultaneously, the study seeks to clarify whether business model transformation is primarily associated with technological capacity itself or with a broader configuration of complementary organisational capabilities.

2. Literature Review and Hypothesis Development

2.1. Business Model Transformation in SMEs

The business model provides a strategic representation of how a firm organises its activities, mobilises resources, creates value for customers, and captures value from its operations. Within the SME literature, Morris et al. (2006) conceptualise the business model as a useful strategic construct that connects organisational decisions with value creation and competitive positioning. From an applied SME perspective, Molina Morejón et al. (2013) similarly show that business models involve interconnected managerial, financial, and operational dimensions whose configuration influences the capacity of smaller firms to improve their performance.

Digitalisation has expanded this perspective by making business model change increasingly dependent on the capacity to integrate technological resources with organisational processes. López Pérez et al. (2013) argue that business model innovation can enable SMEs to overcome competitive constraints by redefining their value propositions, resources, and activities. More recent research reinforces this reasoning. Budler and Božič (2024) show that smaller firms can adopt transitional business models when disruptions force them to reconsider how they operate and deliver value, while Álvarez Baque and Maldonado Palacios (2025) associate the evolution of business models with digital entrepreneurship, organisational transformation, and new value-creation mechanisms.

This transformation is particularly demanding for SMEs because technological change must frequently occur under conditions of financial, managerial, and human-resource scarcity. Digital transformation therefore cannot be reduced to the implementation of individual technologies. Bouncken and Schmitt (2022) demonstrate that strategic digital transformation involves organisational tensions and structural choices, whereas Kessler et al. (2026) identify a combination of orientation, strategy, and organisational resources as relevant to digitalisation success in manufacturing SMEs. Evidence from Latin America likewise indicates that digitalisation can modify SME processes and generate opportunities for new business models, although the extent of transformation depends on firms' capacity to assimilate and strategically deploy technological change (Ayora Recalde et al., 2024).

Technology-driven transformation is also increasingly connected with broader organisational and sustainability objectives. Kannan and Gambetta (2025), through a systematic review of technology-driven sustainability in SMEs, demonstrate that technological change intersects with organisational processes, strategy, and business model configurations. These arguments suggest that business model transformation is best understood not as a single technological outcome but as an organisational reconfiguration through which technological and strategic capabilities alter the firm's mechanisms for creating, delivering, or capturing value.

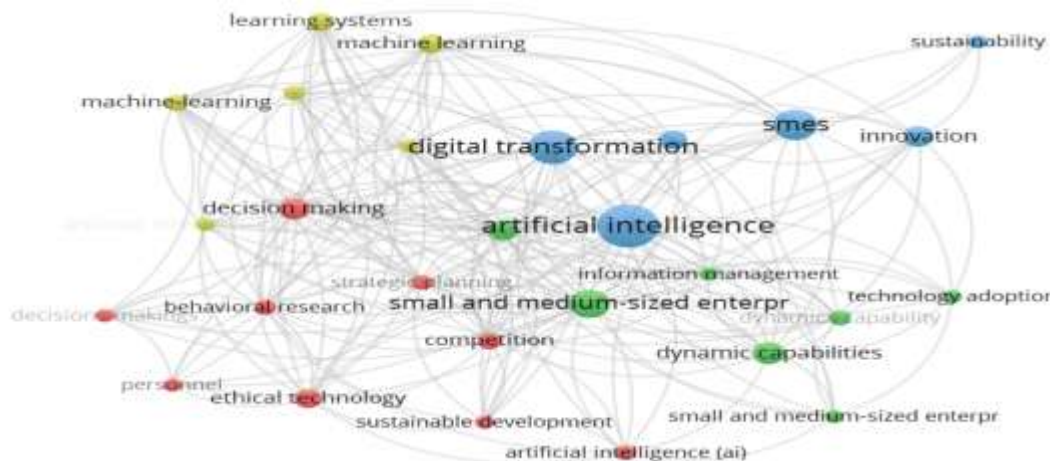
2.2. Bibliometric and Conceptual Convergence of the Literature

The literature on digital transformation in SMEs increasingly connects technological adoption with data analytics, business intelligence, managerial decision making, organisational capabilities, and strategic adaptation. Early research on business intelligence in smaller firms identified the potential of analytical technologies to improve information use while also highlighting persistent technological and resource constraints affecting SMEs (Cerdeira-Leiva et al., 2019). Romero Castro et al. (2024) similarly position business intelligence as an organisational mechanism through which SMEs can transform data into managerial decision support, reinforcing the strategic role of information-related capabilities.

Comparable patterns are evident in the Industry 4.0 literature. Azuaje Pirela et al. (2024) emphasise that SMEs encounter both opportunities and capability-related constraints when incorporating Industry 4.0 technologies, whereas Rojas-Berrio et al. (2022) identify organisational and contextual factors influencing the adoption of these technologies in manufacturing SMEs. From a Latin American managerial perspective, Carmona (2023) further connects digital transformation with changes in managerial decision making through technologies such as ERP systems, artificial intelligence, and data analytics. Taken together, these studies suggest that technological transformation in SMEs is embedded within a broader organisational context involving capabilities, managerial processes, and strategic adaptation.

To complement this substantive review and visualise the conceptual structure of the literature, a keyword co-occurrence analysis was conducted using VOSviewer. A full-counting method was applied with a minimum threshold of 10 occurrences per keyword. Twenty-one keywords met the inclusion criterion and were incorporated into the final network. As shown in Figure 1, the resulting map identifies the principal thematic relationships surrounding artificial intelligence and digital transformation in the SME literature.

