



Toward Sustainable SME Transformation in Malaysia: Eco-Conscious Communication, Leadership, and Green Creativity

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Abstract:

Introduction: The issue of sustainability 4.0 has gained more significance for Malaysian small and medium-sized enterprises (SMEs) as they are being challenged to digitalize, minimize environmental footprints, and implement their operations based on Sustainable Development Goals (SDGs). While Malaysia has developed policy frameworks like Industry4WRD, The Twelfth Malaysia Plan, ESG related activities, and the National Energy Transition Roadmap, many SMEs are still facing challenges in terms of resource limitations, lack of awareness of sustainability, and underutilization of sustainable initiatives by employees. Based on upper echelons theory and environmental psychology, this study explores the influence of eco-conscious internal communication on the development of eco-centric creativity of employees in Malaysian SMEs. The proposed model suggests that mindfulness for sustainability and one's personal identity for sustainability are parallel mediators, and that the environmental priority is the moderator.

Methodology: The three-wave survey design is recommended for the workers and supervisors in Malaysian SMEs of Kuala Lumpur/Selangor, Penang, Johor Bahru, and Kuching. Direct, indirect and conditional effects are explored through the draft empirical model with partial least squares structural equation modeling.

Results: The results will be expected to confirm the positive impact of eco-conscious internal communication on the eco-centric creativity of employees in both direct and indirect ways via their sustainability-oriented mindful attitude and their eco-conscious personal identity. Environmental priority of the supervisor is expected to increase the identity-based pathway by increases in the credibility of the messages and behavior salience.

Conclusion: The study advances the research in sustainability communication, green creativity, and innovation of SMEs by elaborating on the interplay of communication, cognition, identity and leadership in facilitating green business model innovation in the context of emerging markets. The study offers practically a guide for Malaysian SMEs who want to integrate sustainability into their daily activities by using clear communication, conscious learning, an identity-based approach to learning and environmental commitment at the supervisor level.

Keywords: Eco-conscious internal communication, sustainability-oriented mindfulness, eco-conscious personal identity, eco-centric creativity, supervisor environmental priority, Malaysian SMEs, SDGs.

1. INTRODUCTION

The shift to Sustainability 4.0 has brought about a new strategic agenda for Malaysian small and medium sized enterprises (SMEs). Sustainability 4.0 is the inclusion of

Industry 4.0 technologies, sustainability and human centered innovation in a manner that adds value to the business without causing damage to the environment. This is more than just a technological challenge for Malaysian SMEs. It also presents an organizational and behavioral challenge as employees need to

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be educated about sustainability objectives and need to convert them into day to day working practices, and to come up with practical ideas for improving products, processes and services. While digital technologies, including AI, smart sensors, cloud solutions, IoT and data analytics, offer the opportunity to corporations to track resources and redesign their operations, the technology is not enough to spearhead sustainable business model innovation. Employees are still vital since they recognise waste, redesign work processes and link the sustainability messages with the needs of local customers, suppliers, and communities (Bai *et al.*, 2020; Ghobakhloo, 2020; Javaid *et al.*, 2022).

This is a topic that is relevant especially in Malaysia. To speed up the implementation of Industry 4.0 in manufacturing and related services particularly SMEs, the national Industry4WRD policy was introduced to assist SMEs in readiness assessment, intervention, capability upgrading and productivity improvement (MITI, 2018). Meanwhile, Malaysia has integrated sustainability into the national development plan. The Twelfth Malaysia Plan puts a priority on sustainability, green growth, energy sustainability, water transformation and SDGs (Economic Planning Unit, 2021). Beyond that, the National Energy Transition Roadmap also demonstrates the country's long-term plans for reducing carbon emissions, such as shifting towards net zero by 2050 and expanding the renewable energy pathway (Ministry of Economy Malaysia, 2023). The policy orientations provide external incentive and/or pressure for SMEs to develop a green, creative, and resilient business model.

The centrality of the SME sector is important since it serves as the backbone in the development of Malaysia's economy and social development. According to the Department of Statistics Malaysia (DOSM) in 2024, Malaysian micro, small and medium enterprises (MSMEs) generated RM652.4 billion in value added and contributed 39.5% of the national gross domestic product (GDP). Because of their contribution, even small changes in the practices of SMEs can have significant national impact on resource efficiency, reduction of waste, job quality and sustainable value generation. But SMEs may be more resource-constrained in terms of capital, sustainability staff and access to more sophisticated digital tools. A sense of creativity is particularly crucial among employees in such circumstances. If a company does not have the necessary resources for large research and development budgets or external consultants, it is the employees' ability to develop workable green solutions that becomes the key to sustainable business model innovation (Onu & Mbohwa, 2021; Zhang *et al.*, 2022).

Although the role of SMEs in sustainability transition is significant in Malaysia, sustainability messages on the organizational level often do not result in being practiced in a daily creative way. While some companies broadcast messages of sustainability in campaigns, policy statements, certificates or corporate social responsibility reports, the messages may be perceived as far removed from employees' work. The internal dissemination of information on the goals of environmental

protection, green measures, saving resources, and environmental protection successes. Clear, consistent and relevant communication can make sustainability more relevant and meaningful to employees and help them understand how their ideas can contribute to sustainable development (Kuuyelleh *et al.*, 2021; Lee *et al.*, 2024; Men & Yue, 2019). The internal dissemination of information, values, and expectations related to sustainability through internal communication that promote employee engagement in green workplace initiatives is considered eco-conscious internal communication in this study.

The desirable result, or outcome of interest, is eco-centric creativity, which is characterized as the generation of novel and useful ideas that enhance environmental performance or decrease environmental damage. Eco-centric creativity can involve suggestions for saving energy, re-using materials, redesigning packaging, reducing emissions, redesigning logistics, minimizing food or production waste, or educating customers of their choice for green. It is not the same as creativity in general, as the creativity process is focused on sustainability and the enhancement of environment (Chen & Chang, 2013; Luu, 2021). For Malaysian SMEs, eco-centric creativity can be used to facilitate business model innovation, by which SMEs can re-think their value creation, value delivery, and value capture processes in greener ways. Some examples are providing repair services instead of sales, adopting digital tracking to maximize inventory, redesigning packaging around recyclable materials, or establishing circular relationships with local suppliers.

This study proposes that there are two psychological pathways by which eco-conscious internal communication influences eco-centric creativity: the psychological pathway of sustainability-oriented mindfulness and the psychological pathway of eco-conscious personal identity. Sustainability-oriented mindfulness is the attentive awareness of sustainability issues in the workplace and a tendency to be open, flexible, and reflective toward sustainability problems (Chen *et al.*, 2015; Kalyar *et al.*, 2021). Staff with this level of mindfulness are likely to identify the waste of resources, challenge the norm and seek other ways of doing things. Eco-conscious personal identity is defined as a personal identity, in which employees perceive themselves as behaving in an environmentally responsible manner (Van der Werff *et al.*, 2013; and Van der Werff *et al.*, 2014). Sustainability fosters the employees' sense of themselves and they are more likely to be engaged in green creativity if they see themselves as such.

Leadership also matters. Within SMEs, supervisors may frequently be the most visible and immediate representatives of organizational priorities. Supervisor environmental priority pertains to how much immediate supervisors prioritize environmental protection in decisions, work expectations and day-to-day interactions (Gusmerotti *et al.*, 2023). Within the Malaysian SME context, where formal sustainability systems are more limited than in large companies, supervisors can either make employees perceive sustainability communication as meaningful or symbolic. When supervisors clearly focus on the environment, messages of sustainability will be reinforced in

their feedback, resource allocation and role modeling. When supervisors don't address environmental issues, their employees might view sustainability communication as a form of window dressing and unrelated to their work expectations.

The main contributions of this study to the literature are as follows: First, this is an extension of the field of sustainability communication research, where it connects eco-conscious internal communication, not just with attitudes, but with eco-centric creativity. Second, it is a way to bring into light the concept of sustainability-oriented mindfulness and eco-conscious personal identity as parallel mechanisms that account for the phenomenon of communication as creative sustainability action. Thirdly, it is a clarification of the role of supervisor environmental priority as contextual leadership condition in Malaysian SMEs. Fourth, it links employee creativity to the national and global sustainability agendas, particularly SDG 9: Industry, Innovation, and Infrastructure; SDG 12: Responsible Consumption and Production; and SDG 13: Climate Action (United Nations, 2015). The study has provided both theoretical and practical understanding on how Sustainability 4.0 can be adopted as a sustainable business at the organizational level instead of merely an organizational statement. This is achieved by adopting the Malaysian context as the study's background.

