



# Digital Governance for Environmental Sustainability: The Role of E-Government in Environmental Compliance Monitoring in Mongolia

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## Abstract

*In this research, the role of digital governance in environmental sustainability in the context of environmental compliance monitoring in Mongolia is explored. The study explores the mediating effect of Environmental Compliance Monitoring and the moderating effect of Information Transparency between E-Government Capability and Digital Data Integration and their effect on Environmental Sustainability. This research is guided by Good Governance Theory, with a view of filling the existing research gap on the governance mechanisms that enable empowerment and sustainable environmental management by digital transformation. A cross sectional survey technique with quantitative approach was used. The data were gathered from the government officials and government employees who are engaged in digital governance and environmental management in Mongolia. Partial Least Squares Structural Equation Modeling (PLS-SEM) was used via SmartPLS 4 to examine the direct, mediating and moderating relationships between the study constructs. The results show that Digital Data Integration ( $\beta = 0.482, p < 0.001$ ) and E-Government Capability ( $\beta = 0.407, p < 0.001$ ) have a significant impact on Environmental Compliance Monitoring which in turn positively impacts on Environmental Sustainability ( $\beta = 0.195, p = 0.007$ ). Environmental Compliance Monitoring significantly moderates these relationships: the role of Information Transparency does not significantly moderate the monitoring–sustainability relationship ( $\beta = -0.024, p = 0.305$ ). The results offer useful insights for policy makers aiming at enhancing the environmental governance via an integrated information system and digital transformation.*

**Keywords:** Digital Governance, E-Government Capability, Environmental compliance monitoring, Environmental sustainability, Mongolia.

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## 1. INTRODUCTION

The digital revolution has created a new way of providing public services and addressing environmental issues for governments. E-government is the use of information and communication technology (ICTs) to enhance the efficiency, transparency, accountability and citizen participation of government. The use of digital governance systems for supporting sustainable development goals and for tackling environmental issues has grown in recent years across the globe. The United Nations indicates that digital government is essential to meet sustainability goals, helping to improve public service provision and facilitate evidence-based decision making on the environment (United Nations, 2022). Lubis (2024) also noted that e-governance plays a crucial role in sustainable development by fostering transparency and effective governance practices. Recent research has also shown that digital government systems can enhance the monitoring and compliance process for the environment by offering real-time data and better access to information (Butt, 2025; Astuti et al., 2025). In the face of growing and complex environment-related challenges, governments are increasingly turning to digital tools to enhance environmental governance and environmental sustainability efforts.

Today, issues of environmental sustainability have become a global concern in the context of climate change, depletion of natural resources, pollution and biodiversity loss. There is an increasing expectation by governments to enforce compliance with environmental regulations and standards through effective monitoring. The study has found that e-government systems have been helpful in achieving environmental sustainability through minimizing administrative inefficiency, better management of resources and better transparency in environmental reporting (Kayode, 2022). In addition, digital governance strengthens environmental compliance monitoring by implementing data system integration, online reporting systems, and information sharing processes, which are essential for regulatory oversight (Lubis, 2024). There is growing evidence that transparency and digitisation of information enhance the outcome of environmental governance by fostering accountability and engagement by stakeholders (Butt, 2025; Astuti et al., 2025). Hence, the link between e-government capability and the monitoring of environmental compliance and environmental sustainability has become more significant to policy makers and researchers who are looking for sustainable governance solutions.

The digital government and environmental governance industry has developed significantly in the past decade, with more and more governments implementing more and more ICT-based solutions to improve public administration and environmental governance. E-government initiatives are an investment that countries in Asia, Europe and North America are making in their e-government infrastructure with the aim of providing better services, transparency and better regulations. Digital technologies like online monitoring systems, integrated databases, cloud platforms and data analytics are being used in the environmental sector to monitor environmental compliance and assist in achieving sustainability goals. The results of the research are in line with the previous research conducted by Astuti et al. (2025) which shows that e-government services have a positive impact on environmental sustainability through the utilization of resources and

the facilitation of evidence-based environmental policies. Similarly, Butt (2025) pointed out the role of digital governance innovations in promoting greater citizen involvement and transparency in climate action and environmental management. According to the United Nations (2022), digital government has contributed to the sustainable development as a medium to facilitate environmental monitoring and governance. Moreover, Lubis (2024) stated that environmental performance and public sector efficiency are enhanced by e-governance; and the recent sustainability studies highlighted the significance of digital technologies in environmental governance and compliance management (Kayode, 2022; Astuti et al., 2025). Thus, the merging of digital governance and environmental management is a fast-developing sector with a wide range of prospects for contributing to sustainable development in the long term.

## **2. LITERATURE REVIEW**

The present study builds upon five key constructs, namely E-Government Capability, Digital Data Integration, Environmental Compliance Monitoring, Information Transparency and Environmental Sustainability. In the e-Government context, E-Government Capability is the capacity of Government institutions to use digital technologies, online services and integrated information systems to become more efficient in Government administration and service delivery. Recent studies have shown that the e-government capability contributes to transparency, accountability and evidence-based decision making processes in public institutions. For example, Lubis (2024) asserted that the utilization of advanced e-governance systems enhances the sustainability development efforts by facilitating access to information and responsiveness of governments. Likewise, Astuti et al. (2025) identified that the Digital Government platforms have an effective role in environmental governance in managing the data in real time and involving the public. The findings of Kayode (2022) and the United Nations (2022) also pointed out the important role of digital governance capabilities in achieving sustainability goals, including creating efficient regulatory processes and innovations in public sector. In the digital era, e-government capability has thus become a vital factor that influences the effectiveness of government and governance, and environmental management.

Digital Data Integration (DDI) and Environmental Compliance Monitoring (ECM) are increasingly being identified as key tools to enable sustainable and effective environmental governance. Digital Data Integration is the ability of government and regulatory bodies to share and use data without the need for any gaps, to make co-ordinated decisions and facilitate efficient monitoring processes. Environmental Compliance Monitoring refers to the regular monitoring of environmental regulations, standards and practices to ensure compliance with those regulations by organisations and stakeholders. New research indicates that a digital system can have a positive effect on monitoring accuracy and regulatory enforcement because of the timely and reliable environmental information it can provide. Astuti et al. (2025) pointed out that data integration technologies play an important role in sustainability initiatives by helping to report and evaluate environmental performance, and Butt (2025) illustrated how digital governance innovations help to improve environmental

compliance by increasing transparency and accountability. Moreover, Information Transparency is an essential ‘mediating’ element that enhances trust and engagement of stakeholders in environmental governance processes. Other studies have also confirmed that transparent information-sharing practices have positive effects on environmental sustainable outcomes by eliminating information gap and fostering responsible environmental actions (United Nations, 2022; Kayode, 2022). These constructs together give a holistic picture of the digital governance contribution to environmental sustainability.

