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Does Big Data Capability Make Green Human Resource Management More Effective? A Study of Green Organizational Citizenship Behaviour and Environmental, Social, and Governance Performance in the Indian Manufacturing Sector

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Does Big Data Capability Make Green Human Resource Management More Effective? A Study of Green Organizational Citizenship Behaviour and Environmental, Social, and Governance Performance in the Indian Manufacturing Sector

ABSTRACT

Environmental, Social, and Governance (ESG) performance has emerged as a strategic imperative for manufacturing organizations seeking to balance economic growth with sustainability objectives. Drawing on the Ability–Motivation–Opportunity (AMO) framework and the Natural Resource-Based View (NRBV), this study examines how Green Human Resource Management (GHRM) practices enhance organizational ESG performance through the mediating role of Green Organizational Citizenship Behaviour (GOCB). The study further investigates whether Big Data Analytical Capability (BDAC) strengthens the effectiveness of GHRM in fostering employee-driven sustainability behaviours. Using a time-lagged research design, data were collected from 400 employees working in Indian manufacturing organizations and analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The findings reveal that GHRM practices significantly promote GOCB, which in turn enhances organizational ESG performance, indicating that employee voluntary pro-environmental behaviours constitute a critical mechanism linking green management practices to sustainability outcomes. Furthermore, BDAC positively moderates the relationship between GHRM and GOCB, suggesting that data-driven organizational capabilities amplify the behavioural impact of sustainability-oriented HR practices. By integrating organizational, behavioural, and technological perspectives within a unified framework, the study extends AMO and NRBV by demonstrating how internal human and analytical capabilities jointly contribute to ESG performance. The findings offer important implications for managers and policymakers seeking to strengthen sustainability performance through employee engagement and digital capabilities, particularly within manufacturing firms operating in emerging economies.

Keywords: Green Human Resource Management, Big Data Analytical Capability, Green Organizational Citizenship Behaviour, Environmental, Social, and Governance Performance Indian Manufacturing Sector, Sustainability

1. Introduction

Environmental, Social and Governance (ESG) performance has emerged as a defining factor of firm competitiveness, particularly in the resource-intensive manufacturing sector (Zhang et al., 2025). Increasing regulatory pressures, climate challenges and investors' expectations have compelled firms to move from conventional efficiency metrics such as cost minimization, productivity, etc., to tangible sustainability outcomes. (Grewal & Serafeim, 2020; Ning & Shen, 2024). Despite these developments, progress remains uneven; A substantial share of global emissions continues to be driven by industrial activities, and the pace of decarbonization falls short of the international climate goal (Åhman et al., 2017). At the same time, increasing concern about the credibility of ESG underscores a critical challenge: organizations must move beyond symbolic commitments and substantiate them through measurable and credible ESG performance (Sareen et al., 2026). Existing research has primarily approached ESG performance from technological and operational perspectives in which process innovation, efficiency and green technologies are emphasized as central to sustainability outcomes. While these perspectives offer valuable insights, they often overlook the human-centric "Social" and "Governance" dimensions, treating sustainability as a purely technical challenge. In this regard, Green Human Resource Management (GHRM) practices have emerged as an organizational approach that integrates environmental objectives into core HR functions (Mishra, 2017). By fostering environmental capabilities and values, GHRM practices enable firms to align employee behaviour with broader environmental goals (Leidner et al., 2019; Verma, 2026). By doing so, GHRM acts as a bridge between individual values and the firm's broader ESG mandate. However, the mechanisms through which HR-driven practices influence overall ESG performance remain inadequately examined.

Recent literature suggests that employee behaviour constitutes a crucial missing factor in explaining this relationship. While prior studies have established the importance of GOCB in enhancing eco-efficiency, there is a lack of evidence regarding how these discretionary actions aggregate to influence the Governance (transparency) and Social (safety and equity) pillars of ESG. Specifically, Green Organizational Citizenship Behaviour (GOCB), which is defined as voluntary pro-environmental behaviours or actions beyond formal job requirements, acts as a key behaviour process through which sustainability initiatives are translated into practices (Boiral et al., 2015; Daily et al., 2009). These behaviour including voluntary conservation efforts, proactive problem-solving attitude and peer influence, collectively lead to meaningful organizational outcomes (Barik et al., 2026). Although, prior studies have established the importance of GOCB in enhancing environmental performance, its impact on integrated ESG

outcomes remains underexplored, particularly the multi-dimensional nature of ESG (Abdullah & Mamun, 2019; Tejasmayee et al., 2025; Yong et al., 2026).

Moreover, the translation of GHRM driven behaviours into verifiable ESG metrics is contingent upon the availability of relevant organizational capabilities (Shafique et al., 2026). In this context, Big Data Analytical capability (BDAC) has emerged as a key factor that enhances organizations ability to engage in data-driven decision making (Garmaki et al., 2023; Medeiros & Maçada, 2022). Through the integration of technological infrastructure, analytical knowledge and organizational processes, BDAC improves firms' ability to collect, process and interpret sustainability related data (Novicka & Volkova, 2025). This capability is instrumental in addressing ESG transparency and mitigating greenwashing, as it facilitates organisations to transform their sustainability initiatives into measurable and credible outcomes (Zapata-Soto & Guiñez-Cabrera, 2026). Emerging research highlights that such analytical capability improves the effectiveness of organizational practices, highlighting their role as a boundary conditions that determine the effectiveness of organisational practices in deciding when and how sustainability initiatives yield performance benefits (Chatterjee et al., 2024; Sahoo et al., 2023; Singh & El-Kassar, 2019).

Despite these advancements, the existing literature remains fragmented across three key dimensions. First, GHRM studies have largely focused on environmental outcomes. Limited integration has been shaped into the broader ESG framework that increasingly shapes corporate evolution. Second, research on digital capabilities and HR-driven sustainability has progressed in parallel rather than in an integrated manner, and therefore, it has resulted in fragmented explanations of ESG performance. Third, empirical evidence is predominantly concentrated on developed and select emerging regions. There is very insufficient attention to the Indian manufacturing context, despite its unique institutional environment and sustainability challenges.

The Indian manufacturing sector provides a suitable context for addressing these identified gaps. Being one among the fastest growing industrial economics, India faces the dual challenges of sustaining economic growth and the responsibility of achieving its sustainability commitment (Bhattacharjee et al., 2025). Regulatory measures including compulsory implementation of Business Responsibility and Sustainability Reporting (BRSR) have formalized ESG disclosure requirements and particularly, the sector with high energy intensity underscores the urgency of improving sustainability performance (Jagotra, 2026). These

conditions provide strong context for exploring how organizational practices and capabilities interact to influence ESG outcomes.