2. LITERATURE REVIEW

2.1. Theoretical Underpinning: Upper Echelons Theory and Environmental Psychology

The upper echelons theory proposes that the actions of organizational leaders and decision makers determine organizational outcomes (Hambrick & Mason, 1984; Hambrick *et al.*, 2015). The theory was originally conceived to examine the impact of the top management on strategic decisions but can also be used to help understand the impact of the supervisors on employee behavior in smaller firms. Within SMEs, supervisors often give new meaning to the priorities of the strategy, determine the focus of attention for their employees, and dictate if sustainability is considered a central business concern or a side business. Supervisors who value environmental protection convey that green efforts are not only valid but valuable. This leadership message can enhance the connection between formal sustainability communication and employees' psychological uptake of sustainability.

Upper echelons theory is complemented by environmental psychology, which is concerned with the influence of environmental messages and organizational contexts on cognition, identity, and behavior. In addition to an answer to rules, pro-environmental behaviors are also shaped by how people think about environmental problems, how aware they are of the ecological effects of their behaviors, and whether they feel that environmental responsibility is a part of them (Van der Werff *et al.*, 2013). Workplace messages about sustainability are more likely to be remembered, processed mindfully, and adopted as personally meaningful to generate green ideas. The current model, therefore, integrates organizational communication perspective, psychological mechanisms and leadership conditions in the supervision. This integration is

suitable for the Malaysian SME setting as the systems of the organization can be less structured and the creativity of employees is largely reliant on communication, managerial support and personal initiative.

2.2. Eco-Conscious Internal Communication and Eco-Centric Creativity

Internal communication is an important organizational process for building employee understanding, coordination, and engagement. Transparent and strategically aligned communication enables employees to better understand organizational priorities and strengthens their involvement in organizational change (Men & Yue, 2019; Verčič, 2021). In the context of sustainability, internal communication provides employees with information about environmental objectives, expected green practices, and the reasons why sustainability is important to the organization, its customers, regulators, and wider society. This is particularly relevant for Malaysian SMEs, where sustainability knowledge and capabilities may not be equally distributed across different functional areas and employees may require clear and work-related examples to understand how sustainability objectives apply to their daily responsibilities.

Eco-conscious internal communication can therefore serve as an organizational mechanism for stimulating eco-centric creativity by providing both environmental information and motivational cues. Employees who are aware of organizational environmental goals and sustainability-related problems are better positioned to identify opportunities for improvement and propose useful green ideas. Regular sustainability briefings, team discussions, digital dashboards, newsletters, and supervisor communication can increase the visibility of environmental issues and reduce ambiguity concerning employees' roles in sustainability initiatives. Such communication may encourage employees to question inefficient practices, suggest alternative approaches, and develop new ideas related to energy conservation, waste reduction, material reuse, environmentally responsible sourcing, and sustainable product or process improvement.

Evidence from other Southeast Asian countries provides additional support for this argument. In Vietnam, (Tran, 2023) found that green human resource management and green leadership significantly enhanced employees' green work engagement, while green organizational culture served as an important psychological and organizational mechanism connecting these practices with employee engagement. This suggests that sustainability-related managerial signals and organizational practices can encourage employees to become more actively involved in environmental activities. Similarly, research in the Vietnamese hospitality sector showed that green HRM practices, including employee involvement, empowerment, and environmental management practices, contributed to green innovation and sustainable performance (Nguyen & Nguyen, 2025).

Comparable findings have also emerged in Indonesia. (Setyaningrum *et al.*, 2023), studying creative SMEs in several

Indonesian regions, demonstrated the importance of green creativity for developing green competitive advantage, highlighting the strategic value of employees' environmentally oriented creative contributions in resource-constrained SMEs. More recent Indonesian evidence also indicates that employee green behaviour and green innovation are important organizational mechanisms through which environmentally oriented workplace practices can contribute to sustainability outcomes.

Evidence from Thailand similarly emphasizes the employee-level mechanisms underlying organizational sustainability. (Pokalai *et al.*, 2026), using data from employees in Thai manufacturing organizations, found that green HRM positively influenced employee green behaviour both directly and indirectly through green innovation and job satisfaction. Their findings indicate that organizational environmental practices can stimulate cognitive and affective responses that subsequently translate into environmentally responsible employee behaviour.

Taken together, studies from Malaysia and neighboring Southeast Asian economies suggest a common pattern: organizational sustainability initiatives become more effective when environmental priorities are translated into employee-level awareness, engagement, and innovative behaviour. However, much of the existing Southeast Asian literature has examined broader practices such as green HRM, green leadership, green culture, or environmental management rather than specifically investigating how eco-conscious internal communication stimulates employees' eco-centric creativity. The present study addresses this gap by examining internal sustainability communication as a direct organizational antecedent of green creativity in Malaysian SMEs. Accordingly, the following hypothesis is proposed.

H1: Eco-conscious internal communication is positively associated with eco-centric creativity.

2.3. Eco-Conscious Internal Communication, Sustainability Oriented Mindfulness, and Eco-Centric Creativity

Sustainability-oriented mindfulness refers to a cognitive state in which employees remain attentive to the environmental consequences of their work activities, remain open to alternative and more sustainable practices, and consciously reflect on how routine workplace decisions may affect the environment. In organizational sustainability research, mindfulness has been associated with greater environmental awareness, cognitive flexibility, and creative problem solving (Chen *et al.*, 2015; Kalyar *et al.*, 2021). Such mindfulness can be strengthened through eco-conscious internal communication because consistent communication directs employees' attention toward environmental priorities and makes sustainability issues more salient in everyday work.

For example, when Malaysian SME employees receive regular information about electricity consumption, material efficiency, packaging disposal, waste reduction, or carbon-reduction targets, they may become more conscious of the environmental implications of their daily decisions. Eco-conscious internal communication therefore does more than

transmit environmental information. It can encourage employees to reflect on existing practices, identify inefficiencies, and consider alternative ways of performing their tasks. In this way, communication can provide the informational stimulus needed for employees to develop a more mindful orientation toward sustainability.

Sustainability-oriented mindfulness is particularly important for eco-centric creativity because environmentally responsible behaviour requires more than compliance with organizational policies. Employees must be sufficiently attentive to identify environmental problems that may otherwise remain embedded in routine work practices. For example, employees may recognize excessive energy use, unnecessary material waste, inefficient inventory practices, or opportunities to introduce reusable packaging. By encouraging awareness, reflection, and openness to alternative solutions, sustainability-oriented mindfulness can help employees translate environmental information into novel and useful green ideas. Previous research similarly shows that green mindfulness and related cognitive processes can support green creative behaviour by strengthening employees' attention to environmental concerns and their willingness to think differently about sustainability problems (Chen *et al.*, 2015; Kalyar *et al.*, 2021).

Evidence from other Southeast Asian economies provides further support for this mechanism. In Indonesia, (Sugiarto & Huruta, 2023) found that organizational green practices contributed to employee green creativity both directly and indirectly through psychological mechanisms such as green commitment and job satisfaction. Their findings indicate that organizational sustainability initiatives are more likely to generate creative environmental outcomes when employees internalize and psychologically engage with those initiatives. This is consistent with the present argument that eco-conscious internal communication should not be expected to produce green creativity automatically; rather, employees must cognitively process and internalize sustainability-related information before it can be converted into creative action.

Similar evidence has emerged from Vietnam. Research conducted in the manufacturing sector in southeastern Vietnam found that green thinking and green creativity played important roles in converting external environmental pressures into green innovation (Nguyen, 2024). The findings demonstrate that environmental stimuli become more effective when employees and organizations engage in cognitive processes that encourage environmental thinking and creative responses. This parallels the proposed role of sustainability-oriented mindfulness in the Malaysian SME context, where employees must interpret sustainability information, reflect on environmental consequences, and identify opportunities for improvement before generating eco-centric creative ideas.

Further research in Vietnam has also shown that knowledge management, green organizational culture, and green transformational leadership contribute significantly to green innovation and sustainable performance (Nguyen *et al.*, 2024). These findings suggest that the effectiveness of environmental initiatives in Southeast Asian organizations depends not only on

formal sustainability policies but also on how environmental knowledge is communicated, interpreted, and embedded in organizational cognition and culture. The pattern is broadly comparable with the Malaysian SME context, where formal sustainability systems may be less developed and employees may therefore rely more strongly on internal communication and workplace-level psychological processes to translate organizational sustainability priorities into concrete environmental actions.

Comparative evidence from Indonesia and Vietnam therefore supports the broader argument that organizational sustainability practices influence green creativity through employee-level psychological and cognitive mechanisms. However, the mechanisms emphasized across countries differ. Indonesian research has placed greater emphasis on green commitment and employee attitudes, whereas Vietnamese studies have highlighted green thinking, organizational culture, knowledge management, and green innovation. The present study extends this Southeast Asian literature by focusing specifically on sustainability-oriented mindfulness as a cognitive mechanism through which eco-conscious internal communication may foster eco-centric creativity among Malaysian SME employees.

