Toward sustainable development: Construction and appraising enhanced amalgamation framework of Business Intelligence based sustainability report

Mona Mohamed[1], Ahmed M. AbdelMouty[2]

[1]Higher Technological Institute, 10th of Ramadan City 44629, Egypt

[2]Information System Department, Faculty of Computers and Information, Zagazig University, Egypt

Vice Governor of EL-Sharqia, Zagazig, Egypt

Emails: mona.fouad@hti.edu.eg; a_abdelmouty@zu.edu.eg

Abstract

The purpose of this study is to strength information of sustainability Reports (SusRs) toward achieving sustainable development (SusD) according to SustainableDevelopment Goals (UN_SDGs). So, we proposed a robust framework for enhancing and appraising corporate sustainability performance by integrating BI in SusRs to provides a structured approach for nterprises.Due to ability of BI to facilitate collect, analyze, and report processes on sustainability data. Additionality it leads to informed decision-making and improved sustainability outcomes. Our framework highlights the importance of SusR and its impact on stakeholder engagement and transparency. Moreover, it emphasized the potential of BI in enhancing the accuracy, reliability, and completeness of sustainability reporting. The framework's practical application is demonstrated through a case study, which showcases how it can be used to identify sustainability risks and opportunities and develop effective sustainability strategies. Generally, our work contributes to the growing body of research on corporate sustainability by providing a comprehensive framework that can help companies to achieve their sustainability goals while driving business performance.

Keywords: sustainable development; Business Intelligence; optimization

1. Introduction

Enterprises in [1] are facing new obstacles in adjusting their operations and their strategies to the requirements of SDGs to meet the Sustainable Development Goals' (SusDGs) criteria. These obstacles are posed according to the United Nations' 2030 Agenda and its 17 SusDGs.

Subsequently for the corporate community, adhering to the guidelines of sustainable development (SusD) is of the utmost importance. Additionally, a variety of reports have been released by enterprises [1] to provide stakeholders with a clear image of the sustainable practices that they engage in. Demonstrates that Ref [2] where corporate sustainability reports (SusRs) may enhance communication between enterprises and stakeholders. Due to [3] SusRs genuinely aid in raising the level of enterprises' accountability.

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Wherefore [4] analyzed the historical evolution of SusRs during the most recent decades, as in Figure 1. This Figure and scholars of [5] indicated that integrative sustainability reporting (ISusR) considers the effects of business operations from the Triple Bottom Line (TBL) as environmental, social, and economic viewpoints. Environmental, social, and sustainability reports , as well as financial and non-financial reports, based on [6] have increased rapidly in recent decades. So, Large enterprises, as well as SMEs, regularly inform their stakeholders about their social and environmental performance more often through printed materials reporting or on their websites.

On the other hand the study [7]described SusR as the process of measuring, disclosing, and being accountable for an enterprise's environmental, social, and economic performance. It involves collecting data on sustainability-related aspects of enterprise's operations, such as carbon emissions, energy use, waste generation, and labor practices.

Although SusRs are pivotal for stakeholders as investors, customers, employees, and communities through providing them with information on the extent and to what degree enterprises contribute to sustainable development. But [8],[9], [6] discussed several unique obstacles are present in corporate SusR as following.

i. Disparities and imbalanced in information are two-pronged:

Information on enterprise's viability is frequently difficult for stakeholders to get and acquiring it may be extremely expensive in terms of both time and money. Contrarily, businesses might not always be adequately informed on the information requirements of stakeholders. Because of this, stakeholders' informational demands are not always met by sustainability reports, and frequently only a tiny portion of the intended audience is reached.

ii. SusRs' inadequate concentration

Reports on sustainability are frequently attacked for lacking focus and targeting an unduly broad and diffuse audience of prospective readers. The risk of information overload is increased by this lack of target group orientation.

iii. Corporate sustainability is a challenging endeavor.

There is little information available regarding the implementation of accounting and information management systems that would provide a thorough basis for identifying and reporting on sustainability issues, as well as regarding how to connect strategic analysis and management with information management, corporate accounting, and sustainability reporting.

