Sustainability-Oriented Culture, Employee Literacy and Performance Driving Sustainable Supply Chain Performance in Sichuan's Automotive Industry

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ABSTRACT

Drawing on causal chain analysis, this study investigated the interconnected pathways through which sustainability-oriented organisational culture (SOOC), sustainability-oriented employee literacy (SOEL) and sustainability-oriented employee performance (SOEP) influence sustainable supply chain performance (SSCP) within the automotive industry of Sichuan Province, China. A quantitative research design was adopted, involving survey responses collected from 1,050 employees and managers and analysed using partial least squares structural equation modelling (PLS-SEM). Empirical evidence supported 6 of the 9 proposed hypotheses. Among the estimated relationships, SOOC exhibited the strongest direct effect ($\beta = 0.805$), whereas the relationship from SOEP to SSCP demonstrated the highest coefficient ($\beta = 0.815$). The findings further established the significant serial mediating roles of SOEP and SOEL, with a reported coefficient of $\beta = 0.389$ for their relationships with SSCP. However, the direct association between SOOC and SSCP was statistically insignificant. These results contribute to theoretical understanding by identifying human capital as a critical mechanism through which organisational cultural orientations translate into sustainability-related supply chain outcomes. From a managerial standpoint, the evidence highlights the importance of strengthening employees' sustainability literacy and performance capabilities alongside cultivating an organisational culture centred on sustainability to achieve measurable improvements in supply chain performance.

Keywords: Sustainability-Oriented Organizational Culture; Employee Literacy; Employee Performance; Sustainable Supply Chain Performance; Automotive Industry; PLS-SEM

INTRODUCTION

Growing sustainability pressures have placed the global automotive industry under increasing scrutiny, particularly in China, which represents the world's largest automotive market. Although the expansion of China's automotive sector has generated substantial economic benefits, these achievements have been accompanied by considerable environmental degradation, intensive energy and resource consumption, and labour-related challenges extending throughout complex value chains (Masoumi et al., 2019). In response, automotive manufacturers and their suppliers have increasingly adopted sustainable supply chain management (SSCM) as a means of reconciling economic objectives with environmental protection and social responsibility across interconnected production and distribution activities (Carter & Rogers, 2008; Seuring & Müller, 2008). Within this sector, sustainability initiatives commonly address carbon emissions, energy self-sufficiency, responsible labour practices, and

the incorporation of recycled materials into manufacturing processes (Klassen & Vereecke, 2012).

Nevertheless, the growing recognition of sustainability regulations and supply chain strategies within China has not translated into consistently effective implementation. Many enterprises continue to experience difficulties incorporating sustainability objectives into routine organisational activities, despite increasing awareness of their strategic importance (Montabon et al., 2007). Such inconsistencies indicate that successful SSCM implementation cannot be achieved through technological advancement alone; organisational structures and human resource capabilities are equally important. An organisational orientation towards sustainability provides the foundation for long-term strategic perspectives and environmentally and socially responsible decisions throughout the value chain (Gold et al., 2010). Employees are particularly influential in translating these commitments into operational improvements. Individuals possessing adequate knowledge of environmental challenges, green technologies, and resource management are better positioned to recognise improvement opportunities and contribute to continuous sustainability enhancement across supply chain activities (Daily & Huang, 2001; Pagell & Wu, 2009).

The practical contribution of employees becomes evident through their participation in energy conservation, waste reduction, and collaborative activities involving supply chain stakeholders, all of which influence the effectiveness of sustainability practices (Masoumi et al., 2019). Consequently, developing appropriate managerial strategies for improving SSCP requires a comprehensive understanding of how organisational culture, employee literacy, and individual performance interact. SOOC encompasses the collectively held values, assumptions, beliefs, and behavioural norms through which organisations incorporate economic, social, and environmental responsibility into their strategic direction, institutional vision, and operational arrangements (Linnenluecke & Griffiths, 2010). Beyond providing an organisational foundation for environmentally responsible innovation, SOOC encourages consideration of long-term consequences and facilitates decision-making that incorporates stakeholder interests (Baumgartner, 2009). Existing scholarship associates sustainability-oriented cultural environments with stronger long-term financial and market outcomes (Eccles et al., 2014), greater organisational resilience (Ortiz-de-Mandojana & Bansal, 2015), and increased employee engagement arising from opportunities to undertake meaningful work (Aguinis & Glavas, 2019).

The development of SOOC involves several interdependent organisational characteristics, including committed leadership, collectively endorsed values, accessible information and training, meaningful employee participation, transparent performance assessment, and effective feedback mechanisms. However, establishing such a culture requires sustained organisational transformation rather than isolated managerial directives. Employees and organisational groups may resist changes that conflict with existing priorities, while differences among internal subcultures can produce inconsistent interpretations of sustainability commitments (Linnenluecke et al., 2009). Accordingly, embedding sustainability throughout an organisation requires continuing behavioural adaptation, institutional learning, and coordinated systemic adjustments rather than relying exclusively on top-down instructions (Baumgartner, 2009). Within this context, SOEL represents employees' knowledge, comprehension, and awareness of sustainability-related principles and practices relevant to their occupational responsibilities, including the economic, social, and ecological considerations necessary for decisions aligned with organisational strategy (Azapagic, 2003).

Greater SOEL enables individuals to connect strategic sustainability commitments with everyday responsibilities, identify opportunities for environmentally responsible innovation, and contribute to decisions involving long-term organisational consequences (Bansal & Song, 2017; Ones & Dilchert, 2012). Its development therefore depends substantially on translating senior management policies into operational understanding, supported by organisational learning arrangements that strengthen employees' sustainability capabilities (Haugh & Talwar, 2010; Parry et al., 2021). The scope of SOEL extends beyond familiarity with fundamental sustainability principles to encompass recognition of business-related social consequences, awareness of sustainable practices and industry developments, competence in resource and energy management, understanding of environmental regulatory requirements, and the ability to engage relevant stakeholders (Schaltegger & Wagner, 2011). Nevertheless, the multidimensional and context-dependent nature of sustainability can make these concepts difficult for employees to interpret, contributing to persistent discrepancies between sustainability knowledge and actual workplace behaviour.

Addressing this knowledge–behaviour discrepancy requires appropriate motivational arrangements and continuing organisational support, since information provision alone does not necessarily produce meaningful behavioural change (Kollmuss & Agyeman, 2002). SOEP concerns employees' work-related behaviours and outcomes that make direct, positive contributions to the economic, social, and environmental dimensions of organisational sustainability (Ones & Dilchert, 2012). Through such contributions, individual sustainability capabilities become observable workplace practices that may support cost efficiency, innovation, competitive positioning, and the fulfilment of stakeholder expectations across supply chain operations.