Figure 1. Bibliometric co-occurrence map of AI, digital transformation, and capability-related themes in SMEs.



Source: Authors' elaboration using VOSviewer 1.6.20.

Figure 1 shows artificial intelligence occupying a central position within the knowledge network and maintaining connections with digital transformation, SMEs, innovation, technology adoption, dynamic capabilities, and decision making. The network also incorporates technological themes such as machine learning and learning systems, together with broader organisational and strategic topics including sustainability and innovation management. This configuration suggests that contemporary research increasingly treats AI adoption as part of a wider process of organisational and digital transformation rather than as an isolated technological phenomenon. Particularly relevant to the present study is the proximity between AI, digital transformation, SMEs, dynamic capabilities, and technology adoption, which reinforces the rationale for examining technological capabilities together with complementary organisational capacities. Nevertheless, the bibliometric network is interpreted as a descriptive representation of the intellectual structure of the literature rather than as direct evidence supporting the proposed hypotheses. The specific relationships between artificial intelligence capabilities, organisational culture, scalability, resilience, and business model transformation are therefore developed theoretically in the following subsections.

2.3. Artificial Intelligence Capabilities and Business Model Transformations

The growing accessibility of artificial intelligence offers SMEs new possibilities for automating activities, analysing information, supporting managerial decisions, and redesigning processes. Access to AI, however, does not in itself constitute an organisational capability. Strategic value depends on whether firms can select, assimilate, integrate, and apply these technologies within their operations and decision-making processes. Recent SME research reinforces this distinction. Oldemeyer et al. (2026) show that AI acceptance is shaped by both technological and organisational conditions, while McIlveene et al. (2026) emphasise that resource scarcity and capability constraints can prevent smaller firms from converting AI investments into strategic advantage. As AI becomes embedded in business functions, ethical and governance considerations also gain importance. Amarasuriya and Abston (2026), for example, propose a structured approach to ethical AI adoption in small businesses.

Evidence from Latin America points in the same direction. Guatemala et al. (2025) associate digital leadership with the development of AI capabilities in Mexican SMEs, underscoring the importance of managerial and organisational resources. Porras Sandoval et al. (2025) identify AI as an emerging contributor to digital transformation and competitiveness, whereas Jara Obregón and Naspud Espinoza (2024) document persistent knowledge, resource, and implementation challenges. Navós (2025) similarly argues that effective AI use requires organisational strategies that extend beyond technology acquisition.

The potential benefits of these capabilities are also reflected in operational and commercial activities. Carrasco Camones et al. (2025) link AI applications with operational efficiency, innovation, decision making, and sales effectiveness, while Apodaca Gaona (2023) examines their use in supporting predictive organisational decisions. More broadly, Kanyepe et al. (2025) show that technological capabilities remain relevant to SME performance under supply-chain risk conditions.

The strategic relevance of AI therefore lies less in technology ownership than in the organisational capacity to incorporate it into routines, decisions, and resource configurations. Firms that develop this capability should be better positioned to reconfigure the mechanisms through which they create and deliver value. Accordingly:

- H1. Artificial intelligence capabilities are positively associated with business model transformation in SMEs.

2.4. Organisational Culture and Business Model Transformation

Technological transformation also depends on the organisational environment in which new practices are introduced. Organisational culture can influence willingness to experiment, learn, exchange knowledge, accept technological change, and question established routines. These characteristics are especially relevant in SMEs, where strategic decisions and organisational practices tend to be closely connected.

Bokhari (2022) provides evidence that innovation culture can shape relationships involving SME resources, innovation activities, and performance. Similarly, Kessler et al. (2026) demonstrate that successful digitalisation in manufacturing SMEs requires a combination of strategic orientation and organisational conditions rather than technological resources alone. Bouncken and Schmitt (2022) show that digital transformation can challenge established structures and managerial assumptions, further suggesting that organisational context influences the firm's capacity to undertake strategic digital change.

Culture can also shape how SMEs interact with external partners and pursue entrepreneurial strategies. Marino et al. (2024) demonstrate that cultural characteristics influence entrepreneurial orientation and strategic alliance portfolio diversity in SMEs. Although their analysis focuses principally on cultural influences rather than business model transformation directly, it supports the broader argument that cultural conditions affect strategic behaviour.

An organisational culture that supports experimentation, learning, openness to innovation, and adaptation should therefore facilitate the reconfiguration required for business model transformation. On this basis:

- H2. Organisational culture is positively associated with business model transformation in SMEs.

2.5. Scalability and Business Model Transformation

Scalability represents the capacity of a firm to expand activities, processes, or value propositions without requiring proportional increases in resources. Within the present study, scalability is conceptualised as an organisational capability rather than simply as an observed growth outcome. This distinction is important because digital technologies may allow SMEs to replicate processes, extend solutions, or serve additional customers more efficiently, but only when the organisation possesses the capability to expand successful configurations.

The business model literature provides conceptual support for this argument. Morris et al. (2006) stress the configuration and interdependence of business model components, while López Pérez et al. (2013) associate business model innovation in SMEs with the reorganisation of resources, activities, and value propositions. The capacity to extend such configurations becomes particularly important once firms move from experimentation toward broader implementation.

Digitalisation can reinforce this process. Álvarez Baque and Maldonado Palacios (2025) connect digital transformation with evolving business model structures, while Budler and Božič (2024) illustrate how smaller firms can reconfigure business models in response to disruption. Kannan and Gambetta (2025) further show that technological change can affect organisational processes and business model configurations across SMEs. Taken together, these studies suggest that the ability to replicate and extend transformed processes can facilitate broader business model change. Accordingly:

- H3. Scalability is positively associated with business model transformation in SMEs.