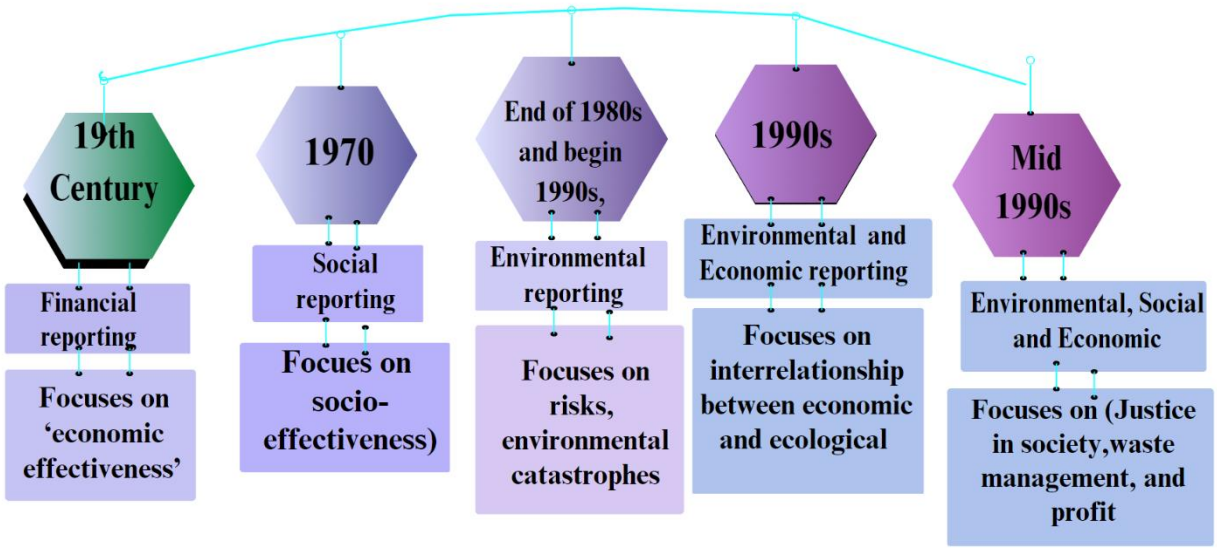

Figure 1: Evolution of sustainability reports

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For releasing these challenges and improve sustainability management subsequently the process of SusR , deployment enhanced techniques for efficiently examine data and provide managers the knowledge they need to make decisions. For example [10] the generation of reports and decision-making processes have been enhanced due to advancements in information and communications technology (ICT). Others as in [11] by the use of ICTs, including the internet for making attainable three advancements in SusR.

One of the best tools that may guarantee that management has better access to precise and up-to-date data when needed is Business Intelligence (BI). Due to [12] its capacity to enable quicker, more precise, and more trustworthy judgements. Scholtz et al.[13] described BI as a technology that is widely accessible and makes it simple to acquire, store, and process information. Deployment BI in enterprise can enhance their operations, optimize their resources, and improve their business performance.

The amalgamation process between BI with SusR considers the optimal successful amalgamation. This results from Figure 2 and Ref [14] where BI can enhance corporate sustainability performance by providing a more comprehensive understanding of TBL of enterprise's operations.

