Design and Explanation of an IoT Utilization Model in Export Businesses: Identifying Antecedents and Consequences

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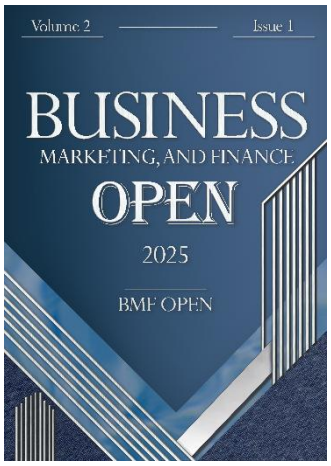

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Abstract: Technologies have significantly influenced business practices, and it can be stated that businesses that do not align with this revolution have little chance of survival. Accordingly, the present study aims to identify the antecedents and consequences of the utilization of the Internet of Things (IoT) in export businesses dealing with agricultural products. This study is applied in terms of purpose, developmental in nature, and employs a mixed-methods approach. The qualitative sample consists of experts and managers from agricultural machinery exporting companies. A total of 13 participants were selected using purposive snowball sampling, and semi-structured interviews were conducted with them. Data analysis in the qualitative phase was performed using thematic analysis based on the three-stage coding method proposed by Braun and Clarke (2006). The quantitative sample, considering an unlimited population, was determined based on Morgan's table and included 384 managers, supervisors, and specialists from exporting companies, selected through convenience random sampling. Data in the quantitative section were collected using a researcher-developed questionnaire, the validity and reliability of which were confirmed. Furthermore, data analysis in the quantitative phase was conducted using structural equation modeling (SEM) with SmartPLS software. The results of the qualitative phase revealed that the most critical antecedents of IoT utilization in export businesses include market and customer needs, decision-making and planning, goal setting, technical infrastructure, and the company environment. Additionally, the consequences of IoT utilization in export businesses encompass market alignment, performance improvement, and profitability. Finally, in the quantitative phase, the relationships between variables were examined through structural equations, and the results indicated significant relationships among the variables. This finding confirmed the proposed IoT utilization model in export businesses.

Keywords: Internet of Things (IoT), export businesses, thematic analysis, agricultural machinery.

1. Introduction

In the recent century, alongside ongoing changes, the adoption of technology has become a necessity and a fundamental requirement, serving as a driving force to assist organizations in achieving their goals and future visions. With the rapid advancement of the internet in various aspects of life, one of the emerging topics is the method of conducting transactions via the internet [1, 2]. Consequently, the continuous development of new applications and businesses based on modern technologies is required, extending beyond internet technology to

encompass all digital innovations, including social media, mobile technology, augmented and virtual reality, big data, and the Internet of Things (IoT). The application of IoT in export businesses is a novel subject; therefore, most research in this area has been conducted in the form of engineering studies and case analyses, leading to a high degree of fragmentation in the literature [3, 4]. Thus, a comprehensive and integrated perspective on the diverse applications of IoT technology in export businesses has not yet been presented. Accordingly, the objective of this study is to identify the antecedents and consequences of IoT adoption in export businesses and to test the proposed model within companies exporting agricultural products.

Today, exports hold a significant position in the international economy. Exporting is the most common method by which companies enter international markets. Economists regard the increase in exports as a source of new employment opportunities, economic growth, tax revenue generation, and improvements in the balance of payments. One of the primary benefits of exports for individual exporters is increased liquidity. However, in the Iranian business environment, many manufacturers either do not engage in exports or their export volume does not align with their production capacity [5]. Lack of awareness, self-doubt, short-sightedness, fear, or unnecessary caution can be among the main reasons businesses hesitate to export their goods and products [6]. More importantly, exports benefit the country even before they provide direct financial gains to exporters [7].

The world around us is constantly changing, and terms such as post-industrial society, knowledge society, and the technological era have been used to describe these transformations [8]. The post-industrial technological landscape and the knowledge-driven world require individuals to be actively involved in critical decision-making processes. As technology evolves [9], collaboration frameworks and work process controls also undergo changes. In such a scenario, neither machine-driven order nor administrative regulations solely dictate work supervision. Additionally, the effective execution of knowledge-based tasks necessitates that individuals comprehend unconventional goals and actions derived from complex work processes [10]. Given these developments, organizational and management theories are entering a new phase referred to as postmodernism. The digital revolution has influenced all aspects of behavior and lifestyle [11], and businesses have not been immune to these changes. Various elements of the digital revolution have significantly altered traditional business equations, one of which is the Internet of Things. The fundamental idea behind IoT is that all objects in the surrounding environment interact with each other to achieve shared objectives [12]. IoT now plays a crucial role in smart homes, logistics, traffic management, environmental protection, public security, intelligent fire control, industrial equipment monitoring, personal healthcare, and various other fields [13].

