Influence of Business Intelligence, Environmental Instability, and Eco-Innovation on Financial Outcomes with Cultural Moderation in Digital Age

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ABSTRACT

This paper aimed to determine whether Business Intelligence (BI), Environmental Uncertainty (EU), and Green Product Innovation (GPI) affect Financial Performance with Organizational Culture as a moderating variable. A total of 311 respondents with minimum managerial level from manufacturing companies listed and not listed on the Indonesia Stock Exchange participated. Data was obtained through questionnaires, and SEM-PLS analysis was used with Smart PLS statistical tool. Research findings show that Environmental Uncertainty affects Financial Performance, while Business Intelligence and Green Product Innovation do not. The impact of Green Product Innovation on Financial Performance is strengthened by Organizational Culture moderation, however, the effect of Business Intelligence and Environmental Uncertainty on Financial Performance is not strengthened by with Organizational Culture (OC) moderation. Academically, this research enriches literature related To Business Intelligence, Environmental Uncertainty, Green Product Innovation, and Financial Performance in the digital era, and can serve as a reference for future research. Practically, the results of this research help companies face competition with faster and more accurate decision making, improving operational quality and customer service. Additionally, for regulators, this research can serve as a basis for formulating policies that support sustainable business, particularly regarding Green Product Innovation and Environmental Uncertainty management.

Keywords*: Business Intelligence, Environmental Uncertainty, Financial Performance, Green Product Innovation.*

ABSTRAK

Penelitian ini bertujuan untuk mengetahui apakah Kecerdasan Bisnis, Ketidakpastian Lingkungan, dan Inovasi Produk Hijau berpengaruh terhadap Kinerja Keuangan dengan Budaya Organisasi sebagai variabel moderasi. Sebanyak 311 responden dengan level manajerial minimal dari perusahaan manufaktur yang terdaftar dan tidak terdaftar di Bursa Efek Indonesia berpartisipasi. Data diperoleh melalui kuesioner, dan analisis SEM-PLS digunakan dengan alat statistik Smart PLS. Temuan penelitian menunjukkan bahwa Ketidakpastian Lingkungan mempengaruhi Kinerja Keuangan, sedangkan Kecerdasan Bisnis dan Inovasi Produk Hijau tidak. Pengaruh Inovasi Produk Hijau terhadap Kinerja Keuangan diperkuat oleh moderasi Budaya Organisasi, namun pengaruh kecerdasan bisnis dan ketidakpastian lingkungan terhadap kinerja keuangan tidak diperkuat oleh moderasi OC. Secara akademis, penelitian ini memperkaya literatur terkait kecerdasan bisnis, ketidakpastian lingkungan, Inovasi Produk Hijau, dan Kinerja Keuangan

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di era digital, serta dapat menjadi referensi untuk penelitian selanjutnya. Secara praktis, hasil penelitian ini membantu perusahaan dalam menghadapi persaingan dengan pengambilan keputusan yang lebih cepat dan akurat, meningkatkan kualitas operasional dan pelayanan kepada pelanggan. Selain itu, bagi regulator, penelitian ini dapat menjadi dasar dalam merumuskan kebijakan yang mendukung bisnis yang berkelanjutan, khususnya terkait inovasi produk hijau dan manajemen ketidakpastian lingkungan.

***Kata kunci**: Kecerdasan Bisnis, Ketidakpastian Lingkungan, Kinerja Keuangan, Inovasi Produk.*

INTRODUCTION

In the digital era, rapid economic development and uncertainty are major challenges for companies, especially in Indonesia. Although influenced by market fluctuations and global policies, innovative strategies can improve company performance (Aldarmaki, 2023). In the health sector, the ability to adapt to uncertainty and the use of digital technology affect financial performance (Suaedi, 2019). The integration of digital decision-making tools also increases the agility and cost efficiency of organizations (Augustin et al., 2024). Besides, digital business transformation also contributes significantly in improving Digital business transformation plays an important role in improving organizational performance (Hidayat et al., 2024). This transformation drives innovation, HR development, and better decision making (Syahpria et al., 2024). Al-Ayed et al. (2023), the use of digital technology helps companies adapt to changing business dynamics and Maaitah (2023) will be more effective if supported by business intelligence to support strategic decisions. However, organizational performance is also influenced by other factors such as the environment, culture, politics, economy, and leadership (Hussain et al., 2023).