2.6. Resilience and Business Model Transformation

Resilience refers to the capacity of firms to respond to disruptions, adapt to changing conditions, reorganise resources, and sustain organisational functioning. For SMEs, resilience is particularly relevant because resource scarcity can increase vulnerability to market, technological, and supply-chain disturbances. At the same time, these constraints may require smaller firms to develop flexible and adaptive responses.

Recent JSBS literature provides particularly strong support for this relationship. Sudirman et al. (2025) connect sustainable resilience strategies with digital technology adoption in SMEs, highlighting the relevance of entrepreneurial orientation and organisational competencies. Pereira Ribeiro et al. (2026) show that combinations of organisational and market-related drivers can enhance SME resilience, reinforcing the idea that resilience emerges from configurations of capabilities rather than from a single resource.

White and Gillis (2026) distinguish dynamic from improvisational capabilities and show how they can play complementary roles when organisations face changing conditions. Franczak and Weinzimmer (2022)

similarly demonstrate the importance of adaptability, risk-taking, and action in explaining positive SME performance. These perspectives position resilience close to the broader logic of organisational reconfiguration: firms capable of responding to disruption should also be more capable of reconsidering established processes and strategic configurations.

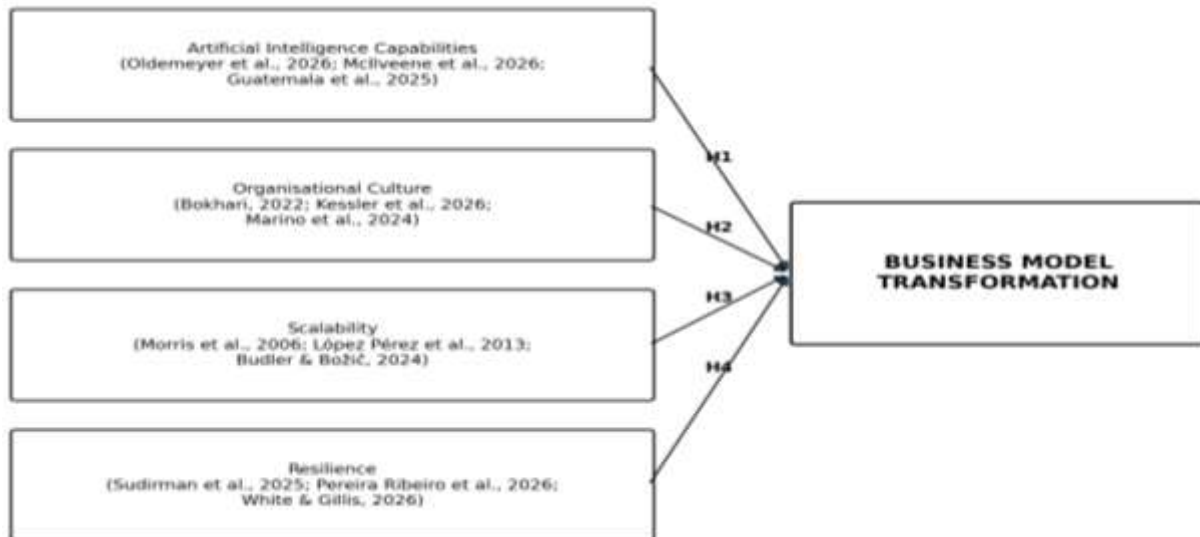
The importance of resilience is further reinforced in manufacturing and supply-chain contexts, where technological capabilities and risk conditions interact with firm performance (Kanyepe et al., 2025). Business model transformation may therefore represent not only a proactive response to technological opportunity but also an adaptive response through which SMEs preserve viability and create new strategic options. Accordingly:

- H4. Resilience is positively associated with business model transformation in SMEs.

2.7. Conceptual Model

The reviewed literature indicates that business model transformation depends on more than technological adoption alone. AI capabilities provide the technological basis for automation, analysis, and new forms of decision support, while organisational culture can create conditions favourable to learning, experimentation, and change. Scalability reflects the capacity to extend successful configurations across the firm, whereas resilience supports adaptation and reorganisation under conditions of disruption and uncertainty. Figure 2 integrates these relationships into the empirical model examined in this study.

Figure 2. Proposed capability-based model of business model transformation in SMEs.



Source: Authors' elaboration based on the literature review.

Figure 2 presents business model transformation as the outcome associated with four complementary firm-level factors. These factors are not treated as interchangeable. AI represents technological capability; organisational culture reflects the internal environment that supports change; scalability captures the capacity to extend new configurations; and resilience reflects the ability to adapt and reorganise under changing conditions. The empirical analysis therefore assesses the partial association of each predictor with business model transformation while accounting for the remaining variables.

3. Methodology

3.1. Research Design and Empirical Context

This study adopted a quantitative, cross-sectional, and exploratory design to examine the associations between artificial intelligence capabilities, organisational culture, scalability, resilience, and business model transformation. The empirical setting comprised small and medium-sized manufacturing firms participating in the automotive cluster of Nuevo León, Mexico. Data were collected between February and March 2026. Given the cross-sectional design, the analysis focused on patterns of association among the constructs rather than causal relationships or population-level effects.

A convenience sampling strategy was used, resulting in a sample of 30 firms. For sampling purposes, SMEs were classified according to the employee-size criterion applied in the study, consistent with the Mexican government classification used for small and medium-sized industrial firms: participating companies employed more than 10 and fewer than 250 workers. Eligibility also required firms to be registered in the automotive-sector registry, engage in export activities, and manufacture original-equipment products supplied to automotive companies with assembly operations in the United States. These criteria ensured that the participating firms operated within an internationally integrated manufacturing environment subject to demanding production, quality, and supply requirements. Because the sampling procedure was non-probabilistic, the sample was treated as an exploratory empirical basis rather than as a statistically representative cross-section of the broader automotive cluster.