Individuals can connect to the global network not only through personal computers but also via mobile phones and laptops. The data transmission process in IoT technology does not require direct human-to-human or human-to-computer interactions; instead, data is automatically transmitted based on predefined settings and at scheduled times [14]. The data generated by IoT can serve as a critical resource for innovation in organizations and marketing activities, particularly in the export sector. Furthermore, export marketing capabilities can create market value through the integration of innovative market-oriented approaches [3].

Rahimi-Nasab et al. (2022) examined the impact of IoT as an environmentally friendly technology in the expansion and enhancement of trade. Their findings confirmed significant relationships between network models of IoT, ecosystem participation, and interactions within e-commerce ecosystems [15]. Yazdani et al. (2021) identified qualitative indicators for evaluating IoT-based business models in smart cities using big data analytics, categorizing them into five groups: value creation drivers, value creation nodes, value exchange, value extraction, and external drivers [4]. Gharekhani and Pourhashemi (2021) investigated the factors influencing the adoption of IoT in Iran's

insurance industry, demonstrating that insurance risk is a key component of insurance companies and that IoT serves as a useful tool for accurately assessing risks and complying with quantitative regulatory requirements [16].

Farahmand et al. (2020) examined the relationships between the dimensions and indicators of IoT technology adoption in smart businesses. Their qualitative findings were categorized into six components: social and cultural factors, human factors, technological aspects, financial dimensions, managerial factors, and government regulations. The quantitative phase of their study confirmed the validity of the proposed model [17]. Samadzadeh (2024) demonstrated that the use of IoT in exports provides significant benefits, including improved operational efficiency, cost savings, enhanced security, and increased customer satisfaction [18]. Nitirajan (2023) explored the digital transformation of livestock exports through AI and sensor technologies, emphasizing their potential to shape the future of the global dairy industry by creating a more sustainable and efficient supply chain [5].

Keo (2021) focused on optimizing and localizing an algorithm for agricultural exports on blockchain with IoT-enabled functionalities. Empirical results indicated that the proposed algorithm significantly improved export volume and total trade value [19]. Magomedov et al. (2020) highlighted the advantages of IoT in business applications, including data collection and exchange, inventory management, and workforce optimization [20]. Falknerk and Wagner (2017) examined the opportunities and challenges of IoT in industrial trade relationships, leading to the development of a research framework for IoT marketing projects [21].

A review of the theoretical foundations indicates that there have been limited and scattered efforts to conduct theoretical or empirical studies on this subject and its implications for Iranian organizations. Furthermore, no comprehensive and cohesive perspective has been provided on the diverse applications of IoT technology in export businesses. Given these circumstances, leveraging IoT capabilities in export businesses could yield substantial benefits, as previously mentioned [15]. Thus, there is a pressing need for IoT knowledge in the export business sector, which presents a research gap.

Despite the widespread academic interest in digital technologies and their practical mechanisms in other countries, this field has received limited attention from researchers in Iran. An extensive search of domestic databases reveals that theoretical studies and exploratory research on this topic are highly limited. Additionally, existing research in this field primarily relies on models developed based on international studies rather than addressing the specific needs and contextual factors of Iranian businesses. This study aims to provide a foundational framework for future domestic research in this domain while addressing the theory-practice gap and related contextual factors in IoT-based business management in Iran. The adoption of IoT in export businesses can foster business model innovation, enabling enterprises to expand their international activities. However, it is worth noting that digital transformation in Iran has not yet reached full maturity, necessitating the identification of its antecedents and infrastructure requirements. Additionally, implementing and adopting this technology involves substantial costs for businesses and industries, leading to uncertainty among managers regarding its outcomes due to its potential disruptive impact. Therefore, this study seeks to identify the antecedents and consequences of IoT adoption in export businesses, specifically among agricultural machinery exporters. Moreover, a summary of previous research suggests that IoT technology, besides enhancing customer trust and satisfaction in e-commerce, significantly influences the structure and operations of businesses. The growing need for business analytics and decision-making support for stakeholders engaged in trade activities is driving a transformation in business practices. This transformation can be both disruptive and opportunistic, creating both opportunities and threats for export businesses. Business owners must identify their weaknesses and address them to leverage IoT-driven

opportunities in agricultural product exports. Given the importance of this subject, this study aims to identify the antecedents and consequences of IoT adoption in export businesses.