Building on this backdrop, the present study develops and empirically examines a comprehensive framework linking GHRM, GOCB, BDAC and ESG performance in Indian manufacturing firms. Specifically, it examines the direct relationship between GHRM and ESG performance, the mediating role of GOCB as a behavioural pathway and the moderating role of BDAC in strengthening these relationships. This study makes three important contributions. First, it conceptualizes GOCB as a key behavioural micro foundation that links GHRM to ESG performance and therefore, responds to the call for process-based explanations of sustainability outcomes. Second, by combining the 'Ability Motivation Opportunity' (AMO) framework with the 'Natural Resource-Based View' (NRBV), it develops a multi-level theoretic perspective connecting HR system, employee behaviour and firm-level ESG performance. Third, it introduces BADC as a strategic capability that strengthens the effectiveness and credibility of sustainability practices and highlights the role of data-driven capabilities in shaping ESG performance.

1. Theoretical background and hypothesis development

1.1 Theoretical Foundation

The present study combines the AMO framework (Appelbaum, 2000) and NRBV (Hart, 1995) to explain how GHRM practices drive employees' discretionary green behaviour and translate it into ESG Performance. Bringing these perspectives together allows for a multi-level explanation that connects organisational systems, employee behaviour and firm-level sustainability outcomes. The AMO framework provides a useful behavioural lens in explaining how HR practices shape employee actions. In the context of GHRM, "Ability" refers to green competencies (Ren et al., 2018), "Motivation" to eco-incentives (Cabral & Dhar, 2019), and "Opportunity" to participative decision-making (O'Donohue & Torugsa, 2016). It suggests that employees are more likely to engage in desired behaviours when they possess the relevant skills, when they are motivated to act, and when they are given opportunities to participate (Ahmad et al., 2021). In the context of GHRM, environmental training builds employees' competencies (Hooi et al., 2022). Likewise, performance management and incentives provided in an organisation reinforce motivation and participative mechanisms create opportunities to contribute to sustainability initiatives (Anwar et al., 2020). Taken together, these practices foster discretionary pro-environmental actions, commonly referred to as Green Organizational Citizenship Behaviour (GOCB).

While AMO helps in explaining how such behaviours emerge, NRBV provides the broader strategic rationale for why they matter. The theory of NRBV argues that firms can achieve sustained advantage by developing capabilities that support environmentally responsible practices, such as pollution prevention and sustainable development (Hart, 1995; Hart & Dowell, 2011). One important points is that these capabilities are not purely structural. They are enacted and sustained through day-to-day organisational behaviour. In this sense, GOCB can be understood as a behavioural micro-foundation of NRBV capabilities, because the cumulative effect of voluntary employee actions contributes to organisational sustainability outcomes (R. Gupta et al., 2025). This perspective addresses a key gap in ESG research because while ESG performance is typically assessed through external indicators such as disclosures and ratings it does not reveal much about the internal organisational processes through which sustainability is actually achieved. By positioning GOCB as the link between GHRM and ESG performance, this study shifts attention toward these underlying behavioural processes.

The framework also incorporates Big Data Analytical Capability (BDAC) as a complementary organisational capability within NRBV framework. BDAC enhances a firm's ability to generate and utilise sustainability-related knowledge by improving data collection, analysis, and interpretation (Shan et al., 2019). Rather than replacing behavioural processes, it strengthens them by enabling more effective monitoring, feedback, and decision-making. In doing so, BDAC is expected to influence the extent to which GHRM-driven behaviours translate into measurable ESG outcomes (Shafique et al., 2026) and therefore, BDAC functions as a boundary condition that influences the effectiveness of GHRM and GOCB in driving ESG performance. Crucially, BDAC is treated here as a "higher-order" resource under NRBV. While GOCB provides the "doing," BDAC provides the "measuring" and "optimizing." This synergy ensures that sustainability efforts are not just performed but are data-validated and strategically aligned with ESG benchmarks.

1.2 Relationship between GHRM and ESG Performance

GHRM has emerged as a strategic means through which organisations embed sustainability into their core operations (Buller & McEvoy, 2016). By integrating environmental and social considerations into HR practices such as recruitment, training, and performance evaluation firms are able to align employee behaviour with broader ESG objectives of the organisation (Chen & Fang, 2026). This perspective moves beyond viewing ESG primarily as a reporting or compliance requirement and instead emphasises the role of internal organisational systems,

particularly HR practices, in operationalising sustainability within routine activities (Chiucchi et al., 2025; Hoang, 2018).

From an NRBV standpoint, GHRM contributes to the development of capabilities that support and enhances long-term environmental and social performance (Ngo, 2026). It first facilitates the creation of environmentally responsible skills, values and routines, which in turn enhance resource efficiency, lower environmental impact by reducing waste, and strengthen stakeholder engagement (Anthony Jr, 2019). These effects are not limited to environmental outcomes alone. They also extend to social and governance dimensions, including employee well-being, ethical conduct, and organisational transparency (Tate & Bals, 2018). Importantly, such alignment is not incidental but systematic, as sustainability considerations are embedded within routine HR processes, decision-making practices, and organisational culture.

Despite this, the empirical studies suggest that GHRM contributes to sustainability outcomes by embedding environmental considerations into organisational routines and culture. However, much of the existing literature has focused on specific aspects of performance, particularly environmental outcomes (Hameed et al., 2020), with relatively limited attention to ESG as an integrated, multi-dimensional construct. Moreover, prior studies have paid limited attention to how internal HR-driven processes translate into externally evaluated ESG performance, creating a disconnect between organisational practices and their representation in ESG metrics (Huma et al., 2026). This limits our understanding of how firms consistently achieve measurable sustainability outcomes. Given that ESG performance captures a more comprehensive view of organisational sustainability, it is important to examine whether GHRM practices translate into these higher-order outcomes. Drawing on the above arguments, GHRM can be expected to function as a foundational organisational mechanism that enables firms to achieve improved ESG performance. Accordingly, the present study proposes the following hypothesis:

H1: GHRM practices positively influence ESG performance.

1.3 Relationship between GHRM and GOCB

GHRM practices play a central role in shaping employees' attitudes and behaviours towards environmental sustainability (Ansari et al., 2021). Drawing on the AMO framework, GHRM enhances employees' ability to engage in sustainability-related activities, strengthens their motivation, and create opportunities for participation in sustainable practices (Jiang et al., 2012; Renwick et al., 2013). These practices not only align employee behaviour with organisational sustainability objectives but also institutionalise environmental values among employees (Jabbour & Renwick, 2019). These conditions are conducive to the development of GOCB, which refers to voluntary behaviours that support environmental sustainability but are not formally required as part of job roles (Boiral et al., 2015). These behaviours include conserving resources, contributing ideas for environmental improvement, and encouraging colleagues to adopt eco-friendly practices.