Based on this explanation, this study aims to obtain empirical evidence regarding factors that influence financial performance by referring to previous research. This study uses an approach from research by Vugec et al. (2020) which examined the impact of business intelligence on organizational performance through distributing questionnaires to more than 50 employees in Croatia and Slovenia. In addition, this study also adds independent variables such as Environmental Uncertainty, Green Product Innovation, and organizational culture.

The first factor, Business Intelligence (BI), plays an important role in analyzing problems and supporting decision making (Maaitah, 2023). BI enables data management through decision support systems, Online Analytical Processing (OLAP), statistical analysis, forecasting, and data mining, and has a significant impact on measuring organizational performance by Vugec et al. (2020), Huang et al. (2022), and Yang et al. (2022). The second factor is environmental uncertainty, which is influenced by market, technology, and competitive pressures. The higher the uncertainty, the greater the need for organizations to adapt effectively (Berlian et al., 2024). Environmental uncertainty has been shown to have a positive impact on performance. The third factor, Green Product Innovation, refers to new or modified products to reduce environmental impact. Sustainable technological innovation is needed to maintain competitive advantage (Dewi & Hasibuan, 2024). Studies also show that green innovation affects organizational performance.

The fourth factor, organizational culture as a moderating variable reflects the basic beliefs that influence the vision, mission, and values of the organization, and plays an important role in determining economic performance (Akpa et al., 2021). A culture that is aligned with the Business Intelligence strategy encourages data-based decision making, improves performance, customer satisfaction, and employee engagement. Organizational culture also helps respond to environmental uncertainty and increases organizational effectiveness. Green product innovation as part of a strategy requires changes in business processes and new skills supported by policies. The relationship between organizational

culture, innovation, and company performance has been studied previously (Aboramadan et al., 2020).

In conditions of high uncertainty, organizations need adaptive strategies to deal with change. The contingency approach emphasizes the importance of organizational flexibility. This research is important because it was conducted in Indonesia, a developing country with different business practices from developed countries. There is a research gap related to Business Intelligence (BI) studies by Paulino (2022) stated that BI increases knowledge sharing, innovation, and performance, while Vugec et al. (2020) found that BI had no significant effect, so further studies are needed. Jusoh (2010) and Adhikara et al. (2022), environmental uncertainty also has a significant effect on organizational performance, but in Indonesia, Sudaryati (2020) found a negative effect when using non-financial performance measures. Regarding green product innovation, Liu (2024) showed that there was no significant difference in financial performance between green and non-green companies, so further research is needed in the Indonesian context.

This study offers a new perspective compared to previous studies by considering differences in time, geographical location, and moderating factors such as organizational culture. The focus is on manufacturing companies in Indonesia, both listed on the Indonesia Stock Exchange (IDX) and not. With this approach, this study is expected to contribute to improving the effectiveness of business strategies in facing environmental uncertainty, as well as exploring the role of Business Intelligence and green product innovation in improving organizational performance.

LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

Business Intelligence on Financial Performance

Business Intelligence was first introduced by American professor Harold Wilensky in 1967 as a technological tool that helps organizations in decision-making. In industry, BI is claimed to solve problems by transforming large amounts of data into information and knowledge. Information generated from Business Intelligence (BI) can predict future trends, enabling organizations to plan their operations effectively. The BI variable consists of data warehouse, OLAP, and Data Mining, adapted from studies by Eidizadeh et al. (2017).