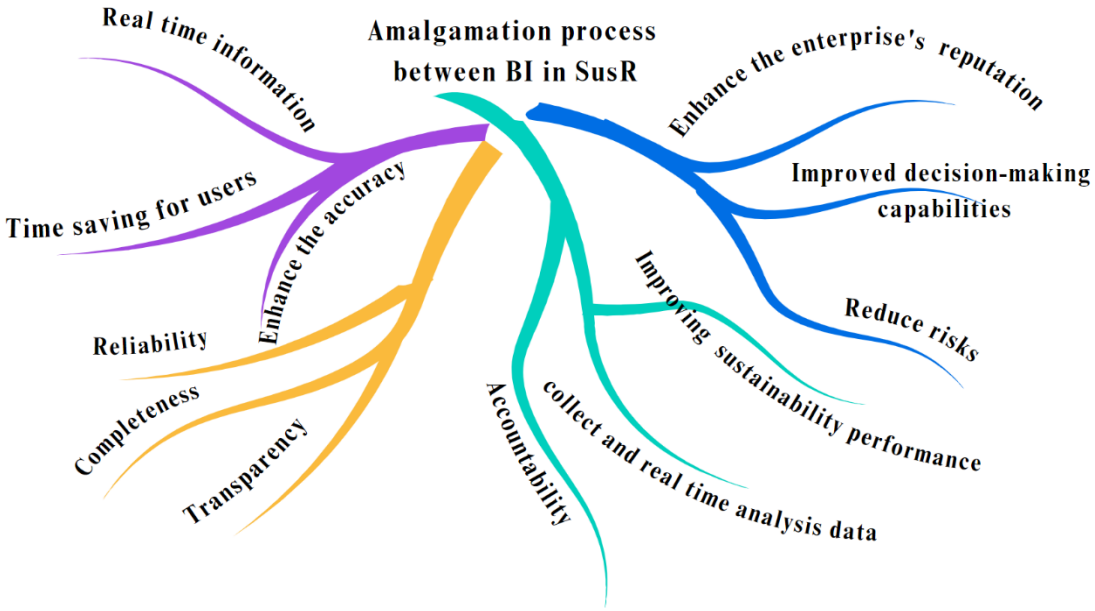

Figure 2: Role of BI in SusR

Despite the successful role for BI in SusR as shown through amalgamation process between BI and SusR, there are still some research gaps that need to be addressed.

The first research gap is the lack of standardization in SusR frameworks, which can make it challenging for companies to collect and analyze sustainability data consistently. The lack of standardization can also make it difficult to compare sustainability performance across different companies and industries.

The second research gap is the need for better data quality and reliability in SusR. Sustainability data can be complex and challenging to collect, leading to errors, inconsistencies, and inaccuracies. This can undermine the credibility of sustainability reports and reduce their effectiveness in driving sustainability performance. There is a need for more research on how to improve data quality and reliability in SR, including the development of data verification and validation tools. While SusR has become more mainstream, it is often still seen as a separate reporting process from financial reporting. There is a need to integrate SusR with financial reporting to provide a more comprehensive understanding of a company's overall performance and value. This will require more research on how to integrate sustainability data into financial reporting frameworks, including the development of new accounting standards and metrics.

This study is eager to provide the following key contributions:

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- Enhance corporate sustainability performance through proposing a comprehensive framework for integrating SusR with BI.
- This study emphasizes the importance of stakeholder engagement throughout the process and provides a structured approach for companies to collect, analyze, report on, act on, and monitor sustainability data.
- Our framework has practical applications and has been demonstrated through a case study, showcasing how it can be used to identify sustainability risks and opportunities and develop effective sustainability strategies.
- The amalgamation process between BI with SusR, permits collecting and analyzing sustainability data for enterprises, leading to more informing decision-making, enhanced sustainability performance, and improved stakeholder engagement.
- The proposed framework contributes to the ongoing discussion on how to enhance corporate sustainability performance and provides practical guidance for companies looking to improve their SR and decision-making processes.

The study organizes into set of sections as motivations of our study based on conducted survey for earlier studies in section 2, translate our contributions in constructing integration framework for BI based SusR in section3, moreover section 4 represents experimental results for applying case studies. Finally, we aggregated our conclusion about previous studied related the importance of BI in SusR; also, our conclusions through experimenting this study in conclusion at section 5.

2. Our study's Motivations

We based our study's motivations on surveys we performed for earlier research on SusR , BI ,and how SusR get benefit from emerging BI in it. In this section we posed hypotheses and response via conducted surveys for previous studies

H_1: How SusRs contribute to increasing business success?