The assessment of SOEP generally encompasses three dimensions: economic contributions, including sustainability-oriented innovation and performance reporting; social contributions, such as occupational health and safety and community support; and environmental contributions, including reduced resource consumption and waste minimisation. However, employees' capacity to achieve these outcomes may be constrained by insufficient specialised knowledge, limited motivation, inadequate managerial commitment, and shortages of appropriate resources or operational tools (Norton et al., 2015). Previous studies consequently emphasise the importance of enabling organisational conditions, particularly supervisory encouragement (Ramus & Steger, 2000), collaborative information exchange (Aragón-Correa et al., 2013), and environmentally oriented human resource management (HRM) practices (Renwick et al., 2012), in supporting employees' sustainability-related behaviours.

At the broader operational level, SSCP reflects the sustained integration and assessment of economic, environmental, and social outcomes throughout interconnected supply chain processes, extending from raw material procurement to manufacturing and subsequent value chain activities (Hu & Sinniah, 2024; Seuring & Müller, 2008). Its strategic importance arises from the potential to reduce operating expenditure and strengthen profitability (Carter & Rogers, 2008), reinforce stakeholder confidence, and improve competitive positioning in markets characterised by increasingly demanding international sustainability standards (Pagell & Wu, 2009). Consistent with the triple-bottom-line perspective, SSCP indicators encompass energy efficiency, emissions management, employment conditions, human rights, occupational safety, transparent reporting, risk management, and environmentally responsible product development. Despite these potential advantages, improving SSCP presents substantial implementation challenges. Technological innovations frequently require considerable

financial investment, while coordinating geographically dispersed supply chain networks can impose additional costs and managerial complexity (Meixell & Gargeya, 2005). Limited cooperation among supply chain partners and resistance to organisational cultural transformation may further obstruct sustainability initiatives (Linnenluecke & Griffiths, 2010). These difficulties demonstrate that sustainability transformation extends beyond technological substitution and depends equally on human resource capabilities, particularly the development of supportive organisational values and employees' sustainability-related competencies (Gold et al., 2010; Klassen & Vereecke, 2012).

Although the individual dimensions of organisational sustainability have received considerable scholarly attention, existing investigations have predominantly examined these constructs separately, leaving the sequential mechanisms connecting organisational culture, employee-level capabilities, and supply chain outcomes insufficiently understood. Empirical evidence addressing these relationships within the automotive industry of western China remains particularly limited. To address this research gap, the present study investigates the relationships through which SOOC influences SOEL, SOEL affects SOEP, and these interconnected processes contribute to SSCP within the automotive industry of Sichuan Province, China. Particular emphasis is placed on analysing the proposed causal chain and identifying the mechanisms through which organisational sustainability commitments are associated with supply chain outcomes. By examining the human foundations of organisational sustainability (Ones & Dilchert, 2012), the research seeks to extend existing SSCM scholarship while providing practical insights for managers and other stakeholders responsible for developing employee capabilities, strengthening sustainability-oriented organisational environments, and improving the competitiveness of automotive enterprises.

The theoretical rationale underlying the proposed causal sequence derives from the understanding that organisational sustainability capabilities develop through the accumulation of resources, the establishment of institutional routines, and their progressive internalisation by organisational members (Gold et al., 2010). From this perspective, SOOC is expected to strengthen employees' awareness of sustainability-related concerns, thereby influencing the issues they prioritise and the knowledge they seek to acquire (Haugh & Talwar, 2010; Linnenluecke & Griffiths, 2010). Beyond its contribution to SOEL, SOOC may directly encourage SOEP by legitimising environmentally responsible conduct and establishing organisational incentives that reinforce such behaviour (Ramus & Steger, 2000). A further direct relationship with SSCP is theoretically plausible because organisational cultural priorities can shape strategic decisions affecting supply chain operations (Eccles et al., 2014).

Meanwhile, SOEL may contribute independently to SSCP by improving the knowledge available for operational decisions, particularly those involving supplier assessment and resource allocation (Daily & Huang, 2001). Employees possessing stronger sustainability literacy may also be better equipped to recognise opportunities for improvement and translate these opportunities into practical workplace activities, thereby enhancing SOEP (Norton et al., 2015). In turn, SOEP constitutes the behavioural mechanism most immediately connected with supply chain outcomes, since sustainability-related activities undertaken in production, purchasing, and logistics can directly influence economic, environmental, and social performance (Klassen & Vereecke, 2012; Pagell & Wu, 2009). Collectively, these theoretical arguments support the possibility that the relationship between SOOC and SSCP operates through indirect pathways involving SOEL individually and the sequential contribution of SOEL and SOEP. Thus, the proposed framework considers both the separate mediating role of

employee literacy and the combined mediating mechanism through which literacy and employee performance connect organisational culture with supply chain outcomes.

Drawing upon the preceding theoretical discussion and empirical literature, a conceptual framework was formulated to represent the proposed relationships among the four principal constructs (Figure 1). Within this framework, SOOC functions as the exogenous construct, with hypothesised direct relationships involving SOEL, SOEP, and SSCP. Additional pathways specify the influence of SOEL on both SOEP and SSCP, together with the relationship between SOEP and SSCP. The framework further incorporates indirect relationships through which SOEL and SOEP are proposed to mediate the association between SOOC and SSCP, both independently and through a sequential mediation process. On this theoretical basis, the following hypotheses were formulated:

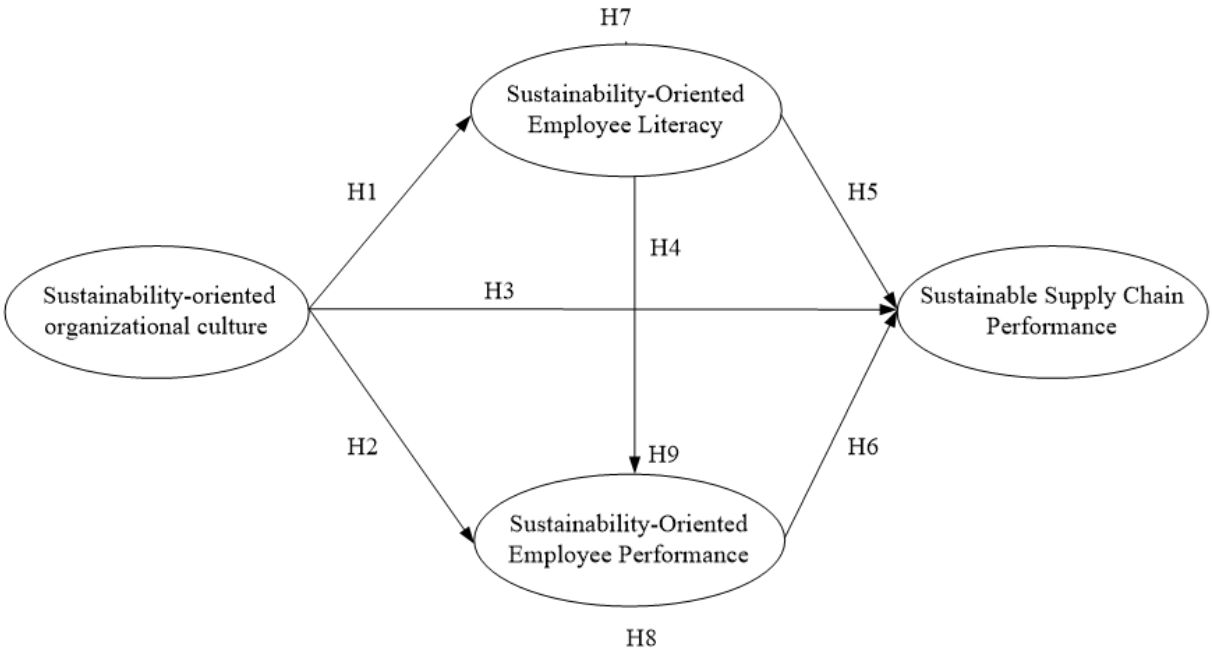

Figure 1: Conceptual Model

H1: SOOC has a positive effect on SOEL.
H2: SOOC has a positive effect on SOEP.
H3: SOOC has a direct positive effect on SSCP.
H4: SOEL has a positive effect on SOEP.
H5: SOEL has a positive effect on SSCP.
H6: SOEP has a positive effect on SSCP.
H7: SOEL mediates the relationship between SOOC and SSCP.
H8: SOEP mediates the relationship between SOOC and SSCP.
H9: SOEL and SOEP serially mediate the relationship between SOOC and SSCP.

MATERIALS AND METHODS

A cross-sectional quantitative survey approach was adopted to investigate the proposed relationships. The study population comprised employees and managers working in the automotive industry of Sichuan Province, China, who possessed at least one year of professional experience. Sample size determination followed the recommendations of Hair et

al. (2019), which specify approximately 10 to 20 observations for each observed variable in structural equation modelling. Given the inclusion of 51 observed variables, a ratio of 20:1 was applied, establishing a minimum required sample of 1020 respondents. This threshold was subsequently increased to 1,050 participants to address potential underrepresentation across individual centres and improve the stability of parameter estimates. A multistage sampling procedure was implemented to obtain a representative sample while limiting selection bias. This procedure involved the random selection of automotive enterprises, followed by the random recruitment of eligible employees and managers within the selected organisations. The analytical model incorporated four latent constructs identified through established theoretical perspectives, relevant conceptual frameworks, and previous empirical investigations. Table 1 presents the respective roles of these constructs and identifies the principal literature sources informing the development of their measurement items.

Table 1: Variables used in the Study and their Sources

Variable Type	Variable Name in the Study	References
Independent Variable	Sustainability-Oriented Organizational Culture (SOOC)	Baumgartner (2009); Eccles et al. (2014); Linnenluecke and Griffiths (2010)
Mediating Variable	Sustainability-Oriented Employee Literacy (SOEL)	Haugh and Talwar (2010); Linnenluecke et al. (2009); Ones and Dilchert (2012)
Mediating Variable	Sustainability-Oriented Employee Performance (SOEP)	Daily and Huang (2001); Norton et al. (2015); Ramus and Steger (2000)
Dependent Variable	Sustainable Supply Chain Performance (SSCP)	Carter and Rogers (2008); Pagell and Wu (2009); Seuring and Müller (2008)

Data collection was undertaken using a structured, closed-ended questionnaire comprising five sections. The first section captured respondents' demographic characteristics and employment-related information, while the remaining sections assessed SOOC, SOEL, SOEP, and SSCP through 12, 12, 12, and 15 measurement items, respectively, yielding 51 observed variables. Item development was informed by the conceptual dimensions established in previous literature. Specifically, SOOC was operationalised through leadership support, shared organisational values, sustainability-related training, employee participation, and evaluation mechanisms. SOEL encompassed knowledge of sustainability principles and practices, regulatory requirements, and sustainable resource management. SOEP was assessed through employees' environmental, social, and economic workplace behaviours, whereas SSCP incorporated environmental, social, economic, and transparency-related outcomes throughout the value chain. Responses were recorded using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Questionnaire administration was facilitated by designated coordinators within participating organisations, with all procedures conducted in accordance with established human research ethics guidelines. Before participation, respondents received information explaining the research objectives and provided written informed consent. Participant anonymity and data confidentiality were maintained throughout the investigation, and the collected information was restricted to academic analysis and aggregate reporting. To mitigate common method bias (CMB), procedural safeguards were incorporated into the questionnaire design, including

explicit assurances of anonymity and the separation of predictor and criterion constructs within the survey instrument (Podsakoff et al., 2003).

The analytical strategy employed PLS-SEM, consistent with its suitability for prediction-oriented investigations involving complex structural relationships and samples intended to represent the target population (Hair et al., 2019). Model assessment proceeded through two successive stages. Initially, the measurement model was examined to establish the reliability and validity of the latent constructs. Indicator reliability was evaluated using outer loadings ≥ 0.70, while internal consistency was assessed through Cronbach's alpha, rho_A, and composite reliability (CR), with acceptable values exceeding 0.70. Convergent validity was determined using average variance extracted (AVE), for which values > 0.50 were considered satisfactory. Discriminant validity was examined through the Fornell–Larcker criterion (Fornell & Larcker, 1981) and the heterotrait–monotrait ratio (HTMT), applying the recommended thresholds of

RESULTS AND DISCUSSION

The demographic and occupational characteristics of the 1,050 survey participants indicated a relatively balanced gender distribution, comprising 530 men (50.5%) and 520 women (49.5%). Regarding age, respondents aged 20–30 years constituted the largest proportion (40.8%), followed by those aged 41–50 years (23.3%), individuals aged 51 years and above (20.3%), and participants within the 31–40-year category (15.6%). Educational attainment varied across the sample, with bachelor's degree holders representing the largest group (38.5%), followed by respondents possessing master's degrees (24.8%), doctoral qualifications (20.5%), and qualifications below bachelor's level (16.3%). Differences were also evident in participants' overall professional experience.

Approximately 33.4% reported more than 5 years of employment experience, whereas 26.9% had accumulated 1–2 years, 24.9% reported 3–4 years, and 14.9% indicated less than 1 year. In terms of organisational position, operational personnel accounted for the largest occupational category (38.5%), while first-line managers represented 22.1%, senior managers 21.7%, and middle managers 17.7% of the sample. Employment tenure within the current organisation was predominantly concentrated in the 1–5-year category (38.7%), followed by respondents with more than 16 years of service (30.4%), those with 6–10 years (16.0%), and individuals reporting 11–15 years (15.0%). Monthly income distributions showed that the largest proportion of participants earned 5,001 yuan or more (42.4%). The remaining respondents were distributed across the 2,001–3,000 yuan (18.3%), 4,001–5,000 yuan (17.0%), 3,001–4,000 yuan (15.7%), and below 2,000 yuan (6.7%) income categories.