The firm constituted the unit of analysis, with one managerial informant representing each participating company. Respondents held managerial positions in operations, production, or quality, functions that provided broad knowledge of manufacturing processes, technological capabilities, organisational practices, strategic priorities, quality requirements, and adaptation needs. This organisational perspective was considered appropriate for assessing the firm-level constructs included in the model.

The questionnaire was administered during a session convened by the industry chamber. Participation was voluntary, and respondents consented to provide information for research purposes under conditions of anonymity. No identifying information about individual respondents or participating firms was used in the empirical analysis.

3.2. Conceptual and Bibliometric Support for the Empirical Model

A keyword co-occurrence analysis was conducted as a complementary bibliometric procedure to examine the conceptual structure of the literature associated with artificial intelligence, digital transformation, and capability-related themes in SMEs. The purpose of this analysis was not to test the proposed hypotheses, but to identify recurrent concepts and visualise their thematic relationships within the bibliographic corpus used to support the theoretical development of the study.

The bibliometric network was generated using VOSviewer version 1.6.20. Keyword co-occurrence was selected as the unit of analysis, and the full-counting method was applied so that each occurrence of a keyword contributed equally to the construction of the network. A minimum threshold of 10 occurrences per keyword was established. Based on this criterion, 21 keywords met the inclusion threshold and were incorporated into the final network visualisation. The resulting map was used to examine the relative prominence, proximity, and connectivity of the most recurrent concepts in the analysed literature.

The bibliometric analysis was interpreted as a descriptive and literature-structuring procedure rather than as empirical validation of the proposed capability-based model. Accordingly, the network was used to complement the substantive literature review and to identify conceptual convergence around artificial intelligence, digital transformation, SMEs, innovation, technology adoption, dynamic capabilities, and related themes.

3.3. Measurement Instrument and Construct Operationalisation

The measurement instrument was developed specifically for this study and consisted of 16 items covering five constructs: artificial intelligence capabilities, organisational culture, scalability, resilience, and business model transformation. The first four constructs were modelled as explanatory variables, while business model transformation represented the dependent construct. Responses were recorded on a five-point Likert-type scale ranging from 1 = strongly disagree to 5 = strongly agree.

Item development was guided by the conceptual definitions and theoretical relationships established in the literature review. The instrument was not adopted from an existing scale; instead, the items were formulated to represent the technological and organisational capabilities examined in the study. Artificial intelligence capabilities, organisational culture, scalability, and resilience were each measured with three items: AI_1–AI_3, CULT_1–CULT_3, SCAL_1–SCAL_3, and RES_1–RES_3, respectively, whereas business model transformation was measured with four items BMT_1 – BMT_4. The theoretical foundations of these constructs are developed in Sections 2.1 and 2.3–2.6.

Content validity was assessed through expert evaluation. Five experts participated in the review of the instrument, yielding an overall Content Validity Index CVI of .86. This assessment was used as the initial content-based validation of the newly developed instrument prior to its empirical analysis.

For statistical analysis, each construct was represented by a composite score calculated as the arithmetic mean of its corresponding items. This approach preserved the original 1–5 response metric, with higher scores indicating higher reported levels of the relevant capability or, for the dependent construct, a greater degree of

business model transformation. Internal consistency was evaluated separately for each construct using Cronbach's alpha before the composite scores were entered into the correlation and regression analyses.

3.4. Empirical Model and Hypothesis Testing

Business model transformation was specified as the dependent variable, with artificial intelligence capabilities, organisational culture, scalability, and resilience entered simultaneously as explanatory variables. This specification allowed the association of each predictor with business model transformation to be estimated while accounting for the remaining variables. The empirical model was specified as:

$$BMT_i = \beta_0 + \beta_1 AI_i + \beta_2 CULT_i + \beta_3 SCAL_i + \beta_4 RES_i + \varepsilon_i$$

Where BMT_i denotes business model transformation for firm i ; AI_i , $CULT_i$, $SCAL_i$, and RES_i represent artificial intelligence capabilities, organisational culture, scalability, and resilience, respectively. The intercept is represented by β_0 , while β_1 through β_4 capture the partial association of each explanatory variable with business model transformation after accounting for the remaining predictors. The error term is represented by ε_i .

The coefficient structure corresponds directly to the four hypotheses developed in Sections 2.3–2.6. H1 predicts $\beta_1 > 0$ for artificial intelligence capabilities, H2 predicts $\beta_2 > 0$ for organisational culture, H3 predicts $\beta_3 > 0$ for scalability, and H4 predicts $\beta_4 > 0$ for resilience. Hypothesis assessment therefore focused on the estimated direction and magnitude of these coefficients together with the robust inferential procedures described in Section 3.5.

Given the cross-sectional and exploratory nature of the study, the estimated coefficients were interpreted as conditional associations rather than causal effects. The model was therefore used to assess whether each predictor retained an independent relationship with business model transformation after the remaining variables were taken into account.

3.5. Statistical Analysis

All statistical analyses were conducted using IBM SPSS Statistics, version 30. Before analysis, the collected questionnaires were screened for eligibility and completeness. Of the 45 questionnaires initially obtained, 15 were excluded because they contained incomplete information or corresponded to firms outside the target automotive sector, leaving a final analytical sample of 30 observations.

