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Green environmental management system and environmental performance: Results from PLS-SEM and fsQCA

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ABSTRACT

Advanced green technology developments have induced key innovation approaches in the manufacturing industry to boost sustainable development (SD) in the present market. Despite the industrial need for green innovation and its associated benefits to regulate and optimise their operations and environmental performance, respectively, green innovation implementation and adoption remain inadequate. Due to the key significance of green innovation for firms operating in emerging markets, this research endeavors to investigate the green innovation influence on the relationship between Environmental Management System adoption and impact on Environmental Performance. To bridge this gap, The current work aimed structuring and validating a study model via the integration of Resource-Based View (RBV) and Institutional theories with the Technology-Organisation-Environment (TOE) framework to persuade companies towards green innovation implementation. Survey questionnaires were disseminated to 183 employees in a manufacturing company to collect the study data, which were then assessed with partial least squares-structural equation modelling (PLS-SEM) and Fuzzy-set Qualitative Comparative Analysis (fsQCA). Resultantly, the model's integrated constructs of perceived benefits, top management support, coercive pressure, normative pressure, and mimetic pressure predicted green management accounting practices. Green management accounting practices directly and significantly impacted green environmental performance, while green innovation significantly and negatively moderated the 'green management accounting practice-green environmental performance' link. Thus, the integrated model provides decision-makers with clear implications of green practice and innovative technology adoption for optimal environmental performance. The outcomes derived from literature reviews on advanced green technologies implied a notable 'green management accounting practice-environmental performance' relationship within emerging countries.

1. Introduction

The environmental concerns resulting from augmented waste and toxin disposal, insufficient natural resource, and high gas and carbon emission levels following industrial and corporate growth on a global scale have inevitably led to adverse climate changes [1,2]. Such complexities can be mitigated through (i) green practices and innovative technologies that complement organisational social responsibilities and (ii) regulatory policies that promote economic activity based on environmental sustainability, specifically amongst major manufacturing

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companies [2]. Notwithstanding, much emphasis is placed on eco-friendly small and medium enterprises (SMEs). Industry players have since elevated their consciousness of environmental concerns and relevant alternatives by evaluating organisational environmental performance [3]. Organisational threats to environmental sustainability have led to the establishment of processes that determine the company's implications on the environment. Meanwhile, these firms currently implement eco-friendly organisational policies following customers' preference for sustainable products and services and environmental legislation developments to maintain a competitive edge in the international market [3].

The significance of green innovation in SMEs is attributed to innovation practices that improve their green environmental performance [4]. For example, the optimal adoption of green innovations conserves resources, mitigates environmental pollution, and strikes a balance between profitability and environmental accountability [5,6]. Such adoption is necessary amongst SMEs following their substantial contributions to national economies. As key economic catalysts in most countries, it is deemed crucial for these enterprises to increase their productivity and competitive edge [2]. The organisational usage of green practices and innovative technologies determines the success of an SME [7].

The introduction and development of policies and corresponding methodologies [8], respectively, such as the green environmental management accounting systems (EMAS) globally boost SMEs and social sustainability [9,10]. As a tool that enables organisational environmental information reporting and environmental performance management to both interior and exterior industry players, EMAS [3,11] facilitates the identification, gathering, and analysis of financial and nonfinancial environmental information to enhance an organisation's economic and environmental performance. This instrument was developed to address the environmental intricacies that could not be resolved by conventional management accounting. Notably, EMAS assists in adopting diverse accounting practices involving carbon management, water management, energy, material flow, and biodiversity for high environmental and financial performance [12]. The tool also allows organisational efficiency and environmental management by regulating energy consumption, natural resources, material cost and usage, and pollution to make eco-friendly decisions and increase organisational quality and competitive edge [13].

Incorporating EMAS, which is integral to the company's environmental management control system, entails collecting financial or physical data from past or forthcoming organisational actions to present time-series patterns to determine strategic operative and development objectives and initiatives [14,15]. Following past research [1], the organisational decision to manage its environment involves combining both accounting and environmental data and strategies for improved organisational environmental performance. In this vein, companies strive to maintain a competitive edge and sustainability via the environmental approach. Organisational efficiency can be improved by removing contamination from manufacturing processes through minimal input, less tedious processes, and compliant-related costs and accountability-orientated control [8]. Empirical works have highlighted the rising momentum of environmental accounting amongst companies that gravitate towards sustainability [16–18] following stakeholders' demand for managers to analyse their environmental concerns and performance [8,3]. The organisational adoption of environmental management, corresponding strategies, and EMAS are key competitive advantages [19].

Notwithstanding, the adoption rate of EMAS remains low amongst SMEs in emerging countries (Jordan) despite the instrument's advantages and essentiality. This paucity, which results from several factors (insufficient knowledge, training, and consciousness of environmental problems, inefficient professional agencies and environmental legislation, low stakeholder pressure, and organisational challenges in identifying, categorising, discerning, regulating, and gauging environmental protection expenses) [3], explains the inadequacy of scientifically evaluating the associations between pertinent factors. In-depth examinations of sustainability-related notions and practices in Jordan proved necessary. The key determinants of system implementation and adoption amongst industry players must be determined to address SMEs' low adoption and awareness levels of EMAS. Despite much research in industrial economies, studies on internalising and adopting the concept remain scarce in developing nations akin to Jordan. None of them has tackled the implementation of environmental management practice in Jordanian SMEs based on sustainabile environmental performance.

The present work expanded the current body of literature on EMAS adoption and its function in improving organisational environmental performance [6]. Most of the studies involving accounting to sustainability emphasised corporate social disclosure [8,12] and the eco-efficiency impacts on organisational performance [20,21], the 'environmental disclosure-firm performance' link [22,23], the degree of environmental disclosure [24] or the organisational financial performance level [9,25]. Relevant literature reviews [3] highlighted knowledge gaps in the management's aspect of adopting environmental accounting, the function of EMAS, TMS, and other factors that optimise corporate greening practice, which require further examination. To date, corporate stakeholders' intention to adopt EMAS has been unexplored in accounting-orientated studies. The research closed this gap by structuring and recommending a comprehensive EMAS implementation model and evaluating its effects from an organisational viewpoint. Three objectives are presented below:

1. To identify the key catalysts for EMAS adoption;
2. To identify the impact of EMAS adoption on green environmental performance;
3. To investigate the moderating influence of green innovation towards the 'EMAS adoption-green environmental performance' relationship.

The current work has contributed to current innovation-orientated literature by presenting multiple constructs with the combination of the TOE model, Institutional theory (INT), and Resource Based View (RBV) theory following the correlation between green practices, innovative technologies, and green environmental performance. Notably, these constructs have been examined in past works to determine the EMAS adoption determinants and their impacts on environmental performance. Secondly, this study assessed the framework's significance amongst Jordanian manufacturing SMEs. The current study outcomes potentially authenticate the environmental performance of organisations adopting green innovation, which significantly influences effective business operations. This empirical work contributes to emerging nations (specifically Jordan) following the need to mitigate its susceptibility to shifts in the global environment and research scarcity on the pertinence of EMAS in daily organisational activities for high green environmental performance. This study tested an integrative model incorporating specific factors that could influence the organisational adoption of EMAS, with extensive discussions on the synergistic impact amongst these factors with fsQCA. The empirical outcomes could provide a holistic comprehension of the EMAS implementation process.