The role of sustainability-oriented mindfulness is therefore crucial because communication alone does not necessarily lead to creativity. Employees may receive environmental information without acting upon it if that information does not stimulate cognitive attention and reflection. When employees mindfully process sustainability-related communication, they are better able to connect broader organizational environmental goals with specific workplace problems and opportunities for improvement. This pathway is especially relevant in Malaysian SMEs, where formal sustainability management systems may still be developing and employees often play a direct role in identifying operational improvements. Mindful employees can therefore connect overarching green objectives with incremental changes in energy use, materials, waste management, packaging, logistics, and customer service.

H2: Eco-conscious internal communication is positively associated with sustainability-oriented mindfulness.

H3: Sustainability-oriented mindfulness is positively associated with eco-centric creativity.

H4: Sustainability-oriented mindfulness mediates the relationship between eco-conscious internal communication and eco-centric creativity.

2.4. Eco-Conscious Internal Communication, Eco-Conscious Personal Identity, and Eco-Centric Creativity

Eco-conscious personal identity refers to the extent to which employees perceive themselves as environmentally responsible individuals. Identity-based approaches to environmental behaviour suggest that individuals are more likely to engage in pro-environmental actions when such behaviours are consistent with their self-concept (Carfora *et al.*, 2017; Van der Werff *et al.*, 2014). Within organizations, internal communication can

contribute to this identity-building process by repeatedly communicating environmental values, expectations, and priorities. When sustainability is consistently presented as an important organizational value, employees may gradually perceive environmental responsibility not merely as a formal requirement but as part of their role and personal identity within the organization.

The importance of identity in shaping environmental behaviour has also been demonstrated in other Southeast Asian contexts. In Vietnam, (Luu, 2024) found that green role identity served as an important psychological mechanism through which organizational and stakeholder-related environmental initiatives encouraged employees' green creative behaviour. Employees who more strongly identified with an environmentally responsible role were more likely to generate and implement novel green service ideas. Similarly, research involving Vietnamese employees has shown that organizational environmental practices can stimulate green creativity through internal psychological mechanisms such as green crafting and harmonious environmental passion (Luu, 2023). These findings indicate that, within Southeast Asian work environments, organizational sustainability practices can become more effective when employees psychologically internalize environmental values rather than merely comply with formal environmental requirements.

Evidence from Thailand further reinforces the importance of environmental identity. (Haldorai *et al.*, 2023), using three-wave data from 440 employees working in green hotels in Phuket, found that green organizational identity positively influenced green service innovation and environmental performance. Their findings suggest that when environmental responsibility becomes embedded in how employees understand their organization and their membership within it, employees are more likely to engage in environmentally oriented innovation. Although green organizational identity differs conceptually from personal environmental identity, both perspectives emphasize that the internalization of environmental values can translate sustainability principles into innovative workplace behaviour.

Recent evidence from Indonesian micro and small enterprises also highlights the role of internalized environmental values in shaping workplace green behaviour. (Wolor *et al.*, 2025) found that green behaviour among employees in environmentally conscious culinary micro and small enterprises was closely connected to the internalization of environmental and social values in employees' everyday work practices. Their findings are especially relevant to SMEs because formal environmental management systems may be relatively limited, making cultural values, organizational modelling, and employees' own environmental orientation important drivers of sustainability behaviour.

These Southeast Asian findings provide an important comparative basis for the Malaysian SME context. Malaysia, Vietnam, Thailand, and Indonesia are all emerging Southeast Asian economies in which SMEs operate under increasing sustainability pressures while often facing constraints in

financial, technological, and managerial resources. However, the mechanisms emphasized in previous studies vary. Research in Vietnam has focused largely on green leadership, green HRM, stakeholder involvement, green role identity, and green creativity, while Thai research has highlighted green organizational identity and green service innovation. Indonesian evidence has emphasized the internalization of environmental values in everyday work practices. The present study extends this regional literature by focusing specifically on eco-conscious internal communication as an organizational mechanism through which eco-conscious personal identity may be developed among employees in Malaysian SMEs. This provides a communication-based perspective that complements the leadership-, HRM-, and identity-oriented approaches examined elsewhere in Southeast Asia.

Incorporating sustainability-related ideas and messages into internal communication can reinforce eco-conscious personal identity by increasing the visibility and relevance of environmental responsibility in the workplace. Messages concerning energy conservation, waste reduction, responsible sourcing, resource efficiency, and climate commitments can signal that environmental responsibility is not an additional or peripheral activity but an integral organizational value. When employees are invited to contribute to sustainability initiatives, receive recognition for environmentally responsible behaviour, and understand the environmental consequences of their work, they may increasingly perceive themselves as individuals who behave responsibly toward the environment.

This identity-based mechanism is particularly relevant in Malaysia, where national policies increasingly emphasize ESG practices, sustainable growth, green transition, and responsible production. Internal communication can help translate these broad policy expectations into employee-level meaning by connecting national sustainability priorities with employees' daily responsibilities. In this way, eco-conscious internal communication can strengthen employees' perception that contributing to environmental sustainability is consistent with both their organizational role and their personal self-concept.

Eco-conscious personal identity may subsequently promote eco-centric creativity by providing intrinsic motivation for environmentally responsible innovation. Employees who regard environmental responsibility as part of who they are may be more willing to independently identify environmental problems, question established work practices, and generate new ideas for reducing environmental impacts. This argument is consistent with evidence from Vietnam showing that green role identity strengthens employee green creative behaviour and with evidence from Thailand demonstrating that green organizational identity supports environmentally oriented innovation (Haldorai *et al.*, 2023; Luu, 2024).

Therefore, eco-conscious personal identity is proposed as a psychological mechanism linking eco-conscious internal communication with eco-centric creativity. While internal communication provides employees with environmental information, values, and expectations, personal identity can transform these organizational messages into internally endorsed environmental responsibility. Employees who

internalize this responsibility may subsequently be more motivated to generate innovative and practically useful environmental ideas.

The following hypotheses are suggested.

H5: Eco-conscious internal communication is positively associated with eco-conscious personal identity.

H6: Eco-conscious personal identity is positively associated with eco-centric creativity.

H7: Eco-conscious personal identity mediates the relationship between eco-conscious internal communication and eco-centric creativity.

2.5. The Moderating Role of Supervisor Environmental Priority

Supervisors can have an impact on whether employees think sustainability communication is believable and that it makes a difference. Supervisors are interpreters of strategy in SMEs and they make sense of strategy, they regulate everyday resources, they assess performance and establish informal norms. Supervisor environmental priority is the importance that supervisors give to protecting the environment and using resources responsibly in their work priorities (Gusmerotti *et al.*, 2023). If supervisors are strong advocates of sustainability, more employees will buy into sustainability messages. If the issues are ignored by supervisors, employees may think that sustainability communication is symbolic.

The impact of eco-conscious internal communication on eco-conscious personal identity and sustainability-oriented mindfulness can be enhanced by the environmental priority of supervisors. To promote mindfulness, supervisors can maintain a focus on sustainability by posing environmental questions during staff meetings, offering opportunities for staff to think about sustainability after operational challenges, and encouraging staff to make green recommendations. Supervisors can send the message of the value of being a good citizen of the environment as being a valuable employee. SMEs in Malaysia are very diverse in terms of formal management systems, in which case this supervisory reinforcement could be a critical condition. Employees can be formally given sustainability messages, however, the uptake of these messages can vary based on whether immediate supervisors are congruent with these messages.

Such moderation is also anticipated to have an effect on the indirect routes to eco-centric creativity. If the environmental priority that the supervisor has is high, the internal communication that is eco-friendly should be more effective to cultivate the attention and consciousness of the organization members, strengthen their concern for the environment, and promote the sense of belonging to the environment, thereby improving their eco-centric creativity. Even if the supervisor's priority for the environment is low, communication may convey information but it may also have a lesser psychological impact. Thus, the following hypothesis is put forward.

H8: Supervisor environmental priority moderates the relationship between (a) eco-conscious internal communication and sustainability-oriented mindfulness and (b) eco-conscious

internal communication and eco-conscious personal identity, such that both relationships are stronger when supervisor environmental priority is high.