Organizations tend to achieve better outcomes when they reach a higher level of maturity in utilizing Business Intelligence (BI). Business Intelligence (BI) maturity reflects the extent to which an organization has developed the necessary skills, technologies, and processes to effectively leverage BI tools and data-driven decision-making. Studies show that organizations with greater BI maturity generally experience more success in their BI initiatives, leading to enhanced performance across various business functions. Larger organizations, in particular, often demonstrate higher levels of BI maturity compared to small and medium-sized enterprises, likely due to more extensive resources and capabilities to invest in advanced BI systems (Huang et al., 2022; Paulino, 2022).

The effective use of Business Intelligence significantly contributes to improved knowledge sharing within organizations. By facilitating the collection, analysis, and dissemination of data, BI promotes collaboration and innovation, enabling companies to respond more agilely to market changes and internal challenges. This capability fosters a culture of continuous improvement and drives competitive advantage. Several empirical studies support the positive impact of Business Intelligence on financial performance, showing that organizations that successfully implement Business Intelligence achieve better profitability and operational efficiency (Vugec et al., 2020; Yang et al., 2022).

H1: Business intelligence has a positive influence on financial performance.

Environmental Uncertainty and Financial Performance

Uncertainty is an unexpected change in external environmental factors. Environmental uncertainty as the level of change and uncertainty in external understanding. Complexity and rate of change are two features that characterize

environmental uncertainty. That complexity is caused by the heterogeneity of relevant environmental events. The rate of change involves the frequency of changes occurring in the external environment. Core elements of external environmental factors, also called external environmental uncertainty, include market pressure and competition. Other studies classify socio-political factors as elements of perceived environmental uncertainty of an organization. The definition of the external environment includes government agencies, customers, suppliers, competitors, and labor unions. This research assesses environmental uncertainty by utilizing eight adapted items from Khandwalla (1972), Govindarajan (1984), Gordon and Narayanan (1984).

Changes in external factors such as technological developments, market dynamics, and fierce competition cause companies to face environmental uncertainty. In such situations, management is pressured to improve the performance of the organization. To respond effectively, managers can leverage external information and market trends through strategic networks that help secure business opportunities. These connections allow companies to remain adaptive and competitive. Environmental uncertainty has an important impact on business performance, as supported by the findings of Kafetzopoulos et al. (2020), emphasizing the importance of proactive management in Environmental uncertainty.

H2: Environmental uncertainty has a positive influence on financial performance.

Green Product Innovation and Financial Performance

Green product innovation refers to the process of designing and developing products that incorporate environmentally sustainable elements, including energy-saving capabilities, reduced emissions, effective waste handling, use of non-hazardous materials, and ecological design considerations. Through such initiatives, companies not only contribute to environmental protection but also minimize legal risks and avoid penalties related to environmental regulations. Moreover, investing in green innovation can unlock new business opportunities and improve competitiveness in the growing green market. By prioritizing eco-friendly product development, organizations are able to strengthen their environmental competencies, improve public perception, and elevate their brand image. These improvements, in turn, can enhance overall financial performance. As noted by Wang and Ahmad (2024), eco-innovation is strongly tied to a company's long-term success and sustainability. To measure Green Product Innovation (GPI), this study adopts three indicators developed by Xie et al. (2019), which capture the company's efforts in producing environmentally conscious products and embedding green values in their operations.

According to Andersén (2021) with green product innovation, raw materials used in production are more efficient, resulting in lower costs. Additionally, companies can obtain legitimacy from society because they have paid attention to the environment, thus having a good impact on the company's survival. The influence of green product innovation on financial performance has been researched by Borsatto and Bazani (2023) and Nsiah, Danso (2022).

H3: Green product innovation has a positive influence on financial performance.