The improvement of enterprise's reputation and risk management may be achieved through [15] by employing SusR . Stakeholders in [16] are given information to help them assess how enterprise actions may affect the economy, society, and environment. SusR is catalyst in [17] through building trust, enhancing systems and processes, moving forward with a company's vision and strategy, lowering compliance costs, and gaining a competitive edge. Adams et al. [18] examined the role of SusR in promoting organizational change and accountability, which demonstrated to lead to organizational change by increasing awareness of sustainability issues, promoting stakeholder engagement, and encouraging the development of new management practices. Scholars conducted a critical discourse analysis of sustainability reports [19] to examine how they can drive change towards sustainability, where the sustainability reports were demonstrated to play a critical role in promoting sustainability by influencing stakeholders' perceptions and behaviors. They analyzed 32 sustainability reports from leading companies and identified the dominant discourses and narratives used in these reports.

H_2: Why BI as one of ICT considers main catalyst in Decision Support System (DSS) for business environment?

BI according to the point of view for Sharda et al.[20] is shell which contains set of components as illustrates in Figure 3 . Each component plays a vital role and employs various techniques for achieving BI's targets of storing, analyzing, measuring, and reporting real time information. For more detailed information about BI and its architecture (See Ref [20]).

H_3: How BI has been volunteered to strengthen SusR?

The gathering, integrating, and reporting of sustainability information is one of the main difficulties enterprises have while managing sustainability [21]. So, Schaltegger et al. [22]provided an overview of the integrative management of sustainability performance, measurement, and reporting. They argued that sustainability should be an integral part of an organization's strategy and management system, rather than just a separate reporting exercise. They discussed the different approaches to measuring and reporting sustainability performance, including environmental management systems, SR, and social accounting. various studies for example[13] utilized BI for supporting enterprises handle their difficulties are including storage of data and a narrow circulation of information. Moreover, scholars provide the

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Sustainable BI Framework for strategic sustainability information management. Others [23] described BI as an important tool achieving sustainable competitive advantage