The analysis began with descriptive statistics and an assessment of internal consistency using Cronbach's alpha. Pearson correlation coefficients were then estimated to examine the direction and magnitude of the bivariate relationships among the five composite variables. Before estimating the multivariate model, diagnostic procedures were applied to assess multicollinearity, residual behaviour, and potentially influential observations. Variance inflation factors (VIF) were used to evaluate multicollinearity, while residual diagnostics included the Shapiro–Wilk test, the Breusch–Pagan test, and the Durbin–Watson statistic. Cook's distance, leverage, and externally studentised residuals were also inspected to identify potentially influential cases.

Given the relatively small analytical sample, inference for the multiple regression model was based on heteroscedasticity-consistent HC3 standard errors. Coefficient uncertainty was further examined through bias-corrected and accelerated (BCa) 95% bootstrap confidence intervals based on 10,000 resamples. Hypothesis assessment considered the direction and magnitude of the estimated coefficients, standardised regression coefficients, HC3-based significance estimates, and BCa confidence intervals rather than relying on a single inferential criterion.

Model explanatory capacity was assessed using R^2 and adjusted R^2 , while standardised coefficients were used to compare the relative magnitude of the associations across predictors. Leave-one-out cross-validation (LOOCV) was conducted as a complementary assessment of model stability. In each iteration, one observation was excluded, the regression model was estimated using the remaining 29 cases, and a prediction was generated for the omitted observation. Cross-validated R^2 , root mean squared error (RMSE), and mean absolute error (MAE) were then calculated from the resulting out-of-sample predictions.

Together, these procedures provided complementary evidence on coefficient robustness, model diagnostics, and predictive stability within the exploratory scope of the study. HC3 estimation and BCa bootstrapping addressed uncertainty surrounding coefficient inference, whereas the diagnostic tests and LOOCV were used to assess influential observations and the stability of model performance.

4. Results

The empirical analysis was conducted in four sequential stages. First, descriptive statistics and internal consistency were examined for the five constructs included in the proposed model. Second, Pearson correlations were estimated to assess the magnitude and direction of the bivariate relationships. Third, regression assumptions and potential influential observations were evaluated before estimating the multivariate model. Finally, the proposed relationships were tested using multiple linear regression with heteroscedasticity-consistent HC3 standard errors and bias-corrected and accelerated (BCa) bootstrap confidence intervals based on 10,000 resamples. Given the exploratory nature of the study and the sample size ($n = 30$), interpretation emphasized effect magnitude, direction, confidence intervals, and stability rather than relying exclusively on conventional significance thresholds.

4.1. Descriptive Statistics, Reliability, and Correlations

The measurement properties of the constructs were initially examined through descriptive statistics and Cronbach's alpha coefficients. The five composite variables showed substantial dispersion across respondents, suggesting sufficient variability for subsequent multivariate analysis. Internal consistency was satisfactory across all constructs, with Cronbach's alpha coefficients ranging from .834 to .867. Pearson correlations were then calculated to provide an initial assessment of the relationships between scalability, resilience, artificial intelligence capabilities, organisational culture, and business model transformation. As shown in Table 1, business model transformation was positively correlated with all four explanatory constructs.

Table 1. Descriptive Statistics, Reliability, and Correlations

Variable	M	SD	α	1	2	3	4	5
1. Scalability	3.28	0.81	.834	—				
2. Resilience	3.26	0.84	.867	.385*	—			
3. AI	3.16	0.91	.848	.261	.452*	—		
4. Culture	3.40	0.90	.860	.293	.455*	.225	—	
5. BMT	3.23	0.78	.859	.555**	.704** *	.622** *	.506**	—

Note. $n = 30$. M = mean; SD = standard deviation; α = Cronbach's alpha; AI = artificial intelligence capabilities; BMT = business model transformation. Correlations are Pearson's r . * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 1 indicates that all five constructs achieved satisfactory levels of internal consistency. Resilience showed the highest reliability ($\alpha = .867$), followed closely by organisational culture ($\alpha = .860$) and business model transformation ($\alpha = .859$). The strongest bivariate relationship with business model transformation was observed for resilience ($r = .704$, $p < .001$), followed by artificial intelligence capabilities ($r = .622$, $p < .001$), scalability ($r = .555$, $p = .001$), and organisational culture ($r = .506$, $p = .004$). Although several predictors were moderately correlated with one another, none of the bivariate relationships approached levels that would immediately suggest problematic construct redundancy. These results provided preliminary support for examining the four predictors simultaneously in the multivariate model.

4.2. Regression Diagnostics

Regression diagnostics were examined before hypothesis testing to assess multicollinearity, residual behaviour, and the influence of individual observations. Variance inflation factors were low across the four predictors, ranging from 1.21 to 1.59: 1.27 for artificial intelligence capabilities, 1.29 for organisational culture, 1.21 for scalability, and 1.59 for resilience. These values provide no indication of problematic multicollinearity and suggest that coefficient estimation was not materially affected by linear dependence among the predictors. Residual diagnostics likewise revealed no material departures from the assumptions examined. The Shapiro–Wilk test did not reject residual normality ($W = .976$, $p = .708$), while the Breusch–Pagan test provided no evidence of heteroscedasticity ($LM = 2.52$, $p = .642$). The Durbin–Watson statistic was 1.71, providing no indication of pronounced residual dependence.

Potentially influential observations were assessed using Cook's distance, leverage, and externally studentised residuals. The maximum Cook's distance was .150, the highest leverage value was .296, and the largest absolute externally studentised residual was 2.34. Although some observations warranted inspection, the diagnostic measures considered jointly did not identify any case whose influence, leverage, or residual magnitude justified exclusion. All 30 observations were therefore retained in the regression analysis.