Organizational Culture, Business Intellegence, and Financial Performance

Organizational culture is a system of shared values and interpretations held by its members, which distinguishes one organization from another. According to Muijen et al. (1999), this culture is characterized by four main dimensions such as supportive culture that emphasizes caring and collaboration, innovative culture that encourages creativity and change, rule-based culture that focuses on structure and procedures, and goal-oriented culture that emphasizes results and achievement. These cultural dimensions influence the way members interact, make decisions, and contribute to the identity and effectiveness of the organization.

Organizational culture has been the subject of numerous studies aimed at uncovering its impact on organizational performance and longevity. Organizational culture has a direct influence on company performance. A cohesive organizational culture, characterized by shared work ethics, beliefs, and values, along with effective communication systems, fosters a sense of identity among employees, leading to improved commitment and performance. It is not solely technical expertise that drives successful BI implementation, but rather the organizational culture that underpins it also plays a crucial role (Strazzullo et al., 2023). Thus, if organizational culture aligns with the BI vision, the organization moves in a better direction. Organizational culture and business intelligence (BI) are interconnected in helping organizations make the right decisions and improve performance.

H4: Organizational culture has a positive influence on of business intelligence on financial performance.

Organizational Culture, Enviromental Uncertainty and Financial Performance

Stakeholder Theory was first introduced in Freema's (2010) Strategic Management, namely the Stakeholder Approach. Since the 1970s, the concept of corporate social responsibility has gained prominence, which is the basis of this theory. Stakeholder Theory is relevant in addressing issues related to environmental uncertainty and organizational performance, because it recognizes that organizations interact with various interest groups. These stakeholders include investors and non-investor groups such as customers, employees, suppliers, local communities, and government agencies, all of whom influence and are influenced by the company's strategic actions and decisions.

Organizational culture and environmental uncertainty are two interrelated elements that can have a significant impact on a company's financial performance. A strong organizational culture acts as a strategic tool for management to respond to environmental uncertainty more proactively, through the formation of shared values, beliefs, and behaviors that support adaptive decision-making processes. This is in line with the findings of Baloch et al. (2022), which emphasize that a conducive organizational culture can increase the effectiveness of an organization in dealing with external dynamics and drive better financial performance. However, this view differs from Sørensen (2002) research, which found that a strong organizational culture tends to be effective in a stable environment, but is less adaptive in more dynamic conditions. The study showed that companies with a strong culture have more consistent performance in stable conditions, but lose this advantage when faced with environmental instability. This difference shows that the effectiveness of organizational culture is highly dependent on the context of the external environment faced by the company.

H5: Organizational culture strengthens positive influence of environmental uncertainty on financial performance.

Organizational Culture, Green Product Innovation, and Financial Performance

The process of implementing strategies such as green product innovation often demands significant adjustments within a company. This includes introducing improvements to existing products, adopting new skills, and modifying business processes. These changes are essential to align with the goals of sustainability and innovation, but they require careful planning and policy support to ensure that organizational performance targets are met. Green product innovation is not just about developing environmentally friendly products, it also involves transforming the way a company operates, which can affect various departments and functions across the organization. For instance, employees may need to learn new techniques or technologies, and workflows might have to be redesigned to accommodate sustainable practices. To facilitate these changes effectively, companies need clear policies that guide implementation, encourage innovation, and foster a culture supportive of continuous

improvement. The role of organizational culture in this context is crucial because it shapes how employees perceive and embrace innovation. A strong culture that values creativity, sustainability, and adaptability can accelerate the successful adoption of green innovations, ultimately leading to better organizational outcomes. Previous studies have highlighted the connection between organizational culture, innovation, and company performance, emphasizing that these elements work together to drive success (Aboramadan et al., 2020). Therefore, for companies aiming to enhance performance through green product innovation, cultivating an appropriate organizational culture and establishing supportive policies are vital steps in the implementation process.

H6: Organizational culture strengthens positive influence of green product innovation on financial performance.

