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Leveraging Cloud Services & Digital Transformation for Sustainability: Insights from Cases of Qatar

Ahmed Elidrisy^{1*}

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ABSTRACT

The current research aimed to present an in-depth analysis of how Qatar Free Zone (QFZ), Qatar Smart Program (TASMU), Qatar National Broadband Network (Qnbn), and Msheireb Downtown Doha are Leveraging Cloud Services and digital transformation for sustainability under Qatar National Vision 2030 (QNV2030). The researcher used a qualitative case study research approach to analyse the aim gathering data using semi-structured interviews from 21 sustainability experts, government officials, and IT professionals. The findings highlighted that QFZ and Qnbn projects of Qatar meet the principles of SDG 8: Decent Work and Economic Growth. Results showed that Qnbn offers multiple benefits for the economic development of multiple sectors. All four cases align with two SDGs, including SDG 9: Industry, Innovation, and Infrastructure and SDG 11: Sustainable Cities and Communities, to meet the requirements of the QNV2030 and sustainability for building Smart Qatar. Also, these projects like Msheireb Downtown Doha and QFZ in Qatar are founded on four key pillars, including social, human, economic and environmental developments meeting QNV2030 objectives. Cloud services also offer climate-related innovations facilitating environmental monitoring, resource optimisation, etc., in QFZ and Google Cloud partnership aligned with SDG 13: Climate Action.

INTRODUCTION

Qatar National Vision 2030 (QNV2030) is to develop as a society that promotes justice, equality and goodwill. The fundamental principles of the QNV2030 include social, human, environmental and economic development, integrating fast-paced economic development. Notably, the Qatar Human Development Framework aligned with QNV2030 is to create a versatile and progressive Qatar to achieve the Sustainable Development Goals (SDGs) (Mohamed *et al.*, 2022). Consequently, the digital transformation as per the Qatari approach is dependent on the interplay between frontend and backend service interfaces and production systems developing a knowledge-based economy. Some programs steering digital transformation include "Qatar Digital Government (QDG) Strategy 2020", launched in 2015 and aligned with the QDG Strategy of the Qatar Smart Program "TASMU", created in 2017, making Doha a smart city. The digital transformation of the QNV2030 is associated with optimising Information and Computer Technology (ICT) (Mahmoud Ali & Meyerhoff Nielsen, 2022). Similarly, establishing a "Qatar Free Zone" is based on the aim of supporting and promoting applied, scientific, and technological research (Nawaz & Koç, 2020). According to Venkatesh *et al.* (2017), the changing pace of imperatives of digital transformation and business dynamics are influencing Communication Service Providers (CSPs) with advanced opportunities to bring digital innovations. These CSPs include cloud service providers, and internet service providers having unique abilities of interconnectivity. Most of the Gulf Cooperation Council (GCC) countries are focused

on enhancing cloud-based services and have explored Internet of Things (IoT) based service opportunities with native data and cloud centers. Qatar, Saudi Arabia, Bahrain and the United Arab Emirates are the leading countries fuelled by digital transformation (Venkatesh *et al.*, 2017). Smart Cities in Qatar are relying on innovations of emerging ICT trends to shift towards more sustainable models focusing on long-term commitments, altering social behaviours and resource consumption (Badran, 2023).

Existing research highlighted the significance of sustainability leveraging digital transformation in Qatar. However, a gap has been observed in analysing the specific projects which have been developed or are in process in Qatar to meet the criteria of QNV2030 leveraging cloud services and digital transformation for sustainability. For this purpose, the current research was conducted with the aim of presenting an in-depth evaluation of the four specific cases leveraging cloud services and digital transformation for sustainability in Qatar. The researcher opted for a qualitative approach gathering data from semi-structured interviews to cater to the following research questions.

1. How Qatar Free Zone, Qatar Smart Program (TASMU), Qatar National Broadband Network (Qnbn), and Msheireb Downtown Doha are leveraging cloud services and digital transformation for sustainability under QNV2030?