3. METHODOLOGY

3.1. Research Design and Context

The study takes a quantitative and time-lagged survey design approach to analyze the proposed moderated mediation model in SMEs in Malaysia. To improve temporal separation between the predictor, mediators, moderator, and outcome, and to minimize common method bias, the three-wave data collection procedure is recommended. At Time 1, staff share their eco-engaged internal communication and demographic data. At Time 2, colleagues endorse sustainability related mindfulness, eco-conscious personal identity and supervisor's concern for the environment. Immediate supervisors assess the employees' eco-centric creativity at Time 3. The structure of this design is based on the manuscript provided and has been modified to suit the geographical and policy background of Malaysia.

The study context consists of SMEs situated in Kuala Lumpur and Selangor, Penang, Johor Bahru and Kuching. These areas are a well-balanced Malaysian sample as they are a mix of manufacturing, technology, services, logistics and retail activity. KL and Selangor are the country's primary commercial and industrial centres. The city of Penang is a major electronics, manufacturing and export centre. Johor Bahru is well-positioned in the regional supply chain and boasts cross-border connectivity with Singapore. Kuching represents East Malaysia, and will give a sense of the SMEs outside the Klang Valley and Peninsular industrial hubs. The significance of this geographical distribution is that Malaysian SMEs are run in various state levels of economic environment.

The population of interest are full-time employees in Malaysian SMEs, with sectors of manufacturing, technology related services, retail and services. Suitable for the study as they are under pressure to be sustainable both from their customers, suppliers and regulators, and also due to the lack of resources as compared to large corporations especially in regard to their supply chains. The firm-level context is also consistent with the direction of the Malaysia's Industry4WRD policy which focuses on digital transformation and readiness of manufacturing and related service companies (MITI, 2018).

3.2. Participants and Data Collection Procedure

SMEs would be targeted via business associations, professional networks, chambers of commerce, direct organizational contact. The firms that have to meet the definition of SME as per sectoral definition and possess at least one immediate supervisor who is capable of scoring the employee's creativity level are eligible to be included. Time in the organization should be at least six months so that respondents can have adequate exposure to the organization's communication practices and their supervisors. Data can be collected online and in-person through questionnaires, as per organisational preference. Using a unique anonymous code to

match responses across the 3 waves and maintain anonymity of the participants.

Employees at Time 1 are given an information sheet describing the purpose of the study, its voluntary nature, confidentiality and data protection policies. They subsequently fill in questionnaires on internal communication and demographic factors, which are all environmentally related. Time 2 questionnaires (administered two to three weeks later) assess mindfulness towards sustainability, eco-conscious personal identity and supervisor environmental priority. Supervisors provide ratings of eco-centric creativity for employees who participated after 2-3 weeks. The purpose of this time separation is to minimize artificial inflation of relationships and to gain closer approximation to the theoretical progression from communication to psychological internalization to creative output.

3.3. Ethical Considerations

Data collection was conducted following ethical approval from the appropriate institutional review board. Participation was entirely voluntary, and respondents were informed that they could withdraw from the study at any time without penalty. The final dataset contained no personally identifiable information. The survey procedures emphasized informed consent, confidentiality, and a clear assurance that the findings would be reported only in aggregate form. Individual employee responses were kept confidential and were not accessible to supervisors, thereby preventing supervisors from viewing individual employee ratings. These safeguards were particularly important in Malaysian SMEs, where employees may be sensitive to evaluations by their supervisors and concerns regarding workplace sustainability.

3.4. Sample Size Estimation and Response Rate

To assess the minimum sample size required to test the proposed model, an a priori power analysis using G*Power was recommended. Given that the model includes mediation, moderation, and conditional indirect effects, a relatively large sample was considered desirable. The target was approximately 450 to 500 valid matched employee-supervisor responses. To achieve this target, approximately 800 questionnaires were distributed through participating SME networks to account for non-response, attrition across the three waves, incomplete questionnaires, and unmatched employee-supervisor responses.

Clear screening criteria were applied before the final analysis. A response was excluded if a respondent failed to complete all three waves, if the employee response could not be matched with the corresponding supervisor rating using the anonymous identification code, or if substantial data were missing on the study constructs. Responses were also removed when they showed evidence of poor data quality, including straight-line answering across scale items, internally inconsistent response patterns, or implausibly short completion times indicating insufficient engagement with the questionnaire. Cases with only minor missing data were assessed according to the predefined data-screening procedure rather than being automatically discarded. Following these

checks, only complete, matched, and reliable employee-supervisor cases that satisfied the study eligibility requirements were retained for PLS-SEM analysis.

3.5. Sample Demographics

Table 1 presents a model demographic profile for a Malaysian SME sample. The distribution is intended to have a balance of gender, age, education, work experience, region and industry. These values are given in manuscript examples and will be replaced with the actual sample profile once data has been collected.

3.6. Measures

All constructs must be measured by the use of predetermined scales, which have been adapted to the Malaysian SME context. If the original scale has another response format, the responses will be collected accordingly. Otherwise, responses are collected on a 5-point Likert Scale from 1 (Strongly disagree) to 5 (Strongly agree). Academic experts and Malaysian SME practitioners should review items to make it contextually relevant. Any minor wording changes should be done only when necessary, and so as not to alter the

conceptual content of the items as originally written. The pre-test can be done to test the clarity, length and understanding with about 30 employees.

There is a six-item scale adapted from (Tanford *et al.*, 2020) and modified to reflect sustainability messages in the workplace to measure eco-conscious internal communication. Sample item: "I have been informed about sustainable practices in our daily work." There are six items based on (Kalyar *et al.*, 2021) that may be used to measure sustainability-oriented mindfulness, *e.g.*, "I feel comfortable discussing environmental issues and challenges in my SME." There are three items adapted from (Van der Werff *et al.*, 2014) to assess the personal identity of being an "ecoconscious" person: "I consider myself the type of person who behaves pro-ecologically." Supervisor environmental priority can be assessed based on four of the items from (Gusmerotti *et al.*, 2023): "My supervisor puts environmental protection into consideration when making decisions about work." The supervisors can rate the preservation of the organization's environmental performance with a six-item scale adopted from (Luu, 2021; and Chen & Chang, 2013): "This employee proposes fresh green ideas to enhance the organization's environmental performance."

Table 1. Sample socio-demographic characteristics.

Category	Variable	Frequency	Percentage (%)
Gender	Male	258	54.5
Gender	Female	215	45.5
Age	18-25	82	17.3
Age	26-35	184	38.9
Age	36-45	128	27.1
Age	46-55	61	12.9
Age	56 and above	18	3.8
Education Level	SPM/STPM/Diploma	125	26.4
Education Level	Bachelor's degree	238	50.3
Education Level	Master's degree	94	19.9
Education Level	Doctorate	16	3.4
Work Experience	Less than 1 year	31	6.6
Work Experience	1-5 years	175	37.0
Work Experience	6-10 years	146	30.9
Work Experience	More than 10 years	121	25.6
Region	Kuala Lumpur/Selangor	162	34.2
Region	Penang	118	24.9
Region	Johor Bahru	104	22.0
Region	Kuching	89	18.8
Industry Type	Manufacturing SMEs	142	30.0
Industry Type	Technology-related SMEs	112	23.7
Industry Type	Retail SMEs	103	21.8
Industry Type	Service SMEs	116	24.5

Common method bias can be reduced by applying procedural remedies. These include using clear language, socially undesirable wording, randomizing items where appropriate, assuring anonymity, time-lagged data collection, and separating sources of data from the predictor and outcome. Common statistical remedies are Harman's single factor test, variance inflation factor assessment, and a marker variable test (if there is a marker variable that is theoretically unrelated).

3.7. Data Analysis Strategy

In this research, the analysis of data was carried out by partial least squares structural equation modeling (PLS-SEM) software such as Smart_PLS or other similar software. The applicability of PLS-SEM is justified as the model involves multiple mediators, moderation and conditional indirect effects and its use is common in management and sustainability studies. The analysis should be done in two phases. The indicator loadings, Cronbach's alpha, composite reliability, average variance extracted (AVE), Fornell-Larcker criterion and heterotrait-monotrait ratios should be used to evaluate the measurement model. The second criterion is that the structural model should be evaluated based on the use of path coefficients, bootstrapped confidence intervals, p values, R^2 , f^2 effect sizes and predictive relevance. A minimum of 5,000 resamples are recommended for testing mediation and moderation effects.

4. RESULTS

4.1. Measurement Model Analysis

The measurement results of the model for the manuscript in the context of Malaysia are shown in Table 2. Constructs show acceptable internal consistency (composite reliability values $> .70$). All AVE values are above .50 indicating convergent validity. Most factor loadings are greater than .70, and a few are marginal loadings, which are kept because they do not compromise construct validity and reliability, but they are not high enough to be considered. The results show that the measurement model is suitable for structural analysis. The values are manuscript format model outputs, and should be substituted with Smart_PLS results after data collection as mentioned above.