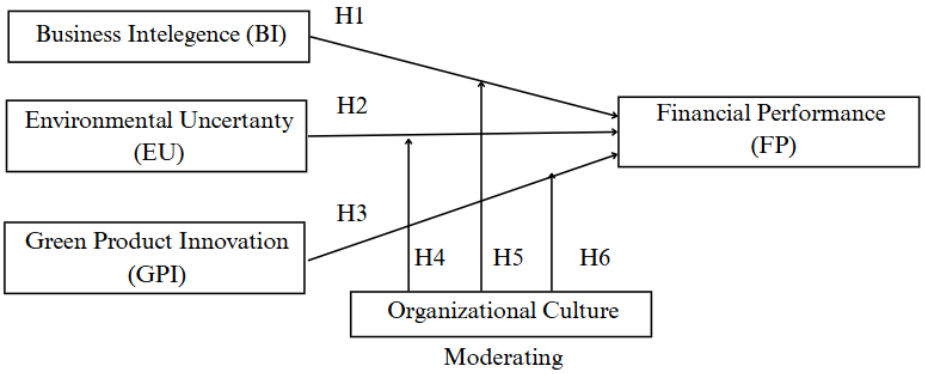

Figure 1. Conceptual Framework

The relationship between business intelligence, Environmental Uncertainty, and Green Product Innovation that affect financial performance with organizational culture as a moderating variable that forms the theoretical framework of this study. Based on Figure 1 that has been illustrated, the research model proposes that business intelligence has a positive impact on financial performance, Environmental Uncertainty has a positive effect on financial performance, Green Product Innovation has a positive effect on financial performance, Organizational culture moderates business intelligence on financial performance, Organizational culture moderates environmental uncertainty on financial performance and work culture moderates green product innovation on financial performance.

RESEARCH METHODS

This study adopts a quantitative approach to examine the influence of Business Intelligence (BI), Environmental Uncertainty (EU), and Green Product Innovation (GPI) on Financial Performance (FP), with Organizational Culture (OC) serving as a moderating variable. The population includes both listed and non-listed manufacturing companies in Indonesia. A total of 311 respondents were selected purposively, focusing on individuals in managerial positions in finance or accounting, whose roles are relevant to the research variables. Primary data was collected through a structured questionnaire distributed online via Google Forms. The dissemination was conducted through email, WhatsApp, and Telegram, targeting respondents from various manufacturing firms. The questionnaire was developed to capture perceptions related to BI, EU, GPI, OC, and FP. All items were measured on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." The instrument was adapted from validated indicators in prior studies to ensure its reliability and validity. The collected data was analyzed using the Structural Equation Modeling (SEM) approach with Partial Least Squares (PLS), operated through SmartPLS software. This method allows for the assessment of both direct and moderating relationships between variables. The structural model used in the study is represented by the following equation:

$$FP = \beta1\ BI + \beta2\ EU + \beta3\ GPI + \beta4\ OC + \beta5\ BI*OC + \beta6\ EU*OC + \beta7\ GPI*OC + \varepsilon$$

Where FP represents Financial Performance, BI is Business Intelligence, EU is Environmental Uncertainty, GPI is Green Product Innovation, OC is Organizational Culture, β1 to β7 are the estimated coefficients, and ε is the error term. Academically, the study contributes to the growing literature on BI, EU, GPI, and FP in the digital era. Practically, it provides insights for companies to enhance decision-making, operational quality, and customer service. Moreover, it offers implications for policymakers in promoting sustainable business practices through policies that support innovation and environmental adaptability.

RESULTS

The findings of this study provide an analysis related to the influence between business intelligence, Environmental Uncertainty, and Green Product Innovation that affect financial performance with organizational culture as a moderating variable. Data were taken from 311 respondents who held managerial positions at least in finance or accounting. Respondent selection was done intentionally, considering the relevance of their positions to the variables studied. Primary data were collected through online questionnaire distribution using the Google Forms platform. The questionnaire was distributed via email, WhatsApp, and Telegram to respondents spread across various manufacturing companies.

