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# THE REALITY AND PROSPECTS OF USING INTERNET OF THINGS (IOT) TECHNOLOGY IN THE ECONOMIES OF THE ARAB REGION (SAUDI ARABIA, UAE, QATAR)

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Original Scientific Paper

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**This study investigates the adoption and a future prospect of Internet of Things technology in Saudi Arabia, the United Arab Emirates, and Qatar. It draws on official data, government and international reports, and peer-reviewed literature across key sectors, including industry, energy, healthcare, and transportation. Employing a descriptive-analytical methodology, the study applies benchmarking and comparative trend analysis to assess IoT adoption in both quantitative and sectoral terms. Quantitative indicators—such as market size, number of connected devices, and sectoral investments from 2019 to 2025—are systematically examined. The analysis identifies critical barriers, including cybersecurity risks, high infrastructure costs, fragmented legal frameworks, and integration difficulties with legacy systems, and demonstrates their constraining effects on scalability. A benchmarking exercise with China highlights similarities and divergences in policy effectiveness and digital transformation strategies. The findings indicate that Saudi Arabia and the UAE are progressing more rapidly than Qatar in smart city and industrial IoT investments, while China's integrated innovation model provides transferable lessons. The study concludes with targeted recommendations—such as harmonising regulatory frameworks, fostering digital talent, and expanding advanced infrastructure—to accelerate IoT adoption and strengthen the Arab region's digital economy.**

**Keywords:** Internet of Things; Economic Development; Digital Transformation; Technology Adoption; Arab Economies.

## INTRODUCTION

The Fourth Industrial Revolution is ushering in a new phase of technological transformation, building on the substantial advances in communication networks and information technology achieved during the previous industrial era (Xu et al., 2018). Among the most influential technologies of this period is the Internet of Things (IoT), which has rapidly expanded through continuous innovations in design, integration, and connectivity (Paniagua & Delsing, 2021). IoT enables seamless interaction among industrial systems, enhancing efficiency and integration across diverse devices.

The adoption of Industrial IoT depends on frameworks that are both scalable and adaptable, ensuring interoperability, security, and real-time performance, which are essential factors for raising productivity and supporting digital transformation in modern industries (Majid et al., 2022). The impact of IoT is evident across sectors, such as manufacturing,

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commerce, healthcare, and education, where it drives productivity, stimulates innovation, and reduces operational costs. Notably, research shows that a 10% increase in IoT connectivity penetration is associated with a 0.23% rise in total factor productivity (TFP), highlighting IoT's critical role in economic growth (Edquist et al., 2021).

The introduction of IPv6 in 2011 was a pivotal step, enabling large-scale connectivity for billions of devices and accelerating IoT deployment. In response, leading technology companies such as Cisco, IBM, and Ericsson launched initiatives to promote IoT integration (Suresh et al., 2014). Since then, IoT has become a key driver of global economic growth, with estimates suggesting it could generate between USD 2.7 trillion and USD 14.4 trillion in value by 2025. Connected smart devices are expected to deliver substantial cost savings and productivity gains, particularly in manufacturing and healthcare, which alone could contribute between USD 1.1 trillion and USD 2.5 trillion. Governments and major corporations are therefore investing heavily in IoT infrastructure to improve public service efficiency, promote smart city sustainability, and strengthen industrial competitiveness (Thierer & Castillo, 2015).

Although these trends are global, their impact is especially pronounced in the Gulf region. Saudi Arabia, the United Arab Emirates, and Qatar have emerged as regional leaders in IoT adoption, driven by ambitious national strategies and substantial investments in digital infrastructure. Despite the authors' affiliation with Algerian institutions, the focus on these Gulf countries is justified by their advanced policy frameworks, rapid technological progress, and the availability of comprehensive data, making them ideal case studies for a comparative and forward-looking analysis of IoT's role in economic transformation.

To provide analytical grounding, this study is guided by the Digital Transformation Readiness Model, which emphasises the importance of infrastructure, regulatory frameworks, human capital, and innovation capacity in shaping national adoption of advanced technologies (Michelotto & Joia, 2024).

Accordingly, the research addresses the following questions:

- What is the current landscape of IoT adoption in Saudi Arabia, the UAE, and Qatar in terms of infrastructure, policy, and sectoral implementation?
- How do these countries compare with global leaders, especially China, in terms of IoT-driven economic impact and digital transformation?
- What are the critical technical, regulatory, and talent-related challenges hindering IoT adoption in these Gulf economies?
- What strategic measures could accelerate IoT diffusion and maximise its contribution to sustainable economic growth in the Arab region?

## LITERATURE REVIEW

Initially, the internet primarily served as a platform for connecting computers and facilitating communication through web pages (Kumar & Raza, 2017). Over time, this scope has broadened with the emergence of the Internet of Things (IoT), which extends connectivity to everyday devices, including household appliances and transportation systems, enabling them to communicate and exchange data intelligently. While definitions of IoT vary, the prevailing view in the literature describes it as a system built on wireless communication technologies, such as sensor networks, and fundamentally reliant on radio-frequency identification (RFID) for device interaction.

Effective IoT implementation also requires robust mechanisms for user authentication and access control to ensure secure data exchange. According to the U.S. National Intelligence Council, by 2025, IoT technologies are expected to be deeply embedded in daily life, influencing sectors such as healthcare, transportation, education, and energy through widespread integration (Said & Masud, 2013).

Recent studies highlight regulatory fragmentation, policy inconsistencies, and workforce skill shortages as major barriers to widespread IoT deployment, particularly in emerging economies. The literature suggests that cohesive and collaborative policy frameworks are essential for maximising IoT's economic and social benefits.

From a theoretical perspective, Michelotto and Joia (2024) propose the Organisational Digital Transformation Readiness framework, which emphasises technological resources, business processes, management capacity, human capital, and organisational culture as key dimensions influencing digital adoption. This model provides a structured lens for evaluating the readiness of nations and institutions to integrate advanced technologies such as IoT (Michelotto & Joia, 2024).

Complementing this perspective, Shoomal et al. (2024) highlight that IoT adoption also faces systemic challenges related to security, privacy, interoperability, standardisation, scalability, and energy efficiency, particularly in the context of supply chains. Their bibliometric analysis reveals a shift from efficiency-oriented research towards resilience and sustainability, while also pointing to blockchain integration as a promising solution for overcoming IoT-related barriers. This contribution enriches the discussion on both policy and practical implications, underscoring that overcoming adoption hurdles requires not only technological innovation but also regulatory support (Shoomal et al., 2024).

## RESEARCH METHODOLOGY

This study employs a descriptive and analytical methodology, drawing on multiple data sources to examine both the current landscape and future outlook of Internet of Things (IoT) adoption in Arab economies, with a particular focus on Saudi Arabia, Qatar, and the United Arab Emirates. The selection of these countries is based not on geographic proximity or the authors' institutional affiliations, but on their notable progress in IoT infrastructure, the presence of ambitious national digital strategies, and the availability of comprehensive and up-to-date data. This targeted selection highlights the most advanced experiences in the Arab region and offers insights that may inform broader regional strategies.