Drawing on the social exchange theory, organisations' visible commitment to environmental sustainability signals responsible intent; in response employees reciprocate through discretionary pro-environmental behaviour (Blau, 1964; Kim et al., 2019). When such commitment consistently reinforced through HR practices, employees are more likely to internalise organisational sustainability values and respond through voluntary environmental behaviours. Thus, GOCB reflects not only compliance, but a deeper intrinsically motivated orientation towards sustainability.

Importantly, this relationship is not purely procedural but also perceptual. Employees' interpretations of organizational commitment to sustainability influence their willingness to engage in voluntary environmental behaviours, suggesting that the effectiveness of GHRM depends not only on implemented practices but also on how they are perceived (Norton et al., 2015). Although prior research has documented a positive association between GHRM and GOCB (Daily et al., 2009; Boiral et al., 2015), further examination is required to establish this relationship in the emerging economy context where sustainability practices are still evolving, and employee-driven environmental behaviour remains underexplored. Thus, the present study proposes hypothesis 2 as:

H2: GHRM practices positively influence GOCB.

1.4 Relationship between GOCB and ESG Performance

GOCB represents an important behavioural mechanism through which sustainability initiatives of an organisation are translated into tangible outcomes (Nguyen et al., 2025). It also refers to employees discretionary behaviour aimed at safeguarding the environment without consideration of formal reward and recognition (Boiral & Paillé, 2012; Daily et al., 2009). GOCB are discretionary in nature and, unlike formal systems or policies, it contributes to organisational processes and outcomes through employees' repeated actions (Robertson & Barling, 2017). In this sense, GOCB serves as a critical micro-level foundation through which firm-level sustainability outcomes are realised.

From the perspective of NRBV, such behaviours contribute to the development and deployment of capabilities that enhance environmental sustainability performance (Hart & Dowell, 2011). Employees who actively engage in environmental initiatives help improve operational efficiency, prevent pollution, reduce waste, and strengthen relationships with stakeholders (Sethumadhavan et al., 2025). At the environmental level, these behaviours support resource conservation and eco-efficiency (Majid et al., 2023); at the social level, they foster collaboration, ethical conduct, and employee well-being (Piao et al., 2022); and at the governance level, they reinforce transparency, accountability, and responsible organisational practices (Ateeq et al., 2025). These contributions extend across environmental, social, and governance dimensions, thereby supporting to overall ESG performance.

Existing studies have linked GOCB in improving environmental and organisational performance (Ghosh & Haque, 2025; Gupta et al., 2026), particularly in manufacturing and supply chain contexts where employee-driven sustainability practices play a significant role (Azam et al., 2022; Khan et al., 2021). It, therefore, serves as a behavioural pathway through which organisational sustainability initiatives are implemented in practice and thus translates sustainability intent into consistent day-to-day practices (Iveroth & Bengtsson, 2014). However, its role in shaping ESG outcomes remains underexplored. ESG performance represents a broader construct that integrates environmental, social, and governance dimensions and is often assessed through externally reported metrics and disclosures (Pillai et al., 2026). This creates a disconnect between internally driven behavioural processes and externally evaluated ESG outcomes, as existing research has largely examined GOCB in relation to environmental or firm performance without explicitly linking it to formal ESG indicators (Camacho, 2025).

Further, prior studies have tended to examine either micro-level behavioural constructs or macro-level ESG outcomes in isolation, offering limited insight into how individual discretionary behaviours aggregate into organisation-wide ESG performance (Figuerola-Ferretti et al., 2025), particularly in emerging economy contexts such as Indian manufacturing. Given the integrative nature of ESG, understanding how employee-level behaviours contribute to these broader outcomes is particularly important. In line with this reasoning, higher levels of GOCB are expected to translate into improved ESG performance at the organisational level. Based on this, third proposed hypothesis is:

H3: GOCB positively influences ESG performance.

1.5 Mediating Role of GOCB

Building on the arguments in the preceding sections, this study proposes that GOCB mediates the relationship between GHRM and ESG performance. While GHRM establishes the organisational conditions for sustainability, its impact ultimately depends on the extent to which employees translate these practices into action. The AMO framework suggests that HR practices influence behaviour, which in turn drives performance (Bos-Nehles et al., 2023; Waseem et al., 2025). In this context, GHRM enhances employees' environmental capabilities, motivation, and opportunities, which, in turn, encourage engagement in GOCB (Muisyo et al., 2022). These behaviours, when aggregated across the organisation, contribute to improved ESG outcomes. By extending beyond formal job requirements, GOCB represents the most direct behavioural expression of GHRM practices, capturing employees' active participation in sustainability-oriented activities (Tham, 2024; Pham et al., 2026). In this sense, GOCB functions as a critical micro-foundation through which organisational sustainability capabilities are developed and enacted.

Although prior studies have examined the mediating role of GOCB in linking GHRM with environmental performance (Chaudhary, 2020;Pham et al., 2020), limited attention has been given to its role in explaining ESG outcomes. Existing research has largely focused on environmental dimensions in isolation, with comparatively little emphasis on how behavioural processes translate into integrated ESG performance across environmental, social, and governance domains (Yong et al., 2019). Moreover, there remains a lack of well-developed multi-level frameworks that explain how HR-driven practices are converted into firm-level ESG outcomes through underlying behavioural mechanisms, particularly in emerging economy contexts. By extending this logic to ESG performance, the present study provides a more

comprehensive understanding of how HR-driven sustainability initiatives translate into measurable outcomes. Thus, GOCB functions as a behavioural pathway through which GHRM influences ESG performance. Accordingly, the present study proposes the following hypothesis:

H4: GOCB mediates the relationship between GHRM practices and ESG performance.

1.6 Moderating Role of Big Data Analytical Capability

While GHRM and GOCB provide the behavioural foundation for sustainability, the effectiveness of GHRM in driving ESG performance is unlikely to be uniform across organisations (Le & Tham, 2024; Sultana et al., 2026). Rather, it may depend on the presence of complementary capabilities that enable firms to translate sustainability initiatives into measurable outcomes. In this regard, BDAC plays a particularly important role. BDAC reflects an organisation's ability to process and analyse large volumes of data to support decision-making (Mikalef et al., 2018; Sabharwal & Miah, 2021).

From an NRBV perspective, BDAC can be conceptualised as a complementary strategic capability that enhances the effectiveness of human-centric sustainability practices by strengthening information processing, responsiveness, and decision accuracy (Dubey et al., 2019; Kumar et al., 2024). By facilitating the collection, processing, and analysis of large volumes of sustainability-related data, BDAC improves transparency, monitoring, and performance evaluation (Kumar et al., 2024; Novicka, 2025). It enables organisations to generate real-time insights, identify inefficiencies, and optimise resource utilisation, thereby reinforcing the implementation of sustainability initiatives through evidence-based decision-making (Gupta & George, 2016; Wamba et al., 2017).