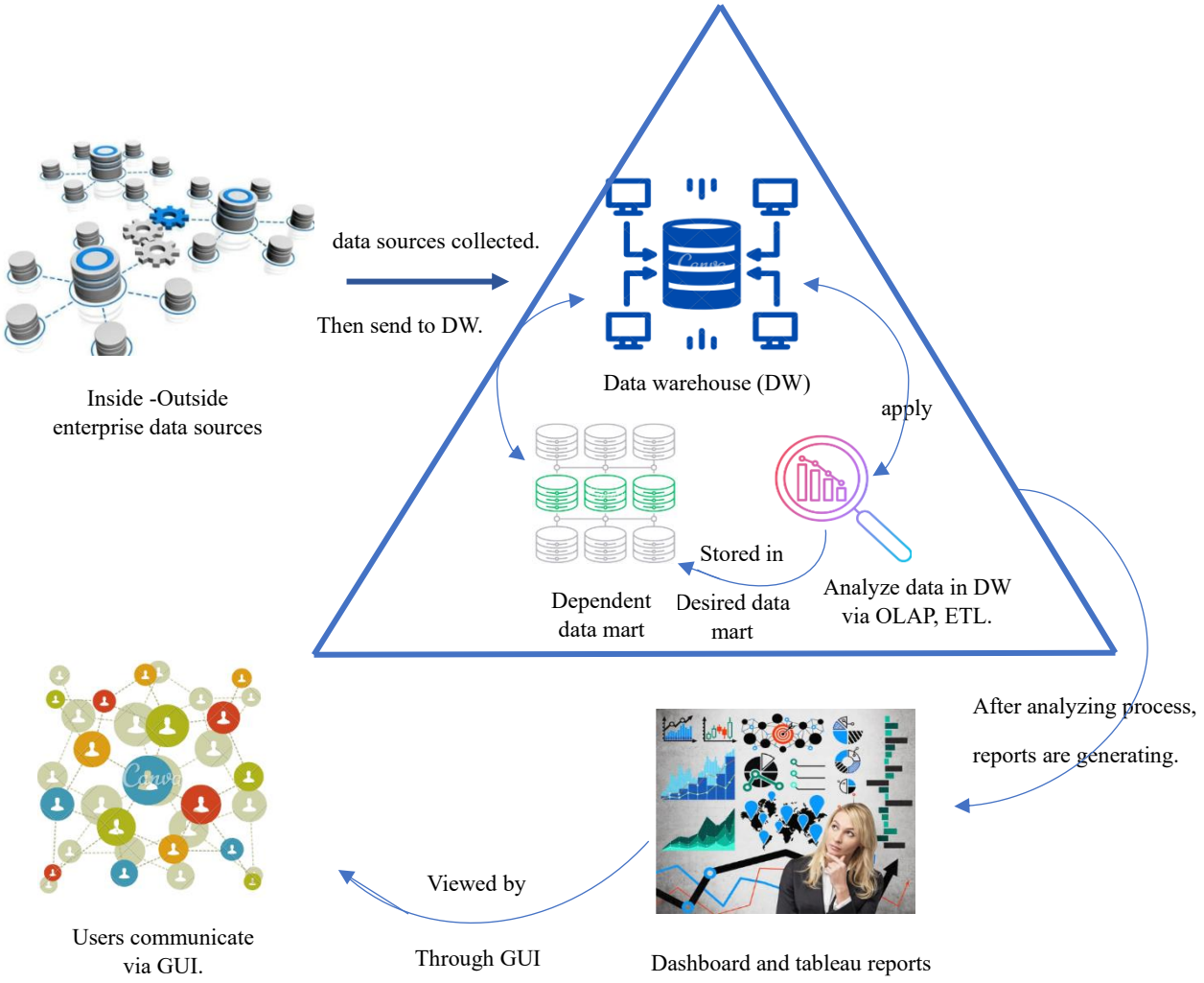

Figure 3: BI Architecture

3. Methodology

This section exposed several steps are involved in constructing an amalgamated framework for enhancing and appraising Corporate Sustainability Performance. The objective of the developed framework is to validate the amalgamated framework's efficiency for BI in SusR. We illustrate in detail the steps of constructing framework.

Step 1: Identification process.

1.1 Enterprises need to identify the sustainability issues that are relevant to their operations and stakeholders. It is a critical step in the design of our proposed framework for appraising and improving corporate sustainability performance.

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1.2 This step involves identifying the most relevant sustainability issues for the company and its stakeholders, based on factors such as the company's industry, geographic location, and stakeholder concerns.
1.3 By doing so, enterprises can prioritize their sustainability reporting efforts and focus on areas that are most material to their business and stakeholders.
1.4 Enterprises that fail to identify the most relevant sustainability issues may produce sustainability reports that are incomplete, inaccurate, or irrelevant to their stakeholders. This can lead to a lack of stakeholder trust and engagement, and a missed opportunity to enhance corporate sustainability performance.

Step 2: Construction of sustainability indicators.

2.1 This is a critical step in the design of our integrated framework in which the sustainability indicators are key metrics used to assess and monitor the environmental, social, and economic impacts of enterprise's operations.
2.2 constructing these indicators, permit enterprises to identify sustainability risks and opportunities, track progress towards sustainability goals, and communicate their sustainability performance to stakeholders.
2.3 In our framework, the construction of sustainability indicators is an essential step in the data collection and analysis process. This involves identifying relevant sustainability issues, such as greenhouse gas emissions, energy consumption, waste management, human rights, and labor practices, and determining the most appropriate indicators to measure progress towards sustainability goals.
2.4 These indicators should be relevant, reliable, and easily measurable. Also, to be aligned with recognized sustainability reporting frameworks such as the Global Reporting Initiative (GRI).

. **Step 3: Collection process.**

3.1 Enterprises need to collect sustainability data using a range of methods, including surveys, interviews, and data analytics.
3.2 This data should be collected on a regular basis and should be aligned with the sustainability indicators developed in step two.

Step 4: Analyzation data procedure.

4.1 Enterprises need to analyze sustainability data using business intelligence tools to identify trends, patterns, and opportunities for improvement.
4.2 This analysis should be used to develop sustainability strategies and action plans.

Step 5: Generalize sustainability performance report.

5.1 Our framework allows them to report on their sustainability performance using a range of communication channels, including sustainability reports, websites, and social media.
5.2 This reporting should be transparent, accurate, and aligned with relevant sustainability reporting frameworks.

Step 6: Act on sustainability data.