This paper is divided into several sections. The following sections present the (i) literature review, from which the hypotheses were developed, (ii) study method and pertinent approaches, (iii) study outcomes, and (iv) academic and practical implications.

2. Literature review

2.1. Related works

Essentially, EMAS comprises an organisation's environmental and economic performance via environmental-orientated accounting systems [8]. The EMAS and conventional accounting approaches can be distinguished by the former's emphasis on environmental aspects, which evaluates environmental information and data and interprets environmental information in financial statements. Incorporating EMAS alleviates costs, enhances the overall (financial and environmental) business performance [9], and decreases the pressure of environmental regulations while concurrently elevating organisational reputation owing to its environmental performance. Fundamentally, EMAS manages the relevant information that impacts the environment and elevates organisational performance. The system is categorisable into monetary and physical factors [26,27]. The former depends on the company's environmental-orientated activities in terms of monetary unit, which present key information for decisions-making. Meanwhile, the latter requires the natural environment information specified in physical unit [26]. Both information systems underscore the managerial role in making informed decisions to improve organisational (environmental and economic) performance.

As an extension of conventional management accounting, EMAS was introduced to alleviate accountants' pressure to accommodate improved environmental management and accounting practices. This system, which constitutes part of environmental accounting, facilitates the identification, classification, allocation, and control of environmental expenses to make informed decisions and catalyse environmental management. Overall, EMAS proves to be more effective than traditional management accounting systems [28]. This instrument initially served to facilitate managers to make decisions that improve organisational environmental performance [9]. Companies extensively use EMAS to reap the following benefits: the identification of cost-saving opportunities, improvements in product pricing and pricing decisions, elevation of environmental performance, informed decision-making processes, optimal innovation [16,3], high organisational reputation, improved stakeholders decisions [8,21], employee retention, low regulatory attention, and high competition [29].

Relevant research [17] underscored specific barriers to such an adoption despite the various benefits derived from implementing EMAS. Most of the results stemmed from studies conducted in newly industrialised nations (Malaysia). Thus, the topic remains relatively unaddressed in emerging economies, such as Jordan. Such findings may not be generalisable to developing countries following the notable cultural, social, economic, and political variances that potentially impact their accounting practices [6]. Extensive studies in emerging economies could provide pivotal insights into the current implementation of EMAS. Insufficient studies on EMAS practices and barriers level amongst organisations in emerging economies have inevitably created a gap in accounting-related works. Consequently, the research aimed to investigate EMAS-related adoption levels and associated challenges amongst Jordanian companies.

2.2. *Theoretical understanding and foundation*

2.2.1. *The TOE model and RBV theory*

This study analysed EMAS implementation and value from an organisational viewpoint. Previous works have similarly examined the topic by emphasising (i) the variables affecting innovation/technology adoption decision and (ii) the catalysts and impacts of innovation/ technology adoption.

Based on past literature reviews, the TOE model presents a vital point that condones innovation adoption [30]. This framework is integral to ascertaining three categories that impact the adoption, through which the technologies are utilised by organisations. The technological category denotes the perceived attributes of the innovation/ technology to be adopted. Tornatizky and Fleischer [30] indicated perceived benefits as a relevant, positive, and significant aspect. The organisational context entails important variables that encompass the number of internal slack resources, with top management support significantly influencing innovation adoption. The environmental context involved the combination of the TOE model with other (Institutional) theory to explore the relationship, with the latter providing institutional environmental components that determine the organisational structure, norms, and actions (innovation adoption). Similar works incorporated the aforementioned theory and TOE framework to explore this environmental aspect [31].

A branch of study has also extended this framework under RBV by incorporating the effect of technology adoption. Specifically, organisational value creation depends on its joining resources, which proves challenging for other companies to emulate due to insufficient economical resources [32]. The impact derived from resources relies on the organisational capacity to utilise rather than leverage innovation. Thus, innovation-induced implications depend on the degree to which the innovation is incorporated into an organisation's principal value chain activities. High usage level potentially increases the impact of the innovation. This concept has branched out into a stream of studies that emphasises innovation adoption antecedents and impact [2,7].

Overall, specific works have incorporated TOE as a general framework to characterise the EMAS adoption drivers, while other counterparts used RBV to denote the EMAS adoption influence on environmental performance.

2.2.2. *Configuration theory*

As a novel theoretical foundation to examine holistic interconnections between the aspects underlying a messy nature, the configuration theory is extensively used within ISs research [33]. In past decades, the two foundations underlying the implications of an outcome are variance and process theories [34]. Under variance theories, each cause reflects an independent impact on the outcome, which constitutes single or multiple predictors. Meanwhile, process theories determine how outcomes shift through a pre-defined period and the aspects triggering that change owing to limitations in explaining fuzzy boundaries and mutual causality in some cases. Notwithstanding, the process theories could not depict a holistic systemic effect.

Despite much research [2] on the correlation between antecedents and organisational intention to implement EMAS, most studies employ variance- or process-based theories. The configuration theory investigates intricate and chaotic causality with a holistic view of pertinent elements, unlike its two other counterparts. This theory aims to determine the patterns and combinations of elements and examine how synergistic influences induce particular results, which are generally influenced by the integration of causal factors. From a configurative stance, current studies that use fsQCA remain in the preliminary stages. In this study, the factors under examination may concurrently impact organisational adoption decisions. Regression-based techniques potentially justify the causal paths through which TOE factors influence organisational EMAS adoption intention. Regardless, the synergistic effects should be seriously regarded. Summarily, the intricacy of EMAS adoption can be fully explained via simultaneous elements rather than a set of factors.

2.3. *Research framework and hypotheses*

Both the TOE model and RBV theory underpinned the current study framework [35]. A model was structured with technological, organisational, and environmental factors (see Fig. 1) upon reviewing pertinent variables. The following sections present a thorough examination of all the contexts for hypothesis development.

2.3.1. *Perceived benefits*

Following past research [36], perceived benefits (PB) are a key innovation attribute that encapsulates the level of consensus with claimed benefit. Another study [37] delineated PB as the degree to which organisations or individuals perceive the advantageousness or usefulness of a system for optimal performance. Perceived benefits significantly affect one's behavioural intention to implement and utilise a novel system or technology [36]. Parallel to past study outcomes, perceived benefits substantially influenced innovation adoption [37].

