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Impact of Digital Transformation on Achieving Sustainability in Utility Sector of UAE

Abdulrahman Salem Alsaleh

RIT

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By

Abdulrahman Salem Alsaleh

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Student Name: Abdulrahman Salem Alsaleh

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Graduate Paper/Capstone Committee:

Name: Dr. Amol Gore

Designation: Professor of Industrial Engineering

Date: 30-August-2023

Name: Dr. Muhammad Imran

Designation: Assistant Professor of Industrial Engineering

Date: 30-August-2023

Abstract

The central focus of the current study is to understand the impact of digital technology on sustainable practices in a utility sector within the UAE. The research examined whether AI, blockchain, and big data can improve sustainability in the company to completely understand how digital technologies influences sustainable practices in the county's utility sector. Data were gathered using the survey data collection method for a quantitative review. The reliability of the data was examined using Cronbach's Alpha, and the strength of the relationships between the variables was investigated using correlation analysis. The extent to which the adoption of AI, big data, and blockchain will influence sustainable practices in the utility sector within the UAE was investigated using regression analysis.

Results showed that, according to the respondent in the utility sector, AI was the most effective in promoting sustainable practices. On the other hand blockchain and big data will have a moderate effectiveness in helping sustainable practices, less than artificial intelligence. Comparative analysis is not the focus of the study, though. As a result, it is discovered that while blockchain and big data will have somewhat moderate influence, AI will greatly impact sustainability in the utility sectors.

Keywords: *Artificial intelligence, Blockchain, Big Data, Utility sector within the UAE, Sustainability.*

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Introduction

With an increasing intensity in melting glaciers, wildfires, heatwaves, devastating floods, and other environmental phenomena, it is but a logical path to study the underlying reasons behind the said increase. Extensive analysis over the subject has led to the identification of climate change as the precursor behind an increase in natural disasters, which itself finds itself subject to the uncaring attitude and unsustainable actions of humans and businesses alike (Sweileh, 2020). While the consistent debate on the primary cause behind climate change is yet to be settled, analysis informs that suitable measures to reverse climate change are being undertaken at different levels across the world (Fawzy et al., 2020). One of the primary drivers that influence counteractive measures is the preliminary impact of a sector in climate change. For the energy sector in UAE, the respective impact can be seen in the form of increase in carbon emissions from 45.66 million metric tons in 2011 to 61.87 million metric tons in 2020 alone (Saleh, 2022). The assessment does not even include the emissions from water-related practices. The combined effect of complexity of operations in the energy sector (primarily electricity-related practices). Consequently, one finds that the emissions from utility sector are increasing by the day only to offset the impact of climate change counteractive measures such as UAE Sustainability Agenda 2030 and UAE Green Agenda 2030. Since the existing practices in the utility sectors of UAE are contributing towards the carbon footprint of the country, there is a definite demand for changes within the sector that can have a definite impact on cutting back on the emissions in the sector.

The quest for offsetting the emissions lies in digital transformation of the sector. Technological tools like Artificial Intelligence (AI), Big Data, and Blockchain have the capacity to transform the utility sector by reducing emissions. For instance, Ahmad et al. (2021) conducted an extensive analysis on the role of AI in managing emissions in the energy sector. The researchers found conclusive evidence that the application of AI in energy sector can aid in energy efficiency optimization via IoT, smart grid, predictive maintenance and other practices. On the other hand, Schuelke-Leeke et al. (2015) found that Big Data can enable better monitoring, corrective practices, and integrate smart grid technologies to curb emissions in the energy sector. Lastly, decentralization and transparency in blockchain was cited by Bao et al. (2020) to have an inhibitory effect on emissions in the energy sector. With this assessment in mind, the current assessment aims to propose the application of digital transformation via AI, Blockchain, and Big Data as the

systems that will help curb the emissions from utility sector in UAE and set the foundation for sustainable practices within the sector.