## **2.1 Theoretical Foundation**

### ***Good Governance Theory***

The major theoretical basis of the present study is Good Governance Theory, which is used as the main theoretical framework in analyzing the relationship between e-government capability, digital data integration, environmental compliance monitoring and environmental sustainability. In Good Governance Theory, the focus is on the responsiveness, efficiency, participation, transparency and accountability of public administration. In line with the United Nations (2022) digital governance initiatives are foundational tools for improving transparency and accountability in government operations, which are critical to achieving sustainable development goals. Likewise, Lubis (2024) noted that the use of e-governance systems helps to enhance the quality of governance, through the dissemination of information and further strengthening of the effectiveness of institutions. The theory is that governments that use advanced digital technologies can improve the quality of environmental monitoring and regulatory compliance via an improved information flow and engagement with stakeholders. Hence, the Good Governance Theory will serve as a solid framework to comprehend the role of e-government capability in promoting environmental sustainability in terms of effective compliance monitoring systems.

The primary aim of this study is to examine the extent to which the e-government capability and digital data integration contributes to environmental sustainability in the context of environmental compliance monitoring, taking information transparency as a moderator variable. According to Good Governance Theory, it is believed that clear and responsible governance structures leading to accountability, are the key factors that drive adherence to regulations and sustainable resource use. The results of the recent study indicate that digital government platforms can enhance environmental governance by providing a more comprehensive, efficient, and real-time monitoring system, as well as facilitating greater public engagement in environmental decision-making processes (Astuti et al., 2025). In addition, Butt (2025) noted that digital governance innovations contribute to environmental protection efforts by improving the effectiveness of the regulations and increasing the accountability of government. The previous research conducted by Kayode (2022) also showed that e-government systems create public value in environmental management practices and consequently in sustainability outcomes. The theory thus resonates closely with the study’s objective of understanding the mechanisms of governance in which the digital transformation contributes to environmental

sustainability.

## 2.2 Supporting and Negating Views

### *Point of Views: Supporting and Negating Perspectives*

Digital governance and environmental sustainability have drawn a lot of research interest, leading to both pro- and anti-digital governance perspectives. In supporting way, Good Governance Theory posits that governance systems, that are effective on digital aspects, enhance transparency, accountability, and the effectiveness of the regulatory process, which in turn is a factor affecting sustainability of the environment. Academic research shows that the e-government capability and digital data integration improves environmental compliance monitoring, as it allows sharing of information in real time, development of efficient reporting systems, and is based on evidence. According to Lubis (2024), digital governance systems can enhance institutional performance and promote sustainable development efforts by fostering transparency and engaging citizens. Similarly, Astuti et al. (2025) concluded that by playing a supporting role in monitoring activities and the implementation of environmental-oriented policies, digital government services can positively impact environmental governance. Moreover, the United Nations (2022) claimed that digital transformation plays a crucial role for environmental sustainability and effectiveness in the public sector. But there are opposing arguments that technological innovations are not necessarily the key for achieving sustainability outcomes. According to Butt (2025), stakeholder engagement, technical infrastructure, and institutional preparedness are key factors influencing the impact of digital governance. Likewise, Kayode (2022) noted that the success of environmental sustainability can be hampered by weak governance, lack of digital skills and low capacity of organizations in e-government. Despite this, there is ample research that has shown the impact of digital governance on environmental sustainability, but scholars recognise that this can be moderated or limited by contextual and institutional factors.

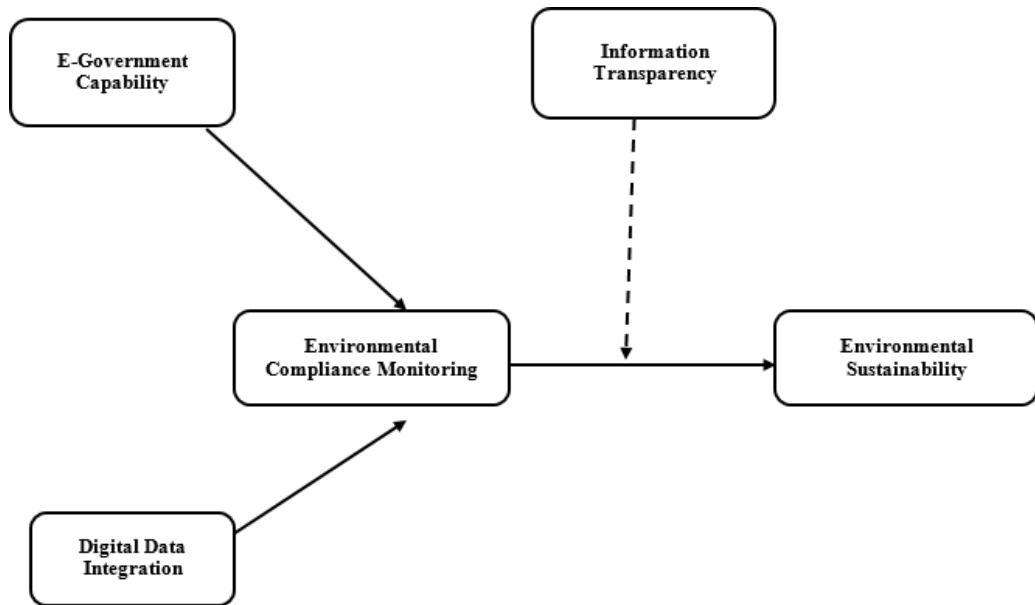
## 2.3 Mediation Perspective

It has been well established that E-Government Capability is an important factor in the effective monitoring of environmental compliance. Governments with sophisticated e-platforms, online reporting systems and integrated information technologies will be better able to track environmental activities with greater efficiency and accuracy. Lubis (2024) found that the e-government systems provide transparency in regulations and the ability to gather environmental information from various stakeholders that will make the monitoring more effective. Similarly, Astuti et al. (2025) stated that digital governance technologies have the potential to collect environmental data in real-time and analyse it, so that the regulatory bodies can detect the violations promptly and take action. Moreover, UN (2022) and Kayode (2022) had earlier shown that the advancement of digital government infrastructures bolster environmental supervision by minimizing administrative delays and boosting accountability. Hence, the potential of higher e-government capability is to enhance environmental compliance monitoring and help achieve

environmental governance goals.