Table 2: Descriptive Analysis of the Studied Variables

Variables	Mean	SD	Interpretation
Sustainability-Oriented Organizational Culture	4.32	0.694	Highest
Sustainability-Oriented Employee Literacy	4.37	0.635	Highest
Sustainability-Oriented Employee Performance	4.42	0.523	Highest
Sustainable Supply Chain Performance	4.42	0.522	Highest

As presented in Table 2, all four constructs received ratings within the "very high" category, indicating consistently favourable perceptions across the measured sustainability dimensions. The highest mean values were recorded for SOEP (M = 4.42, SD = 0.523) and SSCP (M = 4.42, SD = 0.522), followed by SOEL (M = 4.37, SD = 0.635). Although SOOC exhibited the

lowest mean (M = 4.32, SD = 0.694), its assessment nevertheless remained within the highest rating category. The comparatively limited dispersion reflected in the standard deviations suggests considerable consistency among respondents' evaluations, with relatively little variation around the respective means. These uniformly elevated assessments may reflect the increasing prominence of sustainability considerations within automotive enterprises in Sichuan Province, consistent with the intensifying regulatory requirements and sustainability pressures affecting China's automotive industry (Masoumi et al., 2019).

The modest differences between SOOC and the more favourable evaluations of SOEP and SSCP suggest that respondents perceived employee-level sustainability practices and supply chain outcomes somewhat more positively than the underlying organisational cultural environment. This distinction may indicate a comparatively more cautious assessment of cultural conditions, although the differences between the reported means remain small. Furthermore, the generally favourable self-reported evaluations may partly reflect social desirability influences, highlighting the importance of interpreting descriptive statistics alongside more rigorous measurement and structural assessments (Podsakoff et al., 2003). Accordingly, evaluation of the measurement model preceded examination of the hypothesised structural relationships. Table 3 and Figure 2 present the outer loadings and the corresponding evidence concerning construct reliability and convergent validity across the four latent variables.

Table 3: Outer Loadings, Reliability, and Convergent Validity of the Measurement Model

Latent Variable	Observed Variable	Outer Loading	CA	rho_A	CR	AVE
SOOC	SOOC1	0.817	0.957	0.957	0.962	0.679
	SOOC2	0.823				
	SOOC3	0.812				
	SOOC4	0.825				
	SOOC5	0.823				
	SOOC6	0.825				
	SOOC7	0.819				
	SOOC8	0.814				
	SOOC9	0.827				
	SOOC10	0.843				
	SOOC11	0.820				
	SOOC12	0.838				
SOEL	SOEL1	0.841	0.950	0.950	0.956	0.644
	SOEL2	0.820				
	SOEL3	0.759				
	SOEL4	0.793				
	SOEL5	0.799				
	SOEL6	0.818				
	SOEL7	0.800				
	SOEL8	0.801				
	SOEL9	0.784				
	SOEL10	0.820				
	SOEL11	0.789				
	SOEL12	0.803				

Table 3(continued): Outer Loadings, Reliability, and Convergent Validity of the Measurement Model

Latent Variable	Observed Variable	Outer Loading	CA	rho_A	CR	AVE
SOEP	SOEP1	0.789	0.927	0.928	0.937	0.555
	SOEP2	0.729				
	SOEP3	0.757				
	SOEP4	0.708				
	SOEP5	0.757				
	SOEP6	0.735				
	SOEP7	0.767				
	SOEP8	0.749				
	SOEP9	0.707				
	SOEP10	0.744				
	SOEP11	0.753				
	SOEP12	0.741				
SSCP	SSCP1	0.795	0.944	0.945	0.950	0.561
	SSCP2	0.738				
	SSCP3	0.710				
	SSCP4	0.722				
	SSCP5	0.780				
	SSCP6	0.761				
	SSCP7	0.757				
	SSCP8	0.733				
	SSCP9	0.758				
	SSCP10	0.760				
	SSCP11	0.750				
	SSCP12	0.711				
	SSCP13	0.785				
	SSCP14	0.746				
	SSCP15	0.722				

Note: CA = Cronbach's Alpha; CR = Composite Reliability; AVE = Average Variance Extracted.

The measurement model demonstrated satisfactory psychometric properties, with all observed indicator loadings ranging between 0.707 and 0.843, thereby exceeding the recommended minimum threshold of 0.70. Across the individual constructs, SOOC exhibited outer loadings extending from 0.812 (SOOC3) to 0.843 (SOOC10), whereas the corresponding values for SOEL ranged from 0.759 (SOEL3) to 0.841 (SOEL1). For SOEP, indicator loadings varied between 0.707 (SOEP9) and 0.789 (SOEP1), while those associated with SSCP extended from 0.710 (SSCP3) to 0.795 (SSCP1). Internal consistency was similarly supported by Cronbach's alpha coefficients of 0.927–0.957, rho_A values of 0.928–0.957, and CR estimates of 0.937–0.962, all surpassing the stipulated threshold of 0.70. Furthermore, AVE values ranged from 0.555 to 0.679, consistently exceeding the minimum acceptable criterion of 0.50. As illustrated in Figure 2, the collective fulfilment of these assessment criteria provides evidence of adequate indicator reliability, strong internal consistency, and satisfactory convergent validity across all four constructs.

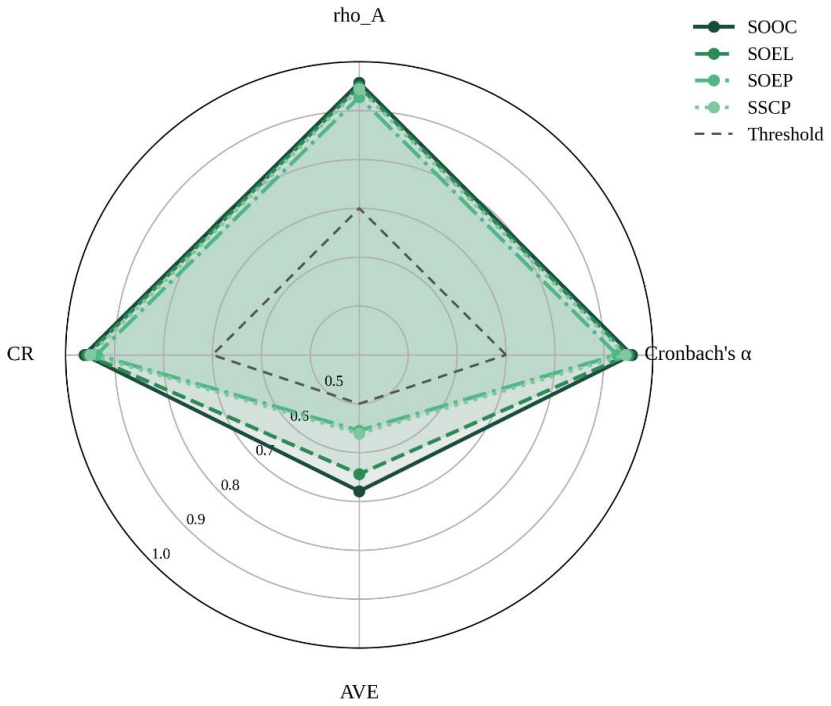

Figure 2: Reliability and Convergent Validity Profile of the Four Constructs Compared with Recommended Thresholds

As reported in Table 4, the square roots of AVE for SOOC, SOEL, SOEP, and SSCP were 0.824, 0.803, 0.745, and 0.749, respectively, while correlations among the constructs ranged from 0.542 to 0.889. Comparison of these values using the Fornell–Larcker criterion indicated that the square root of AVE exceeded the corresponding inter-construct correlations for most construct pairs, providing partial support for discriminant validity. Nevertheless, two relationships failed to satisfy this criterion. Specifically, the correlation between SOEP and SSCP (0.889) exceeded the square root of AVE for SSCP (0.749), whereas the association between SOOC and SOEL (0.805) marginally surpassed the corresponding value for SOEL (0.803). These findings indicate that discriminant validity was not fully established across the measurement model, particularly for the SOEP–SSCP and SOOC–SOEL relationships.