In the context of ESG, BDAC enables organisations to monitor sustainability performance more effectively, identify inefficiencies, and optimise resource utilisation through data-driven insights (Ooi et al., 2026). This not only strengthens the implementation of sustainability initiatives but also enhances their credibility by reducing the likelihood of symbolic or superficial compliance. In this sense, BDAC helps bridge the gap between sustainability intent and verifiable ESG outcomes by enabling more accurate measurement, reporting, and continuous performance improvement.

As a moderating variable, BDAC strengthens the relationship between GHRM and ESG performance. Specifically, high BDAC enables firms to track the "micro-contributions" of employees and convert them into "macro-disclosures". When analytical capabilities are well developed, the noise in sustainability reporting is reduced as organisations get abled to capture, interpret, and leverage sustainability-related information, thereby amplifying the impact of HR-driven practices on credible ESG outcomes (Novicka, 2025; Novicka & Volkova, 2025). Conversely, in firms with low BDAC, the positive effects of GHRM may be lost in "data silos," leading to under-reported or suboptimal ESG performance". The impact of GHRM on ESG performance may remain limited due to weak monitoring, limited feedback mechanisms, and reduced ability to translate initiatives into measurable results. Therefore, the effectiveness of GHRM in driving ESG performance is expected to be contingent upon the level of BDAC within the organisation. Accordingly, the present study proposes hypothesis (H5) as:

H5: BDAC moderates the relationship between GHRM practices and ESG performance, such that the relationship is stronger when BDAC is high.

Insert Figure 1

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3. Research methodology

3.1 Sample procedure and participants

To explore the causal impact of GHRM practices on the employees' ESG performance in organisations, a time-lagged and quantitative approach was adopted. This required collecting data from the working professionals; thus, employees engaged in manufacturing organisations established in the Indian states of Gujarat and Maharashtra were selected as the respondents for the study. The selection of the manufacturing sector is both contextually and theoretically justified owing to its disproportionate environmental footprint and regulatory exposure; making it a salient setting for examining the efficacy of GHRM practices in moulding employees' ESG performance in the organisations. Gujarat and Maharashtra were purposively selected owing to their high concentration of manufacturing industries, strong industrial

infrastructure, and proactive environmental regulatory frameworks, which make them suitable contexts for studying sustainability-oriented organizational practices.

The study employed 'Simple Random Sampling Without Replacement' **(SRSWOR)** with proportional allocation at T1. The voluntary participation of the respondents was ensured and also, they were assured of the confidentiality of their responses.

The sampling frame consisted of employees from six manufacturing firms in Gujarat and Maharashtra, with a total population of N = 1260. Respondents were proportionally selected from each organization according to their population size (see Table I) using a randomization procedure, ensuring equal selection probability and no duplication. Based on a sampling fraction of approximately 31.7%**,** a final sample of 400 respondents was derived.

Data were collected in three waves with temporal separation between measurements of different constructs of the model. This time-lagged design of the study helped in reducing common method bias and helped in strengthening the causal inferences. The respondents selected at T1 were treated as fixed panel, which was subsequently followed in upcoming waves of data collection.

Time 1 (T1) – In the first phase of the study, data on GHRM practices and BDAC were collected from 463 employees and relevant managerial personnel using a simple random sampling.

Time 2 (T2) – After a time lag of 4-6 weeks, the responses on employee's Green Organizational Citizenship Behaviour (GOCB) were collected from same respondents, yielding 432 responses.

Time 3 (T3) – Finally after another gap of 4-6 weeks, the responses on perceived ESG Performance was collected from same set of respondents. In this stage a total of 413 responses were collected.

The entire data collection process spanned over a period of 5 months 10 days. To match the responses across three waves, unique codes were assigned to each participant while maintaining anonymity. While some attrition occurred between different stages, continuous follow-ups and reminders helped retain a substantial portion of the sample. Furthermore, during data screening, only those responses that were successfully matched across all three time points were retained. The final matched sample consisted of 400 complete responses, which were used for subsequent analysis.

For ensuring data adequacy, (Raykov & Marcoulides, 2006) suggests that the total data points are required to be at least ten times equal to the free parameters taken up for the study. The total number of variables used in this study is 34 and hence, our final data set of 400 responses exceeds well the threshold level of minimum 340 observations.

Insert table I

3.2 Scale instrumentation

For the purpose of data collection, the entire questionnaire was divided into two sections: Section 1 consisted of socio-demographic details of the respondents and Section 2 consisted of responses of the participants regarding their GOCB, GHRM practices, BDAC and ESG performance in the organisation. All the scales were adapted from established studies using validated Likert scales. All the constructs exhibited internal consistency ($\alpha > 0.933$) for our study. The details are exhibited in the table II.

Insert table II

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4. Data analysis & results

Initially, the demographic data of our study was evaluated through descriptive statistics followed by assessment of the structural equation modelling through variance based PLS-SEM. (Henseler et al., 2009) suggests that a two-step approach be adopted, where the confirmatory factor analysis (CFA) is first conducted to evaluate the reliability and validity of the adapted scales of the constructs, and then structural model assessment is carried out. PLS-SEM has been preferred for our study owing to its ability to handle sample size issues and non-normal distribution data and thus, has emerged to be an analytical tool with maximising explained variance for predictive structural model (Sarstedt et al., 2014; She et al., 2023).

4.1 Common Method Bias

As suggested by Podsakoff et al. (2012), to examine common method bias, Harman's single-factor method was employed, wherein all the factors were loaded onto a single factor. The results exhibited a value of 38.913%, far below the threshold level of 50%; thereby indicating no issues of common method bias.

4.2 Demographic Analysis

The demographic profile of the respondents shows a balanced yet slightly male-dominated sample, with 65% male and 35% female participants. In terms of age distribution, the largest group falls within the 34–39 years category (32.5%), followed by those aged 30–34 years (27.5%) and 25–29 years (22.5%), while younger respondents (18–24 years) and those aged 40 years and above represent smaller proportions at 10% and 7.5%, respectively. Regarding work experience, most respondents have between 1–4 years (30%), with comparable representation in the 5–9 years (27.5%) and 10–14 years (27%) categories, whereas relatively fewer participants have longer tenure, including 15–19 years (10.8%) and 20 years or more (4.8%). In terms of designation, a majority of the respondents hold managerial positions (69.3%), while the remaining 30.8% are in non-managerial roles. Overall, the sample reflects a predominantly mid-career workforce with moderate experience and a strong representation of managerial employees. Detailed information is presented in ***Table III***.

Insert table III

4.3 Measurement model assessment

In our hypothesised model, the endogenous variable- ESG (Environmental, Social, and Governance) performance has been taken as a reflective-formative higher order construct (HOC) with its latent variables- Environmental, Social, and Governance as lower order constructs. For this purpose, a disjoint two-stage approach has been used to evaluate construct reliability and validity (Sarstedt et al., 2019). To evaluate the quality criteria of the measurement model, factor loadings are estimated, followed by VIF values (for multicollinearity and reliability and validity assessment of the lower order constructs.