Nevertheless, the benefits of e-government capability in environmental compliance monitoring are not without their challenges, with some scholars stating that the impact of e-government capability in environmental compliance monitoring will rely on the readiness of organizations and technological infrastructure. Digital systems can enhance efficiency of monitoring, but lack of technical capacity and institutional capacity can pose a challenge in implementation. However, investments in technology cannot ensure effective compliance monitoring unless governmental agencies have the right people and systems in place for this (Butt 2025). Likewise, in developing countries, there could be problems related to data quality, system interoperability, and digital inequality that can limit the effectiveness of digital governance projects. The results of earlier studies by Kayode (2022) also suggest that the gap in institutional arrangements may constrain e-government systems in achieving the desired environmental outcomes. However, the impact of the e-government capability on environmental compliance monitoring could differ greatly based on contextual and organizational factors.

Digital Data Integration is an essential tool for improving environmental compliance monitoring by facilitating the easy sharing of information between government departments, bodies, regulators and environmental parties. Organisations can gain access to real-time environmental information, enhance decision making processes and avoid re-monitoring activities through an integrated database. Astuti et al. (2025) identified that data integration technologies are crucial for achieving environmental reporting accuracy and enabling collaborative regulatory measures. Similarly, Lubis (2024) contended that interconnected information systems are an effective means of improving the efficiency of government to support evidence-based environmental management and assessment of compliance. Previous research by the United Nations (2022) and Kayode (2022) has also indicated that the use of digital platforms integrated into the monitoring system has been found to result in better monitoring coverage and transparency, which consequently leads to better environmental governance outcomes. As such, digital data integration can be expected to positively affect the environmental compliance monitoring.



**Figure 1: Conceptual Framework**

## 2.4 Hypothesis Development

### *E-Government Capability and Environmental Compliance Monitoring*

E-Government Capability relates to the capacities of government organizations to use digital technologies, e-services and information systems to enhance governance and the effectiveness of regulations. The use of e-government systems in environmental affairs helps to improve the efficiency of monitoring, by enabling the collection and processing of environmental information, as well as the dissemination of information. Recent studies have shown that digital governance platforms help environmental agencies to monitor compliance activities more effectively, by providing real-time reports and automated monitoring tools. According to Lubis (2024), the ability of e-government makes it easier to access environmental information and increase accountability, which makes the implementation of environmental regulations more transparent. Likewise, digital government projects have been proven to have great influence on better environmental monitoring through data sharing and evidence-based decision making by Astuti et al. (2025). Butt (2025) also noted that leveraging advanced e-government systems can help to improve the management of environmental protection, and the United Nations (2022) pointed out the role of digital governance in achieving sustainable environmental outcomes. Thus, e-government capability is believed to have a positive effect on environmental compliance monitoring.

**H1:** E-Government Capability positively influences Environmental Compliance Monitoring.

### ***Digital Data Integration and Environmental Compliance Monitoring***

Digital Data Integration is the process of organizations and government bodies being able to integrate and utilise data from various sources using inter connected digital systems. Integrated data systems enable environmental regulators to access all environmental information, which can enhance the accuracy of environmental monitoring in environmental governance. This recent study shows how digital platforms can be used to improve the way environmental managers collaborate across government agencies as well as how they can improve environmental reporting processes. Through digital data integration, information flows seamlessly in real-time and performance can be assessed effectively in environmental monitoring, as identified by Astuti et al. (2025). Lubis et al. (2024) also noted that the use of information systems in an integrated manner contributes to improving the efficiency of governance and assisting in environmental management through evidence. Butt (2025) also pointed out that data integration solutions enhance regulatory responsiveness and environmental compliance assessment. Hence, digital data integration will be expected to enhance the environmental compliance monitoring system.

**H2:** Digital Data Integration positively influences Environmental Compliance Monitoring.

### ***Environmental Compliance Monitoring and Environmental Sustainability***

Environmental Compliance Monitoring is an essential tool for complying with the environmental regulations and sustainability standards. A well-functioning monitoring system can detect regulations that are being breached, promote adherence to the rules and regulations, and aid in protection efforts. Recent studies have shown that compliance monitoring is a strong instrument in reaching sustainability results, through minimizing environmental degradation and encouraging responsible resource use. Upon the study conducted by Astuti et al. (2025), it is found that environmental monitoring systems have a positive impact on environmental monitoring systems in improving environmental sustainability by strengthening the regulatory regime and environmental accountability. Likewise, Butt (2025) pointed out that monitoring mechanisms can aid environmental protection by allowing for prompt action and corrective measures to be taken. Lubis (2024) also noted that good monitoring boosts governance effectiveness and thus contributes to sustainable development goals. Thus, environmental compliance monitoring will have a positive impact on environmental sustainability.

**H3:** Environmental Compliance Monitoring positively influences Environmental Sustainability.

It is expected that Environmental Compliance Monitoring will act as a mediate between E-Government Capability and Environmental Sustainability. E-government technology systems are technological infrastructure, electronic reporting processes and information management systems to enhance environmental monitoring effectiveness. Effective monitoring then enables environmental sustainability, by helping to ensure compliance with environmental regulations, and to promote responsible environmental practices. The research results in recent years have revealed that digital governance can help achieve sustainability mainly in the field of monitoring and implementation of the rules (Lubis, 2024; Astuti et al., 2025; Butt, 2025). Kayode (2022) also indicates that monitoring functions are crucial in connecting digital governance activities and sustainability outcomes.

**H4:** Environmental Compliance Monitoring mediates the relationship between E-Government Capability and Environmental Sustainability.