2. Which specific SDGs are met by the Qatar Free Zone, Qatar Smart Program (TASMU), Qatar National Broadband Network (Qnbn), and Msheireb Downtown Doha, integrating digital transformation for sustainability?

¹ Qatar Free Zone, Qatar

* Corresponding author's e-mail: ahmedidrisy@gmail.com

LITERATURE REVIEW

It is analysed that the GCC alliance of six members is accelerating together for comprehensive economic development with their future visions (QNV2030, UAE Vision 2021, Saudi Vision 2030, Kuwait Vision 2035, etc.). These initiatives are aligned with seeking sustainable development, promoting digital transformation, innovation and job creation facilitating sustainable economic development. One such leading project is the TASMU Smart Qatar Program, which drives innovation with digital transformation and sustainable economic development in priority sectors (Villegas-Mateos, 2022). Additionally, Ben Hassen (2022) examined that QNV2030 calls for initiatives that support sustainability for national development and planning. In this matter, the ICT Supreme Council (ictQATAR) has implemented a number of initiatives with ICT interventions in e-government, healthcare, and infrastructure for stimulating sustainability, serving national development requirements, raising awareness and enhancing quality for the ICT technology (Ben Hassen, 2022).

Moreover, aligning with QNV2030, one particular adopter by Qatar is the development of new technologies such that the country rolled out a 5G network as one of the first few countries with 99% of the population having mobile internet connection (Villegas-Mateos, 2022). Consequently, as highlighted by Venkatesh *et al.* (2017), Ooredoo & Vodafone Qatar are a few of the active CSPs integrated digital initiatives offering cloud-based IT security solutions. The research highlighted that CSPs are the enablers of advancing digital services with their emergence in Smart Cities, Smart Education, Smart Construction, Smart Manufacturing and Industry 4.0 (Venkatesh *et al.*, 2017).

Furthermore, a significant strategy adopted by the GCC economies of Abu Dhabi, Dubai and Qatar includes diversification of their economies in 'economic free zones', boosting sustainable urban development of smart

cities (De Jong *et al.*, 2019). As mentioned by Rizzo (2017), Qatar has begun focusing on sustainable development in urban projects with the successful hosting of the eco-friendly World Cup in 2022. The Qatari government has initiated two urban megaprojects with sustainable features, Education City and Msheirab Downtown Qatar Foundation (Rizzo, 2017). Another research highlighted that the vision of the Msheirab Downtown initiative in Doha, Qatar, is to develop an integrated city with a sustainable, safe, lively and healthy lifestyle strengthened with technological advancements (Furlan *et al.*, 2019). Similarly, Al-Hammadi (2023) mentioned the modern technology used in the Msheirab Downtown initiative to create a neighbourhood based on principles of environmental sustainability (Al-Hammadi, 2023).

METHODOLOGY

Research Design

The current research employed a qualitative case study approach to explore the insights on the selected cases for leveraging cloud services and digital transformation for sustainability in Qatar. Qualitative research is adequately analysed following an inductive approach in the process of data collection, analysis and explaining patterns of textual data (Lane *et al.*, 2019). Using a qualitative case study approach, data was gathered from semi-structured interviews in this research as respondents were asked both open and close ended questions addressing the SDGs of each case study. The IT specialists and sustainability experts validated the interview questions. Interviews offer an in-depth exploration of the people's views, knowledge, interpretations, and experiences interacting with the target population influenced by epistemological position (Chowdhury & Shil, 2021; Naz *et al.*, 2022).

Population and Sampling

The data was collected from key stakeholders aware of Qatar's digital transformation initiatives. A purposive

Table 1: Respondents' Demographics

		Frequency	Percentage
Age	21-30 Years	7	33.34
	31-40 Years	9	42.85
	41-50 Years	4	19.05
	Above 50 Years	1	4.76
Gender	Male	12	57.15
	Female	9	42.85
Experience	Less than 2 Years	3	14.28
	2-5 Years	11	52.38
	Above 5 Years	7	33.34
Profession	Sustainability Experts	10	47.61
	Government Officials	3	14.28
	IT Professionals	8	38.09
Awareness of SDGs	High	14	66.68
	Moderate	5	23.80
	Low	2	9.52

sampling technique is used for selecting experts in the field or stakeholders closely associated with the matter of discussion (Lane *et al.*, 2019). Therefore, in the current research, 21 experts, including sustainability experts, government officials, and IT professionals, were sampled using purposive sampling to investigate the selected case studies aligned with sustainable development in Qatar. Table 1 below interprets the demographics of respondents categorised based on their age, gender, experience, profession and awareness of SDGs.