Given the relatively small analytical sample, a conservative inferential strategy was adopted despite the absence of material diagnostic concerns. Hypothesis testing relied on HC3 heteroscedasticity-consistent standard errors, with coefficient uncertainty additionally assessed using bias-corrected and accelerated (BCa)

95% bootstrap confidence intervals based on 10,000 resamples. The corresponding coefficient estimates and hypothesis decisions are reported in Section 4.3.

4.3. Robust Regression Results and Hypothesis Testing

A multiple regression model was estimated with business model transformation as the dependent variable and artificial intelligence capabilities, organisational culture, scalability, and resilience as simultaneous predictors. The model explained 71.3% of the observed variance in business model transformation ($R^2 = .713$), with an adjusted R^2 of .667. The conventional overall model test was statistically significant, $F(4, 25) = 15.55$, $p < .001$. More importantly for the present analysis, the HC3 robust joint test also remained statistically significant, $F(4, 25) = 12.33$, $p < .001$. Table 2 presents the individual coefficients, robust standard errors, standardized effects, BCa bootstrap confidence intervals, and hypothesis decisions.

Table 2. Robust Regression Results Predicting Business Model Transformation.

Predictor	B	HC3 SE	Std. β	BCa 95% CI	p	VIF	Hypothesis
Constant	-0.197	0.529	—	[-1.172, 0.740]	.712	—	—
AI capabilities	0.300	0.127	.348	[0.051, 0.522]	.027	1.27	H1 Supported
Organisational culture	0.161	0.111	.185	[-0.023, 0.396]	.162	1.29	H2 Not supported
Scalability	0.262	0.094	.272	[0.073, 0.452]	.010	1.21	H3 Supported
Resilience	0.332	0.122	.358	[0.138, 0.626]	.012	1.59	H4 Supported

Note. Dependent variable = Business Model Transformation. $n = 30$. HC3 SE = heteroscedasticity-consistent standard error. BCa 95% CI = bias-corrected and accelerated 95% bootstrap confidence interval based on 10,000 resamples. $R^2 = .713$; adjusted $R^2 = .667$; robust $F(4, 25) = 12.33$, $p < .001$.

As reported in Table 2, resilience exhibited the largest standardised coefficient ($\beta = .358$), followed closely by artificial intelligence capabilities ($\beta = .348$). Resilience was positively associated with business model transformation ($B = .332$, HC3 SE = .122, $p = .012$), and its BCa confidence interval remained entirely above zero [.138, .626], supporting H4. Artificial intelligence capabilities also showed a positive association ($B = .300$, HC3 SE = .127, $p = .027$), with a BCa interval of [.051, .522], providing support for H1.

Scalability exhibited a smaller but statistically robust positive relationship with business model transformation ($B = .262$, $\beta = .272$, $p = .010$). Its BCa interval [.073, .452] likewise excluded zero; consequently, H3 was supported. In contrast, although organisational culture showed a positive bivariate correlation with business model transformation, its unique multivariate contribution was comparatively weaker ($B = .161$, $\beta = .185$, $p = .162$). The BCa confidence interval [-0.023, .396] included zero. Therefore, H2 was not supported in the multivariate model.

These findings also reveal an important distinction between bivariate and multivariate relationships. Organisational culture was significantly related to business model transformation when considered independently ($r = .506$), yet its association weakened after resilience, AI capabilities, and scalability were simultaneously controlled. The statistical evidence therefore suggests that the strongest unique relationships with business model transformation in this sample were associated with resilience and AI capabilities, followed by scalability.

4.4. Robustness and Predictive Stability

Given the exploratory sample size, leave-one-out cross-validation (LOOCV) was conducted to assess the stability of model performance across observations. The cross-validated R^2 was .595, compared with the in-sample R^2 of .713. The corresponding cross-validated root mean squared error (RMSE) was .489, and the mean absolute error (MAE) was .416.

The decline from the in-sample R^2 to the cross-validated value reflects the more demanding out-of-sample evaluation imposed by LOOCV. Despite this reduction, the model retained substantial explanatory information when each observation was predicted from a model estimated on the remaining 29 cases. Considered alongside the HC3 estimates, BCa bootstrap confidence intervals, low VIF values, and absence of highly influential observations, these results indicate that the main regression patterns were not driven solely by conventional standard-error assumptions or by an individual extreme case.

Overall, the robustness analyses support the main empirical pattern observed in the regression model. Resilience, artificial intelligence capabilities, and scalability were positively associated with business model transformation, whereas organisational culture did not retain a statistically robust independent association after the remaining predictors were considered simultaneously. Given the cross-sectional design, non-probability sampling, and relatively small analytical sample, these findings should be interpreted as exploratory evidence of association rather than causation.

5. Discussion

5.1. Interpretation of the Main Findings

This study examined the relationships between artificial intelligence capabilities, organisational culture, scalability, resilience, and business model transformation in firms belonging to the automotive cluster of Nuevo León, Mexico. The results provide exploratory empirical support for three of the four proposed relationships. Artificial intelligence capabilities, scalability, and resilience were positively associated with business model transformation, whereas organisational culture did not exhibit a statistically robust independent relationship once the other capabilities were considered simultaneously. Overall, the model explained a substantial proportion of the observed variance in business model transformation, suggesting that technological and organisational capabilities may jointly contribute to understanding how SMEs reconfigure the ways in which they create, deliver, and capture value.