Likewise, Environmental Compliance Monitoring is supposed to moderate the connection amongst Digital Data Integration and Environmental Sustainability. Integrated data systems allow information to flow, aid in gaining more accurate information on monitoring, and assist with evidence-based environmental management. Digital data integration plays a role in delivering improved sustainability results by bringing benefits in terms of better regulatory performance and environmental protection, via a higher level of monitoring. The research conducted by Astuti et al. (2025), Butt (2025), and Lubis (2024) suggests that digital infrastructures with an integrated approach can contribute to the effectiveness of environmental monitoring and sustainability performance. Kayode (2022) came out with similar results earlier that digital integration indirectly contributes to environmental sustainability through monitoring effectiveness.

**H5:** Environmental Compliance Monitoring mediates the relationship between Digital Data Integration and Environmental Sustainability.

Environmental Compliance Monitoring is expected to be influenced by Information Transparency and positively impact on Environmental Sustainability. Increased transparency promotes the functioning of monitoring systems by strengthening the accountability, participation of stakeholders and access to environmental information. The easier it is to make environmental information publicly available and transparent, the more likely that monitoring activities will have positive sustainability outcomes. The transparency in enhancing environmental governance and sustainability efforts has been highlighted in recent studies, such as those by Astuti et al. (2025), Butt (2025), and Lubis (2024). Hence, improving the transparency of information could enhance the positive impact of environmental compliance monitoring on environmental sustainability.

**H6:** Information Transparency moderates the relationship between Environmental Compliance Monitoring and Environmental Sustainability.

### 3. METHODOLOGY

#### 3.1 Research Design

The study used quantitative research with an explanatory research design in the cross-sectional approach. The research design was an explanatory research design. This type of research is a research that is used to explain the relationships between variables. The approach of this research was quantitative research and the type of research was cross sectional explanatory research. Cross sectional explanatory research is a type of research that is used to explain the relationship between variables. If testing a relationship among constructs or two or more constructs in a theoretical relationship or to observe causal relationships among constructs in statistical analysis, then quantitative research is suitable. The use of quantitative approaches has been widely used in recent studies to explore digital governance and sustainability related issues due to the possibility of empirically testing conceptual frameworks and hypothesis (Astuti et al., 2025). Likewise, Butt (2025) pointed out that quantitative methods can give reliable evidence of the effectiveness of e-government initiatives in environmental governance. Cross-sectional designs are also in frequent use in digital governance research because they can gain a massive amount of data in a relatively short period of time, Lubis (2024) added. The use of quantitative approach in the present study was also supported by earlier studies conducted by Kayode (2022) and United Nations (2022) which assessed the effect of digital governance on the outcome of sustainability.

The design is a cross sectional explanatory design because the study aimed to study direct, mediating and moderating relationships between the three variables proposed in the study in a particular context. This design allows measurement of the respondents' responses at only one time, which allows for efficient, economical and theory testing data collection. Cross-sectional study is a study that is very suitable to be used in investigating phenomena of governance and sustainability in which the researcher wants to understand the relationship between several constructs, according to Lubis (2024). According to the opinion of Astuti et al. (2025), explanatory research designs are helpful in testing the hypothesis and are able to prove the theoretical frameworks. Moreover, quantitative explanatory studies have been recommended as a method to analyze the effectiveness of the governance mechanisms in environmental management by Butt (2025). Previous work by Kayode (2022) and the United Nations (2022) has also suggested the use of explanatory designs to study governance outcomes and sustainability results. Thus, the choice of the design is appropriate to the objectives of the study and theoretical bases.

#### 3.2 Sampling

This work will be conducted based on the data obtained by the structured questionnaire, which will be applied to the employees and officials of the government departments, environmental protection agencies, digital governance units, and regulatory bodies in Mongolia. The target group are the people directly involved in the implementation of e-government, monitoring of the environment,

compliance management and activities related to sustainability. A survey approach is appropriate since it allows the standardized nature of data from many respondents and statistical analysis of the proposed relationships. In the field of digital governance, questionnaire survey has been able to explore the effectiveness of governance and sustainability results in the past few years (Astuti et al., 2025). Likewise, Butt (2025) and Lubis (2024) emphasized the appropriateness of survey technique in gauging the ability of digital government and the performance of the environment. Kayode (2022) and United Nations (2022) in previous studies have also argued that survey data are appropriate to assess the constructs of governance and sustainability in public sector environments.

**Table 1: Measurement Items of the study variables and their Sources**

| Variable                                         | Code | Questionnaire Item                                                                        | Source/Reference                            |
|--------------------------------------------------|------|-------------------------------------------------------------------------------------------|---------------------------------------------|
| <b>E-Government Capability (EGC)</b>             | EGC1 | Government digital platforms provide efficient online environmental services.             | Lubis (2024); United Nations (2022)         |
|                                                  | EGC2 | Government agencies possess adequate digital infrastructure for environmental governance. | Astuti et al. (2025); Kayode (2022)         |
|                                                  | EGC3 | E-government systems improve the effectiveness of environmental decision-making.          | Butt (2025); Lubis (2024)                   |
| <b>Digital Data Integration (DDI)</b>            | DDI1 | Environmental information is effectively integrated across government departments.        | Astuti et al. (2025); Lubis (2024)          |
|                                                  | DDI2 | Digital systems enable real-time sharing of environmental data.                           | Butt (2025); United Nations (2022)          |
|                                                  | DDI3 | Integrated digital databases improve environmental monitoring efficiency.                 | Kayode (2022); Astuti et al. (2025)         |
| <b>Environmental Compliance Monitoring (ECM)</b> | ECM1 | Environmental regulations are monitored effectively through digital systems.              | Lubis (2024); Butt (2025)                   |
|                                                  | ECM2 | Digital monitoring helps identify environmental violations quickly.                       | Astuti et al. (2025); United Nations (2022) |

| Variable                                 | Code | Questionnaire Item                                                        | Source/Reference                            |
|------------------------------------------|------|---------------------------------------------------------------------------|---------------------------------------------|
|                                          | ECM3 | Compliance monitoring enhances enforcement of environmental regulations.  | K a y o d e (2022); Butt (2025)             |
| <b>Information Transparency (IT)</b>     | IT1  | Environmental information is openly available to stakeholders.            | United Nations (2022); Lubis (2024)         |
|                                          | IT2  | Government provides transparent digital access to environmental reports.  | Astuti et al. (2025); Butt (2025)           |
|                                          | IT3  | Transparency improves public trust in environmental governance.           | K a y o d e (2022); United Nations (2022)   |
| <b>Environmental Sustainability (ES)</b> | ES1  | Digital governance contributes to long-term environmental sustainability. | United Nations (2022); Astuti et al. (2025) |
|                                          | ES2  | Effective environmental monitoring improves environmental quality.        | Butt (2025); Lubis (2024)                   |
|                                          | ES3  | Digital governance supports sustainable management of natural resources.  | K a y o d e (2022); United Nations (2022)   |