4.3.1 Lower order construct measurement model

- Factor loadings

As suggested by (Hair, Sarstedt, et al., 2014), the threshold level of factor loadings that ranges from -1 to +1, with higher values indicating higher correlation of items with their individual underlying construct, is 0.60. In our study, 34 items were evaluated and none of the outer loadings were under 0.60 and hence, no item was removed (***See Table IV***).

- Indicator multicollinearity

The indicator multicollinearity is evaluated through variance inflation factor (VIF) statistic (Fornell & Bookstein, 1982). The study finding depict all the VIF values below the recommended level of 5 (Hair, M.Hult, et al., 2014)and hence, no multicollinearity issues was found.

- Reliability analysis

To estimate the stability and consistency of the measuring instruments, two approaches- Cronbach Alpha and Composite Reliability (CR) are used. The results as demonstrated in Table 2, highlight the Cronbach alpha values ranging from 0.95 to 0.933 and Composite Reliability values ranging from 0.96 to 0.946; thereby showing that all the constructs have adequate reliability statistics above the threshold level of 0.70 (Hair et al., 2011).

- Construct validity

Construct validity is determined by convergent validity, indicated by Average Variance Extracted (AVE) values and discriminant validity, indicated by HTMT and Fornell-Larcker values.

All AVE values in the findings were found above the recommended value of 0.50, indicating that the items of the individual construct have converged to their underlying construct, thus establishing convergent validity (Hair et al., 2021).

For discriminant validity, the HTMT values are equal to or below the cut-off level of 0.90 (Henseler et al., 2015); thus establishing the distinctiveness of each construct in the proposed model. Further, it is found that the square root of AVE of the construct is greater than its correlation with other construct, thereby strongly supporting discriminant validity (Fornell & Larcker, 1981).

Insert table IV

Insert table V

Insert figure 2

4.3.2 Validity of Higher order construct measurement model

The endogenous variable of our hypothesised model- ESG Performance is a reflective-formative higher order construct which has been constructed using the latent scores of its lower order constructs- Environmental, Social & Governance performance. For measuring the construct validity of the formative HOC, the significance of outer weights, outer loadings and VIF values are used. The results exhibit the VIF values below the threshold of 5 (Edeh et al., 2023) and also the outer loadings were found to be higher than 0.50 (Sarstedt et al., 2019). The p-values of outer weight of the LOCs were less than 0.05; thereby showing statistical significance (Sarstedt et al., 2019). Thus, all the criteria were met to establish the construct validity of the higher order construct.

Insert table VI

4.4 Structural Model Assessment

To substantiate the proposed hypotheses, their path coefficient and statistical significance is evaluated through a bootstrapping procedure with 5000 bootstrap samples and confidence interval of 95%. The results of the structural model assessment demonstrated that green HRM has a significant and positive impact on the employees' ESG performance in the organisation (β=0.380, t=9.319, p<0.001); thereby supporting H1. The estimation of hypothesis H2 provided evidence of a significant and positive impact of green HRM on the GOCB of the employees (β=0.599, t=17.443, p<0.001); thereby supporting H2. Similarly, findings of hypothesis H3 estimation exhibited that GOCB of the employees positively and significantly impact their ESG performance in the organisation (β=0.457, t=10.965, p<0.001); thus, supporting H3. Furthermore, the interaction effect of BDAC×GHRM→GOCB was also found significant and positive (β=0.348, t=5.227, p<0.001).

To confirm the adequacy of the sample predictive power, the coefficient of determination (R-square values) was estimated (Hair Jr et al., 2021); findings showed values surpassing the

threshold level of 0.20, exhibiting medium predictive power. Similarly, the Q-square values were estimated for predictive relevance in PLS-SEM; the results showed values: 49.6% (GOCB), 45.7% (ESG Performance), indicating moderate predictive relevance of the path analysis model. The results are summarised in Table VII and Figure 3.

Insert table VII

Insert table 3

4.5 Mediation analysis

To assess the mediating role of employees' GOCB on the relationship of their GHRM and ESG performance, mediation analysis was performed. As depicted in table VIII the results exhibit significant ($p<0.05$) and partial mediation effect of GOCB ($\beta = 0.599 \times 0.457 = 0.273$, $t = 9.292$, $p < 0.001$, LL = 0.227, UL = 0.324). Further, the total effect of GHRM on ESG performance was also found significant ($\beta = 0.653$, $t = 23.067$, $p < 0.001$) and after the mediating variable was included, the direct effect was also found to be statistically significant ($\beta = 0.380$, $t = 9.319$, $p < 0.001$). Further, in accordance to (Preacher & Hayes, 2008), the upper limit (95%) and lower limit (5%) confidence interval did not include zero values validating the statistical significance of the mediating variable. Thus, it is prominently evident that employees' green organisational citizenship behavior bears a complimentary partial mediation effect on GHRM-ESG performance relationship; thereby supporting H4.

Insert table VIII

4.6 Moderated Mediation analysis

The findings provide evidence of the significant effect of the moderating role of BDAC [Index value = 0.159, SE = 0.035, t = 4.59, 95% CI = (0.117, 212)]. Further, it was found that at a higher level of BDAC, the indirect effect of green HRM on ESG performance through GOCB (Path = 0.432, t-value = 8.552, $p<0.001$) is higher when compared with the indirect effect at the mean level (Path = 0.273, t-value = 9.292, $p = 0.002$) and at low level of BDAC (Path = 0.114, t-value = 2.886, $p<0.001$). Supporting these results, the slope analysis (see figure 4) also aligns with the hypothesized relationship, indicating that as BDAC increases, the indirect effect of GHRM on ESG performance through GOCB become stronger; thereby supporting moderated mediation.

Insert table XI

Insert figure 4

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5. Discussion

The core objective of the present study is to investigate how and under what conditions GHRM practices influence ESG performance in Indian manufacturing organization. Integrating the AMO framework within NRBV, this study develops and empirically examines a moderated mediation model in which GOCB serves as the key behavioural mechanism, while BDAC act as an enabling boundary condition. The findings provide strong support for the proposed model and offer a theoretically grounded explanation of how organizational sustainability intent is effectively operationalized into consistent ESG outcomes.