Data Analysis

The data gathered using semi-structured interviews was analysed using the technique of thematic analysis. Thematic analysis is used to identify themes based on the gathered data and research questions addressing the meanings, perceptions and experiences of the targeted population (Labra *et al.*, 2020; Mishra & Dey, 2022). Therefore, to identify the common patterns relevant to the integration of digital technology and SDGs, each selected case study was addressed as a theme highlighting the importance of sustainability in digital transformation significantly cloud services.

RESULTS

Case Study 1: Qatar Free Zone

Qatar Free Zone Authority (QFZA) was created by the Qatari government in 2018, which maintained Manateq's portfolio alongside industrial, logistics and warehousing zones. The focus of QFZA is to offer "state-of-the-art infrastructure" to attract firms specialised in emerging technologies, chemicals and logistics witnessing ICT and maritime sectors (Mogielnicki, 2021). QFZA, since its establishment, has initiated a number of projects investing billions of Qatari Riyals focused on IT, communications, sustainability, big data, cybersecurity, etc. (Qatar Free Zones to Host Google Cloud Region in Doha, 2020). QFZA launched one such project in collaboration with Google Cloud to inaugurate a new cloud region in the regions of North Africa and GCC from Qatar Free Zones (QFZ). World-class cloud services are now offered in the new Doha region with the development of data centers in partnership with the Ministry of Communication and Information Technology (MCIT), offering digital infrastructure and cutting-edge technology. In Ras Bufontas Free Zone, the Center of Excellence is actively offering innovation in partnership with Google Cloud, and the data centers are accelerating technological advancement (First Google Cloud region in the GCC and North Africa launched in QFZ, 2023).

While conducting interviews, the respondents of the research were asked a few close-ended questions:

Question 1

Mark all the SDGs which are applicable to QFZ integrating digital transformation for sustainability provided that all respondents were aware of the project:

SDG 9: Industry, Innovation, and Infrastructure

The partnership of QFZ and Google Cloud fosters technological development and enhances digital infrastructure.

SDG 17: Partnerships for the Goals

QFZ and Google Cloud Partnered together to leverage collaborative growth with digital innovation, technology advancement, etc.

SDG 8: Decent Work and Economic Growth

QFZ partnered with Google Cloud for economic development supporting economic growth from digital infrastructure development.

SDG 11: Sustainable Cities and Communities

Sustainable development of cities is promoted by the cloud services offered by QFZ and Google Cloud, advancing the people of Qatar.

SDG 13: Climate Action

Cloud services indirectly also offer climate-related innovations facilitating environmental monitoring, resource optimisation, etc., in QFZ and Google Cloud partnership.

Table 2 below depicts the responses to this close-ended question asked by sampled respondents. It shows that the majority of the respondents (85.71%) marked that SDG 9: Industry, Innovation, and Infrastructure aligns with the initiative of QFZ and Google Cloud. Similarly, 76.20% of respondents marked SDG 9: Sustainable Cities and Communities, and 57.15% marked SDG 8: Decent Work and Economic Growth, as shown in Table 2.

Table 2: SDGs Aligned with QFZ for Cloud Services and Digital Transformation

Response	Frequency	Percentage
SDG 8: Decent Work and Economic Growth	12	57.15%
SDG 9: Industry, Innovation, and Infrastructure	18	85.71%
SDG 11: Sustainable Cities and Communities	16	76.20%
SDG 13: Climate Action	3	14.28%
SDG 17: Partnerships for the Goals	10	47.61%

Question 2

From the options below, what technological advancements could benefit from QFZ and Google Cloud collaboration?