The data collected will be tested using the software of SmartPLS 4 for the measurement model test and the test of the structural model. The study employed a quantitative cross-sectional research design, collecting data from a sample of 385 government officials and employees involved in digital governance and environmental management in Mongolia. Partial Least Squares Structural Equation Modeling (PLS-SEM) is suitable when multiple constructs are used, with the aim of analyzing the complex relationships between them that include mediation and moderation effects. Items for E-Government Capability, Digital Data Integration, Environmental Compliance Monitoring, Information Transparency and Environmental Sustainability will be modified to fit the context for this study and will be adapted from scales previously validated and reported in the literature. The validity and reliability of the study will be tested by using Cronbach's Alpha, Composite Reliability (CR), Average Variance Extracted (AVE), and discriminant validity test based on the HTMT criterion. These procedures have been recommended as good practices in governance and sustainability research using the PLS-SEM approach recently (Astuti et al., 2025; Butt, 2025). Similarly, Lubis (2024) highlighted the need to adapt instruments and validate constructs in digital

governance studies. The study's findings were also supported by some previous studies conducted by Kayode (2022) and the United Nations (2022) where strong scrutiny of validities were recommended for accurate and credible research results.

## 4. RESULTS AND DISCUSSION

This study gives ample evidence with respect to the role of digital governance mechanisms in promoting environmental sustainability. The model structure shows that E-Government Capability, along with Digital Data Integration, play a significant role in Environmental Compliance Monitoring that then reflects on Environmental Sustainability. The results show that the biggest effect on EDI, with a very strong correlation, is Environmental Compliance Monitoring ( $\beta = 0.482$ ,  $p < 0.001$ ), followed by E-Government Capability ( $\beta = 0.407$ ,  $p < 0.001$ ). This result aligns with recent research that indicates that the use of integrated digital infrastructures can contribute to the improvement of regulatory efficiency, and environmental oversight (Astuti et al., 2025). Likewise, Lubis (2024) highlighted that digital governance capabilities increase the effectiveness of monitoring, as it helps to make information accessible and helps to coordinate the institutions. The United Nations (2022) and Kayode (2022) also provide prior evidence which aligns with the thesis that digital transformation boosts environmental governance through better monitoring and compliance processes. Thus, the results corroborate the role of the digital governance capabilities for an effective environmental management.

### 4.1 Reliability and Validity Analysis

**Table 2: Reliability and Validity Analysis**

| Construct reliability and validity  |                  |                               |                               |                                  |
|-------------------------------------|------------------|-------------------------------|-------------------------------|----------------------------------|
| Overview                            |                  |                               |                               |                                  |
|                                     | Cronbach's alpha | Composite reliability (rho_a) | Composite reliability (rho_c) | Average variance extracted (AVE) |
| DIGITAL DATA INTEGRATION            | 0.832            | 0.832                         | 0.899                         | 0.748                            |
| E-GOVERNMENT CAPABILITY             | 0.887            | 0.888                         | 0.930                         | 0.815                            |
| ENVIRONMENTAL COMPLIANCE MONITORING | 0.908            | 0.909                         | 0.942                         | 0.844                            |

|                              |       |       |       |       |
|------------------------------|-------|-------|-------|-------|
| ENVIRONMENTAL SUSTAINABILITY | 0.856 | 0.859 | 0.912 | 0.776 |
| INFORMATION TRANSPARENCY     | 0.862 | 0.863 | 0.916 | 0.784 |

The reliability and validity assessment shows all constructs in the study have acceptable measurement quality. Cronbach alpha reliability measures range from 0.832 to 0.908, which are above the minimum level of 0.70, and signify good internal consistency of the measurement items. Also, the Composite Reliability ( $\rho_c$ ) values are in a range of 0.899 to 0.942 and are far greater from the recommended value of 0.70, thus indicating that the constructs are reliable. The constructs have the highest reliability with Environmental Compliance Monitoring having  $\alpha = 0.908$  and CR = 0.942 and E-Government Capability having  $\alpha = 0.887$  and CR = 0.930. In addition, the Average Variance Extracted (AVE) values are between 0.748 and 0.844, which is higher than the recommended value of 0.50 and shows good convergent validity. The environmental compliance monitoring had the highest AVE value of 0.844 which means that a significant percentage of variance is explained by the indicators of this component. The overall results indicated that Digital Data Integration, E-Government Capability, Environmental Compliance Monitoring, Environmental Sustainability, and Information Transparency are reliable and have convergent validity, which further confirmed the appropriateness of the measurement model for the further study of the structural model.