Research Aims and Objectives

The following statements will account as research aims and objectives of the study:

- To study the impact of digital transformation on sustainable development of the utility sector.
- To examine the relationship between blockchain technology and sustainable growth in the utility sector.
- To determine the relationship between Artificial Intelligence and sustainable growth of utility sector.
- To assess the relationship between big data and sustainable growth in the utility sector.

Research Questions

The following questions will form the basis of the study:

- What is the impact of digital transformation on sustainable development of the utility sector?
- What is the relationship between blockchain technology and sustainable growth in the utility sector?
- What is the relationship between Artificial Intelligence and sustainable growth of utility sector?
- What is the relationship between big data and sustainable growth in the utility sector?

Significance of the Study

The current study aims to use the existing research on the role of digital transformation in sustainability development as the foundation for innovation and enhancement in the utility sector of UAE. Extensive efforts in the sector have resulted in some cutbacks in emissions; however, for the country to make a transformative change in climate change reversal, every possible measure needs to be undertaken. Consequentially, the study will direct the scope of its attention towards the role of AI, Big Data, and Blockchain in streamlining operations in the utility sector and reducing emissions. Findings from the current study will contribute towards a platform that is increasingly emphasizing the importance of digital transformation for sustainable growth in utility sectors. Additionally, the research is significant since it attempts to revolutionize the conventional

practices in the utility sector of UAE, thereby contributing towards the solution of a problem that has immense implications for the society, economy, and environment of UAE.

Literature Review

Technology and its role in Sustainability: A multifaceted relationship

The concept of climate change and sustainability have become identical with every human and business activity in the recent era. The concept of associating sustainability with every Earthly practice can be attributed to the fact that climate change threatens to destroy life form in its entirety if it is left out with the same trends as in the past. Analysis finds that the same associative behavior for climate change has also been observed regarding technology. At its core, digital technology has come forth as a revolutionary and seismic change to the field of business and the world since it has characterized a complete turnabout in human and business practices. From better predictions to resource optimization and enabling better and informed solutions for the environment and society, technology has been found at the forefront of discussion and even actions related to climate change. A comprehensive analysis finds that while technology has decreased product and process waste, better design capacity, and better management, its relationship with sustainable development can be described as multifaceted at best. Analysis finds that there has been a growing body of literature that has successfully explored the potential for technology to support sustainable development. Additionally, the recent body of literature has also successfully identified some of the key ways in which technology can contribute towards meeting the climate change goals.

Finding solutions to satisfy the demands of the present generation without sacrificing the capacity of future generations to satisfy their own needs is at the heart of sustainable development. The phenomenon has been attributed for not only prioritizing the recent needs and wants of living beings, but rather meeting the current demands with cyclic operations at the core to guarantee that the demands of the future generation are also met. Sustainable development and sustainability necessitate finding the bond between social advancement, economic development, and environmental preservation. While not fully, technology has become the guiding force and one of the driving forces that is enabling the world to create new, more sustainable methods of doing things and by giving the world the necessary tools and approaches that can help manage the

resources more efficiently. A more comprehensive explanation on the subject can be found in the assessment conducted by Godil et al. (2021). The researchers found conclusive evidence that illustrates the role of technology when it comes to reducing transport sector emissions from the environment, thus proposing a method that is contributing towards the society and environment by taking away carbon from the environment. On the other hand, the Carbon Capturing and Mineralization (CCM) technology employed by Abu Dhabi National Oil Company (ADNOC) is yet another technology that is successfully transforming the carbon from the environment into mineral solids that assume rock formation to offset the effect of carbon emitted by ADNOC (ADNOC, 2023). The level of technology's contribution to sustainability and sustainable development can be determined by the fact that several technical systems are crucial in resolving a range of environmental, social, and economic problems. Internet of Things (IoT) (Saengchai & Jermsittiparsert, 2019) for effective resource management and real-time monitoring; Predictive Analysis (Dubey, et al., 2019) for spotting trends and making wise decisions; Cloud Computing (Li, et al., 2020) for scalable and accessible data storage and processing; Neural Networking (Lim et al., 2022) for complex pattern recognition and optimization; Together, these technological advancements support social justice, sustainable economic growth, and improved environmental conservation.