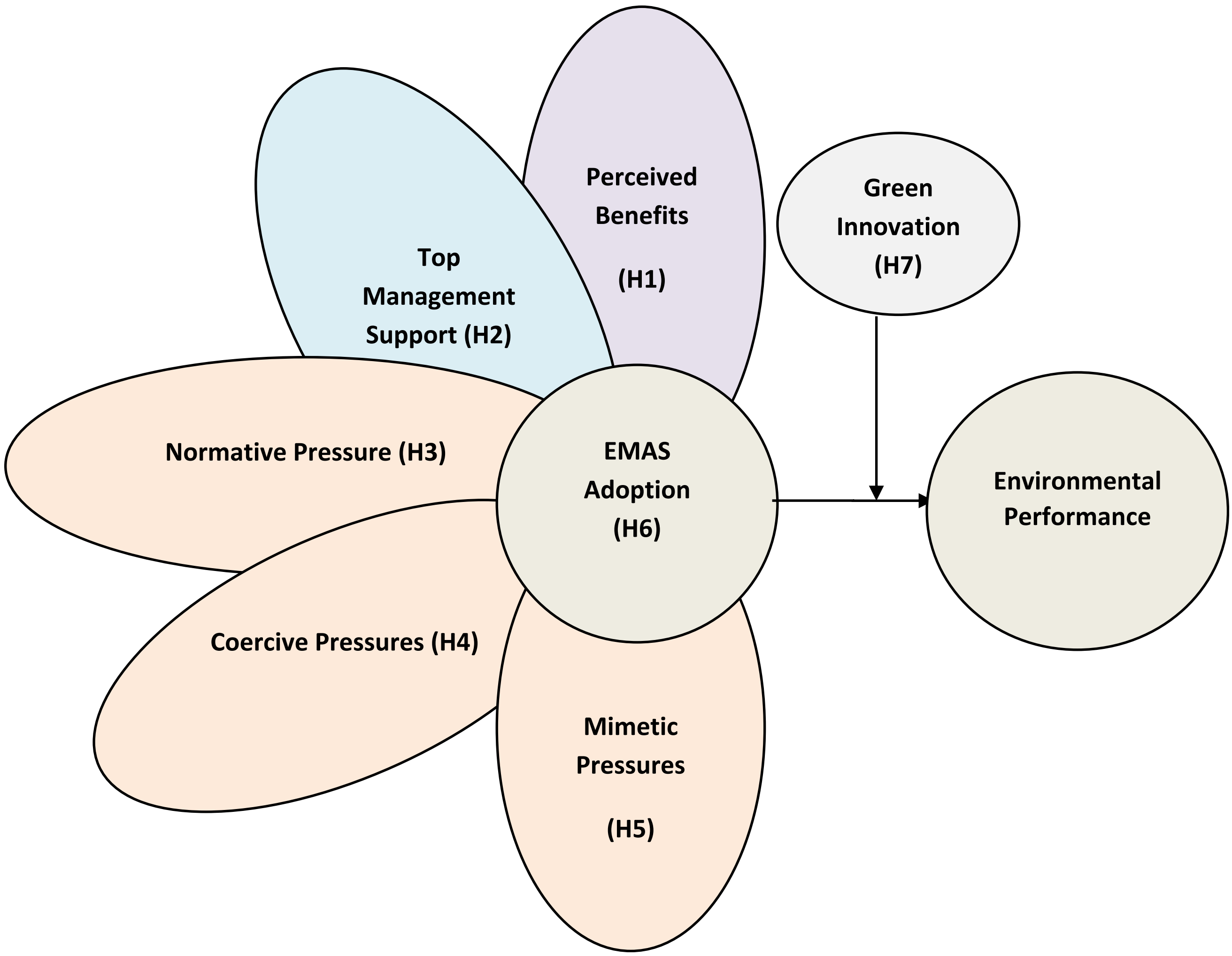

Fig. 1. Configuration model.

Stakeholders must demonstrate a sound comprehension of the perks that can be derived from EMAS for practical system establishment [3]. This denotes the association between organisational interests, social benefits and participation in implementing EMAS. Furthermore, EMAS adoption facilitates organisations with complete, precise, and inclusive data to evaluate performance, increase organisational reputation, improve interactions with other industry players and the community, avoid possible fines, comply with environmental laws, obtain compensation benefits, and mitigate environmental concerns in [3]. Companies can benefit from operating processes (strong business-community trust, improved reputation, and a competitive edge) by aligning organisational activities with societal prerequisites, demonstrating social accountability, and disclosing information and activities on environmental adaptation.

Companies that believe in the economic and environmental benefits reaped by implementing EMAS practices would encourage their managers to prioritise this adoption for improved environmental performance. Hence, the study developed the hypothesis below:

H1. PB has a positive and significant association with the adoption of EMAS.

2.3.2. Top management support (TMS)

The degree of active managerial involvement and commitment when structuring technological systems to ensure employees' utilisation implies support [2]. Specifically, SME managers must make informed decisions and be committed to technology implementation via available and appropriate resources to minimise users' natural resistance to the system and optimise its usage [2,38]. Eco-friendly organisations rely on managerial support and interest to elevate productivity and competitiveness [3,8]. As such, high environmental performance necessitates sufficient organisational resources and top management support, which integrates organisational strategies with environmental concerns and EMAS adoption.

Companies are required to demonstrate their environmental accountability with standard environmental management and a refined accounting system to appropriately disclose environmental data following community pressure, legal enforcement, and demands from environmental groups. Thus, the acceptance of using novel technology and associated changes depend on perceived management needs. Following past works, the top management's commitment and support are integral to the success of environmental management practices [8, 39]. The effectiveness of EMAS heavily depends on managerial and administrative support.

Following the impact of the top management on policy selection and environmental strategy adoption in business activities, past works have highlighted managerial viewpoints as a key determinant of EMAS implementation [3]. Hence, managers' sound awareness of EMAS-orientated benefits and usefulness would enable the seamless adoption of such strategies to provide environmental information, alleviate operational expenses and wastage, explore novel markets, and attract potential customers through green products and practices [3, 40–42]. Meanwhile, low environmental accountability and poor managerial support for EMAS can deter system application [43]. The adoption and use of innovation and technologies, respectively, in SMEs require strong managerial support. Such reliance substantially impacts EMAS adoption [3,42]. In this vein, the following hypothesis was proposed:

H2. TMS has a positive and significant association with the adoption of EMAS.

2.3.3. Normative pressure (NP)

NP denotes the impact exerted by organisations or people belonging to the same industry (professionalism) [2] based on trade associations, media, suppliers, and clients for legitimate behaviour. Trade associations imply the key sources of normative pressure, whereas customer and supplier demand could impact a company's decision to act in a specific manner. Hence, firms are keen to apply technologies and approaches that are deemed useful in the communities in which they operate [44]. Industry players compel businesses to utilise a particular technology or innovation following its adoption by similar businesses.

Sharing knowledge about the usefulness of implementing a particular technology via customers, suppliers, trading agencies, and company networks compels organisations towards adoption intention [45]. Np ensures that (i) suppliers and customers circles are in the same environment and (ii) companies comply with social activities to enhance EMAS adoption. Organisations that implement EMAS manage public perception via control and communication. In this regard, the reputation and image of companies that fail to manage such perceptions and avoid trade unions are negatively impacted [26]. Companies with a tainted reputation can lose their competitive edge and incur major losses [2]. Np is a key predictor of innovations/technologies adoption, as implementing EMAS potentially impacts organisational reputation and competitive advantage [31]. Thus, the following hypothesis was developed:

H3. Np has a positive and significant association with the adoption of EMAS.

2.3.4. Coercive pressure (CP)

CP defined by Di Maggio and Powell [46] as adherence to main branches, present regulations, and resource-leading companies. Also known as the pressure exerted by key stakeholders, coercive power includes governmental regulations and non-governmental entities of customers, competitors and suppliers. These factors pressure companies to comply with and incorporate environmental standards and regulations [26]. Under the Institutional theory, coercive pressure forms legislative mandates and environmental protection standards amongst companies. Relevant research [2] highlighted the significant impact of scientific research, regulatory forces, and competitors on innovation adoption. In examining cloud-based AIS implementation [31], coercive pressures substantially affected the top management's decision-making. Likewise, most government authorities stipulate conditions (coercive pressure) that encourage to adopt EMAS. Such enforcements improve the environmental performance of companies, enable them to receive government support and economic incentives, and elevate their social reputation. For example, the pollution standards and laws of the Jordanian government based on pollution incidents necessitate manufacturing firms to adopt EMAS practices.