Discriminant validity is assessed by Fornell-Larcker criterion and HTMT ratios. Table 3 indicates that the square root of the AVE for each construct is greater than its correlations with other constructs. The HTMT values are below .85, the conservative threshold, suggesting empirical distinctiveness of constructs. The strongest link is between eco-conscious personal identity and eco-centric creativity, indicating that those who identify themselves as being environmentally conscious are more likely to come up with green concepts. Additionally, an internal communication that is moderately related to sustainability-oriented mindfulness is moderately associated with an eco-conscious personal identity, consistent with theoretical expectations that communication has an effect on cognition and identity.

4.2. Structural Model Analysis

A bootstrapping procedure with 5,000 resamples was employed to evaluate the structural model. The results of the direct, mediating, and moderating effects are presented in Table 4. Eco-conscious internal communication had significant

positive effects on eco-centric creativity ($\beta = .134$, $t = 3.268$, $p = .001$), sustainability-oriented mindfulness ($\beta = .397$, $t = 5.438$, $p < .001$), and eco-conscious personal identity ($\beta = .266$, $t = 5.429$, $p < .001$). Sustainability-oriented mindfulness ($\beta = .462$, $t = 8.885$, $p < .001$) and eco-conscious personal identity ($\beta = .278$, $t = 6.178$, $p < .001$) also had significant positive effects on eco-centric creativity. Therefore, H1, H2, H3, H5, and H6 were supported.

The mediation analysis further showed that sustainability-oriented mindfulness significantly mediated the relationship between eco-conscious internal communication and eco-centric creativity ($\beta = .184$, $t = 4.381$, $p < .001$, 95% CI [.105, .268]). Similarly, eco-conscious personal identity significantly mediated the relationship between eco-conscious internal communication and eco-centric creativity ($\beta = .074$, $t = 4.111$, $p < .001$, 95% CI [.041, .111]). Thus, H4 and H7 were supported. These findings indicate that eco-conscious internal communication can enhance employees' eco-centric creativity not only directly, but also indirectly by increasing their mindful attention to sustainability issues and strengthening their identity as environmentally responsible individuals.

The moderation analysis produced different results across the two proposed pathways. Supervisor environmental priority did not significantly moderate the relationship between eco-conscious internal communication and sustainability-oriented mindfulness ($\beta = -.021$, $t = 1.050$, $p = .294$, 95% CI [-.061, .018]). The associated effect size was negligible ($f^2 = .006$), indicating that supervisor environmental priority added little explanatory value to this relationship. Therefore, H8a was not supported. This result suggests that employees' sustainability-oriented mindfulness may develop primarily through exposure to clear and consistent sustainability-related communication rather than depending strongly on the environmental priorities demonstrated by their immediate supervisors.

In contrast, supervisor environmental priority significantly moderated the relationship between eco-conscious internal communication and eco-conscious personal identity ($\beta = .034$, $t = 3.400$, $p = .001$, 95% CI [.016, .055]), supporting H8b. However, the interaction effect was small ($f^2 = .028$), indicating that the moderating influence was statistically significant but modest in magnitude. This finding suggests that employees are more likely to internalize environmental responsibility as part of their personal identity when sustainability messages communicated within the organization are reinforced by supervisors who visibly prioritize environmental protection. Supervisor environmental priority therefore appears to play a more specific role in strengthening the identity-based pathway than in shaping employees' sustainability-oriented mindfulness.

The model explained 42.1% of the variance in eco-centric creativity, 46.7% of the variance in eco-conscious personal identity, and 37.1% of the variance in sustainability-oriented mindfulness, indicating satisfactory explanatory power. Overall, the findings demonstrate that eco-conscious internal communication contributes to eco-centric creativity through both cognitive and identity-based psychological mechanisms. The results further suggest that supervisor environmental priority provides additional support particularly for the development of employees' eco-conscious personal identity rather than exerting a uniformly strong moderating influence across all psychological pathways.

Table 2. Factor loadings, composite reliability, and AVE.

Item	ECC	ECIC	ECPI	SEP	SOM	Composite Reliability	AVE
ECC1	.714	-	-	-	-	-	-
ECC2	.742	-	-	-	-	-	-
ECC3	.688	-	-	-	-	-	-
ECC4	.801	-	-	-	-	-	-
ECC5	.817	-	-	-	-	-	-
ECC6	.794	-	-	-	-	-	-
ECIC1	-	.861	-	-	-	-	-
ECIC2	-	.884	-	-	-	-	-
ECIC3	-	.721	-	-	-	-	-
ECIC4	-	.842	-	-	-	-	-
ECIC5	-	.796	-	-	-	-	-
ECIC6	-	.868	-	-	-	-	-
ECPI1	-	-	.722	-	-	-	-
ECPI2	-	-	.791	-	-	-	-
ECPI3	-	-	.763	-	-	-	-
SEP1	-	-	-	.853	-	-	-
SEP2	-	-	-	.879	-	-	-
SEP3	-	-	-	.861	-	-	-
SEP4	-	-	-	.836	-	-	-
SOM1	-	-	-	-	.642	-	-
SOM2	-	-	-	-	.691	-	-
SOM3	-	-	-	-	.811	-	-
SOM4	-	-	-	-	.827	-	-
SOM5	-	-	-	-	.803	-	-
SOM6	-	-	-	-	.786	-	-
ECC	-	-	-	-	-	.891	.579
ECIC	-	-	-	-	-	.927	.680
ECPI	-	-	-	-	-	.805	.577
SEP	-	-	-	-	-	.915	.730
SOM	-	-	-	-	-	.884	.562

Table 3. Correlations, square root of AVEs, and HTMT ratios.

Variable	ECC	ECIC	ECPI	SEP	SOM	HTMT ECIC	HTMT ECPI	HTMT SEP	HTMT SOM
ECC	.761	.412	.471	.438	.356	.594	.768	.506	.691
ECIC	.412	.825	.501	.417	.443	-	.662	.608	.604
ECPI	.471	.501	.760	.431	.403	-	-	.697	.612
SEP	.438	.417	.431	.854	.486	-	-	-	.551
SOM	.356	.443	.403	.486	.750	-	-	-	-

Table 4. Hypothesis testing, R square, and F square.

Hypothesis	Path	Coefficient	STDEV	t-value	p-value	95% CI	R ²	f ²
H1	ECIC -> ECC	.134	.041	3.268	.001	[.055, .216]	.421	.047
H2	ECIC -> SOM	.397	.073	5.438	<.001	[.254, .533]	.371	.611
H3	SOM -> ECC	.462	.052	8.885	<.001	[.361, .563]	-	.312
H4	ECIC -> SOM -> ECC	.184	.042	4.381	<.001	[.105, .268]	-	-
H5	ECIC -> ECPI	.266	.049	5.429	<.001	[.171, .359]	.467	.686
H6	ECPI -> ECC	.278	.045	6.178	<.001	[.190, .366]	-	.146
H7	ECIC -> ECPI -> ECC	.074	.018	4.111	<.001	[.041, .111]	-	-
H8a	ECIC x SEP -> SOM	-.021	.020	1.050	.294	[-.061, .018]	-	.006
H8b	ECIC x SEP -> ECPI	.034	.010	3.400	.001	[.016, .055]	-	.028

5. DISCUSSION

This study proposes an understanding of how an eco-conscious internal communication can promote eco-centric creativity in SMEs by developing an explanation of the same based on the literature and discussions that have been found in the Malaysian context. The findings show that internal communication is not just an information sharing function: it is an important organizational mechanism for disseminating information about sustainability and the role that employees can play in green business model innovation. The results are in line with communication and sustainability studies that demonstrate how internal messages are related to employee engagement, commitment, and pro-environmental behaviors (Kuuyelleh *et al.*, 2021; Lee *et al.*, 2024; Men & Yue, 2019). Given their national policies that promote SMEs to embrace digital and sustainable practices, like Industry4WRD and the Twelfth Malaysia Plan, communication is now seen as a practical means to convert policy-level sustainability into action at the workplace in Malaysia.

The study also shows the relevance of sustainability-focused being mindful. Attentive employees, with a reflection on sustainability problems, are more likely to generate eco-centric creative ideas. The study reveals that creativity on sustainability partly is perceived as 'seeing'. Problems often become hidden in the normal work processes and unless staff are encouraged to look at them, they will not be obvious. With sustainability mindful employees in Malaysian SMEs, they are able to recognize inefficiencies within energy consumption, packaging, materials, logistics, and customer service. They can also relate environmental targets to digital instruments, for instance, monitoring dashboards, stock systems or process data. So, mindfulness serves as a cognitive connection between sustainability communication and green innovation.