The results confirm a significant positive direct effect of GHRM practices on ESG performance, thereby supporting H_1. The finding underscores the efficacy of HR systems grounded in the AMO framework in shaping sustainability outcomes. Specifically, GHRM practices enhance employee environmental capabilities through structured training, strengthen motivation through green performance management and incentives and creates opportunities

for engagement via participative environmental initiatives (Veerasamy et al., 2024). These elements collectively align individual behaviours with organizational sustainability objectives, thereby contributing to stronger ESG performance. In the context of Indian manufacturing, characterized by high environmental footprint and increasing regulatory pressure, such alignment becomes particularly important (Shubham et al., 2018). The findings imply that the structure of HR interventions can directly enhance the ESG outcomes, even when behvaioural routines are not yet fully developed. This finding is consistent with prior studies linking HR practices to sustainability outcomes (Tejasmayee et al., 2025); however, its pronounced effect in the study may reflect the operational conditions of manufacturing firms in regions such as Gujarat and Maharashtra. In these resource-intensive environments, even small improvements in employee practices such as efficient energy use, waste reduction and adherence to environmental protocol can lead to disproportionately large ESG gains (Kandpal et al., 2024). Thus, contextual factors enhance the effectiveness of GHRM practices, highlighting their strategic significance in driving sustainability performance.

The finding further reveals that GHRM practices positively influence employee GOCB, thereby confirming H_2. The result illustrates the behavioural pathway through which HR practices move beyond formal compliance to shape discretionary pro-environmental behaviour. From the AMO perspective, GHRM practices strengthen employees' capabilities, promote intrinsic and extrinsic motivation and create opportunities for meaningful contribution (Waseem et al., 2025). As a result, employees engage in voluntary behaviours including proactive resource conservation, environmental advocacy and peer influence, which, although not formally required, are critical for sustainability execution (Lülfs & Hahn, 2013). This suggests that HR systems achieve greater effectiveness when they cultivate commitment-driven engagement alongside compliance.

Furthermore, the result confirms H_3, indicating that GOCB has a significant positive impact on ESG performance. This finding demonstrates that employee discretionary behavior as a key micro foundation of organizational sustainability performance. Within the NBRV framework, these behaviours function as strategic capabilities that support pollution prevention, stakeholder engagement and long-term environmental competitiveness (Alkaraan et al., 2024). Instead of relying solely on formal systems or symbolic ESG reporting, sustainability implementation is achieved through the aggregation of continuous, employee-driven behaviour (Chiucchi et al., 2025). This result highlights a shift from macro-level policy adoption to micro-

level behavioural execution, highlighting that ESG performance is fundamentally driven by employees' daily organizational practices.

The mediation analysis further shows that GOCB partially mediates the relationship between GHRM and ESG performance, thereby supporting H_4. This finding enhances understanding of the mechanism through which HR practices are converted into measurable sustainability outcomes. Although GHRM has a direct effect, its impact becomes stronger when it effectively stimulates discretionary green behaviour among employees (Rubel et al., 2021). Accordingly, GOCB functions as a behvaioural conduit through which structured HR policies are translated into continuous and adaptive sustainability practices (Efranto et al., 2026). The partial mediating effect highlights a dual mechanism in which GHRM impacts ESG performance both through formal organizational systems and indirectly through behavioural processes. This duality underscores the importance of integrating structural and behavioural mechanisms to achieve sustained ESG performance.

The moderating role of BADC, as supported in H_5, further enhances this relationship by introducing a boundary condition. The analysis demonstrates that BADC positively moderates the relationship between GHRM and GOCB and enhances the overall indirect effect of GHRM on ESG performance. The result highlights BADC as a key organizational capability that improves the effectiveness HR based sustainability initiatives. By advancing the organizations' data processing capabilities, BADC enables real-time feedback, actionable insights and greater performance visibility to employees (Shafique et al., 2026). This, in turn, promotes environmental responsible actions and supports more informed decision-making at the operational level. Altogether, the highlight is that achieving meaningful ESG performance requires not only formal systems and strategic intent but also the active engagement of employees and the supporting infrastructure that enables data-driven sustainability practices.

5.1 Theoretical implications

Present study advances theoretical knowledge by integrating the AMO framework with NRBV to explain how ESG performance is rooted in micro-level processes. First, we extend the AMO framework by illustrating how GHRM practices operationalize its core dimensions' ability, motivation and opportunity in sustainability context. Our findings suggest positioning GHRM as a systematic mechanism that aligns employee competences, incentives and involvement with environmental goals, thereby, linking organizational intent into employee action. Second, we advance behavioural perspective by identifying GOCB as a mediating mechanism between

GHRM and ESG performance. This suggests that formal HR practices must be complemented by discretionary employee behvaiours to ensure sustained environmental engagement and effective implementation of sustainability initiatives. Third, we contribute to NRBV by establishing GOCB as a fundamental micro driver of environmental capabilities. By linking individual-level behvaiour with organizational outcomes, the findings provide a more comprehensive understanding of how sustainability capabilities are enacted in practice. Finally, we extend both AMO and NRBV by introducing BADC as a complementary capability that strengthens their explanatory power. The results indicate that BADC enhances the GHRM - ESG relationship by reinforcing the behvaioural pathway through improved data transparency and informed decision-making. This underscores the importance of digital capabilities in amplifying the effectiveness of HR driven sustainability initiatives. These contributions present an integrated framework linking HR practices, employee behaviour, and analytical capabilities in driving sustained ESG performance.

5.2 Practical Implication

The findings of the study provide insightful recommendations for policymakers, managers and regulatory authorities in Indian manufacturing sectors that would enable them to effectively leverage sustainable human resource practices and analytical abilities for robust ESG performance.

The significant impact of green human resource management on ESG performance indicates that green HR practices need to be institutionalized by organizations such as targeted environmental training, ESG-linked performance appraisal systems, and employee participation in sustainability initiatives since the scope of GHRM has extended beyond from being a mere compliance oriented function to being a strong catalyst for sustainability and thus, instilling such kind of practices in diurnal employee's working cycle would ensure that environmental responsibility becomes an integral part rather than a peripheral activity.

Secondly, green organisational citizenship behavior needs to be actively cultivated among the employees so as to maximize the positive impact of GHRM. Supportive organizational environment for the employees needs to be created by managerial leaders, thereby motivating them to voluntarily engage in pro-environmental actions extending beyond their routine work responsibilities. Recognizing the employees' discretionary efforts and rewarding them could be an initiative to encourage such behaviors. Additionally, to strengthen employee engagement in sustainable practices, short-term sustainability goals and a reward system, could be established that can lead to continuous reinforcement.

Further, given the big data analytical capability's (BDAC) pivotal role, organizations must invest in data-driven infrastructures to bolster sustainability decision-making. Managers should deploy real-time monitoring systems for resource use—such as energy consumption, emissions, and waste generation—and weave these insights into daily operations. By delivering accessible, actionable data to employees, firms can boost awareness, foster accountability, and drive effective sustainability practices at the operational level. Moreover, to reinforce the behavioral pathway from GHRM to ESG performance, BDAC can be fused with HR systems. This would involve embedding data-driven feedback in performance management, with regular tracking, evaluation, and communication of sustainability metrics. Such integration helps employees grasp their environmental impact and align actions with clear, measurable indicators, promoting sustained pro-environmental behaviors.