According to Hair et al. (2021), the validity assessment depends on the average variance extracted (AVE) value. The AVE value obtained from the test is above 0.5, which indicates that all factors studied are considered valid. In terms of reliability assessment, this study uses a composite reliability value. The test results show a composite reliability value that exceeds 0.7, which indicates that its reliability meets the assessment standards.

Table 1. Validity and Reliability Test

Variable	AVE	Decision	Composite Realibility	Decision
Finance Performance (FP)	0.753	Valid	0.968	Reliable
Business Intelligence (BI)	0.864	Valid	0.974	Reliable
Uncertainty Environment (UE)	0.500	Valid	0.946	Reliable
Green Product Innovation (GPI)	0.784	Valid	0.916	Reliable
Organizational Culture (OC)	0.539	Valid	0.962	Reliable

Based on Table 1 shows that all variables in this study meet the validity and reliability criteria. This can be seen from the Average Variance Extracted (AVE) value for Finance Performance of 0.753, Business Intelligence of 0.864, Environmental Uncertainty of 0.500, Green Product Innovation of 0.784, and Organizational Culture of 0.539 all > 0.5, so all variables are declared valid. Furthermore, the Composite Reliability (CR) value of each variable is also above 0.7, namely 0.968 for Finance Performance, 0.974 for Business Intelligence, 0.946 for Environmental Uncertainty, 0.916 for Green Product Innovation, and 0.962 for Organizational Culture, indicating that all these variables are reliable and consistent for use in further analysis.

Table 2. Data descriptive statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Finance Performance (FP)	311	2.0	6.0	4.3990	0.8222
Business Intelligence (BI)	311	2.0	6.0	4.4550	1.0102
Uncertainty Environment (UE)	311	2.0	6.0	4.3186	0.7385
Green Product Innovation (GPI)	311	1.0	6.0	4.3940	1.0498
Organizational Culture (OC)	311	2.0	6.0	4.5120	0.7885

Based on Table 2 above, it is used to understand the basic characteristics of each research variable before further analysis is carried out. This descriptive analysis includes measures such as minimum, maximum, mean, and standard deviation for each variable. These variables consist of Financial Performance (FP), Business Intelligence (BI), Environmental Uncertainty (EU), Green Product Innovation (GPI), and Organizational Culture (OC). Then the table also provides an overview of the statistical analysis carried out on the responses of 311 participants. Variables in the study ranged from 1.00 indicating strong disapproval from respondents, to 6.00 indicating strong approval. Then based on the table above, it shows that the highest average score is found in the Organizational Culture (OC) variable with an average score of 4,512, followed by Business Intelligence (BI) of 4,455, Finance Performance (FP) of 4,399, Green Product Innovation (GPI) of 4,394, and the lowest is Uncertainty Environment (UE) with an average of 4,319. All variables have a minimum value of 1 or 2 and a maximum of 6 which indicates a fairly wide range of answers. The highest standard deviation was found in the Green Product Innovation variable (1.0498) which showed that the variation of respondents' answers was greater in this variable, while the variable in the Uncertainty Environment variable had the smallest variation with a standard deviation of 0.7385 which showed a higher consistency of answers in this variable. Overall, an average score above 4 indicates that respondents are likely to give a positive rating to all variables measured.

Table 3. Testing the Coefficient of Determination

Testing the Coefficient of Determination	**FP**
R Square	0.267
Adjusted R Square	0.250

Table 3 show coefficient of determination testing is used to measure the extent to which independent variables in a regression model are able to explain the variation of the dependent variable. In the context of regression analysis, the coefficient of determination is expressed by the R Square (R^2) value which ranges from 0 to 1 (Basyit, 2020).