2. Methodology

The study of social phenomena in the social sciences is conducted using various methods, each of which is applied based on its paradigmatic characteristics. Given that the present study aims to identify the antecedents and consequences of IoT adoption in export businesses dealing with agricultural products, this research is developmental in terms of outcome, applied in terms of purpose, and employs a mixed-methods (qualitative and quantitative) approach in terms of data type. The philosophical approach of this study is inductive, and its strategy combines both qualitative and quantitative methodologies, following an exploratory mixed-methods design. Due to its exploratory nature and the sequential process of data collection and analysis, this study falls under the category of sequential exploratory design. To achieve the primary objective—identifying the antecedents and consequences of IoT adoption—thematic analysis has been used for model development and extraction.

Overall, this study applies qualitative research methods to develop measurement tools and quantitative methods for testing and explaining the data. Therefore, the study adopts a mixed-methods approach, incorporating qualitative techniques such as semi-structured and unstructured interviews and direct observations to identify the antecedents and consequences of IoT adoption in agricultural exports. Additionally, quantitative methods have been used for model validation and hypothesis testing. Mixed-methods research serves as a methodological strategy for collecting, analyzing, and integrating quantitative and qualitative data to enhance the understanding of research problems within a single study.

The statistical population of this research consists of senior managers of agricultural machinery exporting companies, industry experts, and university faculty members specializing in related fields. The qualitative phase of the study involved 13 participants, selected using purposive snowball sampling. The interviews continued until theoretical saturation was reached. It is noteworthy that in the qualitative phase, line-by-line coding was employed for data analysis. In the quantitative phase, a sample of 384 participants was selected using convenience random sampling.

Upon completing the research, it is essential to determine whether the theoretical explanations provided in the study hold meaning for participants and to ensure the validity of events and their sequence within the theoretical process (Clarke & Braun, 2013). To achieve this, the results were presented to three managers in the textile industry, and the process of model development was explained to them. The findings from this validation phase were expected to confirm the overall research findings. Additionally, the triangulation technique (Christensen, 1989, as cited in Mohammadpour, 2010, p. 168) was employed to assess the validity and reliability of the findings. This approach ensured continuous engagement with the data, enhancing the depth and breadth of the information. To achieve this objective, after coding and categorizing basic, organizing, and overarching themes, two independent researchers were asked to code a subset of interviews to evaluate the accuracy and validity of the coding process.

In the quantitative phase, the validity of the questionnaires was examined based on expert opinions, and reliability was tested using Cronbach's alpha, which yielded values of 0.617 and 0.703, indicating an acceptable level of reliability.

Data analysis in the qualitative phase was conducted using the thematic coding approach of Clarke and Braun (2006). Thematic analysis is a method for analyzing textual data, transforming scattered and diverse information

into rich and detailed insights. The analytical process begins when the researcher seeks to identify patterns and themes within the data.

In the quantitative phase, a survey was conducted among employees of agricultural machinery exporting companies to test the proposed model of antecedents and consequences. Since it was not feasible to compile a complete statistical list of the population, the population size was assumed to be infinite. Using Cochran's formula, the appropriate sample size at a 5% error level was determined to be 384 participants. The structural equation modeling (SEM) method was applied for hypothesis testing, utilizing SmartPLS software.

3. Findings

As previously mentioned, data analysis in this study was conducted based on the thematic coding approach proposed by Clarke and Braun (2006). This research aimed to go beyond mere objective and empirical codes and categories, seeking to extract abstract categories that could provide a comprehensive explanation of IoT applicability in agricultural product export companies. The theoretical literature served as a guide for the final abstraction and categorization process. Based on the interview analyses, the main antecedents and consequences of IoT adoption were identified. These themes essentially form the framework for IoT applicability in agricultural product export companies within this research. The key phases and the process of concept and code extraction are summarized in Table 1:

Table 1. Antecedents of IoT Adoption in Export Businesses

Overarching Themes	Organizing Themes	Basic Themes
Market and Customer Needs	Forecasting Customer Behavior and Needs	Resistance to change, customer choice, building customer trust, satisfaction-loyalty, behavior and needs prediction
	Market Needs	Market analysis, forecasting transformations, modern methods
Decision-Making and Planning	Better Decision-Making for Processes	Environmentally adapted design, process and performance development, new methodologies and resource efficiency, faster processes, leveraging cutting-edge technology, comprehensive data management (from raw material to customer delivery), order tracking, enhancing bilateral trade flows
	Effective Decision-Making for Business Planning	Business partner collaboration, B2B network coordination, business model transformation, operational efficiency, decision-making for strategic planning
	Planning - Adjustment and Improvement	Team collaboration, continuous engagement with active companies and research centers, employing experts, optimizing additional communication programs, organizational adjustments
Goal Setting	Defining Objectives and Vision	Unlimited objectives, business expansion, enabling participation, virtualization, policy and strategy formulation, service diversification
Technical Infrastructure	Readiness for IoT Infrastructure	Infrastructure consideration, creating internal communication networks, data-sharing infrastructure, infrastructure compatibility with external environments, management, technological, educational, cultural, and social factors influencing e-service adoption, integration of systems
Company Environment	System Integration with IoT	Structural optimization, smart physical environment, new system design
	Hardware and Software Systems	Selecting appropriate hardware, ensuring compatibility of hardware boards with company environment, high-processing power hardware, availability of required software, internet compatibility
	Technology Acceptance	IoT novelty, technology awareness, recognizing advantages and applications, trust in new technology, social acceptance
	Reduced Workforce Requirements	Remote control of departments, fewer personnel but higher expertise
	Automation of Operations	Process automation, enhanced safety, workforce compensation, performance improvement, developing shared virtual gateways

	Smart Operations	Data collection and analysis, industry competitor monitoring, improved strategic decision-making, artificial intelligence, creative applications
	Utilization of Effective Tools and Methods	New tools for business expansion, tool-performance compatibility, new method-objective alignment, employee awareness of tool efficiency, technical enhancement, activity optimization, business challenges

After coding the data in three stages—basic, organizing, and overarching themes—a total of 58 basic codes and 14 organizing themes were identified and categorized under five overarching themes. The results indicate that the most critical antecedents of IoT adoption in export businesses include:

1. Market and Customer Needs
2. Decision-Making and Planning
3. Goal Setting
4. Technical Infrastructure
5. Company Environment

Following the coding process, it was determined that the key consequences of IoT adoption in export businesses include:

1. Market Alignment
2. Profitability
3. Performance Improvement

The results of this phase are summarized in Table 2:

Table 2. Consequences of IoT Adoption in Export Businesses

Overarching Themes	Organizing Themes	Basic Themes
Market Alignment	Greater Flexibility	Agility in the company, adaptation to technological changes, experimenting with new conditions, seeking more efficient solutions
	Adaptability	Mechanical firms' lack of flexibility, avoiding resistance to change, accepting change as a business necessity, service orientation
Profitability	Stakeholder Profitability	Transparent access to information, fulfilling stakeholder expectations, considering stakeholder interests in decision-making, stakeholder identification and categorization
Performance Improvement	Appropriate Support	Hiring support specialists, consistent branding across processes, customer loyalty development, reinforcing brand reputation, government and institutional support, technology investment, automated inventory management, guiding buyers to stores, product and service co-creation
	Data Processing, Analysis, and Interpretation	Processing essential data, filtering out irrelevant data, generating high-quality data for enhanced operations, data storage, effective technology utilization, technical knowledge development
	Performance Enhancement	Strengthening organizational capabilities, prioritizing key performance indicators, customer segmentation, maximizing IoT potential, hiring effective sales personnel, learning from other companies, adopting effective sales tools, creating relevant content, investing in IoT-related tools and equipment
	Improved Productivity and Efficiency	Active presence in digital space, tracking target customer behaviors, effective international marketing, consulting for marketing channel establishment, developing communication and marketing networks
	Process Optimization	Continuous employee training, empowerment and motivation, integration and coordination of marketing departments, improving overall alignment, dynamic structures for customer response, proper support systems
	Departmental Advancement	Enhancing managerial capabilities through IoT, improving technical skills across departments, value creation through technical enhancements, increasing IoT operational proficiency, analyzing and forecasting competitive markets
	Process Development	Market and customer demand identification, customer-centric strategies, relationship-building with customers, value creation, marketing strategy formulation, marketing mix (product, place, price, promotion)

Finally, after completing the theoretical coding process, the researcher presents the findings of the qualitative phase in the conceptual framework below:

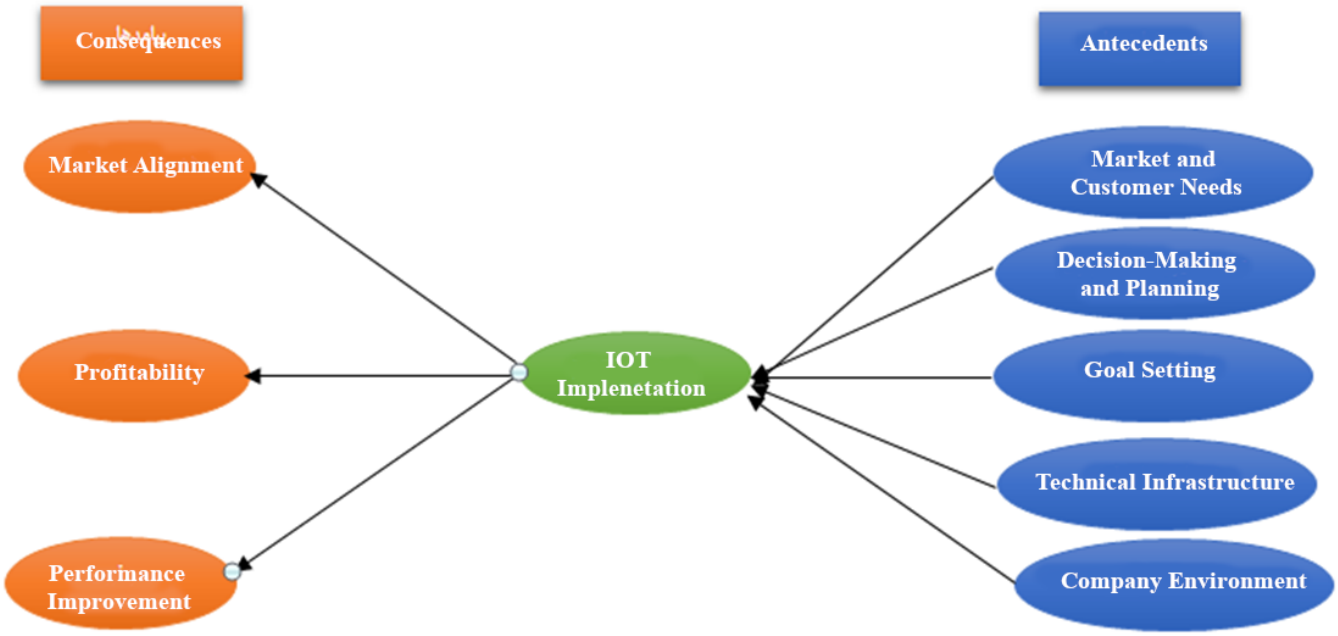

Figure 1. Conceptual Model of IoT Applicability in Export Businesses

After identifying the model, a researcher-developed questionnaire was prepared in the quantitative phase. After confirming content validity using the CVI index and reliability through Cronbach's alpha and composite reliability tests, the questionnaire was distributed to the research sample. Subsequently, based on the collected data, the measurement model and structural model were examined. Measurement models explain the relationship between items and a construct.

Table 3. Factor Loadings

Research Constructs	Item Number	Factor Loading
Market and Customer Needs	1	0.741
	2	0.832
	3	0.769
Decision-Making and Planning	4	0.811
	5	0.821
	6	0.829
Goal Setting	7	0.920
	8	0.911
	9	0.808
Technical Infrastructure	10	0.721
	11	0.701
	12	0.811
Company Environment	13	0.842
	14	0.826
	15	0.832
	16	0.810
IoT Adoption	19	0.799
	20	0.728

	21	0.781
	22	0.889
Market Alignment	23	0.796
	24	0.782
	25	0.828
Performance Improvement	28	0.814
	29	0.821
	30	0.801
Profitability	31	0.871
	32	0.936
	33	0.911

Since all factor loadings for the items exceed 0.4, internal consistency among the items is confirmed.

Next, Cronbach's alpha and composite reliability were used to assess reliability. Table 4 also shows the AVE values. This index is used to assess convergent validity, and values above 0.5 are considered acceptable.