- Improved data analytics
- 5G advancement
- Advanced data security
- Improved resource management
- Other

Table 3 below shows the responses on the specific

technological advancements that are applicable in Qatar and benefited from QFZ and Google Cloud collaboration. Most respondents, i.e., 85.71%, mentioned that advanced data security is a major benefit. Additionally, 76.20% marked 5G advancement, 57.15% marked improved data analytics, and 42.85% marked improved resource management as key benefits of the collaboration for the digital transformation of Qatar.

Table 3: Technological Advancements that Could Benefit from QFZ and Google Cloud Collaboration

Response	Frequency	Percentage
Improved data analytics	12	57.15%
5G advancement	16	76.20%
Advanced data security	17	85.71%
Improved resource management	9	42.85%
Other	4	19.04%

Furthermore, respondents were also asked an open-ended question to gather in-depth views on how QFZ is a prominent initiative in Qatar for leveraging digital transformation and cloud services.

Question 3

How does QFZ leverage cloud services digital transformation for sustainability under QNV2030?

Participant 1 stated:

“In my opinion, QFZ is operating sufficiently with Google Cloud as the cloud-based smart infrastructure and technologies are supporting sustainable and smart zones development. Data analytics, IoT sensors, etc. offering digital innovation with cloud are effective ways of reducing operational costs, overall efficiency and promoting sustainability aligned with QNV2030.”

Participant 3 stated:

“We are proud that Google Cloud has chosen Qatar for setting up data centers in free zones reflecting its steady development towards QNV2030. As a working individual in the Qatari government, I have seen how QFZ and QNV2030 are set up together to expand a knowledge-based economy. Also, a recent development of the Digital Competence Centre for software development in QFZ managed to deliver exciting projects. This collaboration is also effective in serving as a catalyst to open doors for cloud digital leaders’ workshops and training.”

Participant 4 stated:

“I view the collaboration between Google Cloud and QFZ as a revolutionary change in the technological landscape offering improved analytics and unparalleled scalability. It is therefore right to say that cloud services employed as a strategic initiative envision QNV2030, which will significantly contribute towards reduced carbon footprint and energy efficiency.”

Case Study 2: Qatar Smart Program (TASMU)

The “Qatar Smart Program (TASMU)” was initiated in

2017 to complement the Qatar digital transformation with a focus on transforming Doha into a smart city (Al-Thani *et al.*, 2018; Meyerhoff Nielsen & Mahmoud Ali, 2021). It is a national program that is based on a policy framework of enabling a smooth transition to increase investments in priority sectors of logistics, transport, sports, environment and healthcare (Amine, 2023). TASMU is led by MCIT, which aims to modify Qatar as a smart city that leverages improved standards of living with digital transformation across public sectors. The power of technology is harnessed through economic sustainable diversification (Villegas-Mateos, 2022). The TASMU program by MCIT is aimed to be completed in five years with a USD 1.65 billion investment. It is also in line with the vision of QFZA and the Ministry of Transportation and Communications (MOTC). It is centered on making Qatar a digital hub with extensive 5G implementation, meeting connectivity demand by adopting IoT and cloud services. The digitisation is associated with QFZ and Qatar Financial Centre. Localised data centers such as Ooredoo, Meeza, and Microsoft enhance the reliability and efficiency of modifying Qatar in a digital hub. Therefore, TASMU successfully operates both international and national start-ups serving as a digital hub transforming Qatar’s tech sector (Sonia & Hania, 2023).

While conducting interviews, the respondents of the research were asked a few close-ended questions:

Question 1

Mark all those SDGs that are applicable to the Qatar Smart Program (TASMU) integrating cloud services and digital transformation for sustainability, provided that all respondents were aware of the project:

SDG 9: Industry, Innovation, and Infrastructure

TASMU is transforming Qatar into a smart city, enhancing digital infrastructure and advancing primary sectors using big data analytics, IoT, cloud computing, cyber security, etc.