While technology and its ability to manage growth and innovation, well-informed strategies and approaches are central to making a definite impact on sustainable development, there is also a growing body of literature that emphasizes that technology may be contributing towards environment conservation and similar practices; however, it is yet to become a system that does not have detriments of its own. For instance, Lucivero (2020) found conclusive evidence that the same Big Data being cited as one of the transformative technologies that is positively contributing to climate change is negatively affecting the environment. On the other hand, Widdicks et al. (2022) found that the excessive use of digital technological systems can be attributed for “4% of global greenhouse emissions.” While the effect of technology is being only explored for its positive effect on climate change, it is only fair to assume that technology is likely to have a positive effect in sustainable development generally if the overall and individual (both positive and negative) effect of technology is studied for climate, society, and the economy.

Role of Artificial Intelligence (AI) in Sustainable Growth in Utility Sector

The concept of Artificial Intelligence rests on a phenomenon where all the humanoid abilities and characteristics are integrated with machine intelligence and mechanical characteristics to generate a system that is more pronounced, abled, and effective than the humans. Analysis informs that AI and Machine Learning accounts as one of the most transformative technological systems of its time. Therefore, the same analogical relationship explored between technological systems with sustainable development is also being explored for AI and its impact on sustainability. Vinuesa et al. (2020) explored the role of AI in achieving Sustainable Development Goals (SDGs). The researchers found that AI can address 134 targets across all 17 goals, making it a system that contributes to sustainable development. However, a comprehensive explanation also disclosed that AI also can inhibit 59 targets across the SDGs, which requires strategic use of AI in any field across the world.

When analyzed in the context of utility sector, the study's outcome was similar. For instance, Ahmad et al. (2022) studied the impact of AI on sustainability in energy sector. The researchers explored the status quo, opportunities, and challenges associated with the technology in the energy sector, only to find that AI will herald a new era in the field of energy where data-related informed insights combined with resource utilization, system operations, power production, and other activities will be streamlined to a point where the emissions from the sector will be limited. On the other hand, Goralski and Tan (2020) explored the impact and correlation of AI with sustainable development in water utility sector. The researchers attempted to study if AI "could herald a utopian future where humanity co-exists harmoniously with machines, or portend a dystopian world filled with conflict, poverty and suffering" (p. 100330). Evidence from three case studies found that AI can become a powerful enabler of global effort to promote economic, social, and environment development worldwide.

Role of Big Data in Sustainable Growth in Utility Sector

Big Data refers to a system that deals with extremely large datasets to make informed insights about future predictions and past trends. The extent of significance of the technology can be identified by the fact that Big Data has made some of the most informed predictions in the world of business and multiple other fields. When analyzing the role of Big Data for sustainable

development, Sivarajah et al. (2020) proclaimed that the technology has the capacity to make informed insights about future product development, service design, product design, distribution, procurement, hence a larger part of services and activities across the business supply chain. Consequently, Big Data has the capacity to boost sustainable growth. However, analysis by Widdicks et al. (2022) has also found that excessive use of Big Data also can negatively affect the environment. Therefore, it is important to be cautious when dealing with big data.

When analyzed in the light of energy sector, Marinakis (2020) studied a modified system that combined the technical capacity of Big Data with AI and distributed ledger technology. As per the assessment, it was found that the joint capacity of these systems enables "reliable and effective policymaking, as well as supports the creation and exploitation of innovative energy efficiency services through the utilization of a wide variety of data, for the effective operation of buildings" (p. 1555). Additionally, recent literature has highlighted several key areas where big data can support sustainable development in the utility sector. At one end, the assessment from recent literature identifies Big Data can play an integral role in improving the efficiency of energy distribution systems. Big Data will enable data analyzation on energy usage patterns and distribution networks, which can help identify areas where energy with high wastes or inefficient distribution system, thus prompting the necessary actions that will address these issues. Among other things, Big Data will allow for optimization in energy consumption and greenhouse gas emissions while also improving the reliability and resilience of the energy systems. From performance and system optimization to the development of renewable energy systems, Big Data can integrate information based on weather patterns, energy production, and energy demand, utilities can better manage their renewable energy assets and ensure that they are being used to their full potential. Thus, the technology can help to reduce human dependence on fossil fuels and mitigate the impacts of climate change.