Data were obtained from official government reports on digital transformation, complemented by statistics and publications from international organisations such as the World Bank and the World Economic Forum. In addition, peer-reviewed academic studies addressing the economic and sectoral impacts of IoT were systematically reviewed. To ensure validity, preference was given to official statistics and widely cited international datasets, while recency, credibility, and relevance to IoT adoption served as key selection criteria. In cases where figures differed across sources, the study applied cross-checking and provided narrative justification rather than technical harmonisation.

The analysis combined benchmarking and comparative trend analysis. Benchmarking was conducted by aligning the selected countries on a set of comparable indicators, such as market size, device penetration, and sectoral investments, to highlight relative strengths and weaknesses. Comparative trend analysis was applied to assess the direction and pace of IoT adoption between 2019 and 2025, with attention to both absolute growth and relative cross-country differentials. Policy and institutional dimensions, including the existence of national strategies, 5G rollout milestones, and cybersecurity provisions, were examined qualitatively to contextualise quantitative evidence. The Digital Transformation Readiness Model served as the conceptual lens for grouping findings across dimensions of infrastructure, regulation, human capital, and innovation capacity, while China was included as a reference case to illustrate alternative trajectories of large-scale IoT integration.

Overall, this mixed methodological approach combines quantitative indicators with qualitative policy analysis to provide a transparent, policy-oriented framework. It synthesises credible and recent evidence, facilitates cross-country comparison at a high level, and highlights actionable patterns relevant to digital transformation in the Gulf region.

## IOT TECHNOLOGY: FOUNDATIONS AND EVOLUTION

The Internet of Things (IoT) is a cornerstone of the Fourth Industrial Revolution, embodying the integration of smart, connected technologies into modern systems (Dašić & Anufrijev, 2025). Although no single, universally accepted definition exists, IoT is commonly understood as a network of digitally enabled objects—ranging from machines and appliances to vehicles and even living organisms—that communicate and interact via the internet (Meknati, 2021). These objects are equipped with sensors and processors that facilitate autonomous data collection, analysis, and response (Harjanto et al., 2025; Mahmoud et al., 2023).

Whereas traditional internet applications were designed primarily to connect computers, IoT transforms this paradigm by enabling real-time communication among physical objects. This is made possible through technologies such as Bluetooth, RFID, Wi-Fi, and LTE, which allow continuous and seamless data transfer across devices and environments (Kumar & Raza, 2017).

The conceptual foundations of IoT can be traced back to the early 1990s, with pioneering experiments such as the internet-connected toaster and the WearCam. The term "Internet of Things" was first coined by Kevin Ashton at MIT in 1999 during his work on RFID-based identification. Significant milestones in IoT's evolution include the launch of LG's smart

refrigerator (2000), the U.S. military's adoption of RFID (2003), the creation of the IPSO Alliance (2008), and the introduction of IPv6 (2011), which facilitated large-scale device connectivity. Since then, companies such as Cisco and IBM have played a major role in advancing IoT development through both commercial initiatives and educational programs (Suresh et al., 2014).

Modern IoT systems are defined by their scalability, interoperability, and embedded intelligence. They support efficient communication, advanced data analytics, and energy-aware operations, while prioritising data security and robust infrastructure. Collectively, these features position IoT as a transformative force within industrial and digital ecosystems (Al-Taa et al., 2023).

**Indicators for measuring the Internet of Things (IoT) technology**

The digital economy serves as a key driver of IoT technology growth, supported by advanced processors, software solutions, smart devices, and reliable networks such as 4G and 5G. These components facilitate seamless communication and real-time data exchange, thereby shaping the future trajectory of the telecommunications and information technology sectors (Ezema et al., 2019).

The following section outlines the main indicators employed to assess IoT readiness and adoption within the broader framework of the digital economy :

***The Internet of Things (IoT) Market***

Figure 1 illustrates the steady and significant expansion of the global Internet of Things (IoT) market. In 2024, the market was valued at USD 64.80 billion, with projections indicating an increase to approximately USD 76.97 billion in 2025. This upward trajectory is expected to continue, with the market forecasted to reach about USD 356.23 billion by 2034, representing a compound annual growth rate (CAGR) of 18.56% between 2025 and 2034. Such growth highlights not only the increasing global demand for IoT applications but also the growing confidence in their strategic relevance.

Several drivers are contributing to this expansion, most notably the integration of 5G technology, the rising emphasis on automation, and the widespread adoption of smart devices across both industrial and consumer domains. The advantages of 5G—particularly its high data transfer speeds and low latency—are especially critical for enabling advanced IoT infrastructures, supporting enterprises in enhancing real-time decision-making and operational efficiency. Consequently, IoT is increasingly recognised as a cornerstone of digital transformation and a key enabler of productivity in contemporary economies (MarketsandMarkets, 2024).

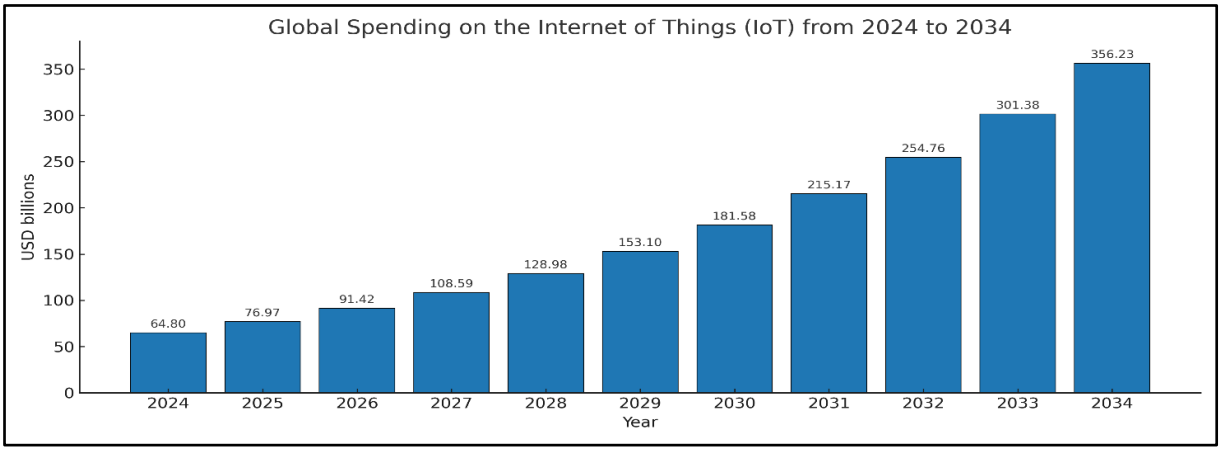


*Figure 1: Global Spending on the Internet of Things (IoT) from 2024 to 2034*
*Source : (MarketsandMarkets, 2024)*

***Number of Devices Connected to the Internet of Things (IoT)***

Figure 2 illustrates the ongoing global growth in the number of devices connected to the Internet of Things (IoT) ecosystem. Between 2019 and 2020, the number of connected devices increased from 7.741 billion to 9.756 billion, surpassing 13 billion by 2022. Projections indicate a significant rise, with estimates suggesting that approximately 37.477

billion devices will be connected by 2033. This rapid expansion highlights the expanding influence of IoT across sectors such as smart vehicles, IT infrastructure, real-time tracking, assistive robotics, and digital inventory management.