Finally, policymakers and industry bodies should promote GHRM and BDAC adoption by crafting sector-specific ESG guidelines and incentivizing digital tools in manufacturing. Support for sustainability training, data infrastructure, and ESG reporting will shift firms from mere compliance to proactive, performance-led strategies.

6. Conclusion and limitations of the study

The results of the study provide empirical evidence of all the proposed hypotheses; thus, establishing that Green HRM practices of the employees significantly enhances ESG performance of the organisations with Green Organizational Citizenship Behavior (GOCB) serving as a catalytic leverage through its direct and partial complementary mediatory role and Big Data Analytical Capability (BDAC) strengthening this pathway as a moderator. Grounded in the AMO framework and NRBV, these findings highlight GOCB as a critical behavioral micro-foundation linking HR-driven sustainability initiatives to firm-level outcomes, while BDAC enables data-validated execution. Theoretically, the integrated model advances understanding of how human, behavioral, and digital capabilities converge to drive ESG success in resource-intensive sectors.

6.1 Limitation and future Scope

Along with theoretical and practical insights provided by the study, certain limitations were also encountered during the course of the study, which can be explored in future research. Firstly, a cross-sectional time-lagged design approach was adopted for the study, which nevertheless minimises common method bias; however, a longitudinal or experiential study could provide more depth to our study. Secondly, the participants selected for our study were

limited to the manufacturing sectors of the two states of Gujarat and Maharashtra, which might lead to self-reported bias or affect the generalizability of the results. Extending this study to other sectors like service, healthcare, or retail would enrich its findings. Further, future research could also employ objective ESG data, multi-source ratings, or expand to other industries and regions for broader validation of the inferred primary data collected results of this study.

Declarations

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics Approval

This study was conducted in accordance with accepted ethical standards for research involving human participants. The research procedures complied with institutional research guidelines and ethical principles for voluntary participation, confidentiality, and anonymity.

Consent to Participate

Informed consent was obtained from all participants prior to their participation in the study. Participation was entirely voluntary, and respondents were informed about the purpose of the study and their right to withdraw at any stage.

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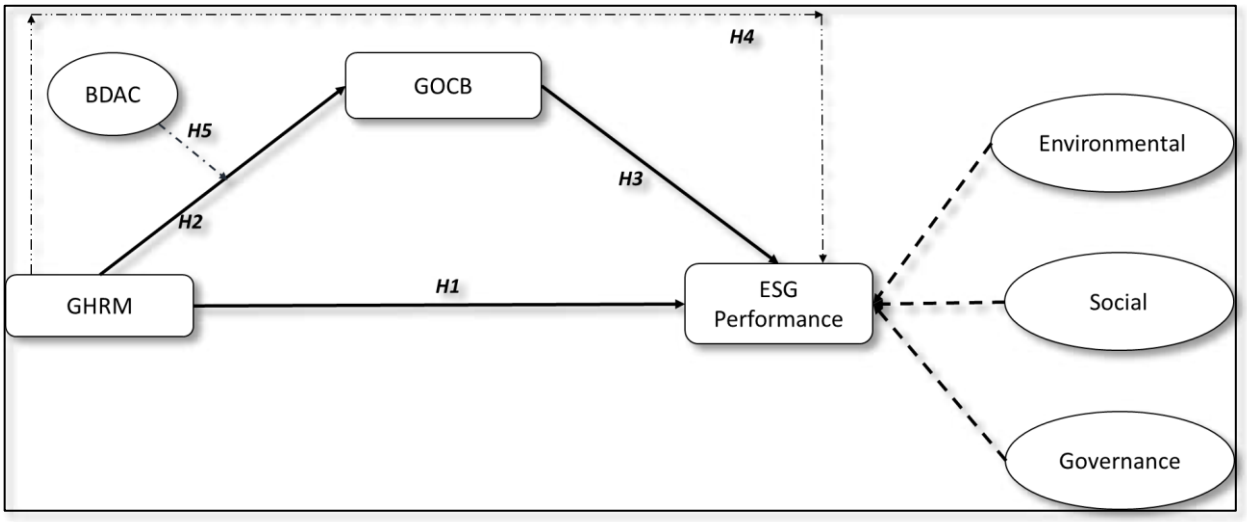
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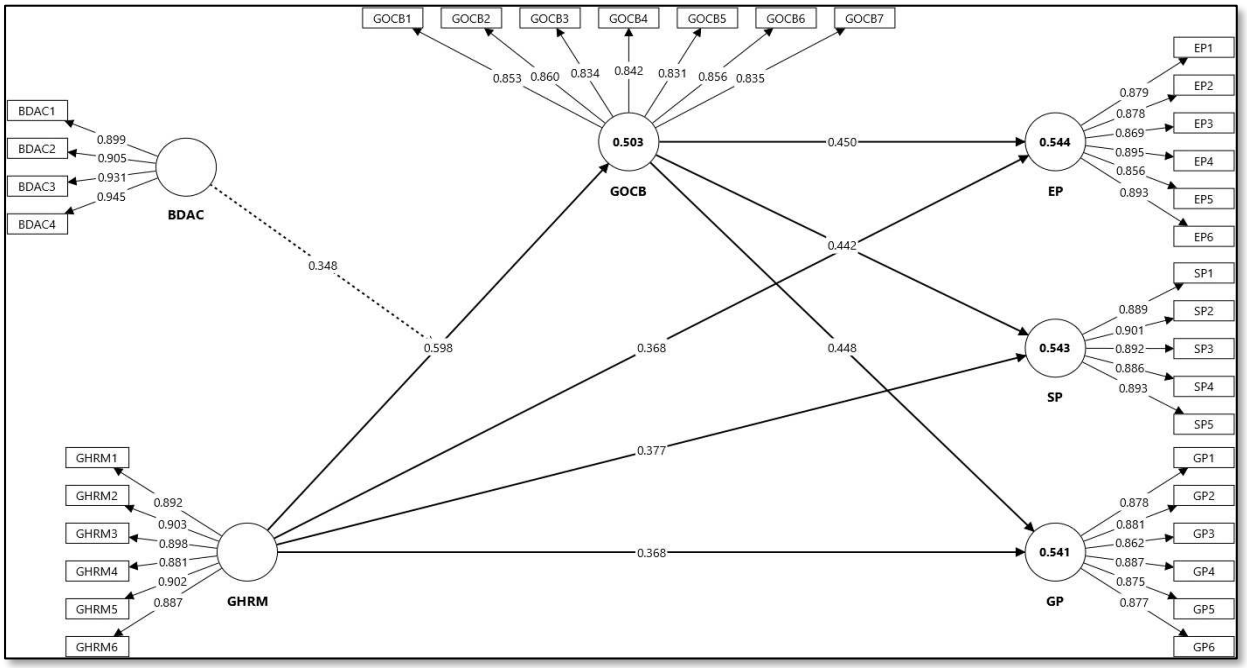
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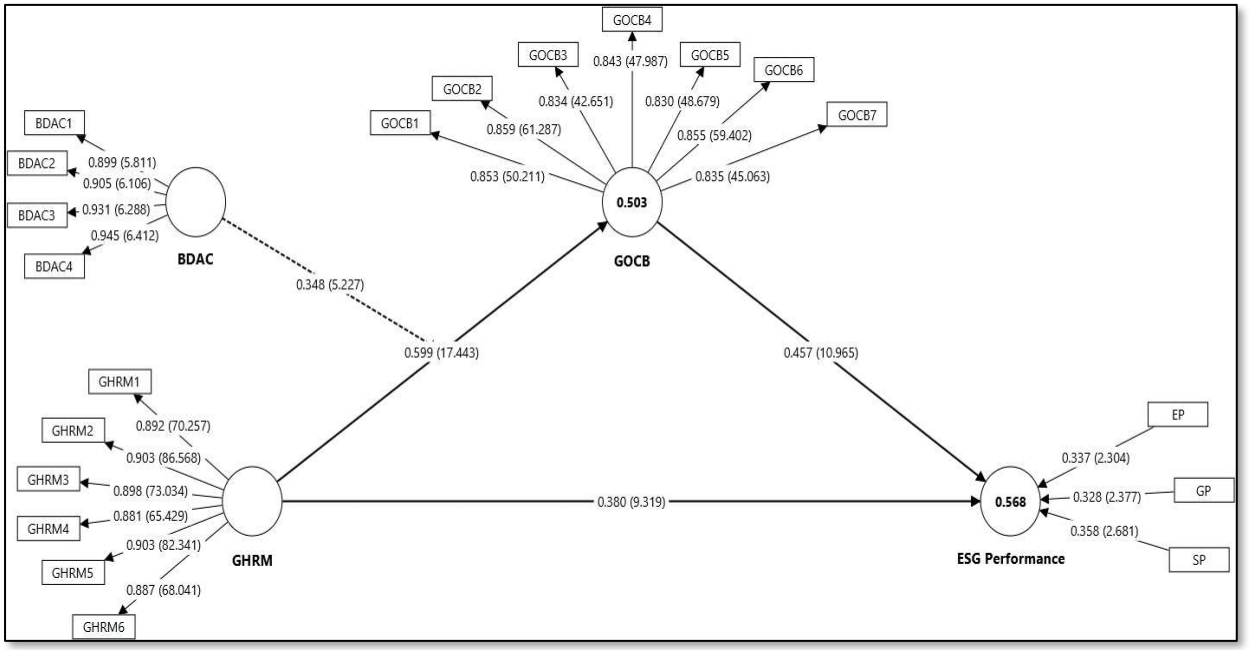
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Figure 1. Conceptual Framework