In line with the INS theory and innovations/technologies adoption studies on SMEs, governmental policies incentivise SME adoption decision via environmental pressures or catalysts that are significantly related to such decisions (not unlike CP in INT). Furthermore, national policies on different promotional initiatives or rules include EMAS implementation and institutionalised adoption [8]. Hence, the multiplicity of CP from various sources can notably influence EMAS adoption and vice versa. These discussions led to the development of the hypothesis below:

H4. CP has a positive and significant association with the adoption of EMAS.

2.3.5. Mimetic pressure (MP)

As an institutional element that indicates ambiguous goals and misinterpreted technologies, mimetic pressure directs a company's capitalisation on external experience by emulating successful competitors [46]. Organisations that attribute their rivals' success to strategic choices would imitate their behaviours and actions to preserve market shares and be sustainable [2]. Despite the ambiguities of such emulations in terms of efficiency, organisations may be influenced by mimetic elements to avoid perceived risks and the trialling expenses incurred by early adopters [31].

This logic can be juxtaposed with SMEs' EMAS implementation decisions. For example, organisations that experience mimetic pressure may imitate business rivals upon learning of their leveraging of EMAS benefits. Companies may not be able to directly explore the system values and outcomes owing to the costs and risks underlying EMAS implementation. These organisations may be driven by mimetic pressure to mitigate the experimentation costs incurred from innovation adoption [31]. Empirically, companies that perceive their business rivals' success in adopting innovation feel pressured to emulate the competitors and maintain a competitive advantage [26].

Based on previous studies on INT, mimetic pressure from business rivals substantially impacted innovation adoption. A study [26] disclosed the significant relationship between mimetic pressure from rival firms and the intention to adopt environmental information systems. Moreover, the rival adopters' perceived success and adoption level determined the extent of mimetic pressure [45]. Despite not integrating INT with EMAS implementation, some studies revealed that EMAS adoption in SMEs was highly driven by competitive (mimetic) pressure. Research on AIS [7] discovered that SMEs' awareness of a competitor within the same industry adopting innovation compels them to follow suit. The EMAS may depend on the mimetic pressure induced by competitors under the INT theory and past innovation adoption studies. Hence, the following hypothesis was proposed:

H5. MP has a positive and significant association with the adoption of EMAS.

2.3.6. The environmental management accounting system and environmental performance

Environmental performance, which is assessed through waste reduction, pollution control, environmental emission reduction, and recycling activity denotes the outcome reflecting an organisation's commitment to sustain the natural environment [47]. The effective adoption and implementation of EMAS allows SME managers and decision-makers to mitigate environmental concerns by addressing them via current information derived from external and internal sources. The timely provision of supporting EMAS data would enable managers to minimise external anomalies and the implications on management's knowledge of environment dynamic, obtain environmental benefit, and comprehend their environmental accountabilities [40]. This system, which collects pertinent information about the organisational reliance on energy and its function in increasing the hazardous carbon emissions resulting from energy consumption, also promotes decision-making [1]. Resultantly, environmental management approaches and financial control are integrated with the environmental management control system. Adopting EMAS can facilitate organisations to achieve environmental quality and performance. Such IT could generate profit by increasing ecological opportunities and demands for enhanced environmental practice via optimal accounting information processes.

The environmental performance of an organisation is measured, regulated, and disclosed by EMAS [47]. Hence, the current work assessed a conceptual model that highlights the correlation between environment strategy, EMAS, and environmental performance. From a scholarly perspective, environmental strategy explicitly influences environmental performance via EMAS, management, and policy [9,47] with its eco-friendly practices and instruments. This statement underscores the notable impact of this strategy on business performance [48]. A high level of EMAS adoption increases a high degree of control and effectiveness of decision-making with reliable, updated, actual, and integrated information, which subsequently improves environmental performance [47]. As evidenced by past study outcomes, EMAS adoption positively impacted environmental performance [49]. The prevalence of such EMAS-related works in Western countries left emerging economies (Jordan) lagging behind research-wise. Hence, a relevant hypothesis was developed:

H6. The EMAS adoption has a positive and significant relationship with environmental performance.

2.3.7. The moderating effect of green innovation on the relationship between emas adoption and environmental performance

The innovative activities upon which eco-friendly and sustainable development principles are built are known as green innovation. Thus, the organisational pressure to exercise environmental protection has resulted in the adoption of green innovation amongst enterprises to maintain a competitive edge [50]. This innovation implies product or process enhancement to conserve energy consumption, recycle waste, reduce fossil fuel burning, mitigate pollution, and manage the environment [51]. Such innovations enhance and develop manufacturing processes and eco-friendly product designs [2,31]. Overall, the environment would be less encumbered with the decrease in greenhouse gas emissions and increase in eco-friendly products and various types of knowledge creation [52].

Under the RBV theory, organisations must obtain a sustainable and competitive edge [2] and develop specific technical capacities to leverage green innovative technology. Counterparts with advanced technologies tend to address technical issues involving green innovations [53].In this vein, EMAS emphasises how firms use green technologies to transform processes, services, and products and boost their environmental performance.

Relevant research [54] defined green innovation as an eco-system innovation that stimulates novel concepts and creative goods, services, procedures, and operations. Fundamentally, green innovation decreases product consumption and the release of hazardous gases (CO^2) into the environment, which is positively related to the competitiveness of manufacturing companies [13]. This innovation, which also improves the green image and overall productivity of the business, positively affects its sustainability and environmental performance [55,56]. Given the inconsistent outcomes derived from the 'EMAS adoption-environmental performance' relationship, green innovation factors could be tested as a moderating variable [9,57]. A relevant hypothesis was developed:

H7. Green innovation has a positive moderating effect on the relationship between EMAS adoption and environmental performance.

3. Methodology and analysis

3.1. Research methods

3.1.1. Instruments

The current work adopted a structured, closed-ended nine-part questionnaire post-literature review. The first section serves to elicit the respondents' demographic details, while sections two to nine measure the following research constructs: EMAS adoption, PB, TMS, MP, CP, NP, green innovation, and environmental performance. The questionnaire validity was pilot-tested with 35 individuals before commencing with the actual survey. Meanwhile, the construct items were assessed with a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

3.1.2. Samples and data collection methodology

The current quantitative work used a questionnaire to collect primary data from manufacturing SMEs in Amman, Zarqa, and Irbid (Jordanian cities). Notably, these cities were chosen following their highest proportion of SMEs in all sectors. Jordanian manufacturing firms are categorised based on their employees' number and the annual revenues gained. This study excluded micro enterprises (primarily cottage and handicraft-related work with minimal environmental impacts), which employ between one to nine full-time staff based on the Amman Chamber Industry. Small enterprises employ from 10 to 49 full-time workers, while their medium-sized counterparts employ between 50 and 249 of them [58]. Following the 2014 Amman Chamber Industry Directory report, Jordanian SMEs, which employ 28 % of the labour force, contribute 35 % to the national GDP. This percentage underscores their significant influence on the broader economic policy of the region. Sample SMEs were selected from multiple manufacturing sectors via simple random sampling. Specifically, 941 out of the 8000 manufacturing SMEs matched the definition of SMEs in the present research.