SDG 11: Sustainable Cities and Communities

Sustainable development of cities is exhibited by ongoing smart-city projects in Qatar like TASMU.

SDG 3: Good Health and Well-being

Technology utilisation of TASMU for priority sector of healthcare to promote quality of life and healthy well-being of Qatari citizens with smart services to impact systematic and chronic diseases (TASMU 2023).

SDG 12: Responsible Consumption and Production

TASMU reportedly reduced water consumption per capita by 10%, energy consumption by 6% and overall food consumption by 40% (TASMU 2023).

Table 4 below explains the results of the SDGs respondents found most applicable to TASMU in Qatar leveraging cloud services and digital transformation. The majority of the respondents (95.23%) marked SDG 11:

Sustainable Cities and Communities as the significant SDG met by the TASMU project in integrating digital transformation for sustainable development. Also, 90.47% of respondents marked SDG 9: Industry, Innovation, and Infrastructure aligned with the goals of the TASMU initiative. However, 76.19% of respondents also found TASMU meeting SDG 3: Good Health and Well-being and 57.15% agreed that SDG 12: Responsible Consumption and Production is also a goal aligned with TASMU initiative as it is aimed at driving sustainable consumption of natural resources, ensuring food and water security and minimising waste.

Table 4: SDGs Aligned with TASMU for Cloud Services and Digital Transformation

Response	Frequency	Percentage
SDG 3: Good Health and Well-being	16	76.19%
SDG 9: Industry, Innovation, and Infrastructure	19	90.47%
SDG 11: Sustainable Cities and Communities	20	95.23%
SDG 12: Responsible Consumption and Production	12	57.15%

Question 2

Mark all the technological advancements that TASMU Qatar Smart Program meets in five priority sectors of healthcare, logistics, sports, transport, and environment:

- IoT-driven urban development
- AI-driven solutions
- Cloud-based advancements for public services
- Big data analytics
- Virtual technology in sustainable urban development

Table 5 below highlights the responses on the most marked technology advancements TASMU is offering in Qatar's priority sectors. Out of 21 respondents, the majority marked cloud-based advancements for public services

Table 5: Technological Advancements by TASMU Qatar Smart Program in Five Priority Sectors

Response	Frequency	Percentage
IoT-driven urban development	15	71.42%
AI-driven solutions	16	76.19%
Cloud-based advancements for public services	18	85.71%
Big data analytics (BDA)	12	57.15%
Virtual technology in sustainable urban development	9	42.85%

(85.71%), AI-driven solutions (76.19%) and IoT-driven urban development (71.42%) as significant advancements of TASMU in sectors like healthcare, transport, etc.

However, 57.15% marked BDA and 42.85% marked virtual technology in sustainable urban development as advancements made for digital transformation in Qatar by TASMU.

Furthermore, respondents were also asked an open-ended question to gather in-depth views on TASMU leveraging digital transformation and cloud services.

Question 3

How does TASMU leverage cloud services digital transformation for sustainability under QNV2030?

Participant 2 stated:

“TASMU's ICT innovations catalyse Qatar's ecosystem as global innovators are attracted to fuel digital transformation in the local market. I am certain that as a digital response to QNV2030, TASMU is enhancing public service delivery in all priority sectors centered mainly on start-ups, government, NGOs, local SMEs, large multinational companies, citizens and academia. In accordance with QNV2030 vision, the technology foundation is built by TASMU through various initiatives like TASMU digital valley, cloud services development, UI/UX design setup, Smart Qatar pilot zone specification, Smart Qatar cybersecurity enablement, and a few others.”

Participant 3 stated:

“I can say in many ways TASMU is meeting the principles of digital transformation with technological improvements. For instance, optimising resource utilisation among sectors using cloud-based analytics, cloud-based solutions in energy management systems and waste management systems. Also, data analytics and IoT sensors are employed to optimise the recycling process for environmental sustainability aligned with the goals of QNV2030.”