Table 4: Discriminant Validity Assessment using the Fornell–Larcker Criterion

Variable	SOEL	SOEP	SOOC	SSCP
SOEL	**0.803**			
SOEP	0.647	**0.745**		
SOOC	0.805	0.545	**0.824**	
SSCP	0.642	0.889	0.542	**0.749**

Note: Values on the diagonal represent the square root of the AVE.

The HTMT results presented in Table 5 revealed values ranging from 0.569 to 0.949, with five of the six construct pairs satisfying the recommended threshold of 0.85. The lowest coefficients were observed for SOOC–SSCP (0.569) and SOOC–SOEP (0.577), followed by SOEL–SSCP (0.677) and SOEL–SOEP (0.688). Although the SOOC–SOEL relationship exhibited a comparatively higher HTMT value (0.843), it remained below the specified threshold, indicating acceptable discriminant validity for these construct pairs (Henseler et al., 2015). In contrast, the SOEP–SSCP relationship produced an elevated HTMT coefficient of 0.949, exceeding the recommended criterion and suggesting substantial conceptual or empirical

overlap between these constructs. Consequently, discriminant validity was not fully supported for this relationship, warranting particular caution when interpreting the corresponding structural model estimates and their implications.

Table 5: Discriminant Validity Assessment using the HTMT Ratio

Variable	SOEL	SOEP	SOOC	SSCP
SOEL				
SOEP	0.688			
SOOC	0.843	0.577		
SSCP	0.677	0.949	0.569	

The model fit statistics reported in Table 6 indicate an acceptable correspondence between the proposed model and the observed data. For both the saturated and estimated models, SRMR values remained below the recommended threshold of 0.08, while the normed fit index (NFI) exceeded 0.90, providing further support for the model's overall fit. Additional diagnostic statistics included d_ULS (1.226), d_G (0.676), and chi-square (3,907.318). Considered collectively, these indices suggest that the specified model provides a satisfactory representation of the empirical relationships, although the interpretation of individual discrepancy measures requires appropriate reference criteria. Particular emphasis was placed on SRMR when evaluating overall model fit, given the continuing methodological discussion surrounding the applicability and interpretation of goodness-of-fit indices within PLS-SEM (Hair et al., 2019).

Table 6: Model Fit Assessment

Model Fit Index	Saturated Model	Estimated Model
SRMR	0.030	0.030
d_ULS	1.226	1.226
d_G	0.676	0.676
Chi-square	3907.318	3907.318
NFI	0.905	0.905

The effect size estimates presented in Table 7 revealed substantial differences in the relative contributions of the hypothesised relationships. The largest effects were associated with SOEP → SSCP (f^2 = 1.903) and SOOC → SOEL (f^2 = 1.837), both considerably exceeding the conventional threshold for large effects. In comparison, the SOEL → SOEP pathway demonstrated a moderate effect (f^2 = 0.214), indicating a meaningful contribution to the explained variance in SOEP. Conversely, the effects associated with SOEL → SSCP (f^2 = 0.015), SOOC → SOEP (f^2 = 0.003), and SOOC → SSCP (f^2 = 0.000) were negligible, suggesting limited incremental explanatory contributions from these direct pathways. Taken together, this pattern is consistent with an indirect relationship between SOOC and SSCP, in which employee-related constructs serve as potential mechanisms linking organisational cultural conditions with supply chain outcomes. Nevertheless, the exceptionally large effect observed for SOEP → SSCP warrants cautious interpretation, particularly in view of the previously identified discriminant validity concerns and the substantial empirical overlap between SOEP and SSCP. These measurement-related considerations should therefore be incorporated into the interpretation of the structural relationships and their relative effect magnitudes.

Table 7: Effect Size (f^2) Analysis of the Structural Model

Relationship	f^2	Effect Size Level
SOEL → SOEP	0.214	Medium
SOEL → SSCP	0.015	No Effect
SOEP → SSCP	1.903	Large
SOOC → SOEL	1.837	Large
SOOC → SOEP	0.003	No Effect
SOOC → SSCP	0.000	No Effect

Note: Interpretation criteria for f^2: 0.02 = Small, 0.15 = Medium, 0.35 = Large.

The hypothesis-testing results presented in Table 8 provided empirical support for six of the nine proposed relationships. Among the significant direct pathways, SOOC demonstrated a strong positive association with SOEL (H1: β = 0.805, p < 0.001), while SOEL was positively associated with both SOEP (H4: β = 0.593, p < 0.001) and SSCP (H5: β = 0.101, p = 0.003). A particularly strong positive relationship was also identified between SOEP and SSCP (H6: β = 0.815, p < 0.001). Beyond these direct associations, the mediation analysis supported the indirect pathway SOOC → SOEL → SSCP (H7: β = 0.081, p = 0.002), together with the sequential mediation pathway SOOC → SOEL → SOEP → SSCP (H9: β = 0.389, p < 0.001).

Table 8: Hypothesis Testing of the Structural Model

Hypothesis	Relationship	β	t	p	95% CI LL	95% CI UL	Test Result
H1	SOOC → SOEL	0.805	19.712	0.000	0.725	0.885	Supported
H2	SOOC → SOEP	0.067	1.408	0.159	-0.026	0.161	Not Supported
H3	SOOC → SSCP	0.017	0.785	0.433	-0.025	0.058	Not Supported
H4	SOEL → SOEP	0.593	10.764	0.000	0.485	0.701	Supported
H5	SOEL → SSCP	0.101	2.925	0.003	0.033	0.169	Supported
H6	SOEP → SSCP	0.815	26.286	0.000	0.754	0.875	Supported
H7	SOOC → SOEL → SSCP	0.081	3.100	0.002	0.030	0.133	Supported
H8	SOOC → SOEP → SSCP	0.055	1.448	0.148	-0.019	0.129	Not Supported
H9	SOOC → SOEL → SOEP → SSCP	0.389	16.133	0.000	0.342	0.436	Supported

Note: β = Path Coefficient; t = t Statistic; p = Significance Level; CI LL and CI UL = Lower and Upper Bounds of the 95% Confidence Interval.