The study sample, sampling method, and sample size and factors were determined during the sampling process pre-data collection [59]. Sample size relies on the regression model processing method adopted and its reliability. Under exploratory factor analysis (EFA), the required sample size should be four to five times the number of variables in factor analysis [59]. Meanwhile, practical research applications necessitate a sample size that exceeds 150 sample units [60]. As recommended by Tabachnick and Fidell [61], the common formula to identify sample size in multiple regression analysis is presented as follows: (n) should exceed 50+8p, with 'n' as the least sample size and 'p' as the independent variables number in the model.

The survey was conducted for a period of 2 months, from Jan 3, 2023, to Feb 5, 2023. Five hundred questionnaires were digitally disseminated to different SMEs via email and Google form URLs. The sample size was chosen to deter the following data-gathering problems: low response rate, non-engaging participants, and missing values. Respondents were briefed on the research nature and objectives and their right to withdraw from the study pre-survey. Notably, 197 out of the 500 questionnaires were returned. The derived data were analysed for non-engaged responses and outliers by calculating and documenting the respondents' standard deviation value. Respondents who filled all or most of the survey questions with the same answer (answer pattern) revealed low or zero standard deviation (SD) values. This outcome denotes the respondents' non-engagement while addressing the questionnaire. In this vein, 14 responses with SD below 1 ($SD \leq 1$) were omitted. The remaining responses were elicited from 183 questionnaires with a 36.6 % response rate. Table 1 summarizes the demographic

Table 1
Descriptive statistics of respondents ($n = 183$).

Demographic statistics	Category	Frequency	Percentage (%)
Position	CEO	89	48.6
	Senior manager	49	26.7
	Manager	45	24.7
Age (years)	20 – 29	19	10.3
	30 – 39	60	32.8
	40 – 49	71	38.7
	50 and above	33	18.2
Experiences (By years)	5 or less	47	25.7
	6 – 10	39	21.3
	11 – 15	50	27.4
	More than 15	47	25.6
Gender	Male	164	89.6
	Female	19	11.4
Education Level	Diploma or below	28	15.3
	Bachelor's	93	50.8
	Master's	33	18.1
	PhD degree	29	15.8

characteristics of the respondents.

The empirical data were also tested for non-response bias to evaluate respondents' hesitance to engage in the study. This evaluation would reveal the influence of characteristics on the external validity of the outcome [62]. As such, this study employed the Mann-Whitney U test to test bias in two respondent groups. The first and second groups represented the first 112 and last 71 respondents, respectively. The groups, which were compared with three measurement items, disclosed no significant differences between early and late respondent groups for the items under study (Sig, $P > 0.05$).

3.1.3. Construct measures

A close-ended questionnaire survey was used in this quantitative study to gather data. The variables of interest were assessed with multiple-item scales. Notably, all 35 questionnaire items are construct-related. Both perceived benefits and TMS was measured by four items each, which were adapted from Kong et al. [37]. Meanwhile, MP, CP, and NP were evaluated by four items each, which were adapted from Latif et al. [26]. Green innovation was assessed with five items adapted from Deb et al. [9]. The EMAS adoption was evaluated with six items adapted from Latif et al. [26]. Lastly, environmental performance was measured with four items adapted from Lisi [63].

The study questionnaire functioned as a primary data collection tool, with the metrics elicited from past works and interviews with seven SME experts. Despite being originally in English, the measures were translated into Arabic and back-translated into English to minimise validity problems. Based on the expert interviewees, the items were rephrased to ensure that they complemented the Jordanian SME setting. Table 2 presents the questionnaire items.

3.1.4. Common method bias

Harman's single factor test served to ensure the absence of common method bias. Common method bias poses an issue if all the factors are merged into factor analysis and the first one explains over 50 % of the variance in data. As such, the dimension reduction technique in SPSS served to merge the factors into one via rotation matrix. The first factor, which explained 38.23 % of the total variance, established no common method bias.

3.2. Data analysis

As a multivariate statistical method that simultaneously evaluates different variables in one model, the PLS-SEM approach was employed in the current work for data analysis. This technique functions optimally (even with intricate models with numerous latent factors) with contingent factors and lower-sized samples [64]. Following past works, a study that gravitates towards prediction or the extension of a current theory requires a path modelling approach, such as PLS-SEM [64]. Consequently, this study chose PLS over other data analysis methods. The proposed model encompassed the contingent factor (moderating variable), which added to its complexity. Meanwhile, the relatively small sample size (183) was lesser than the cut-off values needed for other methods. The TOE, INST, and RBV theories underpinned this explorative research.

Table 2
Constructs measurements.

Constructs	Items	Adopted from
PBs	4	[37]
TMS	4	[37]
Mimetic pressure	4	[26]
Coercive pressure	4	[26]
Normative pressure	4	[26]
Green innovation	5	[9]
EMAS adoption	6	[26]
Environmental performance	4	[63]

Although PLS analysis provides valuable statistical outcomes, it has constraints in handling intricate, non-linear connections. Researchers have employed a two-stage analysis approach by integrating PLS-SEM with fsQCA approach to overcome this limitation [65]. Furthermore, fsQCA approach was applied to understand the combinations of factors (causal descriptors) that contribute to high adoption of EMAS.

4. Results

4.1. Measurement model evaluation

As proposed by Hair et al. [64], assessing the measurement model or outer model is a primary step in PLS-SEM that ascertains the degree of reliability of the indicator constructs. Unreliable constructs could prevent the assessment of the structural or inner model. Thus, evaluating the measurement model involves establishing the construct items' reliability and validity. Table 3 highlights the relevant indicators that represent the measurement model. Specifically, the extracted data supported the reliability and validity of the values, which did not violate the threshold for Cronbach's alpha (0.70), composite reliability (0.70), and average variance extracted (0.50) [64]. All the items demonstrated good convergent and discriminant validities, as the factor loadings on the constructs exceeded 0.40 [64]. Furthermore, the Fornell-Larcker criterion was used in this study to establish constructs' discriminant validity by comparing the squared AVEs with their correlation coefficients.

The squared AVEs on the diagonal space in Table 4 exceeded the correlation coefficient values between constructs, thus establishing their discriminant validity. Specifically, HTMT served to assess discriminant validity, which is ascertained by the correlation between two latent variables. Henseler et al. [66] proposed that all the HTMT values for the model constructs should not exceed 0.90, which is a measure of discriminant validity. Based on Table 5, all the values (0.104 to 0.898) were below this threshold. The latent variables measured distinct concepts without overlapping. Conclusively, the measurement model achieved the reliability, convergent and discriminant validity requirement at both item and construct levels. This research commenced to test the hypotheses in evaluation of the structural model.

4.2. Multicollinearity assumption

Parallel to Hair et al. [64], collinearity in reflective models must be identified to prevent both type 1 and type 2 errors in path significance analysis. Variance inflation factor (VIF) values are extensively used to verify the presence of multicollinearity amongst the model constructs. Table 6 depicts the VIF values for all the study constructs. Following Hair et al.'s [64] strict criterion of 3000, all the VIF values in this study

Table 3
Composite reliability and convergent validity.

	Cronbach's alpha	Composite reliability	Average variance extracted (AVE))
Environmental Performance (EP)	0.710	0.776	0.544
EMAS Use	0.755	0.844	0.576
Perceive Benefits (PB)	0.776	0.857	0.599
Top Management Support (TMS)	0.714	0.816	0.528
Memetic Pressure (MP)	0.714	0.813	0.523
Coercive Pressure (CP)	0.861	0.909	0.716
Normative Pressure (NP)	0.898	0.936	0.828
Green Innovation (GI)	0.886	0.917	0.690

Table 4
Discriminant validity (Fornell-Larcker Test).