Role of Blockchain in Sustainable Growth in Utility Sector

Blockchain is a ledger-based technological system also recognized as a key technological system known for making foolproof interactions sensitive in nature. The technology was also attributed as one of the definite systems that disruptive the existing field. Owing to its successful application to cryptocurrency and finance, the role of Blockchain has been studied for sustainable

development. For instance, Najjar et al. (2022) explored the role of Blockchain for sustainable development across the business supply chain. The researchers found conclusive evidence that blockchain can increase transparency across the supply chain, thus reducing potential for wastes, mismanagement, and frauds to a point where the processes can be streamlined.

Diestelmeier (2019) studied the role of blockchain in the energy sector, finding evidence that blockchain will change the transactional structures across energy sector and reimagine the role of associated actors in the field to develop a system that is more pronounced and transparent. On the other hand, Wang and Su (2020) found that blockchain allows for transition towards the renewable energy sector by powering energy sustainability. Therefore, it is only fair to proclaim blockchain as the heralder of a world where energy transition to clean energy will become more smooth.

Methodology

Research Design

The concept of research design is a preliminary stage of research methodology that directs its attention toward the data characteristics that will be used to make suitable choices. The said choices will direct the research questions to desired answers. The analysis finds that data is categorized based on the source and kind of data. When it comes to the source of data, the data is categorized as primary and secondary data. Primary data, as the name indicates, refers to information collected firsthand by the researcher, whereas secondary information is pre-collected. At present, the research will rely on the collection of primary information. This is because the research aims to study how the digitalization of the utility company is likely to shape the future of operations in the industry to guarantee sustainability. The foundation of the research lies in the fact that advancing time demands the need for integrating technology with sustainability.

By nature of kind, the data is yet again categorized into qualitative and quantitative information. Qualitative information refers to information that has qualitative characteristics, whereas quantitative information has quantifiable information. The research will rely on quantitative analysis to answer the research questions. This is because the current assessment aims to find the extent to which Big Data, Artificial Intelligence, and Blockchain influence sustainability in the Utility Sector of the UAE. While the perception of people can be used to find if Big Data,

Blockchain, and AI can influence sustainability in the utility sector, it would be more prudent to use quantitative data for this case, which is why the quantitative data will be used.

Sample and Population

The notion of population refers to the target group upon which research will be conducted. On the other hand, the sample is a small representation of the population that accurately depicts the characteristics of the population. The population is converted into a sample employing sampling techniques. Currently, the population of the study accounts for people working in a utility sector within the UAE, whereas a random sampling technique will be used to draw a sample of 30-35 people.

Data Collection Tools

After extracting the sample from the target population, the research methodology focuses on the suitable technique that can be used to collect the desired information. The Research methodology is a streamlined process. Consequently, the choices made in the previous stages are used to make decisions in the later stages. Currently, the interest lies in data collection tools that can collect primary and quantitative data. The suitable tools for this kind and source of data are questionnaires, surveys, observations, etc. Of the identified techniques, the current study will rely on a survey. The survey has been chosen as the suitable and desired choice since surveys have the flexibility to allow researcher freedom to mold the questions to their choice and yet do not leave much room for perception bias by the researcher.

Data Analysis Tools

The final stage of research methodology, the current stage, focuses on the tools and techniques that can be used to analyze the collected information. Since quantitative information has been chosen in a context where the impact of Big Data, AI, and Blockchain is being analyzed for sustainability in a the utility sector within the UAE, Cronbach's Alpha, Correlation Analysis, and Regression Analysis will be used to analyze the collected information. The information in question will be analyzed via Minitab, eliminating the fear of human error and researcher bias in analyzing the data. Cronbach's Alpha will be used to test the reliability of the variables, whereas correlation analysis will focus on understanding if a relationship exists between the variables. Lastly, regression analysis will be conducted to analyze if the independent variable has an impact on the dependent variable.