While growth rates remained relatively stable from 2019 to 2023, a marked acceleration is expected after 2025. This increase will be driven by the integration of emerging technologies such as artificial intelligence, fifth-generation (5G) networks, and the broader digitalisation of industries. As a result, scaling IoT will require robust infrastructure and advanced cybersecurity measures to ensure seamless integration, protect data integrity, and maintain operational effectiveness across diverse sectors (Statista, 2024).

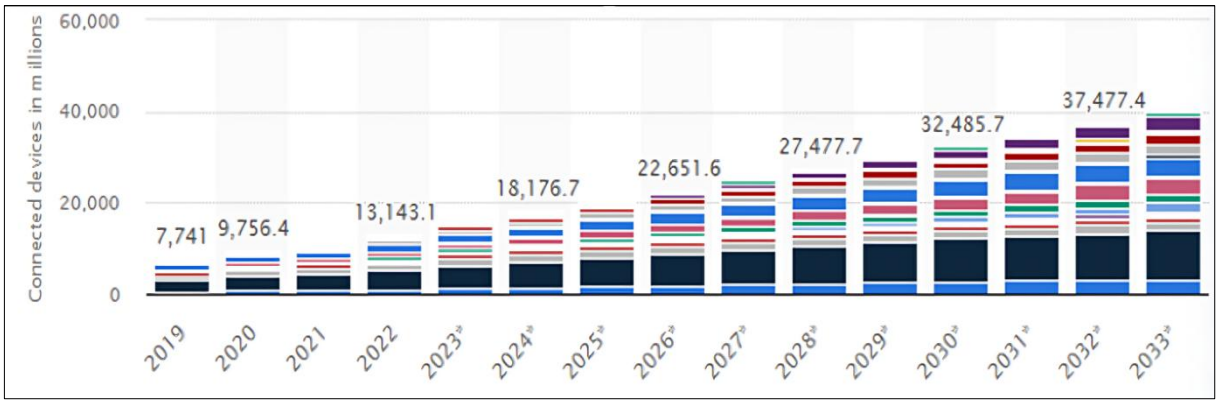


*Figure 2: Number of Devices Connected to the Internet of Things (IoT) Worldwide from 2019 to 2033, by Use Case*

*Source : (Statista, 2024)*

***Corporate Investment in IoT-Related Automation***

Figure 3 depicts the rising trend in global investments in retail automation technologies, reflecting the broader expansion of connected devices. Expenditures in this sector are projected to increase from approximately USD 26.50 billion in 2023 to USD 29.02 billion in 2024, with forecasts reaching nearly USD 71.91 billion by 2034. This corresponds to a compound annual growth rate (CAGR) of 9.5% for the period 2024–2034.

This upward trajectory highlights the retail industry's growing reliance on automation solutions aimed at enhancing customer experiences, streamlining operational workflows, and reducing labour costs. It also mirrors a global commercial transformation in which intelligent technologies—such as AI-powered inventory management, self-service checkout systems, and automated payment platforms—are evolving into essential strategic tools rather than optional innovations. Countries that prioritise investments in retail digitalisation are better positioned to improve both operational efficiency and customer engagement (Statista, 2024).

**5G Network Coverage**

Recent findings from the Ericsson Mobility Report indicate that by the end of 2024, 5G networks are expected to cover about 55% of the global population, with coverage outside mainland China estimated at 45%. This expansion is projected to continue, reaching nearly 85% worldwide by 2030. Despite this overall growth, significant regional differences persist. For example, Europe is likely to achieve close to 80% coverage by late 2024, whereas the Asia-Pacific region (excluding China and India) may only reach 30%, and the Middle East and Africa are projected to remain at around 10% (Borgeaud, 2025; Ericsson, 2024).

These disparities reflect the varying levels of infrastructure development and differing national priorities regarding 5G deployment. Latin America, for instance, is witnessing a rapid increase in adoption, with Brazil anticipated to lead the region—by 2030, it is expected that 77% of mobile connections in Brazil will rely on 5G. Similarly, Chile and Uruguay are forecast to achieve 5G penetration rates of 68% and 65%, respectively. The ongoing rollout of 5G infrastructure in emerging economies is expected to enhance digital inclusion and drive economic growth by improving

connectivity, boosting productivity, and expanding access to innovative services (Statista, 2025).

These structural challenges are consistent with recent findings in supply chain contexts, where IoT integration faces barriers related to security, interoperability, scalability, and standardisation (Shoomal et al., 2024).

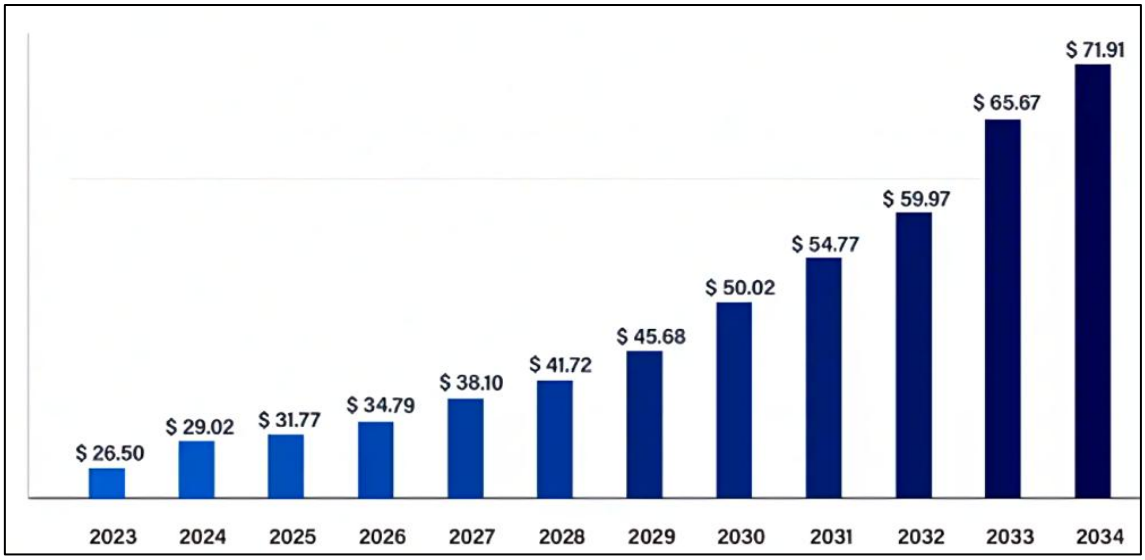


*Figure 3: Global investments in retail automation technologies, 2023–2034*
*Source : (Statista, 2024)*