	CP	EMAS adoption	EP	GI	MP	NP	PB	TMS
CP	0.846							
EMAS Adoption	0.526	0.758						
EP	0.448	0.729	0.738					
GI	0.500	0.358	0.356	0.830				
MP	0.427	0.718	0.702	0.289	0.722			
NP	0.589	0.448	0.373	0.549	0.335	0.909		
PB	0.035	0.426	0.328	0.009	0.414	0.071	0.773	
TMS	0.438	0.641	0.544	0.367	0.602	0.371	0.263	0.726

Table 5
The HTMT criterion.

	CP	EMAS adoption	EP	GI	MP	NP	PB	TMS
CP								
EMAS Adoption	0.659							
EP	0.616	0.898						
GI	0.567	0.433	0.468					
MP	0.541	0.887	0.687	0.344				
NP	0.657	0.534	0.452	0.609	0.407			
PB	0.104	0.550	0.447	0.115	0.551	0.107		
TMS	0.577	0.886	0.825	0.463	0.849	0.459	0.356	

Table 6
Multicollinearity statistics.

Variables	VIF
CP	1.774
EMAS Use	1.200
GI	1.154
MP	1.907
NP	1.570
PB	1.250
TMS	1.702

were below this threshold. The computed values ranged from 1.154 (minimum) to 1.907 (maximum) and suggested the model to be free from multicollinearity.

4.3. *Structural model evaluation*

The PLS-SEM analysed the structural model post-measurement model assessment. The impacts between the independent and dependant variables differed across models (with and without a moderating variable) [64]. As this study aimed to identify the significance of the key effects of EMAS adoption factors on innovation adoption and environmental performance, PLS analysis was conducted sans moderating variable in the first step. This variable was subsequently tested in another model [64]. In this vein, two distinct (direct relationship and moderation relationship) models were developed and tested. The PLS-SEM bootstrapping and algorithm test with 5000 resamples served to identify the path coefficients level and significance for the developed hypotheses. Table 7 highlights the standardised critical ratios (t-values), p-values and path coefficients (β-values), (with supported hypotheses) of each hypothesised association. Six out of the eight hypotheses were supported at 90–95 % confidence levels.

The explanatory power of the theoretical model was further examined by analysing the explained variance (R2) of endogenous variables. The R2 could be used in line with the PLS objective to assess the structural model and maximise the variance explained in endogenous variables [67]. Resultantly, the R2 values for EMAS use (0.715), and EP (0.631) were moderately strong. The effect size of variance in each variable, which remained unaddressed in the endogenous latent variables, is measurable with Cohen's f2 formula. we used Cohen's [68] approach to estimate the effect size by considering large (0.350), medium (0.150), and small (0.020) values as a threshold to examine the effect size of exogenous variables on their endogenous counterparts. The f2 (effect size) outcomes for the EMAS use effect on EP (0.850) and MP effect on EMAS use (0.477) were deemed large. Meanwhile, the f2 results for CP (0.051), GI (0.026), NP (0.025), PB (0.066), and TMS (0.070) disclosed a medium-size effect. The model predictability, which was estimated with Stone-Geisser's Q2 method, revealed that all the endogenous variables demonstrated an acceptable predictive relevance (the Q2 values exceeded zero). Table 8 presents the R2, f2, and Q2 results.

4.4. *Fuzzy-set qualitative comparative analysis (fsQCA) result*

The four-step fsQCA analysis (data calibration process, necessity analysis, sufficiency analysis, and generation of solutions) was applied in this study to gain a sound understanding of the variables' causal complexity [69]. This analysis aimed to determine the combinations of independent variables required to achieve a significant change in the

Table 7
Hypotheses testing results.

	Relationships	Path coeff	STDEV	T –Values	P - Values	Supported
H1	PB → EMAS Adoption	0.154	0.046	3.350	0.001***	Yes
H2	TMS → EMAS Adoption	0.185	0.061	2.992	0.003**	Yes
H3	NP → EMAS Adoption	0.106	0.045	2.359	0.018**	Yes
H4	CP → EMAS Adoption	0.162	0.055	2.917	0.004**	Yes
H5	MP → EMAS Adoption	0.508	0.054	9.343	0.000***	Yes
H6	EMAS Adoption → EP	0.715	0.046	15.595	0.000***	Yes
H7	GI*EMAS Adoption →EP	−0.105	0.033	3.129	0.002	No

Note: Significant at * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

Table 8
Structural estimates summary.

Constructs	R2	f2	Q2
CP		0.051	0.000
EMAS Use	0.715	0.850	0.392
GI		0.026	0.000
MP		0.477	0.000
NP		0.025	0.000
PB		0.066	0.000
TMS		0.070	0.000
EP	0.631		0.321

dependant valuable [70]. First, empirical data were converted to a fuzzy set via the scale calibration process. This process converted the study data into a 5-point Likert scale ranging from 0 to 1 on a continuous scale with the fsQCA 3.0 software (see Table 9). A maximum value of 1 denotes full-set membership, while a minimum value of 0 implies full-set non-membership. A mean value is selected as the crossover value between both memberships.

4.4.1. *Necessity analysis*

Necessity analysis was performed to determine whether a specific causal condition (PB, TMS, MP, NP, and CP) is deemed necessary for EMAS adoption. Following fsQCA-orientated literature, a conditional variable proves necessary for the outcome variable if the consistency threshold exceeds 0.900 (Ragin, 2009). This analysis was conducted with two cases: the presence and absence of the proposed condition. No single variable fulfilled the necessary condition for EMAS adoption (see Table 10). Alternatively, multiple conditional variables must interact and match to improve EMAS adoption.

4.4.2. *Sufficiency analysis*

The truth table was generated for all the model conditions to test their sufficiency. Table 10 highlights the configurations for organisational intention to adopt EMAS post-fsQCA analysis. Consistency assesses the extent to which a perfect subset relation is approximated, while coverage measures the degree to which a causal combination accounts for instances of an outcome [33]. Resultantly, the consistency scores for configurations, which exceeded the cut-off value of 0.75 [71], implied adequately specified models. Table 9 presents the overall solution coverage, where the four solutions consistently explained 98.4 % of organisational intention to adopt EMAS.

Based on Table 11, four distinctive configurations could induce organisations to adopt EMAS. The two core components that increased the intention to implement EMAS were perceived benefits and top management support. Solution 1 revealed the highest unique coverage score (0.228), thus implying that all factors (excluding normative pressure) significantly contributed to the organisational intention to use EMAS. Based on the necessary condition analysis for this outcome, TMS and perceived benefits were deemed necessary conditions with consistency scores of 0.979 and 0.972, respectively. These solutions shared both conditions. Overall, the success of EMAS adoption was achieved with top management support and perceived benefits.

Table 9
Study constructs fuzzy set.

Construct	Full-non-membership	Crossover point	Full membership
EP	1.000	3.910	5.000
EMAS Adoption	1.000	3.910	5.000
PB	1.000	2.972	5.000
TMS	1.000	3.910	5.000
MP	1.000	3.910	5.000
NP	1.000	3.910	5.000
CP	1.000	4.110	5.000

Table 10
Necessity analysis.