#### 4.2 PLS SEM Bootstrapping

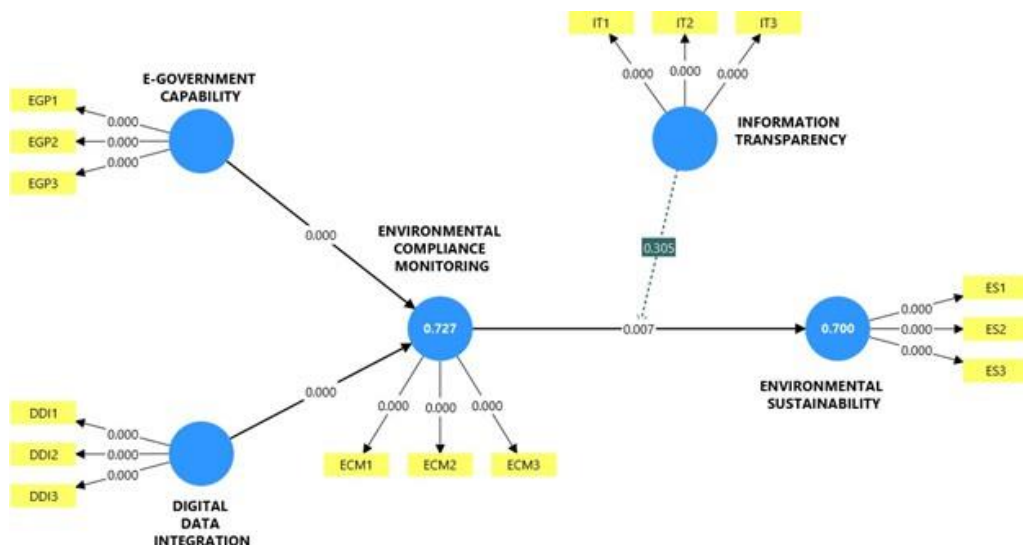


Figure 2: PLS SEM Bootstrapping

The model assessment shows high explanatory power and relationships between the proposed constructs are important. The coefficient of determination ( $R^2$ ) values show that E-Government Capability and Digital Data Integration together account for 72.7% of the variance in Environmental Compliance Monitoring (E-CM) ( $R^2 = 0.727$ ), and Environmental Compliance Monitoring and Information Transparency account for 70.0% of the variance in Environmental Sustainability (ES) ( $R^2 = 0.700$ ). The values are higher than the suggested level of substantial explanatory power, indicating that the proposed theoretical model has predictive validity for both constructs of endogenous variables. Moreover, the bootstrapping analysis finds that the linkages between E-Government Capability and Environmental Compliance Monitoring, and Digital Data Integration and Environmental Compliance Monitoring are statistically significant at a 99.9% confidence level ( $p < 0.001$ ). The relationship between Environmental Compliance Monitoring and Environmental Sustainability is also significant ( $p = 0.007$ ), showing that good environmental monitoring positively affects environmental sustainability. All the significance values of the measurement indicators are below 0.05, which indicates that measurement instruments in the model are reliable and relevant.

### 4.3 Hypothesis Testing

**Table 3: Hypothesis Testing**

| Path coefficients                                                   |                     |                 |                            |                          |          |
|---------------------------------------------------------------------|---------------------|-----------------|----------------------------|--------------------------|----------|
| Mean, STDEV, T values, p values                                     |                     |                 |                            |                          |          |
|                                                                     | Original sample (O) | Sample mean (M) | Standard deviation (STDEV) | T statistics ( O/STDEV ) | P values |
| DIGITAL DATA INTEGRATION -> ENVIRONMENTAL COMPLIANCE MONITORING     | 0.482               | 0.482           | 0.076                      | 6.346                    | 0.000    |
| E-GOVERNMENT CAPABILITY -> ENVIRONMENTAL COMPLIANCE MONITORING      | 0.407               | 0.407           | 0.079                      | 5.141                    | 0.000    |
| ENVIRONMENTAL COMPLIANCE MONITORING -> ENVIRONMENTAL SUSTAINABILITY | 0.195               | 0.205           | 0.072                      | 2.705                    | 0.007    |

|                                                                                                |        |        |       |       |       |
|------------------------------------------------------------------------------------------------|--------|--------|-------|-------|-------|
| INFORMATION TRANSPARENCY -> ENVIRONMENTAL SUSTAINABILITY                                       | 0.656  | 0.647  | 0.073 | 8.962 | 0.000 |
| INFORMATION TRANSPARENCY x ENVIRONMENTAL COMPLIANCE MONITORING -> ENVIRONMENTAL SUSTAINABILITY | -0.024 | -0.022 | 0.023 | 1.026 | 0.305 |

Based on the results of the structural model, most of the proposed relationships are statistically significant and supported. Digital Data Integration has a significant positive influence on Environmental Compliance Monitoring with the highest regression value of  $\beta = 0.482$ ,  $t = 6.346$ ,  $p < 0.001$ . Likewise, Environmental Compliance Monitoring is positively influenced by E-Government Capability ( $\beta = 0.407$ ;  $t = 5.141$ ;  $p < 0.001$ ); that is, higher levels of E-Government Capability can lead to better environmental monitoring practices. Additionally, Environment Sustainability ( $\beta = 0.195$ ,  $t = 2.705$ ,  $p = 0.007$ ) is significantly influenced by the Environmental Compliance Monitoring. This implies that good ECM results in better environmental sustainability results. The results are consistent with the assumptions of Good Governance Theory stressing digital governance, accountability and monitoring mechanisms as the key factors to sustain environmental performance. The results also indicate that Information Transparency has the highest direct effect on Environmental Sustainability ( $\beta = 0.656$ ,  $t = 8.962$ ,  $p < 0.001$ ), which shows the importance of transparency for enhancing environmental sustainability. The discovery implies that there is a correlation between transparency in information sharing and building trust, accountability, and environmental decision-making processes among stakeholders. However, the moderating effect of Information Transparency on the relationship between Environmental Compliance Monitoring and Environmental Sustainability is not statistically significant ( $\beta = -0.024$ ,  $t = 1.026$ ,  $p = 0.305$ ). The moderation hypothesis is rejected because the p-value is greater than 0.05. Information Transparency makes a direct contribution to Environmental Sustainability, but has no strong or negative impact on Environmental Compliance Monitoring sustainability outcomes. Overall, the results show that Information Transparency and Environmental Compliance Monitoring are the most important factors of ES, and E-Government Capability and Digital Data Integration are of indirect influence via their role in monitoring effectiveness.