6.1 Our framework allows us to act based on the analysis of sustainability data and the development of sustainability strategies and action plans.
6.2 This involves implementing sustainability initiatives, monitoring progress, and adjusting as necessary.

Step 7: Monitor and appraise sustainability performance.

7.1 Our framework allows us to monitor and evaluate the enterprise' sustainability performance on an ongoing basis.
7.2 This involves collecting and analyzing sustainability data, reporting on progress, and adjusting as necessary.

4. Results and Discussions

The experimental portion of this work is based on a case study of Wipro Limited, a world-renowned provider of IT, BPO, and consulting services. Cognitive computing, hyper-automation, robots, the cloud, analytics, and other developing technologies are all used to ease our customers' transition into the digital era and ensure their continued success. It has earned widespread acclaim for its extensive list of offerings, its dedication to sustainability, and its

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ethical business practices. We have nearly 220,000 hardworking staff members helping customers on six different continents. The world we create together will be better and more daring because of the ideas we uncover and the connections we make. Also, the most recent reports from experts like Forrester, IDC, and Everest Group confirm that they are a global leader in AI-related services. The harmful impact of fossil fuels on our ecosystem is finally being recognized, albeit belatedly. As the end of the world approaches, people are increasingly investing in renewable energy sources. Thankfully, the sun is a reliable source of eco-friendly power. In response, Wipro and MachineHack have created a prediction competition to maximize solar power output through using Machine Learning (ML) techniques. In order to maximize solar power output, a solar energy provider needs a prediction model that can accurately forecast 'Clearsky DHI,' 'Clearsky DNI,' and 'Clearsky GHI. Each sample of data is composed of set of the following attributes: Year, Month, Day, Hour, Minute, Clearsky DHI, Clearsky DNI, Clearsky GHI, Cloud Type, Dew Point, Temperature, Pressure, Relative Humidity, Solar Zenith Angle, Precipitable Water, Wind Direction, Wind Speed, and Fill Flag.

Descriptive statistics play an important role in analyzing corporate sustainability performance as they help to summarize and present the data in a meaningful and understandable way. Descriptive statistics provide a clear and concise picture of the distribution of the data, including measures of central tendency, as tabulated in Table 1. As shown, descriptive statistics can help to simplify and present the data in a meaningful and understandable way, enabling stakeholders to easily identify trends, patterns, and areas for improvement. This information can be used to analyze the distribution of a company's greenhouse gas emissions across different operations or product lines. This can help the enterprise to identify which areas have the highest emissions and where it should focus its efforts to reduce its environmental impact.

Table 1: Wipro data descriptive statistics for analyzing corporate sustainability performance.

	count	mean	std	min	25%	50%	75%	max
Year	175296	2013.5	2.871908	2009	2011	2013.5	2016	2018
Month	175296	6.523549	3.448543	1	4	7	10	12
Day	175296	15.72782	8.799349	1	8	16	23	31
Hour	175296	11.5	6.922206	0	5.75	11.5	17.25	23
Minute	175296	15	15.00004	0	0	15	30	30
Clearsky DHI	175296	53.06543	64.20141	0	0	0	103	565
Clearsky DNI	175296	330.0653	370.0308	0	0	0	736	1040
Clearsky GHI	175296	254.3655	327.705	0	0	0	535	1063
Cloud Type	175296	2.540474	3.021879	0	0	1	6	10
Dew Point	175296	13.56443	8.196787	-17	8	15	21	26.9
Temperature	175296	18.26677	8.943096	-9	12	20	25	40
Pressure	175296	1003.185	5.935749	970	1000	1000	1010	1024
Relative Humidity	175296	79.37637	19.67824	7.19	65.59	84.23	97.95	100
Solar Zenith Angle	175296	89.72946	40.08545	8.55	56.45	89.86	123.06	171.55
Precipitable Water	175296	2.903732	1.546979	0.122	1.534	2.866	4.223	7.7
Wind Direction	175296	188.8778	99.01473	0	97.4	200	272	360
Wind Speed	175296	2.262871	1.281902	0	1.3	2	3	12.9
Fill Flag	175296	0.740433	6.575655	0	0	0	0	100