Conversely, the hypothesised direct relationships between SOOC and SOEP (H2) and between SOOC and SSCP (H3) were not statistically supported. Similarly, the indirect relationship represented by H8, involving SOEP as the sole mediator between SOOC and SSCP, did not attain statistical significance. Figure 3 illustrates the proposed structural model, whereas Figure 4 presents the estimated path coefficients alongside their corresponding 95% confidence intervals (CIs). As depicted in Figure 4, the CIs associated with H2, H3, and H8 included zero, indicating insufficient statistical evidence for these relationships. In contrast, the intervals corresponding to all six supported hypotheses excluded zero, providing further confirmation of their statistical significance.

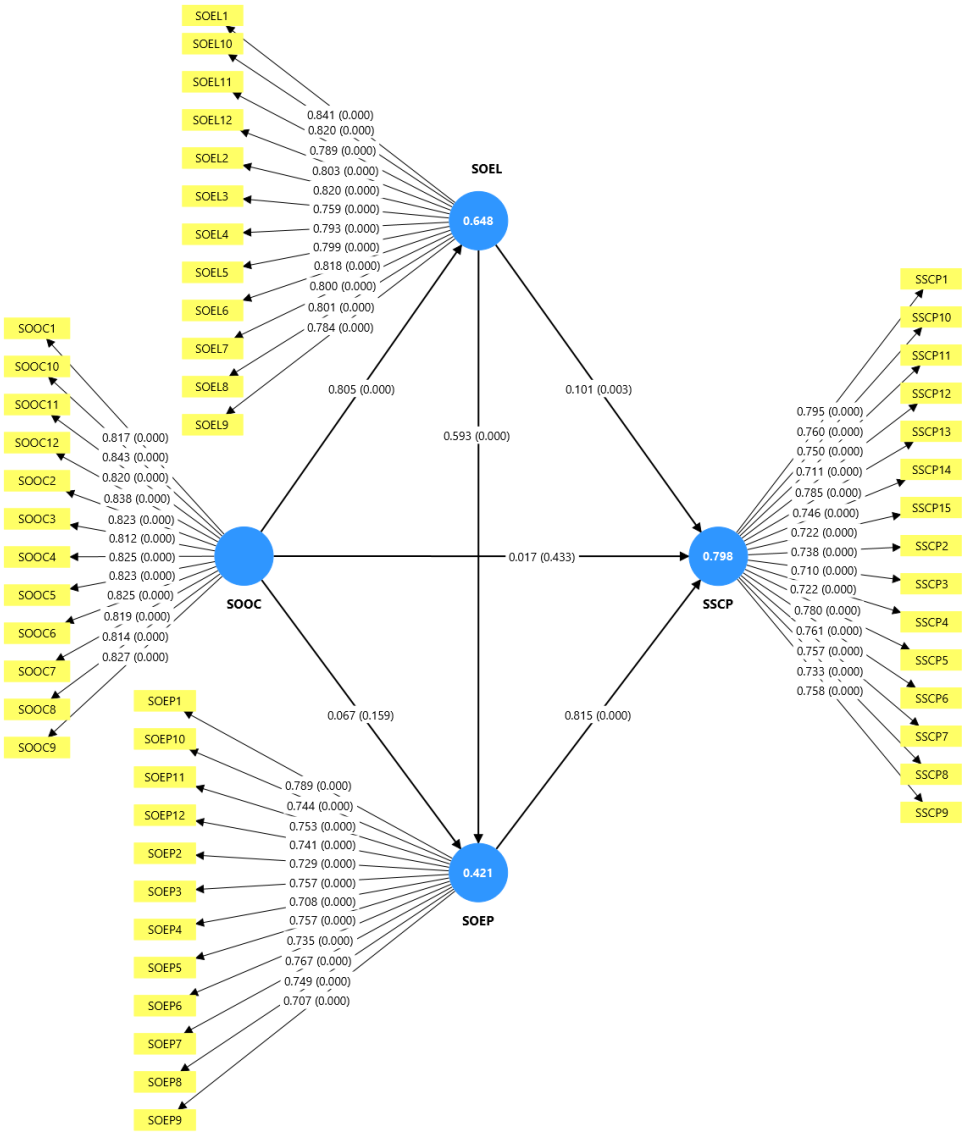

Figure 3: Tested Structural Model

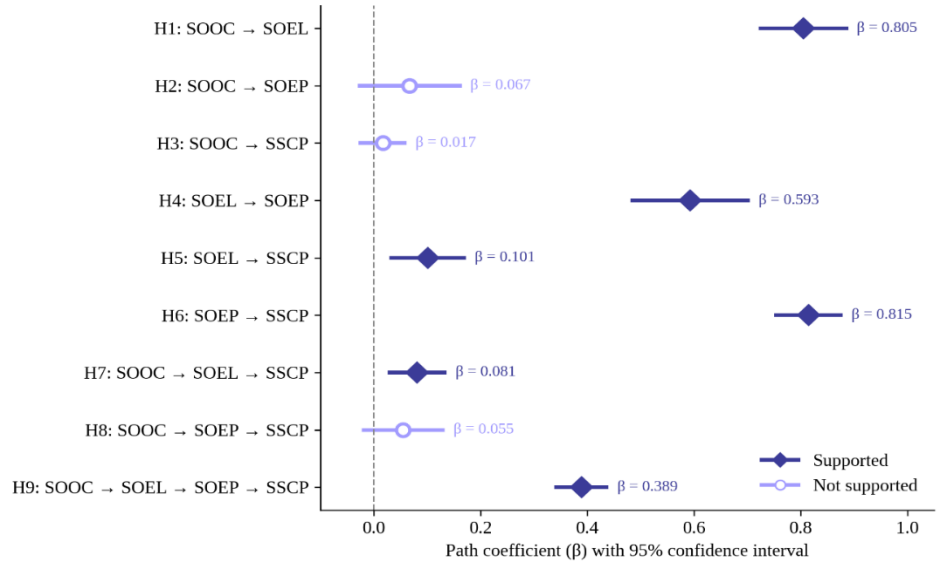

Figure 4: Path Coefficients and 95% Confidence Intervals for the Nine Hypotheses

The decomposition of effects reported in Table 9 and illustrated in Figure 5 highlights the predominance of indirect pathways in the relationships linking SOOC with employee-related constructs and SSCP. Specifically, the total effect (TE = 0.542) of SOOC on SSCP was largely attributable to its indirect effect (IE = 0.525), whereas the direct effect (DE = 0.017) contributed only marginally to the overall relationship. A comparable pattern emerged for the association between SOOC and SOEP, where the indirect component (IE = 0.477) substantially exceeded the direct component (DE = 0.067), yielding a total effect of TE = 0.545. In contrast, SOEL exhibited both a direct association (DE = 0.101) and a more pronounced indirect association (IE = 0.483) with SSCP, producing a combined effect of 0.584. The relationship between SOEP and SSCP was characterised entirely by a substantial direct effect (DE = TE = 0.815). These differences are visually represented in Figure 5, where indirect contributions account for the largest proportion of the effects associated with SOOC, whereas the direct pathway is particularly prominent for SOEP. Collectively, the findings suggest that the association between SOOC and SSCP operates predominantly through intervening employee-related mechanisms rather than through an independent direct pathway.