Based on Table 3 above, it shows that the processed results produce an R Square value of 0.267 indicating that around 26.7% of the variation in Financial Performance (FP) can be explained by the independent variables in the model, namely Business Intelligence (BI), Environmental Uncertainty (EU), and Green Product Innovation (GPI). Then the adjusted R Square value of 0.250, which means that the variation or behavior of the independent variables, namely Business Intelligence, Environmental Uncertainty, Green Product Innovations, and Organizational Culture as moderating variables can explain 25% of the variation in the dependent variable, Financial Performance. The remaining 75% represents the variation of other independent variables that affect Financial Performance but are not included in the model. For a research model with an individual unit of analysis (respondents from a particular company), or in other words, a micro research model, the coefficient of determination value of 25% is classified as weak if it is more than 0.19 but does not exceed 0.33.

Table 4. Hypothesis Testing

Hypothesis	**Prediction**	**Coefficient**	**T Statistic**	**P Values**
BI -> FP	+	0.088	1.202	0.115
EU -> FP	+	0.138	1.772	0.039**
GPI -> FP	+	0.047	0.723	0.235
BO -> FP		0.312	4.155	0.000**
BI*OC -> FP	+	0.026	0.364	0.358
EU*OC -> FP	+	-0.068	0.858	0.196
GPI*OC -> FP	+	0.110	1.435	0.076*

From Table 4 above, it shows that the value of the coefficient in Business Intelligence on Financial Performance is 0.888 with a t-value of 1.202 and a p-value of 0.115. This

shows that Business Intelligence has a positive but not significant influence on Financial Performance because p value > 0.05. Then Environmental Uncertainty on Financial Performance shows that the coefficient value of Environmental Uncertainty on Financial Performance is 0.138 with a t-value of 1.772 and a p-value of 0.039. This shows that Environmental Uncertainty has a positive and significant influence on Financial Performance because the p value < 0.05.

Furthermore, Green Product Innovation on Financial Performance shows that the coefficient value of Green Product Innovation on Financial Performance is 0.047 with a t value of 0.723 and a p-value of 0.235. This shows that Green Product Innovation on Financial Performance has a positive and insignificant effect on Financial Performance because the p value > 0.05. Furthermore, the Organizational Culture on Financial Performance showed the result of a coefficient value of 0.312 with a t-value of 4.155 and a p-value of 0.000. This shows that Organizational Culture (OC) has a positive and significant influence on Financial Performance, because the p-value < 0.05. Then for Business Intelligence moderated by Organizational Culture on Financial Performance, the results show that the Coefficient is 0.026 with a t-value of 0.364 and a p-value of 0.358. This shows that the interaction between BI and OC does not have a significant influence on FP, because the p-value > 0.05.

Furthermore, for Environmental Uncertainty moderated by Organizational Culture on Financial Performance, the results showed that the coefficient was -0.068 with a t-value of 0.858 and a p-value of 0.196. This shows that the interaction between Environmental Uncertainty and Organizational Culture does not have a significant influence on Financial Performance, as the p-value > 0.05. Furthermore, Green Product Innovation was moderated by Organizational Culture on Financial Performance, showing a coefficient of 0.110 with a t-value of 1.435 and a p-value of 0.076. This shows that the interaction between Green Product Innovation and Organizational Culture has a positive and insignificant influence on Financial Performance, as the p-value is close to 0.05.

DISCUSSION

Statistical analysis shows that while Business Intelligence has a positive link to Financial Performance (FP), the effect is not statistically significant. This suggests that implementing BI alone does not ensure improved financial outcomes. Practical barriers—such as insufficient infrastructure, lack of skilled staff, high implementation costs, and weak strategic alignment—can limit its effectiveness. Additionally, data security risks complicate adoption. These findings align with Vugec et al. (2020), who found no significant BI impact on FP, but differ from Paulino (2022), who stressed the importance of organizational readiness and strategy.