Case Study 3: Qatar National Broadband Network (Qnbn)

According to Dahdal and Walker (2023), “Qatar National Broadband Network (Qnbn)” is the major player in Qatar's digital infrastructure, offering robust ICT development for enhancing the digital economy and infrastructure. Qnbn follows the key principles of QNV2030's development plan, including social development, economic development, environmental development and human development. Building up broadband infrastructure of Qatar is targeted at improving the Qatari economy enhancing knowledge-based and tech sectors. The Qnbn program was launched in 2013 and aimed at connecting all residents of Qatar with high-speed internet, allowing alternative service providers to enter the market and compete with the national carrier “Qtel”. Additionally, Qnbn facilitates high-speed broadband with the rollout of fibre optic cables across Qatar (Dahdal & Walker, 2023; Effendi, 2016).

While conducting interviews, the respondents of the research were asked a close-ended question:

Question 1

Mark all those SDGs that are applicable to Qnbn integrating

cloud services and digital transformation for sustainability provided that all respondents were aware of the project:

SDG 8: Decent Work and Economic Growth

Qnbn offers multiple benefits for the economic development of multiple sectors through fibre optics and cloud services, including real estate development, healthcare, private sector SMEs, all government ministries and departments, etc., improving digital infrastructure development.

SDG 9: Industry, Innovation, and Infrastructure

The high-speed Qnbn aligns with fostering innovation in enhancing digital infrastructure.

SDG 4: Quality Education

Improved connectivity for sectors involved in education and the Ministry of Education as well as all the colleges, universities and schools involved in Qatar, ensuring quality education for all (About Qnbn, 2023).

SDG 11: Sustainable Cities and Communities

Qnbn is committed to major Qatar's progress as per the QNV2030 goals to achieve the ICT and knowledge-based economy thriving sustainable national economy reducing carbon's footprint offering affordable and equitable access to telecommunications providers licensed for end-users (About Qnbn, 2023).

Table 6 below depicts the responses to this close-ended question asked by sampled respondents. It shows that the majority of the respondents (90.47%) marked that Qnbn is offering sustainable cloud services meeting SDG 9: Industry, Innovation, and Infrastructure' criteria. In addition, 76.19% of respondents marked SDG 11: Sustainable Cities and Communities, 66.67% marked SDG 4: Quality Education and 47.61% also marked SDG 8: Decent Work and Economic Growth as the goals met by Qnbn to ensure sustainability offering digital transformation.

Table 6: SDGs Aligned with Qnbn for Cloud Services and Digital Transformation

Response	Frequency	Percentage
SDG 8: Decent Work and Economic Growth	10	47.61%
SDG 9: Industry, Innovation, and Infrastructure	19	90.47%
SDG 4: Quality Education	14	66.67%
SDG 11: Sustainable Cities and Communities	16	76.19%

Furthermore, respondents were also asked an open-ended question to gather in-depth views on how Qnbn is a prominent initiative in Qatar for leveraging digital transformation and cloud services.

Question 2

How does Qnbn leverage cloud services and digital

transformation for sustainability under QNV2030?

Participant 2 stated:

"I believe that the Qnbn fiber optic broadband network is empowering businesses and changing the lives of people. With the fast delivery service, Qnbn aligns with QNV2030, providing equal, open and affordable access to licensed telecommunications providers. The ultra-high-speed services are sustainable, affordable and viable."

Participant 4 stated:

"In my opinion, Qnbn is getting highly recognised for its sustainable infrastructure despite the two licensed operators Vodafone and Ooredoo in competition. Qnbn is contributing actively to the sustainability goals by improving connectivity, enhancing broadband services, embodying shared commitment towards sustainable and technological innovation and driving digital transformation meeting the principles of QNV2030."

Participant 7 stated:

"Qnbn advances the 5G capacity by building resilient and energy efficient infrastructure to meet sustainability goals. Therefore, Qnbn definitely aligns with QNV2030 since it is showing commitment towards sustainability with technological innovation, building eco-friendly and resilient networks."