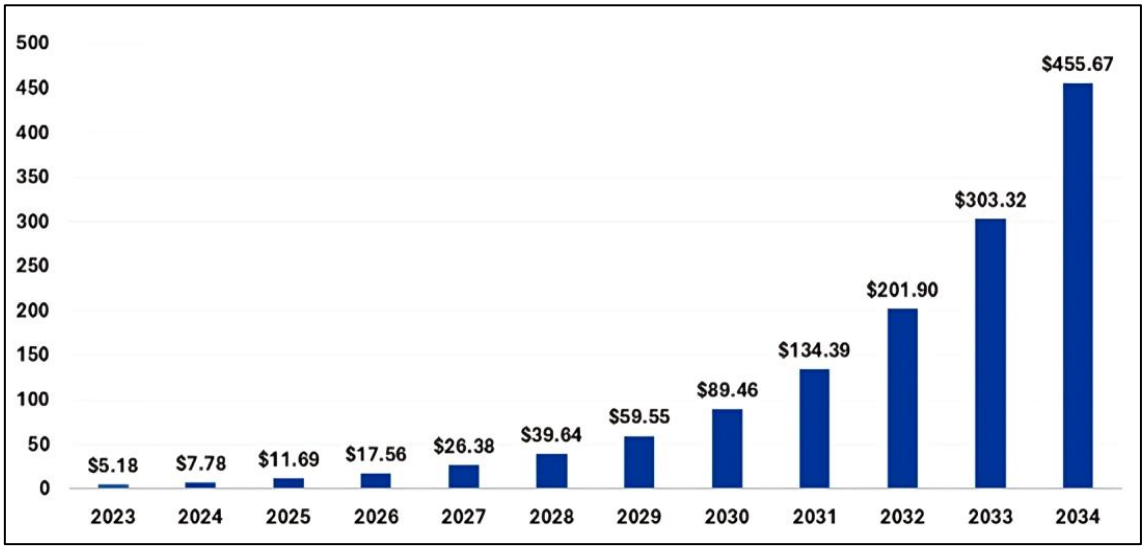


*Figure 4: Global market for 5G-enabled IoT technologies, 2023–2034*
*Source : (Statista, 2024)*

Figure 4. highlights a significant surge in the global market for 5G-enabled Internet of Things (IoT) technologies, with its value estimated at USD 7.78 billion in 2024. Projections indicate a remarkable increase to approximately USD 455.67 billion by 2034, reflecting an exceptional compound annual growth rate (CAGR) of 50.23%. This rapid expansion underscores the pivotal role of 5G networks in enabling the forthcoming generation of IoT applications, especially those demanding high-speed and low-latency connectivity.

In 2023, the solutions segment dominated the market, capturing over 63% of the share, while Non-Standalone (NSA) 5G architectures contributed to 59% of the total revenue. Furthermore, large enterprises accounted for more than 70% of the global expenditure on 5G IoT technologies, emphasising the strategic importance of 5G

infrastructure as a foundation for scalable and high-performance IoT systems.

The anticipated growth in connected devices, expected to surpass 37.5 billion by 2033, further highlights the necessity for robust and flexible digital ecosystems. Key sectors such as smart cities and retail are increasingly adopting 5G-powered IoT solutions to improve operational efficiency and service quality. While nations with advanced digital strategies stand to gain the most, developing countries like Algeria face challenges related to infrastructure and regulatory frameworks that must be addressed to fully leverage IoT's potential and secure a competitive position in the evolving global digital economy (MarketsandMarkets, 2024).

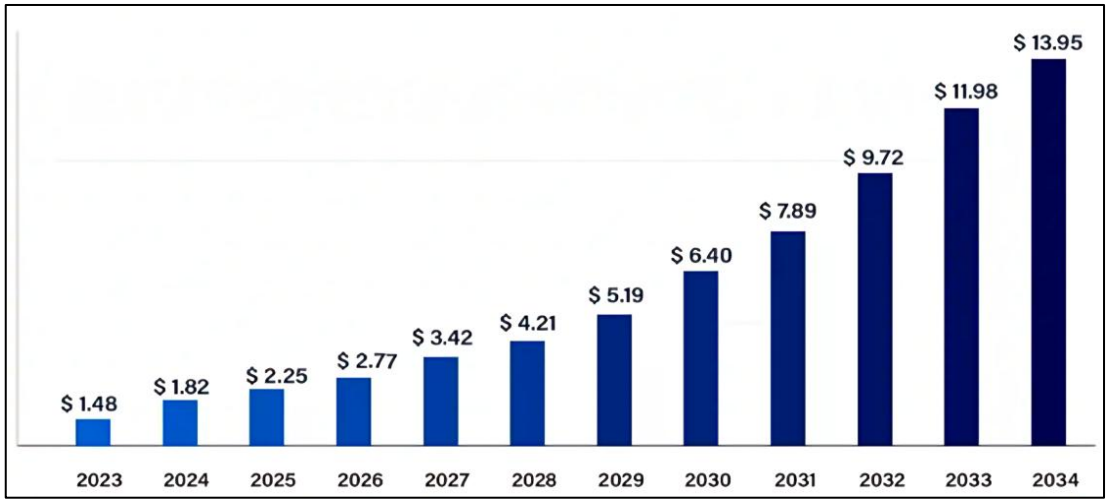


*Figure 5: Global market for smart cities based on IoT technologies, 2023–2034*
*Source : (MarketsandMarkets, 2024)*

By the end of 2024, several major industrial sectors experienced significant reductions in patent filings related to Internet of Things (IoT) technologies. The medical sector, while still leading in overall activity, saw a pronounced 41% drop in filings, declining from 2,172 in the second quarter to 1,283 in the third (MDN, 2024). The consumer sector followed this downward trend, with a 57% decrease as applications fell from 801 to 347 (JD, 2024). Similarly, the electrical sector registered a 53% reduction, with filings dropping from 434 to 203 (PT, 2024). The retail industry also saw a notable decline of 46%, moving from 354 to 191 applications (RIN, 2024). Even the defence and aerospace sectors, though smaller in scale, were not immune, experiencing a 56% fall in filings from 140 to 62 (Army Technology, 2024).

These widespread declines likely indicate a strategic reassessment of innovation priorities across these industries. Possible contributing factors include economic uncertainty, shifts in investment focus, and changes in regulatory landscapes. The slowdown in patent activity may also reflect a temporary reduction in high-risk research and development spending, as organisations pause to realign their innovation strategies with evolving market dynamics.