Data visualization is crucial for the analysis of corporate sustainability performance because it helps to make complex and large datasets more accessible, understandable, and actionable. Sustainability data often includes a range of quantitative and qualitative indicators that are interrelated and complex, making. It is difficult to identify patterns, trends, and insights. In Figure 4, we presented raw data into visual representations that are easier to interpret and communicate. Through data visualization, we can identify patterns and trends in sustainability performance that may not be immediately obvious from looking at raw data. We can also communicate sustainability performance to stakeholders, including shareholders, employees, customers, and communities, who may have varying levels of understanding of sustainability data. Correlation maps are important for the analysis of corporate sustainability performance because they can help to identify and understand the complex relationships that exist between different sustainability indicators.

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By visualizing the correlations between different sustainability indicators (See Figure 5), we gain insights into which factors have the most significant impact on sustainability performance. The degree of correlations helps us to prioritize sustainability initiatives and guide resource allocation towards the areas that are likely to have the greatest impact on overall sustainability performance. more emphasized correlation map can be generated for only variables of interest as shown in Figure 6.

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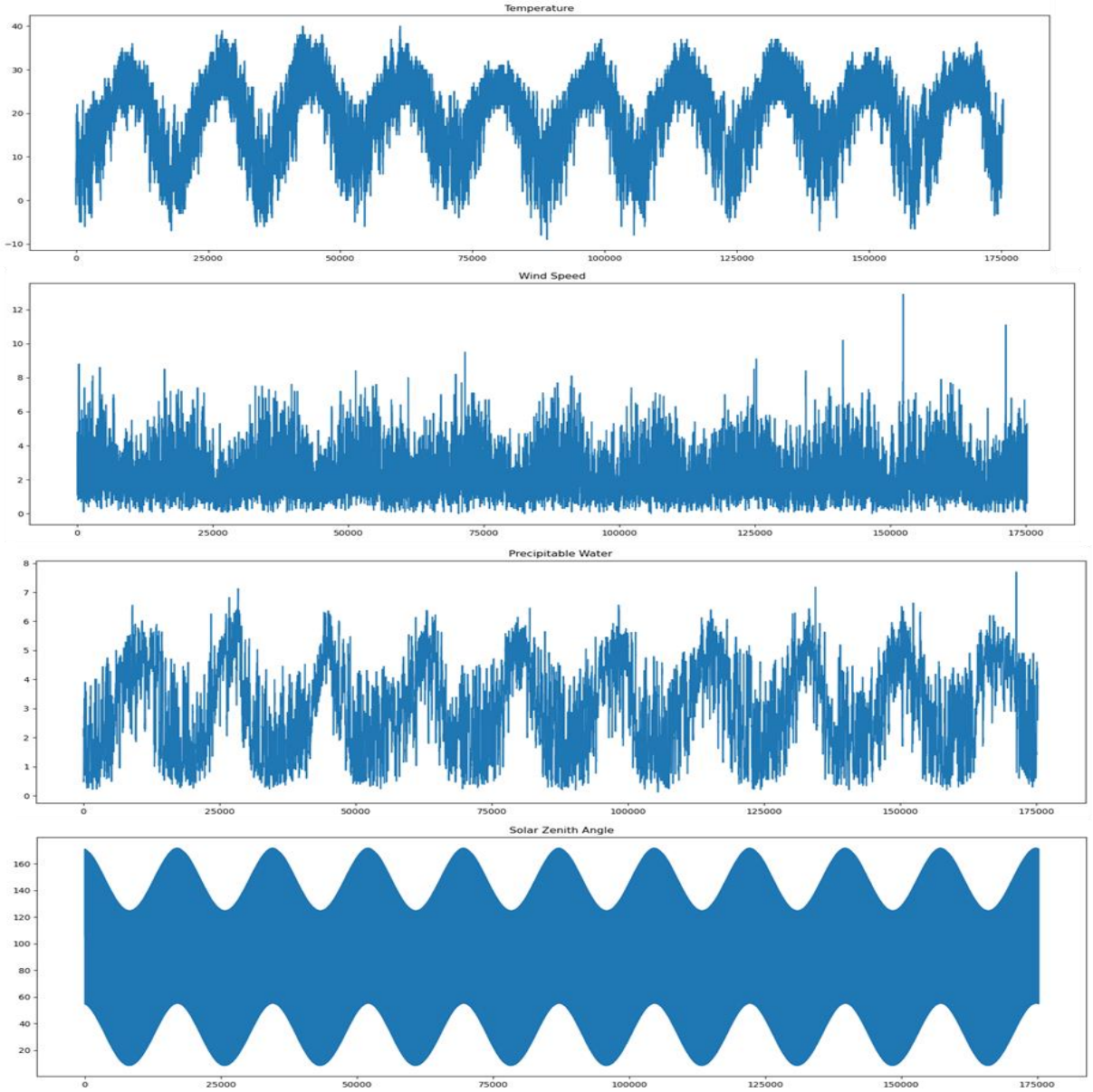