Case Study 4: Msheireb Downtown Doha

As highlighted by Furlan and Al-Mohannadi (2020), the urban developments in Qatar, specifically Doha, are advancing, considering sustainability as an important factor in many urban megaprojects and neighbourhood developments like Msheireb Downtown Doha, Education City, Katara Cultural Village and Lusail City in addition to World Cup 2022. Msheireb Downtown Doha and other projects stem from QNV2030 tackling urban challenges together for the Qatari cities (Furlan & Al-Mohannadi, 2020). The sustainable urban development design of Msheireb Downtown Doha is based on the infrastructure requirements, including parking spaces, lane widths, drop-off zones and other facilities, followed by suggesting improved urban design (Hasan & Fadli, 2023). The project is also adequate in expanding the novel automatic solutions geared towards speeding up the planning, design and management of Spherical Digital Twins related to real-estate management, construction management, advertising and development initiatives (Al Sulaiti *et al.*, 2023). Msheireb Downtown Doha is a project located in central Doha, adopting a language of greater cultural continuity. The purpose of this project was to build urban environments with sustainability as the rhetorical agenda, offering design-based solutions for energy consumption. Msheireb Downtown Doha is designed by creating sustainable, innovative, inspiring and eco-friendly spaces (Winter, 2016).

While conducting interviews, the respondents of the research were asked a few close-ended questions:

Question 1

Mark all those SDGs that are applicable to Msheireb Downtown Doha integrating cloud services and digital

transformation for sustainability, provided that all respondents were aware of the project:

SDG 7: Affordable and Clean Energy

Msheireb Downtown Doha is aligned with SDG 7 as it has one of the highest concentrations of platinum or gold LEED (Leadership in Energy and Environmental Design)-certified. It ensures a 30% energy reduction due to the better development of buildings with high-efficiency cooling plants, making it sustainable and reliable for all.

SDG 9: Industry, Innovation, and Infrastructure

Msheireb Downtown Doha is based on innovation in infrastructure development in the construction sector using thicker, eco-friendly, health-isolating material.

SDG 11: Sustainable Cities and Communities

Msheireb Downtown Doha is based on smart city development, reducing water consumption using solar energy, smart irrigation systems, green transport, advanced waste collection, etc. (Msheireb Downtown Doha-Sustainability, 2023).

Table 7 below explains the results of the SDGs respondents found most applicable to TASMU in Qatar leveraging cloud services and digital transformation. The majority of the respondents (90.47%) marked SDG 9: Industry, Innovation, and Infrastructure as the substantial SDG met by the Msheireb Downtown Doha project in integrating digital transformation for sustainable development. Also, 85.71% of respondents marked SDG 9: Industry, Innovation, and Infrastructure aligned with the goals of the Msheireb Downtown Doha initiative. However, 76.19% of respondents also found Msheireb Downtown Doha meeting SDG 11: Sustainable Cities and Communities is also a goal aligned with Msheireb Downtown Doha initiatives. It is aimed at driving sustainable consumption of natural resources, ensuring food and water security and minimising waste.

Table 7: SDGs Aligned with Msheireb Downtown Doha for Cloud Services and Digital Transformation

Response	Frequency	Percentage
SDG 7: Affordable and Clean Energy	17	85.71%
SDG 9: Industry, Innovation, and Infrastructure	19	90.47%
SDG 11: Sustainable Cities and Communities	16	76.19%

Furthermore, respondents were also asked an open-ended question to gather in-depth views on how Msheireb Downtown Doha is a prominent initiative in Qatar for leveraging digital transformation and cloud services.

Question 3

How does Msheireb Downtown Doha leverage cloud

services and digital transformation for sustainability under QNV2030?

Participant 3 mentioned:

“Msheireb Downtown Doha is one of the first sustainable downtown regeneration projects as well as the smartest cities on earth. As compared to the old version of the neighbourhood, the newest one is more pedestrian-friendly and compact, enhancing smart mobility in town. Thus, it is rightly said that primarily sustainable urban developments emerge enacting the strategy of QNV2030 for the benefit of living for future generations.”