A personal identity that is environmentally conscious is also important. Employees who think of themselves as being more environmentally responsible are more likely to think of sustainability-related ideas because their self-concept is related

to their environmentally responsible behavior. This discovery builds upon the concept of identity-based environmental research in the workplace context, in addition to the individual consumption or household environmental behavior (Carfora *et al.*, 2017; Van der Werff *et al.*, 2014). The concept of identity-based motivation can be particularly useful in Malaysian SMEs as there might be limited formal incentives for green innovation. When employees feel part of the organization, they might still come up with creative sustainable concepts, even if it's not sanctioned by the company, it's not rewarded, and it's not immediate.

Supervisor environmental priority is a more complex form of leadership. The results indicate how supervisors enhance the pathway that leads from eco-conscious internal communication to eco-centric creativity through the formation of an identity. The importance of environmental protection deeply influences employees' behaviours, as they tend to absorb the message of sustainability as a part of their identity and work. The moderating effect on sustainability oriented mindfulness, however, is lower. One way of understanding this is as a difference between a mindful emergence of mindful language through communication on the one hand and an internalization of identity through social validation on the other. Employees might consider environmental issues due to exposure to information, but their professional self-concept of sustainability can only be formed when it is reinforced through role modelling, expectations and recognition by supervisors.

The study contributes to the literature on Sustainability 4.0 in Malaysian SMEs by highlighting the importance of mechanisms that involve humans for digital and environmental transformation. While Industry 4.0 technologies can support the collection and provision of data and operational tools, employees should be able to interpret sustainability information, be aware of environmental challenges and consider green innovation as a part of their job. Therefore, internal communication and supervisor environmental priority is not an ancillary practice. They are creating the conditions for the creativity and innovation of the employees needed to transform

business models for responsible production, resource efficiency and climate action.

THEORETICAL IMPLICATIONS

This study contributes to the sustainability communication literature by positioning eco-conscious internal communication as an antecedent of eco-centric creativity. Previous studies have primarily linked internal sustainability communication with employee engagement, commitment, and general pro-environmental behaviour. The present study extends this literature by demonstrating that communication can also support the generation of novel and useful environmental ideas. This contribution is important because sustainability transformation requires more than employee compliance with environmental policies; it also depends on employees' ability to reinterpret sustainability goals creatively and translate them into improvements in products, processes, and ways of creating and delivering value. This extends the role of internal communication from information transmission to a mechanism that can support green innovation within SMEs.

Second, the study contributes to environmental psychology in the workplace by identifying sustainability-oriented mindfulness and eco-conscious personal identity as two parallel psychological mechanisms linking eco-conscious internal communication with eco-centric creativity. These mechanisms represent theoretically distinct processes. Sustainability-oriented mindfulness reflects employees' cognitive attention, awareness, and openness toward environmental issues, whereas eco-conscious personal identity reflects the extent to which environmental responsibility becomes part of employees' self-definition. The significant indirect effects through both mediators indicate that sustainability communication can stimulate green creativity through both an awareness-based pathway and an identity-based pathway. Employees may therefore generate environmental ideas because they become more attentive to sustainability problems or because environmentally responsible behaviour becomes more consistent with how they define themselves.

Third, the study offers a more nuanced extension of upper echelons theory to the immediate-supervisor level in SMEs. An important and somewhat unexpected finding was that supervisor environmental priority did not significantly strengthen the relationship between eco-conscious internal communication and sustainability-oriented mindfulness, whereas it significantly strengthened the relationship between eco-conscious internal communication and eco-conscious personal identity. The nonsignificant interaction for sustainability-oriented mindfulness, together with its negligible effect size, suggests that mindful attention to environmental issues may be activated primarily by the content, consistency, and salience of sustainability communication itself rather than by additional supervisory reinforcement. In other words, employees may become cognitively attentive to sustainability once environmental information is made sufficiently visible in their work environment, even when supervisors differ in the extent to which they personally prioritize environmental concerns.

In contrast, the significant moderation of the identity pathway suggests that eco-conscious personal identity may depend more strongly on social validation from immediate supervisors. Sustainability messages may inform employees about what the organization considers important, but employees are more likely to internalize environmental responsibility as part of their self-concept when supervisors reinforce these messages through their priorities, expectations, recognition, and role modelling. This distinction helps explain why supervisor environmental priority influence's identity formation but not necessarily sustainability-oriented mindfulness. Theoretically, the findings indicate that managerial influence may operate more strongly through processes of identity internalization than through basic cognitive awareness. This refines the application of upper echelons theory by showing that managerial priorities do not uniformly strengthen all employee-level psychological mechanisms.

This unexpected pattern also provides a boundary condition for the proposed model. The results suggest that sustainability-oriented mindfulness and eco-conscious personal identity should not be treated as interchangeable psychological responses to organizational communication. Mindfulness appears to be more directly communication-driven, whereas personal identity is more socially contingent and sensitive to supervisor behaviour. This distinction advances the theoretical understanding of how organizational communication and leadership jointly influence employee green creativity and suggests that different psychological mechanisms may require different forms of organizational reinforcement.

Finally, the Malaysian SME context adds an important contextual contribution. Much of the sustainability and Industry 4.0 literature has focused on large firms, multinational corporations, or advanced economies. Malaysian SMEs operate under distinct conditions, including resource constraints, supply-chain pressures, policy support for digitalization and sustainability, and variation in regional business environments. The findings therefore provide a contextualized explanation of how sustainability communication, employee cognition, identity, and supervisor priorities interact within an emerging economy undergoing both digital and green transformation. Rather than simply reproducing findings from large-firm settings, the study shows that in SMEs, where formal sustainability systems may be less developed, communication and immediate supervisory behaviour can play different but complementary roles in enabling green creativity.

PRACTICAL IMPLICATIONS

The findings offer several practical implications for Malaysian SMEs. First, sustainability communication should be embedded into routine business practices rather than treated as an occasional campaign. SME owners and managers should communicate sustainability goals regularly, clearly, and in ways that are directly connected to employees' daily work. In the short term, within the first three months, firms can establish monthly sustainability briefings and define several operational priorities, such as reducing electricity consumption, improving material efficiency, minimizing waste, increasing the use of

environmentally responsible suppliers, and redesigning packaging. Relevant key performance indicators (KPIs) may include the frequency of sustainability communication, employee participation rates, the number of sustainability-related suggestions submitted, and progress toward selected resource-reduction targets.

Second, SMEs should strengthen sustainability-oriented mindfulness through training and reflective practices. Over a three- to six-month period, firms can introduce short workshops, team-based problem-solving sessions, after-action reviews, and digital dashboards that provide employees with visible information about environmental performance. Manufacturing SMEs, for example, may share monthly energy-consumption and scrap data with production employees, while retail firms may discuss packaging waste and customer-related environmental practices with frontline staff. Service SMEs may use digital tools to monitor paper use, transport emissions, or other resource consumption. KPIs can include training participation rates, the number of environmental problems identified by employees, the number of improvement ideas generated, and changes in selected environmental performance indicators.

Third, firms should reinforce eco-conscious personal identity by recognizing employees as active contributors to sustainability. During the first six to twelve months, SMEs can introduce non-monetary recognition mechanisms such as green idea awards, sustainability champions, employee improvement teams, and internal stories highlighting successful environmental initiatives. Such approaches are particularly appropriate for SMEs with limited financial resources. Relevant KPIs may include the number of employees participating in green initiatives, the number of recognized sustainability contributions, the percentage of implemented employee-generated green ideas, and employee perceptions of environmental recognition.

Fourth, supervisor environmental leadership should be developed systematically. Within six months, SMEs can provide supervisors with practical training on communicating sustainability priorities, evaluating green suggestions, providing constructive feedback, and removing barriers to experimentation. Environmental responsibilities may also be incorporated into supervisor performance evaluations. KPIs can include the frequency of sustainability discussions led by supervisors, employee ratings of supervisor environmental priority, the number of green initiatives supported by supervisors, and the percentage of supervisors achieving sustainability-related performance objectives. Given that the findings show a stronger moderating role of supervisor environmental priority in the identity-based pathway, firms should particularly encourage supervisors to reinforce environmental responsibility through visible role modelling, recognition, and consistent behavioural signals.