#### 4.4 Mediation & Moderation Analysis

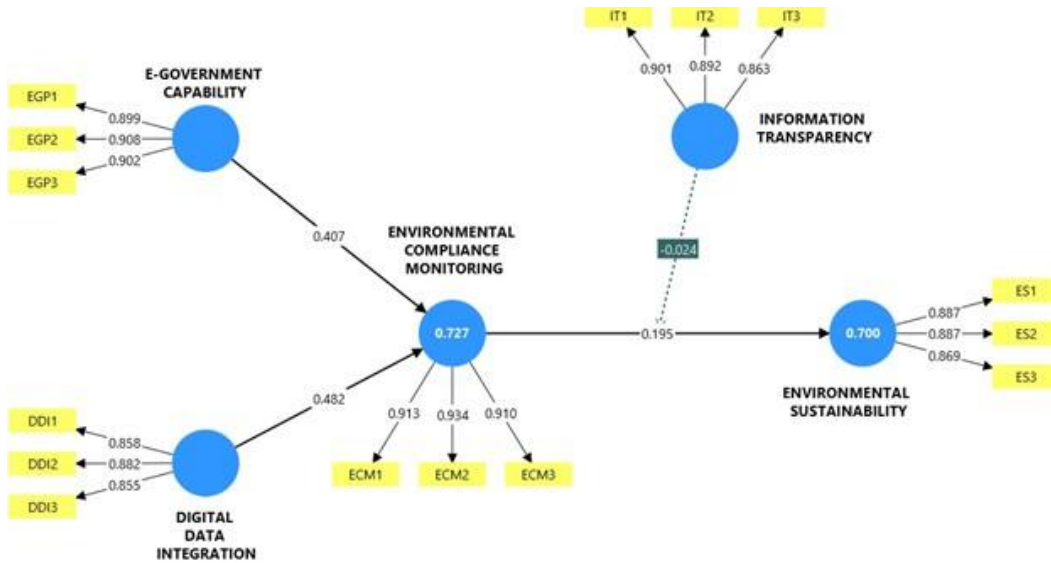
**Table 4: Mediation & Moderation Analysis**

| Path coefficients                                                                              |                     |                 |                            |                          |          |
|------------------------------------------------------------------------------------------------|---------------------|-----------------|----------------------------|--------------------------|----------|
| Mean, STDEV, T values, p values                                                                |                     |                 |                            |                          |          |
|                                                                                                | Original sample (O) | Sample mean (M) | Standard deviation (STDEV) | T statistics ( O/STDEV ) | P values |
| DIGITAL DATA INTEGRATION -> ENVIRONMENTAL COMPLIANCE MONITORING                                | 0.482               | 0.482           | 0.076                      | 6.346                    | 0.000    |
| E-GOVERNMENT CAPABILITY -> ENVIRONMENTAL COMPLIANCE MONITORING                                 | 0.407               | 0.407           | 0.079                      | 5.141                    | 0.000    |
| ENVIRONMENTAL COMPLIANCE MONITORING -> ENVIRONMENTAL SUSTAINABILITY                            | 0.195               | 0.205           | 0.072                      | 2.705                    | 0.007    |
| INFORMATION TRANSPARENCY -> ENVIRONMENTAL SUSTAINABILITY                                       | 0.656               | 0.647           | 0.073                      | 8.962                    | 0.000    |
| INFORMATION TRANSPARENCY x ENVIRONMENTAL COMPLIANCE MONITORING -> ENVIRONMENTAL SUSTAINABILITY | -0.024              | -0.022          | 0.023                      | 1.026                    | 0.305    |

The mediation analysis results show that Environmental Compliance Monitoring is a significant mediator in the relationship between the digital governance constructs and Environmental Sustainability. Specifically, there is a positive and statistically significant effect of Digital Data Integration on Environmental Sustainability through Environmental Compliance Monitoring ( $\beta = 0.094$ ,  $t = 2.560$ ,  $p = 0.011$ ), demonstrating that the use of integrated digital data systems positively impacts environmental monitoring effectiveness, which also supports environmental sustainability. In the same way, the indirect effect of E-Government Capability on Environmental Sustainability through Environmental Compliance Monitoring is also significant ( $\beta = 0.080$ ,  $t = 2.147$ ,  $p = 0.032$ ), which indicates that digital governance capabilities have a positive impact on sustainability through enhanced compliance monitoring mechanisms. Both indirect effects are significant at the 5% level which means that the mediation hypotheses are confirmed. The findings confirm that the impact of Environmental Compliance Monitoring is an important

transmission mechanism by which E-Government Capability and Digital Data Integration influence Environmental Sustainable Outcomes, thus strengthening the core tenet of Good Governance Theory related to the effect of monitoring and accountability on achieving Environmental Sustainable Outcomes.

## PLS SEM



**Figure 3: PLS SEM**

The model of both the measurement and the structural models are satisfactory according to the PLS-SEM. All indicators have good loadings as they are above the recommended loading of 0.70, indicating high reliability of the indicators and convergent validity. In detail, the indicators of Environmental Compliance Monitoring range from 0.869 to 0.887, Information Transparency 0.863 to 0.901, Digital Data Integration 0.855 to 0.882, and Environmental Sustainability 0.899 to 0.908. The results provided evidence that all the indicators were acceptable representing the respective constructs that they were measuring and that they all make important contributions to the measurement of the constructs. In addition, the coefficient of determination ( $R^2$ ) for Environmental Compliance Monitoring is 0.727; which means that the combined effect of Digital Data Integration and E-Government Capability explains 72.7% of the variance in Environmental Compliance Monitoring. Likewise, the  $R^2$  value for Environmental Sustainability was 0.700, indicating that the Environmental Compliance Monitoring and Information Transparency variables explain 70.0% of the variance in Environmental Sustainability outcome. The values show that the proposed model has high prediction accuracy, as well as high explanatory ability.

## 4.5 Model Fitness

**Table 5: Model Fitness**

| <b>Model fit</b>   |                 |                 |
|--------------------|-----------------|-----------------|
| <b>Fit summary</b> |                 |                 |
|                    | Saturated model | Estimated model |
| SRMR               | 0.054           | 0.055           |
| d_ULS              | 0.349           | 0.358           |
| d_G                | 0.331           | 0.324           |
| Chi-square         | 727.472         | 704.554         |
| NFI                | 0.857           | 0.862           |

The model fit assessment suggests that the proposed structural model has an acceptable level of overall model fit. The values of Standardized Root Mean Square Residual (SRMR) values for saturated model (0.054) and estimated model (0.055) are below the recommended value (0.08), which shows good fit between the observed data and the proposed model. In addition, the Normed Fit Index (NFI) values of 0.857 for the saturated model and 0.862 for the estimated model are above the lower limit of 0.80 indicating good model adequacy. The discrepancy measures such as d\_ULS (0.349, 0.358), and d\_G (0.331, 0.324) are not very large, suggesting a lack of large difference between the empirical covariance matrix and the model-implied covariance matrix. Furthermore, the Chi-square values of 727.472 and 704.554 for the two models are regarded as adequate because of the complexity of the model and the sample size. Overall, these fit statistics show that the model proposed exhibited good explanatory power and satisfactory model fit for the relationships between E-Government Capability, Digital Data Integration, Environmental Compliance Monitoring, Information Transparency and Environmental Sustainability.