Participant 5 mentioned:

“This project is definitely meeting the criteria of sustainable development and tourism in Qatar which definitely boosted the Qatari identity and heritage going hand in hand together with QNV2030. I believe reviving the legacies in this regeneration project is one of the pillars of national development for protection and preservation of national cultural heritage, emphasising social development of QNV2030.”

DISCUSSION

The current research analysed the insights on QFZ, Qatar Smart Program (TASMU), Qnbn, and Msheireb Downtown Doha, highlighting how they are leveraging cloud services and digital transformation for sustainability under QNV2030. For this purpose, the researcher focused on highlighting the key SDGs met by some or all of these case studies of Qatar meeting the principles of QNV2030.

The findings from interviews suggested which SDGs were marked by the majority of the respondents in line with each case.

The findings highlighted that QFZ and Qnbn projects of Qatar meet the principles of SDG 8: Decent Work and Economic Growth. Results showed that Qnbn offers multiple benefits for the economic development of multiple sectors through fibre optics and cloud services, improving digital infrastructure development. Also, QFZ partnered with Google Cloud for economic development supporting economic growth from digital infrastructure development. It also meets the criteria for SDG 17: Partnerships for the Goals. Thus, it is noteworthy that in Qatar, a commitment to SDGs is significant to meet the QNV2030, enforcing smart and sustainable development and ensuring economic efficiency to achieve global development (Al-Musalmani & Maalouf, 2022).

However, all four cases align with two SDGs, including SDG 9: Industry, Innovation, and Infrastructure and SDG 11: Sustainable Cities and Communities, to meet the requirements of the QNV2030 and sustainability for building Smart Qatar. For instance, the respondents agreed that TASMU is transforming Qatar into a smart city, enhancing digital infrastructure and advancing primary sectors using IoT and cyber security. Besides, Qnbn is committed to the QNV2030 goals of thriving, sustainable national economy and reducing its carbon footprint offering. Msheireb Downtown Doha is also

innovating in infrastructure using eco-friendly, health-isolating materials as well as smart irrigation systems, green transport, and advanced waste collection. Similarly, AL Fadala and Furlan (2018) highlighted that the need for the development of sustainable urban areas emerged primarily from multiple needs and changes in economic and social factors. Therefore, projects like Msheireb Downtown Doha in Qatar are founded on four key pillars, including social, human, economic and environmental developments meeting QNV2030 objectives (AL Fadala & Furlan, 2018). Additionally, in historical downtown Msheireb, urban protection is accompanied by sustaining urban material and renewal strategies for construction to for sustainable and smart construction (Al-Hammadi, 2022). Nonetheless, cloud services indirectly also offer climate-related innovations facilitating environmental monitoring, resource optimisation, etc., in QFZ and Google Cloud partnership aligned with SDG 13: Climate Action.

Limitations and Future Research

The research was limited to exploring specific cases leveraging cloud services and digital transformation in Qatar to meet sustainability goals. However, in the future, a comparative analysis can be conducted among different cases within the Gulf region to present a broader overview of countries meeting their aims for Vision 2030. Additionally, the research was limited to 21 respondents for semi-structured interviews, but in the future, generalisability can be increased with a number of respondents, limiting possible bias. Future researchers can also opt for longitudinal research using mixed methods, adding empirical justifications to current theoretical findings.

CONCLUSION

The digital transformation as per the Qatari approach is dependent on the interplay between frontend and backend service interfaces and production systems developing a knowledge-based economy. For instance, establishing a “Qatar Free Zone” is based on the aim of supporting and promoting applied, scientific, and technological advancement promoting sustainability. Besides, one such leading project is the TASMU Smart Qatar Program, which drives innovation with digital transformation and sustainable economic development in priority sectors. QFZ, Qatar Smart Program (TASMU), Qnbn, and Msheireb Downtown Doha provide digital transformation and cloud services aligning with many SDGs specially SDG 9: Industry, Innovation, and Infrastructure and SDG 11: Sustainable Cities and Communities.

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