Table 4. Reliability and Convergent Validity

Constructs	Cronbach's Alpha	Composite Reliability	AVE
Market and Customer Needs	0.710	0.721	0.513
Decision-Making and Planning	0.766	0.821	0.651
Goal Setting	0.786	0.844	0.684
Technical Infrastructure	0.823	0.863	0.506
Company Environment	0.723	0.943	0.706
IoT Adoption	0.749	0.901	0.719
Market Alignment	0.814	0.911	0.564

Based on the results in the above table, the values required for assessing reliability and convergent validity are at a desirable level.

According to the results in the above table, the HTMT values for all research constructs are below 0.9, confirming the discriminant validity of the measurement models. To assess discriminant validity, the HTMT index was used. Values less than 0.9 are considered desirable (Henseler et al., 2015).

Table 5. Discriminant Validity (HTMT Index)

Variable	Market and Customer Needs	Decision-Making and Planning	Goal Setting	Technical Infrastructure	Company Environment	IoT Adoption	Market Alignment
Market and Customer Needs							
Decision-Making and Planning	0.810						
Goal Setting	0.721	0.784					
Technical Infrastructure	0.563	0.846	0.848				
Company Environment	0.441	0.704	0.548	0.729			
IoT Adoption	0.220	0.712	0.711	0.830	0.639		
Market Alignment	0.369	0.610	0.760	0.816	0.688	0.793	

The researcher then evaluated the goodness of fit for the structural model. Two key criteria for evaluating structural model fit include the coefficient of determination (R^2) and the Q^2 index. This index is itself measured by

the communality and redundancy criteria, and positive values indicate an acceptable quality for the structural model. Table 6 shows these results.

Table 6. Structural Model Fit

Constructs	Redundancy	Communality	R^2
Market and Customer Needs		4.361	
Decision-Making and Planning		4.214	
Goal Setting		4.396	
Technical Infrastructure		5.145	
Company Environment		12.631	
IoT Adoption	0.211	5.147	0.552
Market Alignment	0.470	2.296	0.751
Performance Improvement	0.080		0.596
Profitability	0.043		0.561

Based on the results in the above table, the model's predictive quality is satisfactory. Cohen (1988) argues that R^2 values greater than 0.26 are desirable, thereby confirming the structural model fit. Finally, the SRMR index was used to assess the overall model fit. Hair et al. (2022) consider values below 0.08 acceptable for this index. In this study, the SRMR value obtained by the PLS software was 0.064, which falls within the desirable range.

After confirming the model's fit, the researcher examined the relationships among the components of the developed framework. Table 7 shows the results of this analysis.

Table 7. Path Coefficients and Significance Values

Row	Path	Path Coefficient	t-Value	Result
1	Market and Customer Needs → IoT Adoption	0.531	12.369	Significant
2	Decision-Making and Planning → IoT Adoption	0.336	7.145	Significant
3	Goal Setting → IoT Adoption	0.596	14.256	Significant
4	Technical Infrastructure → IoT Adoption	0.440	10.191	Significant
5	Company Environment → IoT Adoption	0.581	12.256	Significant
6	IoT Adoption → Performance Improvement	0.712	36.529	Significant
7	IoT Adoption → Market Alignment	0.319	3.214	Significant
8	IoT Adoption → Profitability	0.530	12.367	Significant

As shown in the table, paths with a t-value greater than 1.96 are significant, indicating that at the 95% confidence level, the relationships among the variables are confirmed. Consequently, the identified model is validated. In other words, all the extracted dimensions have strong, significant interactions, such that any change in one dimension leads to changes in the others.

4. Discussion and Conclusion

Since the early 1980s, with the advent of the first desktop computers, information technology (IT) has played a crucial role in the global economy. Companies rely on IT for rapid communication, data processing, and marketing intelligence. IT is an integral component of every industry, assisting businesses in enhancing operational processes, achieving cost efficiency, increasing revenue growth, and maintaining a competitive advantage in the market. One of the major research gaps in business studies, including export businesses, which has not yet been adequately addressed by researchers, is the use of the Internet of Things (IoT) in export operations. To bridge this research gap, the present study aimed to identify the antecedents and consequences of IoT adoption in export businesses. The reason for this focus is that export business owners remain uncertain about the outcomes of implementing IoT,

considering the significant costs associated with this technology. Therefore, by identifying the antecedents and consequences of IoT adoption, this study attempts to address this gap in the literature.