As shown in Figure 6, the global market for IoT-related patents and intellectual property is projected to expand from USD 6.44 billion in 2024 to about USD 31.50 billion by 2034, implying a compound annual growth rate of roughly 17.2% over the period. North America is expected to remain the largest regional market, estimated at a little over USD 3.03 billion in 2024, and to grow at a comparable pace. These projections reflect the accelerating rate of IoT innovation in high-income economies that prioritise strategic protection of technological assets. The increasing scale of IP-mediated investment underscores the rising importance of intellectual property as both a competitive asset and an indicator of innovation leadership. With 2024 as the baseline year, the trajectory aligns with the broader wave of digital transformation, driven by 5G, AI, and edge computing, that is hastening the development and commercialisation of IoT systems. In this context, the evolution of the IoT IP market serves not only as a barometer of technological progress but also as a practical gauge of national innovation capacity and long-term economic competitiveness (Precedence Research, 2025).

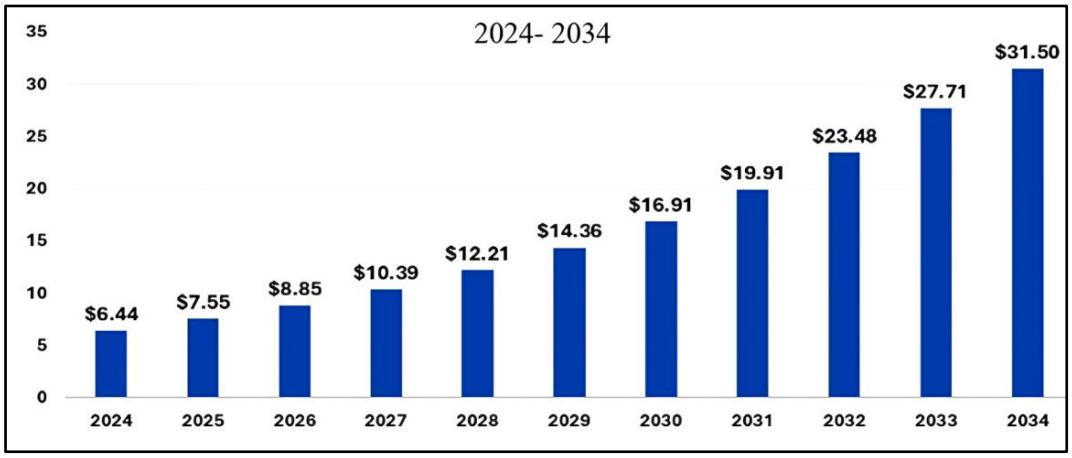


*Figure 6: Global market for IoT-related patents and intellectual property 2024–2034*
*Source* : *(Precedence Research,2025)*

## THE IMPLEMENTATION AND APPLICATION OF BLOCKCHAIN TECHNOLOGY IN ARAB COUNTRIES

### The Kingdom of Saudi Arabia

Saudi Arabia has identified the Internet of Things (IoT) as a cornerstone of its national transformation efforts, closely aligning its deployment with the objectives of Vision 2030. The integration of IoT technologies is evident across a range of sectors, including industry, smart cities, healthcare, and the oil and gas sector. In industrial settings, IoT solutions are leveraged to enhance operational efficiency and enable real-time monitoring, while in healthcare, connected platforms facilitate remote patient monitoring and asset tracking, leading to improved quality of care (Benrahali, 2024).

A prominent illustration of Saudi Arabia's commitment to IoT-driven urban development is the NEOM smart city initiative, which utilises IoT for intelligent resource allocation, sustainability, and the creation of high-standard urban environments. The energy sector also capitalises on IoT through predictive maintenance and automation, resulting in greater operational reliability and safety. These advancements are underpinned by substantial public and private investments in digital infrastructure, reflecting a strong institutional drive to broaden the IoT landscape. Consequently, Saudi Arabia is establishing itself as a leading regional centre for IoT innovation, fostering opportunities for technology vendors, startups, and collaborative ventures between academia and industry (Research and Markets, 2024).

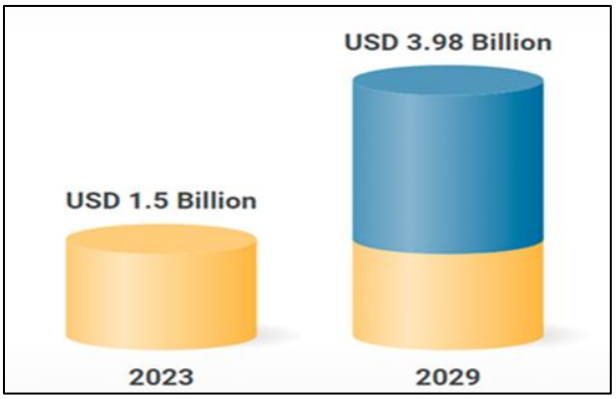


*Figure 7: IoT Spending in the Kingdom of Saudi Arabia (2023–2029)*
*Source* : *(Research and Markets, 2024)*

As depicted in Figure 7, the Internet of Things (IoT) market in Saudi Arabia was valued at approximately USD 1.5 billion in 2023 and is projected to grow at a compound annual growth rate (CAGR) of 17.5% through 2029. This growth trajectory reflects the Kingdom's strategic emphasis on leveraging smart technologies to enhance efficiency across key sectors such as healthcare, energy, manufacturing, and transportation. In parallel, Saudi Arabia is accelerating the integration of blockchain technologies as a complementary pillar of its digital infrastructure, aligned with the objectives of Vision 2030.

The Communications, Space, and Technology Commission (CST) has established a regulatory framework aimed at fostering innovation within the blockchain sector, encouraging service

localisation, and enhancing digital productivity (CST, 2025). A notable example is Saudi Arabia's participation in Project mBridge, a cross-border central bank digital currency initiative that demonstrates the Kingdom's proactive engagement in blockchain-enabled financial networks (Jones, 2024).

Additional blockchain applications are also emerging within public administration, such as identity verification and land registry systems, which seek to improve transparency and reduce fraud (Entrepreneurial Arabia, 2025). In the banking sector, blockchain adoption is strengthening the security and efficiency of financial transactions, while in healthcare, decentralised medical data platforms are being employed to advance clinical research and data-driven diagnostics (Entrepreneurial Arabia, 2025).

Despite these advancements, Saudi Arabia continues to face challenges, including cybersecurity risks, fragmented regulatory frameworks, and a shortage of specialised talent. Nevertheless, ongoing government initiatives are laying the groundwork for the scalable and sustainable deployment of both IoT and blockchain technologies in the Kingdom (Betraining, 2025).

**The United Arab Emirates**

The United Arab Emirates (UAE) has established itself as a regional leader in the adoption of Internet of Things (IoT) technologies, utilising comprehensive national strategies to propel its digital transformation agenda. A significant milestone was the introduction of Dubai's Internet of Things Strategy in 2017, which was intricately linked to the Smart Dubai 2021 initiative. This strategic plan aimed to create a fully integrated smart city framework and achieve paperless governance by systematically implementing IoT across both public and private sectors (Emirates, 2023).