Condition	Consistency	Coverage
PB	0.8321	0.8411
~ PB	0.4411	0.6988
TMS	0.8311	0.8278
~ TMS	0.4310	0.6934
MP	0.5512	0.7533
~ MP	0.8243	0.8203
NP	0.8895	0.8930
~ NP	0.5246	0.6943
CP	0.8811	0.8868
~ CP	0.5122	0.6793

Table 11
Configurations for organisational high intention to EMAS adoption.

Configurations	Solution 1	2	3	4
Technological Factors PB	⬤	⬤	⬤	⬤
Organisational Factors TMS	⬤	⬤	⬤	⬤
Environmental Factors	●			
MP		●	●	●
NP	○	●		●
CP		●	○	●
	●			
			○	
Consistency	0.987	0.981	0.967	0.982
Raw Coverage	0.378	0.235	0.205	0.296
Unique Coverage	0.228	0.091	0.021	0.081
Overall solution consistency	0.981			
Overall solution coverage	0.731			

5. Discussion

The study was all about digging into how certain factors, known as TOE, help SME manufacturing companies use EMAS - that's a system aimed at boosting their environmental game. It also looked at whether adding GI would change things up in how EMAS helps improve environmental performance.

Turns out, using EMAS really does make a positive difference to the environment. However, throwing GI into the mix kind of stirred the pot negatively between adopting EMAs and seeing better environmental results. Also, specific TOE elements like PB, TMS, CP, NP, and MP were significant in pushing for more adoption of EMAS based on previous studies [2,72]. The integrated theories underpinning this study investigated the impacts of multiple factors on EMAS use amongst SMEs. The TOE dimensions positively impacted such adoption, which rendered EMAS adoption amongst SMEs compulsory to attain environmental goals. These enterprises can secure resources from external and internal environments via green innovation [73–75].

Regarding the TOE constructs, perceived benefits proved integral for workers to collaborate with and guarantee high organisational (department) performance [76]. Managers' perceived benefits of EMAS use could increase the probability of its adoption. From an accounting perspective, accounting departments that benefit from EMAS would induce other business departments to follow suit. In this regard, EMAS facilitates the fulfilment of environmental accountability and social requirements, the development of social trust in business, and the attainment of a positive business image, position, and competitive edge. The research outcomes corresponded to those derived by Wang et al.

[77] and Malik et al. [78].

As evidenced by past literature [2,37,77], top management support positively influenced EMAS adoption. An organisation could adopt green technologies and develop green products via green digital manufacturing technologies and tools with top management support. As managers and business operators play a pivotal role in making technology adoption-orientated decisions, managerial perceptions of such benefits could induce overall organisational support [2,79]. In developing strategies and making decisions to attain the organisation's sustainable development goals, their introduction of EMAS to organisational members would accelerate its adoption. The EMAS, which offers proactive environment strategies and precise information, mitigates operational costs, penetrates novel markets, and attracts prospective consumers via green practices, should be leveraged by the business operators and management.

Coercive, normative, and mimetic pressure, the three elements of institutional pressure, significantly and positively influenced EMAS use. Based on the empirical outcomes, companies that experience much pressure from the aforementioned components are prone to implement EMAS to achieve a grounded and legitimate association with stakeholders. Government bodies that enforce regulatory regulations, standards, and policies on companies that exploit the natural environment significantly influenced organisational behaviour and decision-making process. Like, parent firms implement policies and rules to protect data, resources, and the environment. High adherence to such stipulations would penalise unrelenting firms and adversely impact their overall reputation and performance.

Parallel to the study outcomes, mimetic pressure positively and significantly impacted EMAS use. Focal companies would be compelled to emulate their competitors' adoption of new technologies to remain competitive. Such imitation lowers the risks of failure. In line with current technological advancements, it is deemed vital for organisations to maintain a competitive edge over business rivals. Previous works disclosed the significance of mimetic pressure on behavioural processes, specifically those entailing intricate yet comprehensible adoption [37]. Meanwhile, mimetic pressure reduces with high EMAS adoption. Normative pressure also significantly and positively impacted EMAS adoption amongst manufacturing SMEs. Technology adoption is a key solution to fulfilling customer demands, which is a fundamental organisational goal. The outcomes corresponded to previous works that revealed the positive impact of institutional isomorphism on technology adoption [26,29,37,45].

The study outcomes disclosed a significant 'EMA adoption-environmental performance' relationship, which coincides with past empirical works [1,9]. Summarily, the effective use of EMAS leads to organisational control, informed decision-making, positive implications, and high environmental performance [47]. Managers' engagement with EMAS enabled them to make informed and accurate environmental decisions and reduce resource wastage and environmental pollution [80]. Generally, companies that are committed to environmental practices emphasise green resources for improved performance. This statement paralleled the RBV theory and past studies, where specific organisational resources or strategies can enhance its environmental performance [2] and successfully adopt EMAS. As an effective tool, EMAS addresses environmental effects and mitigates adverse outcomes. Numerous studies have characterised EMAS as an effective instrument that quantifies environmental issues, based on which decision-making occurs. Essentially, EMAS facilitates companies to obtain a competitive edge, save cost, reduce cost wastage, improve operational efficiency, increase profit, and enhance organisational environmental performance.

In examining the moderating role of GI in the 'EMAS adoption-environmental performance' relationship, past research has underscored the need to further investigate this correlation [13]. The current work responded to this call by exploring the aforementioned link. Nevertheless, the derived outcome did not inadequately support the moderating role of green innovation on the hypothesised association. A significant and negative moderating effect of green innovation was identified on the 'EMAS adoption-environmental performance' relationship, unlike the study prediction. In justifying the unanticipated outcome, the role of each factor in this relationship must be holistically understood. Perceivably, EMAS is a voluntary management tool that enables companies to enhance their environmental performance by systematically evaluating, managing, and improving their environmental effects.

Green innovation denotes the development and adoption of novel and eco-friendly technologies, processes, and practices such AI and chatbots. Both EMAS and green innovation strive to optimise environmental performance but operate at different levels. The EMAS involves implementing an environmental management system that mitigates the negative effect of organisational operations on the environment, whereas green innovation develops and adopts more sustainable (smart) technologies that minimise the environmental impact of these operations. The influence of EMAS on environmental performance may not necessarily rely on the level of green innovation adopted by a company following variances in their approach. Hence, an organisation can still benefit from adopting EMAS and improve its environmental performance without implementing key green innovation practices.

Companies that place much emphasis on green innovation may disregard other notable aspects of environmental management. For example, these organisations may invest in expensive new technologies or processes without effectively addressing fundamental environmental management practices (waste or pollution reduction) [81,82]. Such haste may not enable organisations to fully realise the benefits of their investments in green innovation [83,84]. Other key areas of environmental management that could significantly impact environmental performance may also be neglected. Furthermore, green innovation may divert organisational resources from more effective environmental management practices and environmental performance [85,86]. In some cases, companies may heavily invest in green innovation to improve their public image without fully considering the environmental and financial costs incurred from these investments. A mismatch could occur between the organisational level of investment in green innovation and its overall environmental goals [11,15]. For example, a company may invest in a single high-profile green innovation project while disregarding other areas that could substantially affect environmental performance.