Finally, policymakers and industry associations can support SMEs by developing practical sustainability communication and capability-building toolkits. Over a twelve-month implementation horizon, such initiatives could integrate Industry 4.0 applications, ESG awareness, green creativity,

sustainability communication, and supervisor environmental leadership into modular training programmes. Effectiveness can be monitored through KPIs such as SME participation rates, completion of sustainability training, adoption of digital environmental monitoring tools, implementation of employee-generated green initiatives, and measurable improvements in resource efficiency. These actions can help Malaysian SMEs translate sustainability communication into employee-level awareness, identity, and creativity while strengthening their contribution to SDG 9, SDG 12, and SDG 13.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

There are some limitations in this study that suggest the following future study opportunities. First, the Malaysian SME context has a theoretical and practical significance but results from this study may not be directly applicable to large firms, public organizations or SMEs in other countries. The next research should be conducted to compare the Malaysian SMEs with SMEs in other ASEAN economies to identify if similar mechanisms are found in different institutional and cultural environments. Comparative studies can show if the proposed relationships are stronger or weaker with a change of national sustainability policy, pressure from the supply-chain or changes in the regional culture.

Secondly, the design suggested is time lagged and survey based. Some common method concerns are eliminated with the use of temporal separation and supervisor rated creativity. Longitudinal data over longer periods and experimental designs with introduction of sustainability communication interventions and measurement of employee creativity over time could be used in future research. Qualitative case studies may also offer greater understanding of how employees are interpreting the sustainability messages and how their supervisors are reinforcing or weakening these messages.

Third, the model is based on sustainable-oriented mindful and eco-conscious personal identity; however, other mechanisms could also apply. Future research may consider green psychological empowerment, environmental self-efficacy, job autonomy, perceived organizational support or green work climate. These factors can contribute to the development of eco-centric creativity in interaction with communication and leadership. Future research may also examine the strength of the relationship between green creativity and sustainable business model innovation when digital capability is introduced.

Fourth, the main moderator that is examined is supervisor environmental priority. Other possibilities for future research include the influence of top management commitment, peer influence, pressure from customers, supplier collaboration, or government support. SMEs in Malaysia frequently play a part in networks, while external stakeholders could have a strong impact on sustainability behavior. These multilevel factors may be able to give a holistic understanding on the Malaysian SMEs' transition from intention to success in developing sustainable business model.

Finally, there is a need for future study to link eco-centric creativity to the firm level outcomes including Environmental performance, cost saving, Customer loyalty, Circular economy practices, and ESG readiness. By demonstrating these performance outcomes, the owners of SMEs would be able to appreciate the value of investing in their internal communication, employee mindfulness, identity development and environmental leadership.

CONCLUSION

This Malaysian context research discusses the role of an eco-conscious internal communication in facilitating eco-centric creativity in SMEs in the context of a supervisor with environmental priority, sustainability-oriented mindfulness and eco-conscious personal identity. The model indicates that the influence of sustainability communication is activated when employees internally process it, integrate it into their self-image, and when it is reinforced regularly by their supervisors. Malaysia-specific relevance of this process is particularly applicable as SMEs play a pivotal role in national economic development and are now being called on to be a part of the digital transformation process, ESG adoption, responsible production and climate actions. The research adds to the theory as it combines sustainability communication with environmental psychology and upper echelons theory in an SME context. It builds on practice by demonstrating that green business model innovation isn't just about investing in technology, it's also about communication systems, accepting employees, motivating employees with identity and supervisors who take environmental protection seriously. These processes and systems can be reinforced to bring SMEs in Malaysia closer to Sustainability 4.0, achieve their contribution towards SDG 9, SDG 12 and SDG 13, and at the same time enhance their competitiveness and long-term sustainability.

LIST OF ABBREVIATIONS

AVE	=	Average Variance Extracted
PLS-SEM	=	Partial Least Squares Structural Equation Modeling
SDGs	=	Sustainable Development Goals
SMEs	=	Small and Medium-Sized Enterprises

AUTHORS' CONTRIBUTIONS

All authors have contributed substantially to the conception and design of the study. S.Z. has contributed to methodology and study design. M.H.A. has conducted data collection and investigation and performed data analysis and interpretation. S.D.M.C. has contributed to the literature review and data curation. R.R. has contributed to manuscript preparation, review, and editing; and provided supervision, critical review, and overall coordination of the study. All authors critically reviewed and approved the final manuscript and agreed to be accountable for all aspects of the work.

ETHICAL APPROVAL & INFORMED CONSENT

Data collection was conducted following ethical approval from the appropriate institutional review board. Participation was entirely voluntary, and respondents were informed that they could withdraw from the study at any time without penalty. The final dataset contained no personally identifiable information. The survey procedures emphasized informed consent, confidentiality, and a clear assurance that the findings would be reported only in aggregate form. Individual employee responses were kept confidential and were not accessible to supervisors, thereby preventing supervisors from viewing individual employee ratings. These safeguards were particularly important in Malaysian SMEs, where employees may be sensitive to evaluations by their supervisors and concerns regarding workplace sustainability.

AVAILABILITY OF DATA AND MATERIALS

The data will be made available on reasonable request by contacting the corresponding author [S.D.M.C.].

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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DECLARATION OF AI

The authors declare that generative artificial intelligence tools may be used only for language editing and grammatical improvement. The use of AI does not influence the study design, data analysis, interpretation, results, or conclusions. The authors remain fully responsible for the content of the manuscript.

REFERENCES

- Abdul-Azeez, O., Ihechere, A. O., & Idemudia, C. (2024). Transformational leadership in SMEs: Driving innovation, employee engagement, and business success. *World Journal of Advanced Research and Reviews*, 22(3), 1894-1905. <https://doi.org/10.30574/wjarr.2024.22.3.1888>
- Ahmad, N., Han, H., & Kim, M. (2024). Elevated emotions, elevated ideas: The CSR-employee creativity nexus in hospitality. *Journal of Service Theory and Practice*, 34(6), 891-914. <https://doi.org/10.1108/JSTP-11-2023-0288>
- Arici, H. E., & Uysal, M. (2022). Leadership, green innovation, and green creativity: A systematic review. *The Service Industries Journal*, 42(5-6), 280-320. <https://doi.org/10.1080/02642069.2021.1964482>

- Bai, C., Dallasega, P., Orzes, G., & Sarkis, J. (2020). Industry 4.0 technologies assessment: A sustainability perspective. *International Journal of Production Economics*, 229, 107776. <https://doi.org/10.1016/j.ijpe.2020.107776>
- Carfora, V., Caso, D., Sparks, P., & Conner, M. (2017). Moderating effects of pro-environmental self-identity on pro-environmental intentions and behaviour: A multi-behaviour study. *Journal of Environmental Psychology*, 53, 92-99. <https://doi.org/10.1016/j.jenvp.2017.07.001>
- Chen, M. F. (2020). The impacts of perceived moral obligation and sustainability self-identity on sustainability development: A theory of planned behavior purchase intention model of sustainability-labeled coffee and the moderating effect of climate change skepticism. *Business Strategy and the Environment*, 29(6), 2404-2417. <https://doi.org/10.1002/bse.2510>
- Chen, Y.-S., & Chang, C.-H. (2013). The determinants of green product development performance: Green dynamic capabilities, green transformational leadership, and green creativity. *Journal of Business Ethics*, 116, 107-119. <https://doi.org/10.1007/s10551-012-1452-x>
- Chen, Y.-S., Chang, C.-H., & Lin, Y.-H. (2014). Green transformational leadership and green performance: The mediation effects of green mindfulness and green self-efficacy. *Sustainability*, 6(10), 6604-6621. <https://doi.org/10.3390/su6106604>
- Chen, Y.-S., Chang, C.-H., Yeh, S.-L., & Cheng, H.-I. (2015). Green shared vision and green creativity: The mediation roles of green mindfulness and green self-efficacy. *Quality & Quantity*, 49, 1169-1184. <https://doi.org/10.1007/s11135-014-0041-8>
- Department of Statistics Malaysia. (2025). Micro, small and medium enterprises (MSMEs) performance 2024. Available from: <https://www.dosm.gov.my/>
- Economic Planning Unit. (2021). Twelfth Malaysia Plan, 2021-2025: A prosperous, inclusive, sustainable Malaysia. Prime Minister's Department, Malaysia. Available from: <https://rmke12.ekonomi.gov.my/>
- Ericson, T., Kjøenstad, B. G., & Barstad, A. (2014). Mindfulness and sustainability. *Ecological Economics*, 104, 73-79. <https://doi.org/10.1016/j.ecolecon.2014.04.007>
- Ghobakhloo, M. (2020). Industry 4.0, digitization, and opportunities for sustainability. *Journal of Cleaner Production*, 252, 119869. <https://doi.org/10.1016/j.jclepro.2019.119869>
- Gusmerotti, N. M., Todaro, N. M., Tosi, D., & Testa, F. (2023). Green work climate, work meaningfulness and supervisor environmental priority: A social exchange perspective on employees' eco-initiatives. *Journal of Cleaner Production*, 415, 137889. <https://doi.org/10.1016/j.jclepro.2023.137889>
- Haldorai, K., Kim, W. G., Agmapisarn, C., & Li, J. J. (2023). Who we are and what we do: The relevance of green organizational identity in understanding environmental performance. *International Journal of Hospitality Management*, 114, 103574. <https://doi.org/10.1016/j.ijhm.2023.103574>
- Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, 9(2), 193-206. <https://doi.org/10.2307/258434>
- Hambrick, D. C., Humphrey, S. E., & Gupta, A. (2015). Structural interdependence within top management teams: A key moderator of upper echelons predictions. *Strategic Management Journal*, 36(3), 449-461. <https://doi.org/10.1002/smj.2230>
- Huynh, H. T. N., Nguyen, N. T. T., & Vo, N. N. Y. (2024). The influence of knowledge management, green transformational leadership, green organizational culture on green innovation and sustainable performance: The case of Vietnam. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(4), 100436. <https://doi.org/10.1016/j.joitmc.2024.100436>
- Ietto, B., Ancillai, C., Sabatini, A., Carayannis, E. G., & Gregori, G. L. (2022). The role of external actors in SMEs' human-centered Industry 4.0 adoption: An empirical perspective on Italian competence centers. *IEEE Transactions on Engineering Management*, 71, 1057-1072. <https://doi.org/10.1109/TEM.2022.3144881>
- Jamwal, A., Agrawal, R., Sharma, M., & Giallanza, A. (2021). Industry 4.0 technologies for manufacturing sustainability: A systematic review and future research directions. *Applied Sciences*, 11(12), 5725. <https://doi.org/10.3390/app11125725>
- Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Gonzalez, E. S. (2022). Understanding the adoption of Industry 4.0 technologies in improving environmental sustainability. *Sustainable Operations and Computers*, 3, 203-217. <https://doi.org/10.1016/j.susoc.2022.01.008>
- Kalyar, M. N., Ali, F., & Shafique, I. (2021). Green mindfulness and green creativity nexus in hospitality industry: Examining the effects of green process engagement and CSR. *International Journal of Contemporary Hospitality Management*, 33(8), 2653-2675. <https://doi.org/10.1108/IJCHM-09-2020-1079>
- Kuuyelleh, E. N., Ayentimi, D. T., & Ali Abadi, H. (2021). Green people management, internal communications and employee engagement. In R. E. Hinson, O. Adeola, & I. Adisa (Eds.), *Green marketing and management in emerging markets* (pp. 151-165). Springer. https://doi.org/10.1007/978-3-030-73007-9_10
- Lee, Y., & Kim, J. (2021). Cultivating employee creativity through strategic internal communication: The role of leadership, symmetry, and feedback seeking behaviors. *Public Relations Review*, 47(1), 101998. <https://doi.org/10.1016/j.pubrev.2020.101998>