Among the predictors, resilience showed the strongest standardized relationship with business model transformation, closely followed by artificial intelligence capabilities and scalability. This pattern is relevant because it suggests that business model transformation in SMEs may depend not only on access to emerging technologies but also on the firm's capacity to absorb disruption, adapt its operations, and reconfigure resources under changing conditions. This interpretation is consistent with research emphasizing adaptability, dynamic capabilities, and resilience as important mechanisms through which SMEs respond to uncertainty and technological change (Franczak & Weinzimmer, 2022; Sudirman et al., 2025; White & Gillis, 2026).

The findings should nevertheless be interpreted within the exploratory scope of the study. The cross-sectional design and convenience sample do not permit causal inference. Accordingly, the observed coefficients indicate associations among firm-level capabilities rather than evidence that strengthening a particular capability will necessarily produce business model transformation. Even under these constraints, the results provide useful initial evidence from a manufacturing setting that remains comparatively underrepresented in the empirical literature on AI-enabled SME transformation.

5.2. Artificial Intelligence Capabilities and Business Model Transformation

The positive relationship between artificial intelligence capabilities and business model transformation provides support for H1. AI capabilities emerged as one of the two strongest predictors in the model, indicating that firms with greater capacity to incorporate AI into their organisational activities also tended to report higher levels of business model transformation.

This finding supports an interpretation of AI as an organisational capability rather than merely a technological acquisition. Recent SME research has increasingly emphasized that the strategic value of AI depends on the firm's ability to integrate technology with knowledge, processes, managerial practices, and organisational resources. Oldemeyer et al. (2026), for example, highlight the relevance of organisational and user-related conditions for AI acceptance in SMEs, while McIlveene et al. (2026) stress that resource constraints can limit the capacity of small firms to transform AI investments into strategic advantage. Similarly, research in the Mexican SME context has identified digital leadership and organisational capabilities as relevant conditions for the development of AI-related capabilities (Guatemala et al., 2025).

The result therefore suggests that AI should not be interpreted as an isolated technological input. Rather, its relationship with business model transformation appears to reflect a broader capability to use data, automation, analytical tools, and intelligent systems to reconsider how activities are organised and how value is generated. This interpretation is also consistent with recent discussions of digital transformation in SMEs, where the introduction of new technologies becomes strategically relevant when it is connected to managerial decision making, competitiveness, and organisational reconfiguration (Porrás Sandoval et al., 2025; Rojas-Berrio et al., 2022).

5.3. Organisational Capabilities: Culture, Scalability, and Resilience

The strongest relationship observed in the model corresponded to resilience, providing support for H4. This result reinforces the argument that business model transformation is closely associated with the capacity of

SMEs to respond to disturbances, reorganise resources, and maintain strategic flexibility. Resilience has increasingly been conceptualised not simply as recovery from disruption but as a capability that enables firms to adapt and reconfigure their activities under conditions of uncertainty.

The result is consistent with Sudirman et al. (2025), who connect resilience strategies with digital technology adoption in SMEs, and with Pereira Ribeiro et al. (2026), who examine factors associated with the strengthening of SME resilience. White and Gillis (2026) further distinguish between dynamic and improvisational capabilities, illustrating how different organisational mechanisms may complement one another when firms must respond to changing environments. Within the context of the present study, resilience may therefore provide SMEs with the organisational flexibility required to modify processes, resource configurations, and value-creation mechanisms when technological or market conditions change.

Scalability was also positively associated with business model transformation, supporting H3. Although its standardized coefficient was smaller than those of resilience and AI capabilities, the relationship remained statistically robust. This result suggests that firms capable of expanding or replicating activities without proportional increases in resources may also be better positioned to transform their business models. From this perspective, scalability can be interpreted as a capability that facilitates the extension of newly configured processes, technologies, or value propositions across the organisation.

This relationship is particularly relevant for digital transformation because technological solutions often create value when firms can move from isolated implementation to broader organisational deployment. Digital transformation studies in SMEs have similarly emphasized strategic flexibility, capability development, and organisational reconfiguration as conditions that allow technologies to generate wider organisational effects (Bouncken & Schmitt, 2022; Kessler et al., 2026). The present findings extend this logic by suggesting that scalability may represent an important organisational complement to AI-related capabilities.

The results for organisational culture require a more nuanced interpretation. Although culture was positively and significantly correlated with business model transformation at the bivariate level, H2 was not supported once AI capabilities, resilience, and scalability were included simultaneously in the regression model. This does not necessarily imply that organisational culture is irrelevant. Rather, its explanatory contribution may overlap with other organisational capabilities or operate indirectly.

Prior studies have linked innovation-oriented cultures with SME performance and organisational outcomes (Bokhari, 2022), while research on digital transformation has highlighted the importance of organisational conditions, leadership, openness to change, and internal alignment (Bouncken & Schmitt, 2022; Kessler et al., 2026). One possible interpretation is therefore that culture functions as an enabling context in which more proximal capabilities such as resilience, scalability, or AI use develop. Under such a configuration, culture may influence business model transformation indirectly rather than through a strong independent direct effect. This possibility should be examined in future studies using larger samples and mediation or moderation designs.

5.4. Theoretical Implications

The findings contribute to the SME strategy literature in three ways. First, they support a capability-based interpretation of business model transformation. Consistent with the view of business models as configurations of activities and value-creation mechanisms (Morris et al., 2006), the results suggest that transformation is associated with a broader configuration of technological and organisational factors rather than with technology adoption alone.

Second, the study contributes to the emerging literature on AI in SMEs by showing that AI capabilities retain a meaningful association with business model transformation when resilience, scalability, and organisational culture are considered simultaneously. This extends research that has largely focused on technology adoption, implementation barriers, performance, or acceptance by positioning AI capability within a broader strategic configuration of firm-level factors.