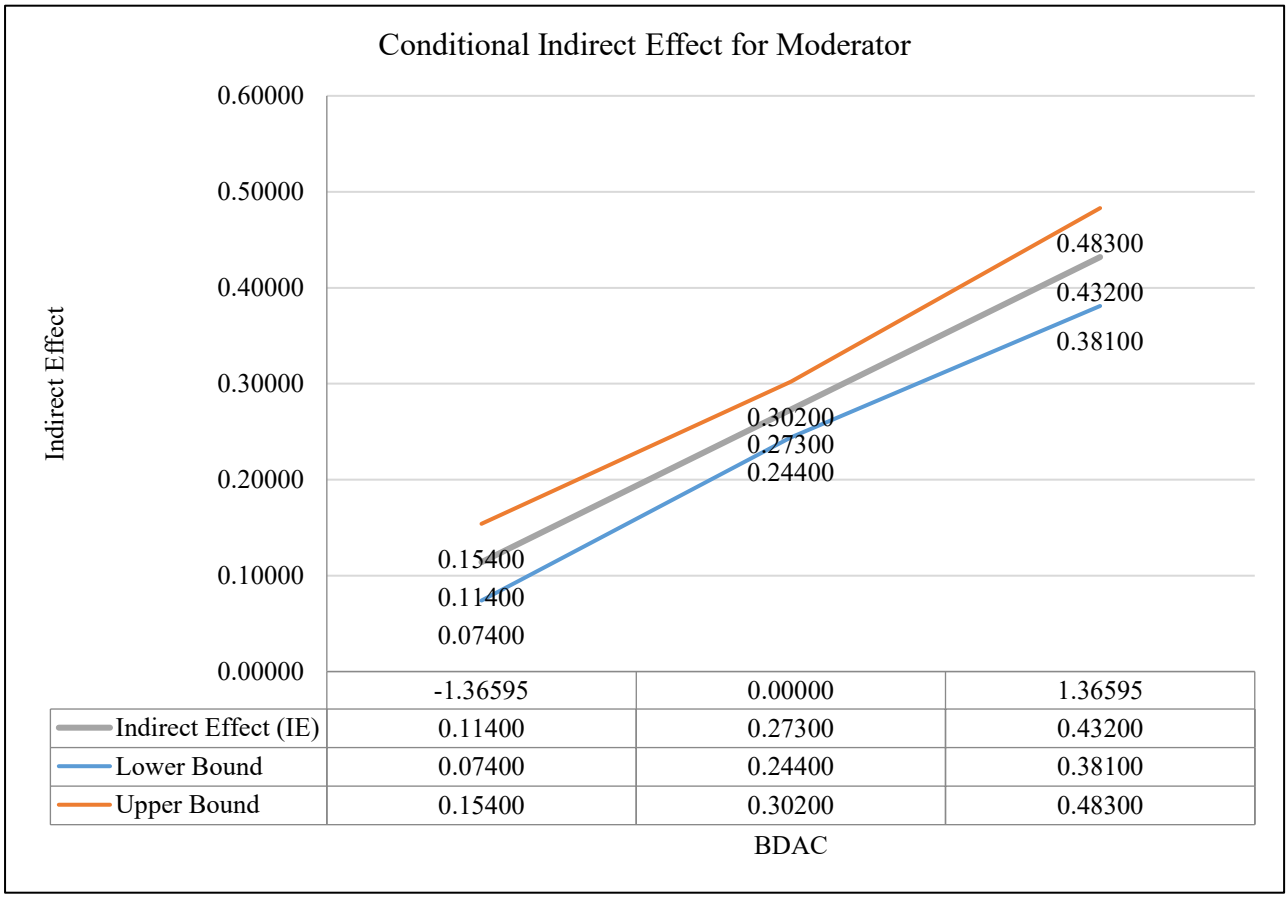
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Figure 2. Measurement Model Analysis



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Figure 3. Bootstrapping (*t*-values) for the higher order model



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Figure 4. Slope Analysis

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