Findings and Discussion

Age

Age is an essential factor that helps understand the viewpoint of people towards a subject. While the field of business values experienced people, i.e., adults and older adults, there is also value in the viewpoints of the young generation. This is because while older people bring an experienced view, young people can bring innovative ideas and growth to the company and sector. Therefore, company- and sector-related research has always focused on studying the age of respondents. The following visual shows the outcome when it comes to the age of respondents:

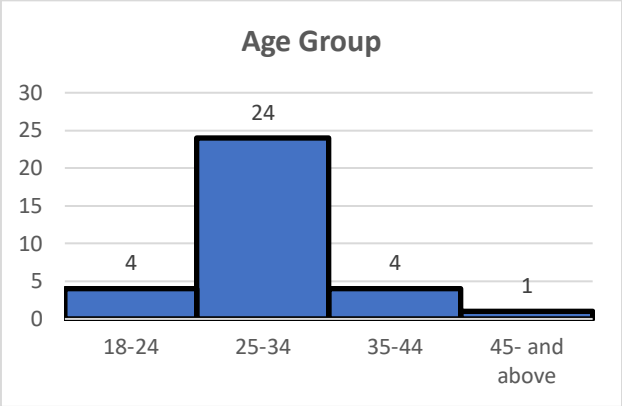


Figure 1: Age

The graph output which is taken form the survey shows that 4 out of 33 respondent belong to the age group of 18-24 years, whereas most of the respondent were in the age of 25-34 which likely to bring a dominating view point of people in this age. 4 out of 33 respondent and from age 35 to 44 while only 1 respondent is form the age 45 and above.

Gender

Like age, knowledge of the gender of the people is yet another integral part of the business- and sector-related study. The following visual shows a gender-related distribution of the respondents:

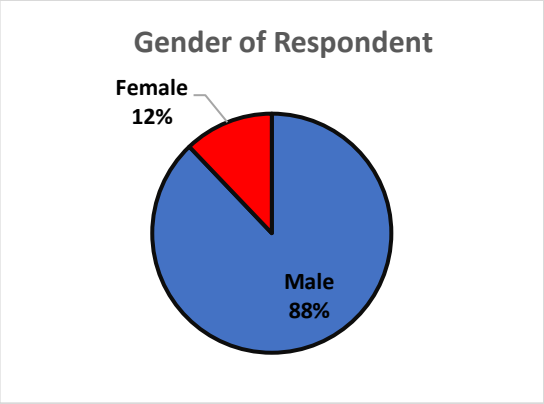


Figure 2: Gender

The graph output shows that males are more dominant in this survey with 88% while females are only 12%. Maybe this is because of the number of men are much higher in this industry.

Level of Education

Level of education holds equal importance in the world of business as age and gender. People with higher degrees have formally learned about applying better and more systematic approaches in the business/sector. While people without good degrees also present good ideas, people with formal degrees are often more persuasive in achieving the outcome and have more technical knowledge in the engineering field. In the interest of understanding the role of the level of education for research, the following chart shows the level of education of the respondents:

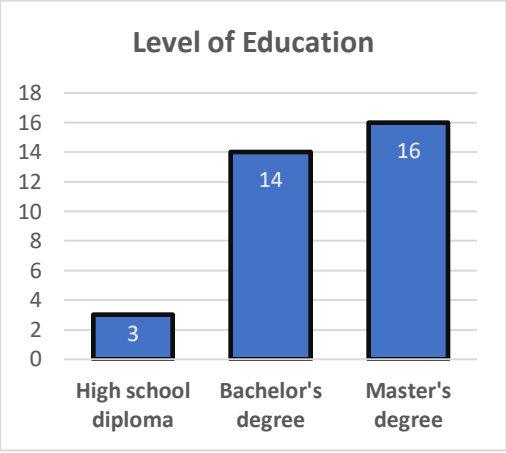


Figure 3: Education

The survey's respondents' educational backgrounds showed a varied composition. There was a strong emphasis on higher education among the participants, as seen by the 16 master's degree holders and the 14 bachelor's degree holders. Only three respondents, on the other hand, had high

school degrees, showing a substantially lower number of people with only a secondary education. The distribution indicates a population that may be highly educated and specialized, perhaps including professionals or subject-matter specialists.