The strategy's multifaceted approach—encompassing governance, deployment, security, monetisation, and speed—has enabled extensive IoT integration within critical industries. In the industrial domain, IoT has boosted productivity through automation and remote diagnostics. The energy sector has leveraged smart grid technologies and consumption analytics, while the healthcare sector has utilised connected medical devices to enhance patient care and alleviate hospital overcrowding. Additionally, smart urban management systems have been pivotal in optimising traffic flow, monitoring air quality, and improving citizen services.

The UAE's rapid digital advancement has been further supported by a robust regulatory framework. The Telecommunications and Digital Government Regulatory Authority (TDRA) introduced the IoT Policy and Framework to standardise implementation, safeguard data security, and encourage responsible innovation (Al Shumaili, 2022). These regulations highlight the UAE's commitment to both technological progress and cybersecurity.

From a market standpoint, the UAE has shown early dominance in IoT investments. Valued at USD 35 billion as early as 2019, the sector reflects strong institutional backing for smart technologies (Hamdi, 2019). Forecasts for 2030 predict that revenues in the IoT devices market will reach USD 3.02 billion, with a compound annual growth rate (CAGR) of 20.4% between 2025 and 2030, primarily driven by smart city projects and industrial digitalisation (Grand View Research, 2025).

Furthermore, 5G-enabled IoT applications, including connected mobility, telemedicine, and environmental monitoring, are expected to grow at a CAGR of 48.7%. The blockchain industry, which complements IoT by providing secure data validation and transaction processing, is projected to exceed USD 52 billion by 2030, with a CAGR of 42%, fueled by national digital economy programs (Bonafide, 2025).

Together, these advancements underscore the UAE's strategic vision, regulatory alignment, and technological capabilities, positioning the country as a frontrunner in regional digital transformation and a potential global exemplar in the integration of emerging technologies.

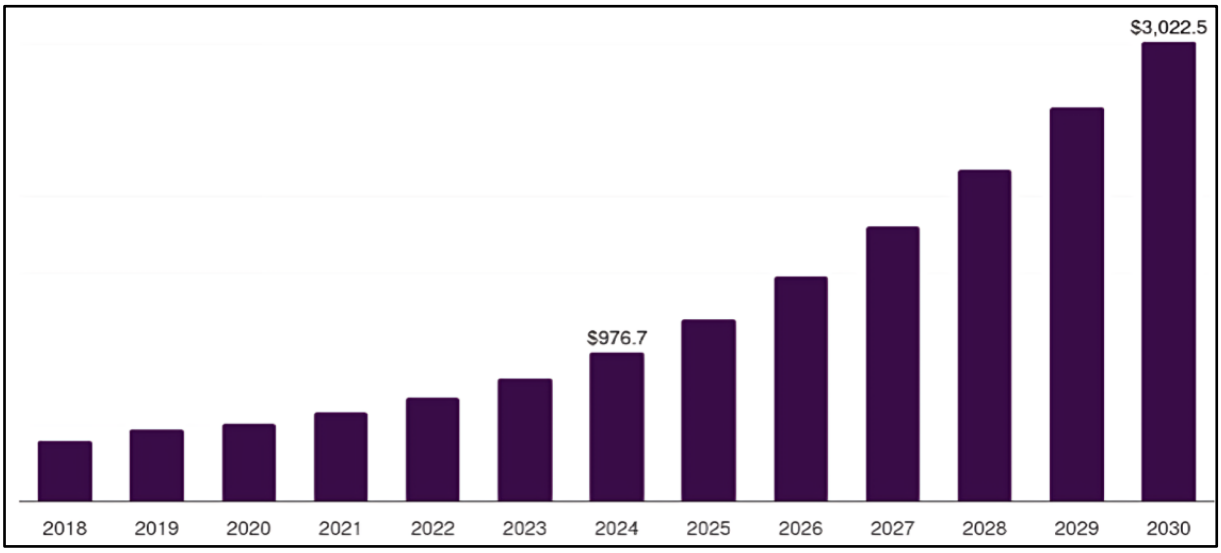


*Figure 8: Internet of Things Devices Market in the United Arab Emirates, 2018-2030*
*Source : (Grand View Research, 2025)*

As illustrated in Figure 8, the Internet of Things (IoT) devices market in the United Arab Emirates recorded significant growth in 2024, with revenues reaching approximately USD 976.7 million. Projections suggest that this figure will rise substantially, approaching USD 3.02 billion by 2030, driven by a compound annual growth rate (CAGR) of 20.4% between 2025 and 2030 (Grand View Research, 2025). This strong growth trajectory underscores the UAE's strategic commitment to digital transformation and its sustained efforts to integrate intelligent technologies across both public services and private sector operations.

A component-level breakdown indicates that sensors represented the largest revenue segment in 2024, highlighting the nation's emphasis on real-time data collection and environmental responsiveness. The anticipated increase in edge devices—technologies that enable decentralised data processing—signals a broader transition towards distributed computing architectures. This shift aligns with global advancements in smart infrastructure, where reducing latency and strengthening device-level autonomy are increasingly recognised as critical factors for efficiency and scalability.

The UAE's growing investment in edge-centric IoT ecosystems reflects its forward-looking approach to building future-ready digital infrastructure, particularly in key sectors such as mobility, energy management, public safety, and smart governance. By embracing decentralised architectures, the country is positioning itself to deliver next-generation IoT solutions capable of providing adaptive, high-performance services in real time.

**The State of Qatar**

Qatar has experienced rapid growth in adopting Internet of Things (IoT) technologies, establishing itself as a key regional player in digital innovation aligned with its National Vision 2030. The IoT market in Qatar was valued at approximately USD 614.6 million in 2022, with projections reaching about USD 1.82 billion by 2026—an impressive annual growth rate of 31%, as illustrated in Figure 9. This remarkable expansion is largely attributed to ambitious smart city initiatives, such as the 'Tasmu' program, which integrates advanced digital solutions across critical sectors, including transportation, healthcare, environment, and logistics. These developments collectively reflect Qatar's strong commitment to building a data-driven, innovation-oriented economy.

Qatar is steadily consolidating its position as both a regional and global leader in digital innovation, a trajectory driven by the accelerated adoption of Internet of Things (IoT) technologies and the rapid expansion of 5G infrastructure. The nation's proactive strategy has placed it at the forefront of IoT and 5G advancements, reflecting a clear vision of transforming Qatar into a technology-driven economy (AlWatan, 2019). According to a recent GSMA report, the number of IoT connections in the Middle East and North Africa is projected to

reach nearly 470 million by the end of 2025, creating substantial opportunities for Qatar's telecommunications sector to expand its footprint within this evolving digital landscape (Sayed, 2023).


*Figure 9: Internet of Things Market Size in Qatar (Million USD)*
*Source : (Digital, 2022)*

IoT applications in Qatar are producing measurable impacts across essential sectors. In healthcare, connected devices enable remote patient monitoring and data-driven diagnostics, contributing to improved outcomes and more efficient resource allocation. The transportation sector benefits from smart infrastructure and real-time traffic management systems, reducing congestion and enhancing mobility. In residential contexts, IoT deployment supports energy efficiency and enhances user experience through automation and real-time control.