For Environmental Compliance Monitoring (ECM) the Digital Data Integration's coefficient ( $\beta = 0.482$ ,  $p < 0.001$ ) was the highest of all the variables in the model, indicating that it has a significant effect on ECM. The findings are in line with Astuti et al. (2025) which stated that the efficiency of environmental monitoring can be improved by the use of integrated digital systems, which has better information sharing and real-time reporting. Likewise, according to Lubis (2024), the introduction of digital integration in governance can enhance the effectiveness of governance, as it can support coordinated decision making between public institutions. Butt (2025) was also able to demonstrate the contribution of digital infrastructures to the improvement of the environmental monitoring and regulatory compliance, by facilitating the access to environmental information. Kayode (2022) and United Nations (2022) also earlier noted the importance of better governance outcomes from the use of integrated information systems in improving outcomes for sustainable development. Based on the above, the present findings strongly corroborate the previous evidence on the relevance of digital integration in the

environmental governance and monitoring activities.

#### 4.6 Discussion

The present study explored the relationship between E-Government Capability, Digital Data Integration, Environmental Compliance Monitoring as mediating variable, Information Transparency as moderating variable and Environmental Sustainability. The results are both theoretically and literature-based relevant, as well as practically relevant, and contribute to the existing knowledge on digital governance and environmental sustainability. Theoretically, the study builds on Good Governance Theory by providing evidence that digital governance capabilities can promote sustainability outcomes by improving monitoring capabilities. Governance effectiveness is enhanced through technological innovation and information management systems; this is supported by the significant effects of E-Government Capability and Digital Data Integration on Environmental Compliance Monitoring as explored in the theoretical assumption. The findings were consistent with that of Lubis (2024) and Astuti et al. (2025) who stated that digital governance has a positive effect on the sustainability of the institutions and effectiveness of the governance. Moreover, Butt (2025) and United Nations (2022) stated that technology based governance improves accountability and environmental governance. Therefore, the results give empirical evidence of the use of Good Governance Theory on the environmental sustainability field.

From the literature point of view, the results confirm earlier studies which concluded that digital governance is one of the significant factors in determining the environmental performance. Digital Data Integration and Environmental Compliance Monitoring are found to be significantly correlated with each other where  $\beta = 0.482$ , which is in accordance with Astuti et al. (2025) who found that the integrated information system was seen to have a positive effect on environmental oversight and the effectiveness of environmental regulations. Likewise, Lubis (2024) emphasized the importance of digital incorporation in empowering data-informed governance and sustainability efforts. Furthermore, the E-Government Capability has a significant influence on Environmental Compliance Monitoring with a beta coefficient of 0.407, corroborating the findings of the previous studies by Butt (2025) and Kayode (2022) which found that E-Government systems have a positive impact on enhancing regulatory monitoring and the performance of the public sector. The present study adds to the body of evidence, however, from a context which has not had much attention in the literature on digital governance, Mongolia. The results therefore contribute to the body of knowledge and indicate that digital governance can not only improve the administrative efficiency, but also have a direct impact on the environmental management and sustainability.

#### 5. CONCLUSION

This study focused on the relationships between E-Government Capability and Digital Data Integration in relation to Environmental Compliance Monitoring, Information Transparency and Environmental Sustainability in the context of Mongolia. The results show that digital governance mechanisms have a strong

impact on fostering environmental sustainability by facilitating environmental monitoring processes. More specifically, E-Government Capability and Digital Data Integration have a strong influence on Environmental Compliance Monitoring and this in turn on Environmental Sustainability. The findings suggest that the use of digital technologies and integrated information systems for effective monitoring and regulatory enforcement can be a way for governments to improve environmental performance. The results are in line with the propositions of Good Governance Theory, which shows that the technological capabilities have a positive effect towards strengthening the effectiveness of governance and achieving sustainable development goals (Lubis, 2024; Astuti et al., 2025).

This study also makes a contribution to the literature as it validates the mediation of Environmental Compliance Monitoring. The strong indirect effects indicate that digital governance programs do not directly impact sustainability, but rather through increased monitoring and compliance processes. This finding is in agreement with the previous research carried out by Butt (2025) and Kayode (2022) which had focused on the importance of monitoring systems in meeting environmental policy goals. Moreover, the high  $R^2$  values suggest that the proposed framework has a high explanatory power and successfully captures the main factors that influence the environmental sustainability in the framework of digital governance.

### **5.1 Future Research Direction**

The results of this research suggest a number of ideas for further research. First, there is a possibility of extending the proposed framework with other constructs related to governance, like digital maturity, environmental accountability, regulatory effectiveness, stakeholder participation and organisational readiness. Other factors beyond the current research have been suggested to influence sustainability outcomes, such as institutional and technological factors (Astuti et al., 2025; Lubis, 2024). In addition, future studies could investigate other mediating and moderating processes to deepen the understanding of how digital governance can help achieve environmental sustainability. These extensions would enhance explanation of governance models and more understand governance's challenges related to sustainability.

Second, the study's methodology was cross sectional, making it difficult to draw conclusions about cause and effect over the course of the study. Longitudinal research is needed in the future to analyze the impact of digital governance projects in various phases of their implementation on environmental sustainability. Furthermore, it was carried out in a single country (Mongolia), and these results might not be applicable to other country settings. This could be helpful in drawing lessons from comparative studies between different countries on the impact of institutional, cultural and regulatory factors on the effectiveness of digital governance (United Nations, 2022; Kayode, 2022). These studies would help develop governance theories which are more widely applicable.

Third, methodological improvements also can enhance future research. The current study adopted quantitative survey approach and PLS-SEM analysis, but

future research could incorporate mixed method approaches of surveys, interviews and case studies to provide more in-depth analysis of governance processes and sustainability outcomes. Qualitative investigations might give a better explanation to the reasons why the moderating effect of Information Transparency was not significant in the present study. Besides, future research could be conducted based on other theories, including Good Governance Theory, and other theories that can be used as supplementary theories, namely Institutional Theory, Resource-Based Theory, and Dynamic Capabilities Theory, as they can provide wider explanations of digital governance phenomena (Butt, 2025; Lubis, 2024).

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