Third, the findings highlight the value of distinguishing between more proximal capabilities and contextual organisational conditions. Resilience and scalability showed independent associations with business model transformation, whereas organisational culture did not retain a statistically robust direct association in the multivariate model. This pattern suggests that these factors may play different roles in the transformation process. Culture may provide a supportive organisational environment, while resilience and scalability may operate as more proximal capabilities through which firms adapt, extend, and reconfigure their business models.

5.5. Practical Implications for SME Managers

The results also offer practical implications for managers of manufacturing SMEs. First, investments in AI should be accompanied by efforts to develop the organisational capacity required to integrate technological

solutions into processes and strategic decisions. Purchasing AI tools without strengthening complementary capabilities may limit their contribution to business model transformation.

Second, the prominence of resilience suggests that managers should consider adaptive capacity as a strategic component of digital transformation. Firms may benefit from developing flexible processes, contingency mechanisms, cross-functional decision structures, and the capacity to reallocate resources when market or technological conditions change.

Third, scalability should be considered when designing AI and digitalisation initiatives. Pilot projects that cannot be replicated across functions or expanded without excessive additional resources may generate limited strategic impact. Managers should therefore evaluate not only whether a technological initiative works, but also whether it can be extended and incorporated into the broader business model.

Finally, the non-significant direct effect of organisational culture should not lead managers to disregard culture. Instead, it suggests that cultural initiatives should be connected to concrete organisational capabilities. Promoting openness to innovation, learning, experimentation, and technological change may be most valuable when these cultural conditions are translated into stronger AI capabilities, greater resilience, and scalable organisational practices.

Taken together, the findings suggest that business model transformation in manufacturing SMEs is associated with a configuration of complementary capabilities in which resilience, artificial intelligence capabilities, and scalability play particularly relevant roles. The evidence therefore shifts the managerial discussion from whether SMEs should adopt AI to a more strategic question: whether they possess the organisational capabilities required to convert emerging technologies into meaningful changes in the way the firm creates and delivers value.

6. Conclusions

6.1. Main Conclusions

This study examined the relationships between artificial intelligence capabilities, organisational culture, scalability, resilience, and business model transformation in firms participating in the automotive cluster of Nuevo León, Mexico. Using an exploratory empirical design based on data from 30 companies, the study provides initial evidence that business model transformation is associated not only with technological capabilities but also with complementary organisational capacities that enable firms to adapt, expand, and reconfigure their activities.

The findings support three of the four proposed relationships. Artificial intelligence capabilities were positively associated with business model transformation, supporting H1 and indicating that firms with a greater capacity to integrate AI into their activities also tend to exhibit higher levels of business model transformation. Scalability was positively associated with business model transformation, providing support for H3, while resilience exhibited the strongest standardized association among the predictors and supported H4. Together, these results suggest that the strategic value of technological transformation may depend on the firm's capacity to scale new practices and respond adaptively to changing conditions.

Organisational culture presented a more complex pattern. Although it showed a positive bivariate relationship with business model transformation, its independent contribution was not statistically robust when AI capabilities, scalability, and resilience were considered simultaneously. Consequently, H2 was not supported. Rather than indicating that culture lacks relevance, this result suggests that its influence may operate indirectly through the development of more proximal capabilities or in interaction with other organisational conditions. This relationship warrants further investigation using research designs capable of testing mediation and moderation mechanisms.

Overall, the study contributes to the SME strategy literature by proposing and empirically exploring a capability-based explanation of business model transformation. Its central implication is that AI should not be understood as an isolated technological investment. Business model transformation appears to be associated with a broader configuration in which technological capabilities coexist with organisational resilience and the ability to scale changes across the firm. For managers, this means that digital transformation initiatives should extend beyond technology acquisition and include the development of organisational conditions that enable technologies to be incorporated into processes, decision making, and value-creation mechanisms.

6.2. Limitations

Several limitations should be considered when interpreting the findings. First, the study relied on a convenience sample of 30 firms from the automotive cluster of Nuevo León. The sample is therefore not

statistically representative of the entire cluster or of manufacturing SMEs in Mexico, and the findings should be interpreted as exploratory rather than generalisable evidence.

Second, the cross-sectional design captures organisational conditions at a single point in time and does not establish temporal precedence or causality. Third, the analysis relied on one managerial informant per firm, drawn from operations, production, or quality functions. Although these respondents were selected because of their broad knowledge of organisational and manufacturing processes, the use of a single perceptual source may introduce common-method and respondent-related bias. Finally, the relatively small analytical sample limited the complexity of the statistical models that could be estimated reliably and warrants caution when extrapolating the observed relationships beyond the participating firms.

6.3. Future Research

Future studies should test the proposed model using larger and more diverse samples, including SMEs from other manufacturing industries, regions of Mexico, and international contexts. Probability-based sampling would also strengthen external validity and allow more precise generalisation of the findings.

Longitudinal research would be particularly valuable for examining whether the development of AI capabilities precedes changes in business models and whether resilience and scalability influence the speed or sustainability of that transformation. Larger samples would additionally permit the use of structural equation modelling to evaluate latent constructs, indirect effects, and alternative configurations.

The non-significant direct effect of organisational culture also opens an important research avenue. Future studies could examine whether culture operates as an antecedent of AI capability, resilience, or scalability, or whether it moderates the relationship between technological capabilities and business model transformation. Finally, research could incorporate objective indicators of digital investment, operational performance, innovation outcomes, and business model change to complement managerial perceptions. Such extensions would help determine whether the capability configuration identified in this exploratory study remains stable across sectors, organisational sizes, and different stages of digital transformation.

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