Years of Experience

Years of experience is an appealing component of an individual. People with higher experience have dealt with many complexities and issues before. The figure 4 shows that most respondent have a 3-5 years of experience (11) while the next comes 6-8 years of experience (8).

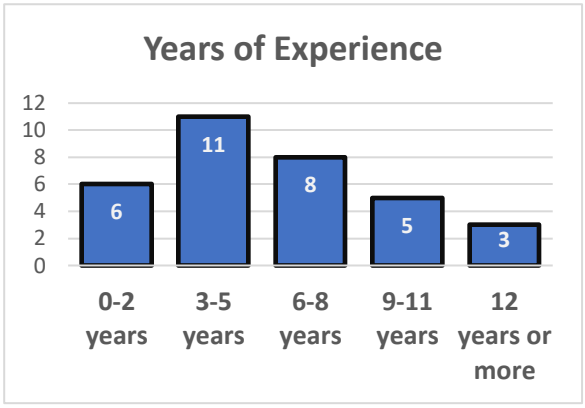


Figure 4: Experience

Support in Digital Technology for Sustainability

The following visual shows the response of respondents when asked which technology can drive sustainability in the Utility sector of UAE. Figure 5 shows around 70% of the respondent proclaimed that AI, Blockchain, and Big Data have equal capacity to drive sustainability in the Utility sector of UAE. On the other hand 7 preferred Artificial Inteligence, 2 have chosen block chain, 1 have chosen other in which he indicated all technologies drive sustainability except big data and none have chosen big data.

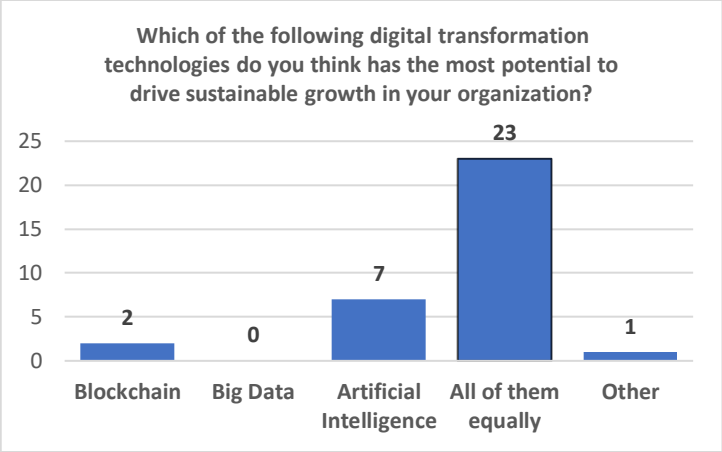
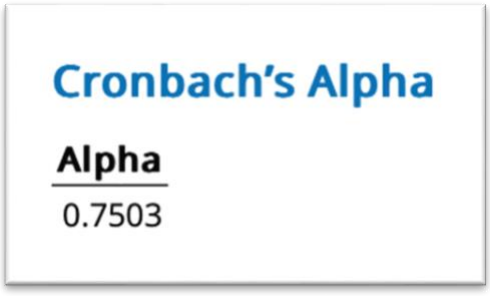


Figure 5: Support for Technology

Cronbach's Alpha

Cronbach's Alpha has been cited as one of the most effective and frequented approaches when studying the reliability of quantitative data. The value indicates whether the respondents consistently responded to the inquiry (Amirrudin et al., 2021). While the approach is limited in generating an overall review of the subject, it is still effective. Still, the approach helps identify whether the respondents' viewpoint was consistent. A consistent viewpoint helps inform that the viewpoint of people in the population supports the findings. The output from Mintab shows the outcome for all four variables of the study:



The output shows that the Cronbach Alpha output for the obtained data is 0.7503, which indicates that the data is reliable since is alpha is greater than 0.70. This means that the view points of the respondents are consistent.