Overall, this study was conducted to identify the antecedents and consequences of IoT adoption in export businesses dealing with agricultural products. The research methodology followed a mixed-methods approach. Data were collected through interviews with 13 senior managers, industry experts, and university faculty members, as well as through field observations by the researcher. These data were analyzed using thematic analysis. To achieve the research objective, interview data were systematically coded, including basic themes, organizing themes, and overarching themes. Ultimately, the main theoretical framework and the IoT applicability model for export businesses were developed.

The findings of this study indicate that the most important antecedents of IoT adoption in export businesses include market and customer needs, decision-making and planning, goal setting, technical infrastructure, and company environment. Before adopting any strategy or policy, managers must first define the goals and vision of their business. The key objectives of IoT adoption in export businesses include simplifying communication, strategic thinking and knowledge transfer, increasing workplace efficiency, enhancing safety, and establishing a competitive advantage. After defining these objectives, managers must determine how IoT adoption will position their businesses in competitive markets. With IoT integration, millions of physical objects are expected to become interconnected, creating a broad distribution network capable of extracting meaningful insights from raw data. This system facilitates all export business operations through radio frequency identification (RFID) and other advanced technologies.

The adoption of any technology in business must align with market and customer needs. Technologies that fail to meet these needs will have a short lifespan. Therefore, export business owners must segment their target markets and focus on areas where IoT can provide a competitive advantage by better addressing market and customer demands. The company environment is composed of macro and micro factors that influence the implementation of information and communication technologies (ICT). Export businesses must conduct environmental analyses and advocate for governmental support policies, such as regulations and subsidies, particularly in the context of sanctions and foreign currency revenues, which require government attention. Following this support, export businesses should develop the necessary infrastructure for IT deployment.

Technical infrastructure refers to the hardware and software required to facilitate communication between users, servers, and network services. IT infrastructure must enable fast and secure communication among authorized users and service providers and be scalable and upgradeable to meet the evolving technological needs of the organization. Failure to properly integrate network infrastructure not only wastes investment but also incurs substantial future costs related to troubleshooting and resolving technical issues. Regarding decision-making, planning, and process optimization, IoT—when implemented correctly—streamlines business operations. The adoption of IoT in export businesses results in several key outcomes, including market alignment, performance improvement, and profitability enhancement.

IoT transforms the business architecture of export companies, enabling business owners to identify and eliminate non-value-adding processes. This leads to two major benefits: simplification of trade and export operations, reducing bureaucratic complexities, and cost reduction in service delivery and product manufacturing, leading to operational optimization and increased profit margins. Moreover, IoT-enabled devices embedded in consumer products allow marketers and managers to collect real-time data on product usage patterns, including when and

how they are used, and even predict potential failures. These insights enhance consumer behavior understanding, enabling more targeted and efficient marketing campaigns.

One of the key limitations of this study is that the variance of the target constructs was not fully explained, which may indicate the presence of additional antecedents influencing IoT adoption in export businesses. The authors recommend that future researchers focus on assessing the maturity level of digital transformation in export businesses, given that IoT adoption is still in its early stages in the country. Future studies should also propose strategies and recommendations to advance digital transformation and technological innovation in export businesses.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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References

[1] G. Muridzi, "Uptake of Internet of Things by SMEs in Digital Era in Emerging Economies: A Systematic Literature Review," *International Journal of Research in Business and Social Science (2147-4478),* vol. 13, no. 1, pp. 38-46, 2024, doi: 10.20525/ijrbs.v13i1.2937.

[2] E. E. Cranmer, M. Papalexi, M. C. tom Dieck, and D. Bamford, "Internet of Things: Aspiration, implementation and contribution," *Journal of Business Research,* vol. 139, pp. 69-80, 2022/02/01/ 2022, doi: 10.1016/j.jbusres.2021.09.025.

[3] A. Aghili Ashtiani, A. Talooei Ashlaghi, and M. R. Motadel, "A model for analyzing the ecosystem of the Internet of Things business model in the field of rehabilitation in Iran using structural equation modeling," *Journal of Rehabilitation Medicine,* vol. 11, no. 257, pp. 656-677, 2022, doi: 10.32598/SJRM.11.4.13.

[4] H. R. Yazdani, B. Sohrabi, and M. Jalilian, "Quality indicators affecting the evaluation of Internet of Things business models based on big data analysis in smart cities," *New Research in Decision Making,* vol. 6, no. 2, pp. 125-154, 2021.

[5] S. Neethirajan, "Artificial intelligence and sensor technologies in dairy livestock export: charting a digital transformation," *Sensors,* vol. 23, no. 16, p. 7045, 2023, doi: 10.3390/s23167045.