Market forecasts remain optimistic: Qatar's IoT sector is expected to reach USD 3.47 billion by 2029, underscoring the country's sustained commitment to digital transformation and the adoption of sustainable technologies (Mordor Intelligence, 2024). This expansion aligns closely with the Qatar Digital Agenda 2030, a comprehensive national strategy led by the Ministry of Communications and Information Technology. The agenda aims to foster a robust digital economy through targeted innovation policies, advanced infrastructure, and institutional reforms designed to improve business efficiency and quality of life (Ministry of Communications and Information Technology, 2022).

The Digital Agenda also includes forward-looking initiatives, such as the development of a secure, regulated cryptocurrency market, which is projected to grow at a compound annual growth rate (CAGR) of 5.9% between 2025 and 2031. At the same time, blockchain technologies are increasingly being applied to enhance financial services, promote transparency in government operations, and support healthcare platforms focused on secure medical record management (Mordor Intelligence, 2024). Collectively, these strategies reaffirm Qatar's commitment to leveraging IoT and emerging technologies as key enablers of sustainable development, economic diversification, and digital leadership in the region.

**Benchmarking Gulf IoT Adoption Against a Global Leader**

The Gulf countries, particularly Saudi Arabia, the United Arab Emirates, and Qatar, have made significant strides in adopting Internet of Things (IoT) technologies, driven by comprehensive national strategies and targeted sectoral investments. To better contextualise these regional developments, this section benchmarks the Gulf experience against China, which stands out as a global leader in IoT infrastructure, smart city development, and digital industrialisation. The analysis integrates key dimensions of the Digital

Transformation Readiness Model, including strategic vision, market growth, main sectors of application, technological enablers, regulatory environment, and challenges identified. The following table provides a structured assessment of these dimensions in Saudi Arabia, the UAE, Qatar, and China, highlighting both quantitative indicators and qualitative factors that shape IoT adoption.

*Table 1: Comparative assessment of IoT adoption in Gulf countries and China*

| Dimension | Saudi Arabia | UAE | Qatar | China |
|---|---|---|---|---|
| **Strategic Vision** | Vision 2030 integrates IoT into smart cities, healthcare, and energy sectors | Smart Dubai 2021 and national digital agendas emphasise full IoT integration | Qatar National Vision 2030 and Digital Agenda 2030 drive IoT expansion | National innovation-led strategy supports IoT in smart cities and industrial upgrading |
| **Market Size / Growth** | USD 1.5 billion in 2023; projected CAGR of 17.5% to 2029 | USD 976.7 million in 2024; expected to reach USD 3.02 billion by 2030 (CAGR 20.4%) | USD 614.6 million in 2022; projected USD 3.47 billion by 2029 | One of the world's largest IoT markets; extensive deployment in urban and manufacturing sectors |
| **Main Sectors of Application** | Oil & gas, smart cities (e.g., NEOM), healthcare | Smart cities, transportation, healthcare, energy | Healthcare, transport, logistics, smart homes | Construction, manufacturing, public services, smart mobility |
| **Technological Enablers** | Government and private investment in infrastructure | Early integration of 5G and regulatory frameworks (TDRA) | Emphasis on smart infrastructure, connected devices | Strong integration with AI, 5G, edge computing; supported by national R&D hubs |
| **Regulatory Environment** | Guidelines via CST to support blockchain and IoT regulation | IoT policies and national cybersecurity frameworks established by TDRA | Digital governance strategy led by Ministry of Communications | Institutional support, but challenges in governance and standardisation remain |
| **Challenges Identified** | Cybersecurity risks, regulatory gaps, talent shortages | Need for continuous policy updates and secure deployment | Still evolving regulatory structures; dependency on state-led planning | Fragmented regulation, adoption barriers in traditional industries |
| **References** | (Benrahali, 2024; Betraining, 2025; CST, 2025; Research and Markets, 2024) | (Al Shumaili, 2022; Emirates, 2023; Grand View Research, 2025) | (Digital, 2022; Ministry of Communications and Information Technology, 2022; Mordor Intelligence, 2024) | (Cheng et al., 2024; Wang et al., 2021) |

The comparative assessment reveals notable differences in the strategies pursued by Gulf countries and China regarding the implementation of Internet of Things (IoT) technologies. Saudi Arabia, the United Arab Emirates, and Qatar have embedded IoT within their national digital transformation agendas, guided by ambitious visions such as Vision 2030 and Smart Dubai 2021. These initiatives align with dimensions of the Digital Transformation Readiness Model—specifically Strategic Vision, Technological Enablers, and Regulatory Environment—by supporting steady growth in digital markets, encouraging institutional reforms, and promoting the deployment of IoT applications in key sectors such as energy, healthcare, and smart cities.

In contrast, China represents a more advanced and consolidated IoT ecosystem, characterised by large-scale industrial integration, AI-enabled platforms, and government-backed innovation policies. China's strengths reflect the model's emphasis on Market Size/Growth, Technological Enablers, and Challenges Identified, demonstrating its vast market scale, strong research and development capacity, and close collaboration between public and private sectors.

Nonetheless, both contexts continue to face persistent challenges. The Gulf region struggles with regulatory inconsistencies and a shortage of specialised human capital, while China faces imbalances in adoption across industries and fragmented governance mechanisms—observations that correspond to the Challenges Identified dimension of the model. Despite these differences, all four economies share a strong commitment to harnessing IoT as a catalyst for economic modernisation, improved service delivery, and enhanced global competitiveness in the digital era.

**Results**

Overall, the data confirms a notable expansion of the Internet of Things (IoT) market across the Gulf countries, though with differences in scale and pace. Saudi Arabia's market was valued at USD 1.5 billion in 2023, with an expected CAGR of 17.5% until 2029, supported by Vision 2030 initiatives such as NEOM. The UAE reached USD 977 million in 2024 and is projected to grow to USD 3.02 billion by 2030, largely driven by smart city programs and early adoption of 5G. Qatar's market stood at USD 615 million in 2022, with an annual growth rate of 31% expected to push it to USD 1.82 billion by 2026 under the TASMU program.

For comparison, China presents a more mature and large-scale IoT ecosystem, characterised by integration into manufacturing, smart mobility, and public services, and reinforced by synergies with AI, 5G, and edge computing.

These findings provide a quantitative baseline for assessing IoT adoption in the Gulf and China. They correspond broadly with the dimensions of the Digital Transformation Readiness Model, particularly strategic vision, technological enablers, and market size/growth

**Discussion**

This study demonstrates that IoT adoption in the Gulf region is advancing in alignment with ambitious national digital transformation strategies. Evidence from Saudi Arabia, the United Arab Emirates, and Qatar confirms measurable improvements in productivity and efficiency across healthcare, energy, and transportation, consistent with prior research on IoT as a driver of operational optimisation and service innovation (Edquist et al., 2021; Majid et al., 2022; Paniagua & Delsing, 2021).