Correlation Analysis

Statistical literature informs that correlation analysis is one of the most frequently used metrics when analyzing the relationship between two or more variables. There is sufficient evidence that correlation analysis gives accurate and effective responses. The correlation analysis outcome is limited to -1 and +1 (Senthilnathan, 2019). The negative sign indicates an inverse relationship between variables, whereas the positive sign indicates a direct relation. On the other hand, a value close to 0 shows no correlation, whereas a value close to 1 indicates a high correlation (Senthilnathan, 2019). The following table shows the correlation analysis between the variables of the study:

Correlations

	Block chain	Big Data	Artificial intelligence
Big Data	0.278		
Artificial intelligence	0.390	0.256	
Sustainability	0.553	0.513	0.724

Table 1: Correlation Matrix

To fully characterize the study's outcome, only the correlation between independent variables, i.e., Artificial Intelligence, Big Data, and Blockchain, will be studied with the dependent variable, i.e., Sustainability. Table 1 shows Artificial Intelligence has a significant effect on Sustainability with a correlation value of 0.724 which is considered as a very strong correlation. On the other hand, the relationship of Sustainability with Block Chain and Big Data can be described as moderate relationship since the value of correction between Sustainability and Block Chain is 0.553 while between Sustainability and Big Data is 0.55. The correlation value between all independent and dependent variables is positive, meaning that adopting the explored digital technologies will likely boost sustainability. Additionally, the impact of Artificial Intelligence is found to be most significant.

Regression Analysis

While correlation analysis is recognized as one of the most effective techniques for analyzing the relationship between two or more variables, analysis finds that the technique lacks when it comes to identifying which variable affects the relationship. Additionally, correlation analysis finds the strength of relationships without quantifying the relationship. Therefore, regression analysis is often used as an accompaniment to correlation analysis since regression analysis successfully identifies the extent to which change in independent variables is likely to influence the dependent variable (Gomila, 2021). With this idea in mind, the following table shows the regression analysis between independent variables and dependent variables for the current study:

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.232959	69.25%	66.07%	53.09%

Table 2: Correlation Matrix

Table 2 shows the value of R-squared, coefficient determination, is around 70% which indicates that the regression equation is a decent fit for the data, this value signifies that around 70% of the variability in the dependent variable is explained by the independent variable.

Table 3 shows the output of the regression equation from the collected data:

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	0.499	0.570	0.87	0.389	
Block chain	0.1793	0.0801	2.24	0.033	1.23
Big Data	0.324	0.117	2.77	0.010	1.11
Artificial intelligence	0.4005	0.0830	4.83	0.000	1.21

Table 3: Regression Analysis

In continuation with the findings of correlation analysis, table 3 indicated that Artificial Intelligence is likely to have the strongest influence on sustainability in the Utility Sector within the UAE. The regression value is 0.40 and the P value is less than 0.05 therefore we can accept the hypothesis that Artificial Intelligence affects the change in Sustainability, therefore adopting AI will increase sustainability in the utility section by 40%. Moreover, both block chain and big data P values are less than 0.05 therefore we can accept the hypothesis of both since any change in block chain and big data will affect sustainability. Block chain will improve sustainability by 17% while big data will improve sustainability by 32%.

Conclusion

The core theme of the current assessment lies in understanding the impact of digital technologies on sustainable practices in the Utility sector of the UAE. To fully understand the extent to which digital technologies affect sustainable practices in the Utility sector of the UAE, the research studied if AI, blockchain, and Big Data can boost sustainability in the sector in UAE. A quantitative review was conducted, with the data collection technique being a 'survey.' Analysis was conducted with Minitab through Cronbach's Alpha for reliability, Correlation Analysis to study the strength of the relationship between the variables, and Regression Analysis to study the extent to which AI, Big Data, and Blockchain adoption will influence sustainable practices in the Utility sector of UAE. Comparative analysis is not central to the study. Therefore, it is found that while AI significantly boost sustainability in the UAE utility sector, Blockchain and Big Data’s impact are somewhat moderate.

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