Table 9: Direct, Indirect, and Total Effects

Variables	SOEL			SOEP			SSCP		
	DE	IE	TE	DE	IE	TE	DE	IE	TE
SOOC	0.805***	—	0.805***	0.067	0.477***	0.545***	0.017	0.525***	0.542***
SOEL	—	—	—	0.593***	—	0.593***	0.101**	0.483***	0.584***
SOEP	—	—	—	—	—	—	0.815***	—	0.815***

Note: DE = Direct Effect; IE = Indirect Effect; TE = Total Effect. $^{**}p < 0.01$. $^{***}p < 0.001$.

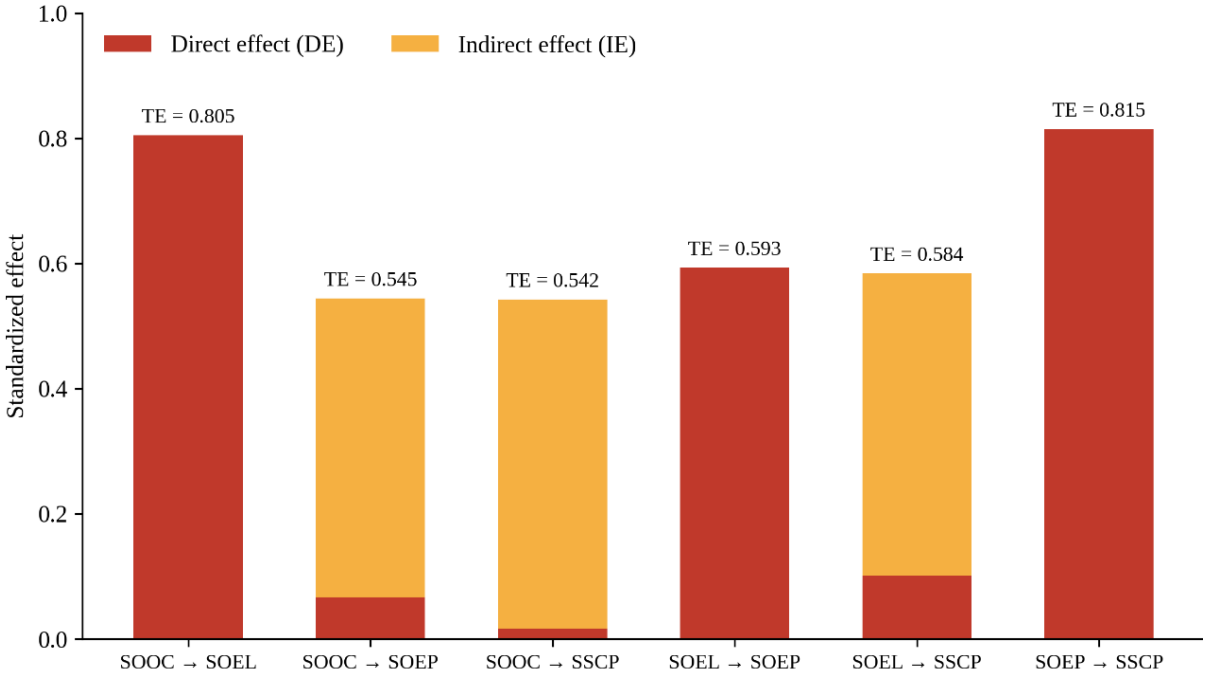

Figure 5: Decomposition of Total Effects into Direct and Indirect Components

Taken together, the findings indicate that the relationship between SOOC and SSCP operates predominantly through indirect mechanisms rather than a statistically significant direct pathway. SOEL emerges as an important intermediary through which organisational sustainability commitments become associated with SOEP, while SOEP represents the strongest direct predictor of supply chain outcomes. This pattern suggests that organisational

culture establishes the underlying orientation towards sustainability, but its contribution to measurable outcomes depends substantially on the development and practical application of employees' knowledge and capabilities. Such an interpretation is consistent with Linnenluecke and Griffiths (2010) and Gold et al. (2010), who emphasise that embedding sustainability requires employee learning and behavioural transformation alongside organisational directives.

It also corresponds with Haugh and Talwar (2010) conceptualisation of sustainability as an institutionalised organisational practice sustained through continuous learning. The particularly strong association between SOEP and SSCP may reflect the operational proximity of employee behaviour to supply chain outcomes, as activities involving energy conservation, waste minimisation, and responsible resource utilisation translate sustainability policies and knowledge into observable workplace practices (Masoumi et al., 2019). Furthermore, the mediating contributions of SOEL and SOEP are consistent with the green HRM literature, which associates employees' environmental knowledge and supportive organisational conditions with stronger ecological workplace behaviour (Ramus & Steger, 2000).

These findings also reinforce the triple-bottom-line perspective, according to which economic, environmental, and social sustainability outcomes are realised through coordinated operational activities throughout supply chain processes (Carter & Rogers, 2008; Seuring & Müller, 2008). Particularly noteworthy is the absence of statistically significant direct relationships between SOOC and either SOEP or SSCP, together with the unsupported indirect pathway involving SOEP as the sole mediator. This pattern differs from previous evidence associating sustainability-oriented cultural characteristics directly with organisational performance (Eccles et al., 2014). One possible explanation is that, within Sichuan Province's automotive industry, organisational sustainability values may be insufficient to influence employees' practical behaviour unless accompanied by the knowledge and competencies necessary to incorporate those values into occupational responsibilities. This interpretation is compatible with Kollmuss and Agyeman (2002), who emphasise that environmental values and awareness do not automatically produce corresponding behavioural changes without appropriate enabling conditions.

SOEL may therefore constitute a particularly important intermediary connecting organisational cultural commitments with workplace effectiveness and, subsequently, broader supply chain outcomes. Nevertheless, the substantial correlation and elevated HTMT coefficient between SOEP and SSCP suggest that respondents may perceive employee sustainability practices and supply chain sustainability outcomes as closely interconnected. This conceptual and empirical overlap warrants caution when interpreting the exceptionally strong structural relationship between these constructs. Another important finding concerns the relatively small but statistically significant direct association between SOEL and SSCP, particularly in view of the substantial explanatory capacity of the estimated structural model, which accounted for a high proportion of variance in the target constructs (R^2 = .648 for SOEL and R^2 = .798 for SSCP).