Figure 4: Visualization of important features in our cases studies

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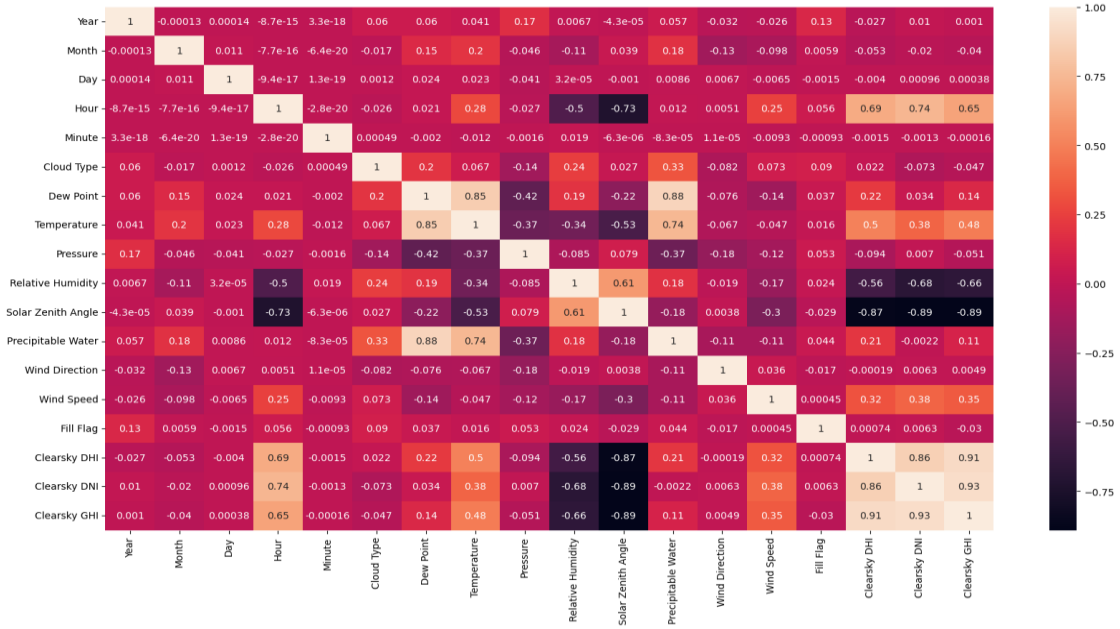

Figure 5: Visualization of correlation map for our case study on corporate sustainability performance.

Figure 6: Visualization of correlation map between important features in our case study on corporate sustainability performance.

5. Conclusion

According to the earlier studies which related to our aim area, we conducted this study and enhancing in field of SusR through constructing a framework for integrating SR with BI that can enhance corporate sustainability performance. By adopting this framework, companies can collect and analyze sustainability data more effectively, leading to better decision-making, improved sustainability performance, and enhanced stakeholder engagement. Our framework emphasizes the importance of stakeholder engagement and provides a structured approach to collecting, analyzing, reporting on, acting on, and monitoring sustainability data. The findings demonstrated that our framework could provide practical guidance for companies to have more informed decision-making, better stakeholder engagement, and a more sustainable business.

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