[6] T. Hakanen, M. Antikainen, P. Pussinen, and M. Muikku, "Boosting service export: a roadmap for IoT-enabled business models," in *ISPIM Innovation Symposium*, 2015, p. 1.

[7] L. Martí and R. Puertas, "The importance of export logistics and trade costs in emerging economies," *Maritime Economics & Logistics,* vol. 19, pp. 315-333, 2017, doi: 10.1057/mel.2015.31.

[8] Y. Al-Hadhrami, N. Al-Hadhrami, and F. K. Hussain, "Data Exportation Framework for IoT Simulation Based Devices," in *Advances in Networked-based Information Systems: The 22nd International Conference on Network-Based Information Systems (NBiS-2019)*, 2020: Springer International Publishing, pp. 212-222, doi: 10.1007/978-3-030-29029-0_20.

[9] M. Razmi Shandi, Y. Norouzi, and M. Alipour Hafezi, "A conceptual model for the application of the Internet of Things in the new services of digital libraries in Iran," *Journal of Information Processing and Management Research,* vol. 25, no. 3, pp. 693-728, 2020.

[10] M. R. Sultanuzzaman, H. Fan, E. A. Mohamued, M. I. Hossain, and M. A. Islam, "Effects of export and technology on economic growth: Selected emerging Asian economies," *Economic Research-Ekonomska istraživanja,* vol. 32, no. 1, pp. 2515-2531, 2019, doi: 10.1080/1331677X.2019.1650656.

[11] H. Norouzi, S. Abdollahpour, S. Ganjali Vand, and S. G. Masoumi, "The impact of export market orientation on increasing exports in the dried fruit industry," *Journal of International Business Management,* vol. 1, no. 3, pp. 103-133, 2018.

[12] M. Y. Haddoud, N. Kock, A. K. E. Onjewu, V. Jafari-Sadeghi, and P. Jones, "Technology, innovation and SMEs' export intensity: Evidence from Morocco," *Technological Forecasting and Social Change,* vol. 191, p. 122475, 2023, doi: 10.1016/j.techfore.2023.122475.

[13] L. Zhang, I. K. Dabipi, and W. L. Brown Jr, *Internet of Things applications for agriculture Internet of things A to Z: technologies and applications*. 2018, pp. 507-528.

[14] N. Goumagias, J. Whalley, O. Dilaver, and J. Cunningham, "Making sense of the internet of things: a critical review of internet of things definitions between 2005 and 2019," *Internet Research,* vol. 31, no. 5, pp. 1583-1610, 2021, doi: 10.1108/INTR-01-2020-0013.

[15] L. Rahimi Nasab, H. Vazifeh Doost, and K. Hamadi, "The impact of IoT management as an environmentally friendly technology on the expansion and improvement of trade," *Environmental Science and Technology,* vol. 24, no. 4, pp. 61-72, 2022.

[16] M. Gharekhani and S. E. S. Pour Hashimi, "Investigating the factors affecting the acceptance of the Internet of Things in the insurance industry," *Insurance Research Journal,* vol. 37, no. 1, pp. 105-144, 2022.

[17] A. A. Farahmand, R. Radfar, A. Pour Ebrahimi, and M. Sharifi, "Explaining the relationships between the dimensions and indicators of the acceptance model of Internet of Things technologies in smart business," *Business Management Quarterly,* vol. 12, no. 48, pp. 233-253, 2020.

[18] S. Samadzad, "Investigating the Impact of the Internet of Things on the Probability of Entry in Export Market," pp. 167-188, 2024, doi: 10.4018/979-8-3693-0210-1.ch010.

[19] S. Cao, "A novel optimal selection algorithm for agricultural trade export in blockchain-enabled Internet of Things," *Wireless Communications and Mobile Computing,* vol. 2021, pp. 1-10, 2021, doi: 10.1155/2021/6646398.

[20] I. A. Magomedov, A. M. Bagov, and A. L. Zolkin, "Internet of things: future business," in *European Proceedings of Social and Behavioural Sciences*, 2020, doi: 10.15405/epsbs.2020.10.03.62.

[21] C. Falkenreck and R. Wagner, "The Internet of Things-Chance and challenge in industrial business relationships," *Industrial Marketing Management,* vol. 66, no. 10, pp. 181-195, 2017, doi: 10.1016/j.indmarman.2017.08.007.