Nevertheless, persistent challenges—including cybersecurity vulnerabilities, high deployment costs, and fragmented regulatory frameworks—suggest that the Gulf states are still in a transitional phase rather than a fully consolidated digital ecosystem. This partially supports earlier scholarship emphasising that adoption effectiveness depends not only on technological readiness but also on institutional and regulatory alignment (Cheng et al., 2024; Wang et al., 2021). Similar challenges have been documented in supply chain contexts, where IoT integration is hampered by security, interoperability, scalability, and standardisation issues (Shoomal et al., 2024).

A critical dimension concerns the gap between strategic ambitions and practical implementation. While initiatives such as Saudi Vision 2030 and the UAE Digital Government Strategy articulate clear objectives, effective translation of these goals requires stronger collaboration between public and private actors. This corroborates international evidence highlighting the central role of public–private partnerships in accelerating digital transitions (Benrahali, 2024).

The discussion also underscores the interdependence between IoT and complementary technologies such as artificial intelligence, blockchain, and 5G networks. This technological convergence has been widely recognised as a key driver of sustainable digital ecosystems (Ericsson, 2024; Ezema et al., 2019).

Finally, the comparative assessment with China illustrates the analytical value of the Digital Transformation Readiness Model, particularly its dimensions of strategic vision, market size and growth, sectoral application, technological enablers, regulatory environment, and identified

challenges. By applying this framework, the study demonstrates how variations in planning, infrastructure, and institutional alignment explain cross-country differences in adoption trajectories. This highlights the study's original contribution: providing the first comparative application of the model to Gulf economies in the context of IoT adoption.

## CONCLUSION

This study provides evidence that the Internet of Things (IoT) is emerging as a transformative driver of economic development in the Gulf region, with substantial progress observed in Saudi Arabia, the United Arab Emirates, and Qatar. IoT adoption has enhanced productivity, operational efficiency, and digital service delivery. At the same time, persistent challenges—including cybersecurity risks, high deployment costs, and fragmented regulatory frameworks—continue to hinder the full realisation of its potential. Addressing these barriers and strengthening institutional alignment will be critical for positioning the Gulf region as a global hub for IoT innovation.

The analysis also reaffirms the applicability of the Digital Transformation Readiness Model, illustrating how strategic vision, market size and growth, sectoral application, technological enablers, regulatory environment, and identified challenges collectively shape the trajectory of IoT adoption. By applying this framework to Gulf countries in comparison with China, the study offers an original contribution: providing one of the first systematic, cross-country assessments of IoT readiness in the Arab context. This underscores the need for targeted reforms to overcome structural constraints and to sustain the momentum generated by national digital transformation strategies.

### Future Prospects

Looking ahead, the prospects for IoT adoption in the Gulf region are closely tied to the continued implementation of ambitious national digital transformation strategies, including Saudi Vision 2030, the UAE Digital Government Strategy, and Qatar's Digital Agenda 2030. The expansion of 5G networks, the proliferation of smart city initiatives, and the integration of complementary technologies such as artificial intelligence and blockchain are expected to sustain robust growth in the IoT market through 2030. Compared with China—already a global leader in IoT through large-scale industrial deployment, massive R&D investment, and unified national standards—the Gulf countries are still consolidating fragmented frameworks. Nevertheless, their ambitious digital visions provide strong potential to narrow this gap. If these trajectories continue, the region is well positioned to emerge as a leading hub for IoT-driven innovation and digital competitiveness. These forward-looking insights, grounded in the comparative evidence presented in this study, reinforce the importance of aligning infrastructure, regulation, and human capital to sustain momentum.

### Recommendations

In light of these findings, the following recommendations are proposed:

- Enhance investments in digital infrastructure, while modernising legal and regulatory frameworks to create an enabling environment for secure and innovative IoT applications, directly addressing the current issue of fragmented regulations and high infrastructure costs.
- Strengthen public-private partnerships to accelerate the deployment of cutting-edge technologies and bridge implementation gaps, particularly in sectors where legacy systems remain dominant.
- Promote research and development in areas such as artificial intelligence, IoT architecture, and cybersecurity, through dedicated national strategies and institutional support, to mitigate identified cybersecurity vulnerabilities and reduce reliance on imported technologies.
- Implement specialised training and capacity-building programs to address the technical skills gap and foster a digitally skilled workforce, ensuring that human capital development keeps pace with IoT adoption.
- Expand IoT adoption in strategic sectors, including smart healthcare, energy optimisation, and intelligent transport systems, where the Gulf states already show initial but uneven progress.
- Support digital entrepreneurship and innovation, particularly among startups focused on IoT-based solutions and services, helping to diversify economies beyond oil and build knowledge-based ecosystems.
- Encourage regional collaboration among Arab countries to harmonise digital strategies,

exchange expertise, and develop shared technology standards, thereby avoiding duplication and enabling cross-border IoT integration.

– Conduct regular monitoring and impact assessments to track IoT deployment and its economic outcomes, ensuring sustainable digital integration that aligns with broader development goals.

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# REALNOST I PERSPEKTIVE PRIMENE TEHNOLOGIJE INTERNETA STVARI (IOT) U EKONOMIJAMA ARAPSKOG REGIONA (SAUDIJSKA ARABIJA, UAE, KATAR)

**Ova studija istražuje usvajanje i buduće perspektive tehnologije Interneta stvari (IoT) u Saudijskoj Arabiji, Ujedinjenim Arapskim Emiratima i Kataru. Zasniva se na zvaničnim podacima, vladinim i međunarodnim izveštajima, kao i na recenziranoj literaturi u ključnim sektorima, uključujući industriju, energetiku, zdravstvo i transport. Primenom deskriptivno-analitičke metodologije, studija koristi benchmarking i komparativnu analizu trendova kako bi procenila usvajanje IoT tehnologije u kvantitativnom i sektorskom smislu. Kvantitativni indikatori – poput veličine tržišta, broja povezanih uređaja i sektorskih investicija u periodu od 2019. do 2025. godine – sistematski se razmatraju. Analiza identifikuje ključne prepreke, uključujući rizike sajber bezbednosti, visoke troškove infrastrukture, fragmentirane pravne okvire i poteškoće u integraciji sa postojećim sistemima, i pokazuje njihovo ograničavajuće dejstvo na mogućnost širenja. Benchmarking sa Kinom ističe sličnosti i razlike u efikasnosti politika i strategijama digitalne transformacije. Nalazi pokazuju da Saudijska Arabija i UAE napreduju brže od Katara u ulaganjima u pametne gradove i industrijski IoT, dok integrisani model inovacija Kine nudi prenosive pouke. Studija se završava ciljnim preporukama – poput harmonizacije regulatornih okvira, razvoja digitalnih talenata i proširenja napredne infrastrukture – sa ciljem ubrzanja usvajanja IoT tehnologije i jačanja digitalne ekonomije arapskog regiona.**

**Ključne reči:** Internet stvari; Ekonomski razvoj; Digitalna transformacija; Usvajanje tehnologije; Arapske ekonomije.