6. Study implications

6.1. Theoretical implications

The current work revealed several implications, such as the development of an innovation adoption model following the incorporation of the TOE framework and INS and RBV theories. The authenticated model offered novel associations to be examined in green practices, EMAS, and management accounting domains via fsQCA. Essentially, these paths highlighted two key aspects: (i) the feasibility of a common goal through various means and (ii) the simultaneous coexistence of multiple paths. To date, this research pioneers the examination of EMAS use with decision-making elements in Jordan. The study also expands the current body of literature on green innovation practice adoption, which has limited studies on the overall effect of such adoptions. Incorporating the TOE framework and Institutional and RBV theories into one model to explore the phenomenon under study also enhances both models' predictive and explanatory powers and produces outcomes with implications for academic circles and practitioners.

This research delineated the factors influencing EMAS adoption as concurrent and equifinal. Following Rihoux and Ragin [87], the 'configurational perspective' effectively internalises complex causality. Based on the study outcomes, one factor may not sufficiently develop a path that induces EMAS use. Each path to promote EMAS adoption entails factors that simultaneously catalyse EMAS adoption via three equivalent approaches. Furthermore, a substitutable link between these elements could improve EMAS adoption. The results are a novel means of justifying the EMAS adoption paths from a holistic viewpoint via configurational analysis.

The current work supported the 'EMAS adoption-environmental performance' relationship, which is moderated by green innovation. Nevertheless, the moderating effect was unsupported by the empirical outcomes. This finding outlines a distinct theoretical implication. Although green innovation is a primary catalyst for green innovation technologies and environmental performance, research on its moderating effect remains scarce. Based on the current study results, green innovation could significantly and negatively affect the 'EMAS adoption-environmental performance' correlation. This finding depicted the contingency effect of green innovation on both variables with concrete evidence. Green innovation may enhance environmental performance without attaining environmental sustainability. Hence, factors of resource efficiency, pollution prevention, and waste reduction programmes could play a pivotal role in improving environmental performance. As EMAS focuses on improving environmental performance through better management practices rather than the adoption of new technologies or processes, the impact of green innovation towards the 'EMAS adoption-environmental performance' relationship may prove significant and negative. Some organisations could significantly enhance environmental performance using better management practices alone, without necessarily adopting significant green innovation practices.

6.2. Practical implications

The study outcomes may have implications for managers, stakeholders, government bodies, and policymakers with concerns about Jordanian SMEs lagging behind in terms of EMAS adoption. The factors examined in this study could increase the organisational awareness of current regulatory rules, policies, and regulations on EMAS implementation. Moreover, from a governmental viewpoint, policymakers can develop legal documents that regulate the adoption of EMAS and other innovative technologies amongst companies. Stipulations on how to disclose or encourage businesses to divulge information on their green practices, environmental violations penalties, and taxes should be clear. Organisations must collaborate with innovation and SME consultants to organise training courses on environmental protection and environmental accounting to sustain business orientations and implement strategies that support environmental standards and regulations. Likewise, SMEs stockholders could establish of environmental reporting systems and quality auditing mechanisms for the utilization of EMA by SMEs, training institutions and professional entities could launch campaigns to promote EMAS-related benefits based on corporate responsibilities. Seminars can be conducted to discuss environmental issues, provide short-term accounting and auditing courses, and conduct programme visits for EMAS implementation and the increase of organisational consciousness about the 'green innovation-environmental performance' relationship. The validated model potentially facilitates SME managers to identify the EMAS adoption drivers and the implications of such adoptions on organisational environmental performance. Finally, the model emphasises the notable effects of such adoption on previously-disregarded green environmental performance.

The absence of concrete evidence on the moderating effect of GI in this study holds significant implications. Empirically, SMEs' wide utilisation of EMAS enhanced their environmental performance, even with the absence of green innovation or novel technology. The SME managers should actively adopt EMAS, which facilitates the attainment of environmental benefits. Specifically, these individuals must focus on their business rivals' strategies and be sensitive to the unique requirements of their respective SMEs. The study outcomes also proposed targeting EMAS vendors. By determining the substantial factors related to EMAS use and environmental performance, vendors can employ this information to develop more effective promotional strategies for their software. Vendors could convince SME owners and managers of the significance of EMAS and its subsequent enhancement of business outcomes. Additionally, these vendors could portray effective adoption amongst competitors in the SME sector or share success stories of other EMAS-orientated SMEs to motivate potential users and address their concerns. Such efforts could reduce the ambiguity and anxiety associated with SME managers' EMAS implementation.

7. Limitations and recommendations for further research

This study collected cross-sectional data on the causal relationships between the variables in Jordan, which restrict the ability to represent the proposed model. Hence, the outcomes may not be appropriate to thoroughly assess causal relationships. Future works could conduct a longitudinal study to overcome such limitations and avoid results bias for outcome validity and accuracy. Another limitation concerns the study sample, which involved manufacturing SMEs that directly interact with the natural environment. Potential scholars could include non-manufacturing and service-orientated SMEs that may be included in future samples to provide a holistic understanding of the subject matter. Furthermore, the reliance on the low response rate of (36.6 %) and all 35 construct-related questionnaire items exhibit significant limitations to the verification and validation of this study results. Such factors may limit the representativeness and generalizability of the study findings. Therefore, it is recommended for future studies to improve the response rate by employing strategies such as incentives, follow-up reminders, or even personalized communication to boost participant engagement. At the same vein, researchers should consider refining the questionnaire items to emphasis on key constructs for a more insightful and targeted analysis. Additionally, the sample may be extended to include other industries and nations to compare and contrast the EMAS implementation outcomes. This research examined specific TOE variables to gauge their impact on EMAS adoption and its effect on environmental performance. Further research could regard other internal and external TOE variables based on their influence towards the same element or SMEs' financial, social and environmental sustainability; consider of emergence of the environmental movement with corporate responsibility and sustainability management. Additionally, further studies could regard obstacles/barriers being faced by SMEs majorly in the adoption of green practices. Given that this research only emphasised the moderating effect of a variable, other counterparts may have diverse or mediating effects on the relationship. Future scholars could explore such impacts to yield enriching and holistic outcomes.

8. Conclusion

This study primarily aimed to investigate how TOE factors are operated to improve EMAS adoption and its implications on environmental performance. Furthermore, the study also identified the contingent effect of GI in the 'EMAS adoption-environmental performance' relationship. The utilisation of TOE, institutional, and RBV theories on manufacturing SMEs, which strived to maintain a competitive edge in a dynamic environment, was also tested. Resultantly, EMAS adoption positively and significantly impacted environmental performance. GI revealed a negative and significant contingent role between the two. Additionally, the TOE factors of PB, TMS, CP, NP, and MP significantly and positively influenced EMAS use following past works

For these SMEs aiming high in competitive markets where changes happen fast, getting their hands on both internal resources like smart innovations and external ones can mean they're better equipped environmentally speaking. By embracing green practices through tools such as EMAS guided by solid strategies from various business theories—they're not just ticking boxes but actually making strides towards real green goals.

CRediT authorship contribution statement

Abdalwali Lutfi: Writing – original draft, Formal analysis, Data curation, Conceptualization. **Ahmad Al-Hiyari:** Validation, Methodology, Investigation. **Ibrahim A. Elshaer:** Writing – review & editing, Supervision, Project administration. **Mahmaod Alrawad:** Writing – review & editing, Resources, Methodology, Formal analysis. **Mohammed Amin Almaiah:** Writing – review & editing, Validation, Software, Resources, Formal analysis.

Declaration of competing interest

No.

Data availability

Data will be made available on request.

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