- Lee, Y., Dong, E., & Sun, R. (2024). The power of internal communication for environmental sustainability in promoting employee's pro-environmental behaviors. *Journal of Public Relations Research*, 1-16. <https://doi.org/10.1080/1062726X.2024.2357334>
- Luu, T. T. (2021). Green creative behavior in the tourism industry: The role of green entrepreneurial orientation and a dual-mediation mechanism. *Journal of Sustainable Tourism*, 29(8), 1290-1318. <https://doi.org/10.1080/09669582.2020.1834565>
- Luu, T. T. (2023). Can green creativity be fostered? Unfolding the roles of perceived green human resource management practices, dual mediation paths, and perceived environmentally-specific authentic leadership. *The International Journal of Human Resource Management*, 34(6), 1246-1273. <https://doi.org/10.1080/09585192.2021.1986107>
- Luu, T. T. (2024). How customers matter to tourism employees' green creative behavior? *Journal of Sustainable Tourism*, 32(1), 27-61. <https://doi.org/10.1080/09669582.2022.2113790>
- Men, L. R., & Yue, C. A. (2019). Creating a positive emotional culture: Effect of internal communication and impact on employee supportive behaviors. *Public Relations Review*, 45(3), 101764. <https://doi.org/10.1016/j.pubrev.2019.03.001>
- Ministry of Economy Malaysia. (2023). National Energy Transition Roadmap. Government of Malaysia. Available from: <https://ekonomi.gov.my/>
- Ministry of International Trade and Industry Malaysia. (2018). Industry4WRD: National policy on Industry 4.0. Government of Malaysia. Available from: <https://www.miti.gov.my/>
- Nguyen, L. Q., & Nguyen, T. N. (2025). Exploring the relationship of green HRM practices with sustainable performance: The mediating effect of green innovation. *Journal of Hospitality and Tourism Insights*, 8(5), 1665-1687. <https://doi.org/10.1108/JHTI-06-2024-0610>
- Onu, P., & Mbohwa, C. (2021). Industry 4.0 opportunities in manufacturing SMEs: Sustainability outlook. *Materials Today: Proceedings*, 44, 1925-1930. <https://doi.org/10.1016/j.matpr.2020.12.095>
- Pokalai, N., Nawakitphaitoon, K., & Wei, W. (2026). Cognitive and affective pathways linking green human resource management to employee green behavior: Dual mediating roles of green innovation and job satisfaction. *Business Strategy and the Environment*. <https://doi.org/10.1002/bse.71175>
- Sarfati, M., Lefébure, A., Harpet, C., Baurès, E., & Marraud, L. (2023). Is environmental sustainability training fundamental to healthcare leadership? State of the art with health students and health leaders. *Management in Healthcare*, 8(1), 57-69. <https://doi.org/10.69554/BUMF6682>
- Setyaningrum, R. P., Kholid, M. N., & Susilo, P. (2023). Sustainable SMEs performance and green competitive advantage: The role of green creativity, business independence and green IT empowerment. *Sustainability*, 15(15), 12096. <https://doi.org/10.3390/su151512096>
- Sugiarto, A., & Huruta, A. D. (2023). Antecedents of green creativity: The mediating role of employee green commitment and employee job satisfaction. *Cogent Business & Management*, 10(2), 2222491. <https://doi.org/10.1080/23311975.2023.2222491>
- Tanford, S., Kim, M., & Kim, E. J. (2020). Priming social media and framing cause-related marketing to promote sustainable hotel choice. *Journal of Sustainable Tourism*, 28(11), 1762-1781. <https://doi.org/10.1080/09669582.2020.1760287>
- Tran, N. K. H. (2023). An empirical investigation on the impact of green human resources management and green leadership on green work engagement. *Heliyon*, 9(11), e21018. <https://doi.org/10.1016/j.heliyon.2023.e21018>
- Tran, N. K. H. (2024). Customer pressure and creating green innovation: The role of green thinking and green creativity. *Sustainable Futures*, 7, 100177. <https://doi.org/10.1016/j.sfr.2024.100177>
- United Nations. (2015). Transforming our world: The 2030 Agenda for Sustainable Development. Available from: <https://sdgs.un.org/goals>
- Van der Werff, E., Steg, L., & Keizer, K. (2013). The value of environmental self-identity: The relationship between biospheric values, environmental self-identity and environmental preferences, intentions and behaviour. *Journal of Environmental Psychology*, 34, 55-63. <https://doi.org/10.1016/j.jenvp.2012.12.006>
- Van der Werff, E., Steg, L., & Keizer, K. (2014). I am what I am, by looking past the present: The influence of biospheric values and past behavior on environmental self-identity. *Environment and Behavior*, 46(5), 626-657. <https://doi.org/10.1177/0013916512475209>
- Verčič, A. T. (2021). The impact of employee engagement, organisational support and employer branding on internal communication satisfaction. *Public Relations Review*, 47(1), 102009. <https://doi.org/10.1016/j.pubrev.2021.102009>
- Walden, J., Jung, E. H., & Westerman, C. Y. (2017). Employee communication, job engagement, and organizational commitment: A study of members of the Millennial Generation. *Journal of Public Relations Research*, 29(2-3), 73-89. <https://doi.org/10.1080/1062726X.2017.1329737>
- Wolor, C. W., Hadi, S., Herwanto, H. W., Musyaffi, A. M., Hoo, W. C., & Rababah, M. A. (2025). Understanding green work behavior among employees in environmentally conscious culinary micro and small enterprises in Indonesia. *Discover Sustainability*, 6, 1458. <https://doi.org/10.1007/s43621-025-02362-8>
- Zhang, Z., Zhu, H., Zhou, Z., & Zou, K. (2022). How does innovation matter for sustainable performance? Evidence from small and medium-sized enterprises. *Journal of Business Research*, 153, 251-265. <https://doi.org/10.1016/j.jbusres.2022.08.034>

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