Statistical tests reveal that environmental uncertainty positively affects financial performance, suggesting that higher uncertainty encourages companies to become more adaptive and innovative to maintain competitiveness. This aligns with Kafetzopoulos et al. (2020), who found that firms managing uncertainty effectively tend to achieve better financial outcomes. From a Stakeholder Theory perspective, such uncertainty pushes companies to strengthen relationships with stakeholder, shareholders, customers, suppliers, and regulator to ensure stability. In response, companies adopt not only internal adjustments but also strategic use of external resources like partnerships and innovation. Therefore, environmental uncertainty can drive strategic growth and financial improvement.

Statistical tests showed that the hypothesized link between certain factors and financial performance was invalid, aligning with Liu (2024), who found no short-term financial benefits from green innovation. This contrasts with studies by Imran et al. (2021), Abbas and Khan (2023), and Ahmed et al. (2023), which reported positive effects. The difference may stem from low green innovation levels in this sample and obstacles like high costs, limited R&D budgets, and complex recycling processes. While green innovation can support long-term sustainability, its financial impact depends on company readiness in resource allocation, cost management, and competency development.

Research shows that organizational culture positively impacts organizational performance, supporting Akpa et al. (2021), who found it enhances company efficiency, employee commitment, and goal coordination. However, as a moderating variable, organizational culture does not significantly strengthen the relationship between Business Intelligence (BI) and financial performance, as indicated by a non-significant p-value. This may be due to misalignment between the implemented culture and BI's strategic vision. For culture to effectively moderate, it must align with systems and policies that support BI use. Without this alignment, culture may fail to enhance BI's role in financial decision-making.

The findings show that Organizational Culture does not significantly moderate the link between Environmental Uncertainty and Organizational Performance. Despite its theoretical role in helping firms adapt, the study found that culture has not effectively enhanced this relationship. This may be due to poor internalization of values, limited employee involvement, or a culture that lacks adaptability. The non-significant p-value (> 0.05) indicates insufficient evidence for a moderating effect. In practice, fostering a more adaptive culture through improved communication and employee engagement is essential. This research is in line with research found by Sørensen (2002), who found that a strong organizational culture tends to be effective in stable environments, but is less adaptive in more dynamic conditions. These results contrast with Baloch et al. (2022), who highlight a strong relationship between organizational culture, environmental factors, and financial performance.

The analysis shows that a supportive organizational culture significantly enhances the effect of green product innovation on financial performance. Companies that promote sustainability and innovation are better positioned to leverage green initiatives for financial gain. This finding aligns with Aboramadan et al. (2020), who emphasized that a conducive culture supports innovation by helping firms adapt to market and regulatory shifts. Thus, organizational culture plays a key role in maximizing the strategic value of sustainable product development.

CONCLUSION

The study found that Business Intelligence (BI) and Green Product Innovation (GPI) did not significantly improve financial performance, while Environmental Uncertainty (EU) had a positive effect. Organizational Culture increased the impact of GPI but did not significantly affect the effects of BI or EU. The limited impact of BI may be due to poor implementation or lack of organizational readiness. However, the study has limitations such as data was collected via email, WhatsApp, LinkedIn, and Facebook, which may affect the accuracy, timeliness, and representativeness of the sample, potentially limiting how well the findings reflect real-world conditions. This research has important academic and practical implications. Academically, it enriches the literature on Business Intelligence, Environmental Uncertainty, Green Product Innovation, and financial performance in the digital era, providing a basis for future studies on factors affecting company performance amid environmental challenges. Practically, it offers valuable insights for companies facing intense competition, helping them make faster, more informed decisions to improve operations, products, and customer service, thereby boosting productivity. For policymakers, the findings serve as a reliable reference for developing policies that promote sustainable business practices, especially in green innovation and managing environmental uncertainty. As suggestions for further research, it is recommended to use interview methods to obtain more in-depth and comprehensive data. The utilization of secondary data offers a viable option to enhance data precision and gain a more comprehensive view of the correlations among the variables under investigation. Future research can delve deeper into understanding a company's financial performance by utilizing a wider range of research methods, leading to more insightful and applicable findings.

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