Although much of the association between SOEL and SSCP appears to operate through SOEP, the significant direct pathway suggests that employees' sustainability knowledge may also be relevant to supply chain outcomes beyond their immediate workplace performance. Such contributions may involve identifying operational deficiencies, communicating sustainability concerns to suppliers, supporting responsible procurement decisions, or participating in sustainability reporting activities (Klassen & Vereecke, 2012). Accordingly, the potential value of SOEL may extend beyond individual task execution by supporting knowledge exchange and

coordinated improvements across interconnected supply chain participants (Gold et al., 2010). Regional and workforce characteristics may also help explain the prominence of indirect pathways within the proposed model. The rapid development of Sichuan Province's automotive industry, together with the reported proportion of respondents in the 20–30-year age category (40.8%) and those with 1–5 years of tenure in their current organisations (38.7%), suggests a workforce containing a substantial proportion of relatively young employees and individuals with comparatively limited organisational tenure.

In such circumstances, sustainability commitments articulated at the organisational level may not become fully embedded in routine operational practices without structured opportunities for learning and capability development. This interpretation is broadly consistent with evidence that sustainability values may be understood differently across organisational subcultures (Linnenluecke et al., 2009), as well as research highlighting information exchange and collaborative engagement as important conditions for implementing proactive environmental strategies (Aragón-Correa et al., 2013). From a managerial perspective, the findings indicate that establishing SOOC alone may be insufficient to generate measurable improvements in SSCP. Organisations should therefore complement cultural development initiatives with systematic investments in SOEL and SOEP. Relevant interventions include structured sustainability training, appropriately designed incentive arrangements, and performance appraisal systems incorporating clearly defined sustainability objectives. At the policy level, workforce capability development should be approached as an industry-wide priority rather than being restricted primarily to compliance with technical and regulatory standards.

Potential policy and organisational initiatives include specialised training in green technologies and sustainable resource management, financial incentives or subsidies encouraging enterprises to invest in employee sustainability education, and collaborative arrangements between automotive companies and professional training institutions. From an academic perspective, the study extends understanding of the relationships connecting SOOC with SSCP by examining SOEL and SOEP as sequential mediating mechanisms, thereby addressing an aspect that has received comparatively limited attention in earlier investigations. These findings also provide a basis for designing integrated organisational development programmes implemented through successive stages. The initial stage should establish a credible cultural foundation by ensuring that sustainability commitments are clearly communicated, visibly supported by management, and incorporated into organisational objectives.

The second stage should concentrate on strengthening SOEL through targeted, occupation-specific learning opportunities that demonstrate how sustainability principles can be applied in procurement, manufacturing, logistics, and quality management. At this stage, SOOC is expected to provide a more effective foundation when organisational arrangements actively encourage employees to acquire and apply relevant knowledge. The third stage should focus on translating these acquired competencies into sustained workplace practices by embedding sustainability-related responsibilities within job descriptions, performance evaluation procedures, and employee recognition systems. Within this implementation framework, monitoring and rewarding identifiable sustainability-related actions may provide a relatively immediate route towards improved supply chain outcomes.

Activities such as reducing energy consumption, minimising operational waste, and engaging suppliers in responsible practices represent tangible employee contributions that can be assessed against organisational sustainability objectives. The strong association between SOEP

and SSCP supports prioritising these operational behaviours, although the cross-sectional evidence does not establish their causal effects. At the theoretical level, the study makes two principal contributions to SSCM scholarship. First, it extends the analysis of supply chain sustainability beyond organisational and interorganisational perspectives by highlighting employee-level mechanisms through which SOOC is associated with supply chain outcomes. In doing so, it identifies SOEL and SOEP as potentially important micro-level components of broader sustainability processes.

Second, the findings provide empirical support for a sequential knowledge-to-behaviour explanation rather than a predominantly direct culture-to-performance relationship. Within this interpretation, organisational cultural conditions are associated initially with employee knowledge, which is subsequently linked to sustainability-related workplace behaviour and broader supply chain outcomes. Such a perspective may help explain differences across previous studies, suggesting that associations between organisational culture and firm-level performance reported by Eccles et al. (2014) and Ortiz-de-Mandojana and Bansal (2015) could partly reflect underlying variations in employee capabilities and motivation.

LIMITATIONS AND SCOPE FOR FUTURE RESEARCH

Despite its contributions, the present investigation is subject to several limitations that should be considered when interpreting the findings and identifying opportunities for further research. First, the empirical sample was restricted to employees and managers within the automotive industry of Sichuan Province, China. Consequently, the applicability of the findings to other industrial sectors, geographical settings, and organisational environments remains uncertain. Second, the research employed a cross-sectional design based on self-reported questionnaire responses, introducing potential exposure to CMB and self-reporting biases. The simultaneous measurement of the constructs also limits the extent to which the observed associations can substantiate causal direction or establish temporal relationships among the proposed mechanisms. Third, the measurement model did not fully satisfy the discriminant validity requirements indicated by the Fornell–Larcker criterion and HTMT assessment. Accordingly, the particularly strong structural pathway connecting SOEP and SSCP should be interpreted cautiously because the two constructs exhibited substantial empirical overlap.

Future investigations should extend the analysis to additional industries and geographical regions to assess the generalisability of the proposed relationships. Longitudinal research designs and multisource data collection strategies would also provide stronger opportunities to investigate temporal ordering and evaluate the direction of the hypothesised relationships. Further refinement of the measurement instruments for SOEP and SSCP is necessary to establish clearer conceptual distinctions and reduce potential overlap between their indicators. Combining employee-reported assessments with independently recorded supply chain performance measures, including emissions, energy consumption, supplier audit evaluations, and occupational safety outcomes, could reduce dependence on perceptual information and strengthen the robustness of subsequent conclusions. Additional research could incorporate moderating factors, such as organisational size, senior management support, and digital technology adoption, to clarify the conditions under which the proposed relationships become stronger or weaker. Moreover, qualitative and mixed-methods approaches could provide deeper insights into how employees interpret organisational sustainability values, translate these values into workplace practices, and experience the organisational conditions that may explain the absence of a significant direct relationship between SOOC and SOEP in the present setting.

CONCLUSION

The findings identify employee-related capabilities and behaviours as central mechanisms connecting SOOC with SSCP in the automotive industry of Sichuan Province, China. Rather than demonstrating a statistically significant direct association between SOOC and SSCP, the analysis indicates that this relationship operates predominantly through indirect pathways involving SOEL and SOEP. Specifically, SOOC exhibits a strong positive relationship with SOEL, which is subsequently associated with SOEP, while SOEP demonstrates the strongest direct relationship with SSCP. Although the estimated direct effects of SOOC on SOEP and SSCP were comparatively small, neither relationship attained statistical significance. The results therefore suggest that organisational sustainability commitments are more closely associated with measurable supply chain outcomes when accompanied by the development of employee knowledge and its translation into practical sustainability-related behaviour. For automotive manufacturers seeking to strengthen SSCP, these findings highlight the importance of establishing a supportive organisational environment and adopting a phased development strategy that integrates cultural commitment, employee learning, and performance-oriented implementation. Ultimately, the proposed framework positions SOOC as the strategic foundation, SOEL as the capability-building mechanism, and SOEP as the operational pathway most closely associated with improved SSCP.

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