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Article

The Impact of Logistics Systems on Improving Water Distribution Efficiency and Service Quality for Rafa Water Company in Makkah Region

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Abstract: Logistics systems are considered one of the fundamental factors influencing the efficiency of service and procurement distribution within the supply chain. They encompass planning, implementation, and monitoring processes necessary to ensure the delivery of resources to beneficiaries at the right time and place and at the lowest possible cost. Accordingly, the research problem is defined as examining the impact of logistics systems on improving the efficiency of water distribution and service quality in Rawa Water Company in the Makkah Al-Mukarramah region, as well as identifying the level and various dimensions of this impact. The significance of this study lies in its contribution to enriching scientific literature in the field of logistics systems and water resource management by clarifying the role of these systems in enhancing water distribution efficiency and improving service quality. The study aims to measure the level of water distribution efficiency in Rawa Water Company and to determine the role of logistics systems in improving this efficiency. The study adopted the descriptive-analytical approach, and the population consisted of all administrative employees working in departments directly involved in or supporting decision-making within the company. A questionnaire was used as the primary data collection tool due to its suitability for the nature of the approach and its ability to provide accurate information. The findings revealed that logistics systems significantly contribute to reducing water loss, organizing operations, and accelerating service delivery. The study also recommended investing in modern technologies such as artificial intelligence and the Internet of Things to improve demand forecasting, reduce losses, and enhance operational efficiency, in addition to strengthening the technological infrastructure supporting the effective implementation of logistics systems within the company and raising awareness of the importance of logistics systems by promoting an organizational culture that emphasizes their role in improving service quality and overall performance.
Keywords: Logistics systems, improving water distribution efficiency, service quality, water company

1. Introduction

Logistics systems represent fundamental determinants influencing the efficiency of service distribution and procurement across the supply chain. These systems encompass the planning, implementation, and control of operations necessary to transport goods and resources from point of origin to end-consumer at the designated time, location, and optimal cost efficiency (Grigg, 2024). In the context of water services, logistics systems fulfill a critical role in ensuring water availability, driving effective distribution, and enhancing service quality delivered to consumers - thereby boosting stakeholder satisfaction and operational sustainability (Mala, 2018). Furthermore, Grigg (2024) demonstrates that integrated management of water distribution systems significantly improves network efficiency, mitigates Non-Revenue Water (NRW) losses, and elevates the overall standard of service delivered to the community.

Pursuant to Saudi Vision 2030, which emphasizes upgrading logistics infrastructure and optimizing supply chain efficiency through advanced technological adoption, the water sector emerges as a strategic pillar to guarantee service continuity and achieve target quality standards. Driven by rapid urban expansion across the Makkah Region, complex operational challenges have emerged regarding distribution, maintenance, and incident dispatch management (Saudi Vision 2030, 2023). Despite the strategic shift of the water company operating in the Makkah Region toward adopting advanced logistics management systems, questions persist regarding their tangible efficacy in driving substantive improvements in operational efficiency and service quality. Consequently, the research problem centers on empirical investigation and measurement of the actual impact that modern logistics systems exert on corporate operational performance and customer satisfaction levels.

2. Research Problem

Water utility companies face mounting operational challenges in maintaining efficient water distribution and ensuring high service quality for end-users. These issues stem from rapid population growth, urban expansion, and escalating water demand, further compounded by last-mile supply connections, maintenance, and incident dispatch response. Although Rafa Water Company in the Makkah Region has adopted modern logistics systems, the precise, empirically verified contribution of these systems toward enhancing water distribution efficiency and service quality remains unclear. As a result, the research problem addresses the critical need to investigate and quantify the impact of modern logistics systems on improving water distribution efficiency and service quality at Rafa Water Company in the Makkah Region.

3. Research Significance

The significance of this study lies in its contribution to enriching the academic literature within logistics systems and water resource management. By elucidating this pivotal role, this research addresses a distinct knowledge gap, particularly within the Saudi context. Practically, the findings offer strategic value to decision-makers at Rafa Water Company, provide actionable insights to refine logistics frameworks, optimize distribution mechanisms, and elevate service delivery. Ultimately, this supports operational performance efficiency, enhances stakeholder satisfaction, and fosters long-term water resource sustainability across the Makkah Region.

4. Research Objectives

1. To measure the level of water distribution efficiency at Rafa Water Company in the Makkah Region.
2. To determine the role of logistics systems in improving water distribution efficiency at Rafa Water Company in the Makkah Region.
3. To determine the role of logistics systems in improving service quality at Rafa Water Company in the Makkah Region.

5. Theoretical Framework

Logistics

The Kingdom of Saudi Arabia stands as a regional leader in logistics sector development, leveraging its strategic geographic location bridging three continents: Asia, Africa, and Europe. The State has placed paramount importance on advancing transport infrastructure, ports, airports, and expressways to transform the Kingdom into a global logistics hub in alignment with Saudi Vision 2030 targets (Saudi Vision 2030, 2020). The strategic weight of the logistics sector resides in its vital role in supporting international trade, facilitating freight movement, mitigating transport overheads, and maximizing supply chain efficiency—thereby enhancing the national economy's global competitiveness (Al-Saadi, 2021).

Substantial capital investments in maritime ports—as detailed by the Ministry of Transport and Logistics Services (2022)—such as Jeddah Islamic Port and King Abdulaziz Port in Dammam, alongside modern road network systems and railways, have significantly enhanced internal and external transport efficiency. Furthermore, the Kingdom is actively developing integrated logistics zones and deploying advanced digital systems for transport and inventory management. Consequently, the logistics sector represents an essential pillar supporting e-commerce, manufacturing industries, the food sector, energy, and other critical economic domains (Al-Saadi, 2021).

Concept of Logistics

Logistics denotes the seamless integration of transport and international trade to deliver required volumes within specified time frames to targeted locations at optimal cost efficiency. This is achieved by linking transport operations with ancillary functions—such as inventory management, packaging, branding, insurance, and banking operations—that collectively drive performance optimization, quality enhancement, and cost reduction by guaranteeing core parameters: flexibility, speed, and reliability (Rassa Hayat, 2017).

Operationally, **Logistics** is defined as *"the efficient and effective management of the flow and storage of goods, services, and related information from the raw material origin to the point of final consumption"* (Amina, 2020).

It is also defined as *"the art and science of managing the flow of goods, energy, information, and other resources—such as products, services, and human capital—from the point of production to the point of consumption"* (Wafa, 2019).

While definitions vary across academic literature, they converge on a unified core concept. The widely accepted consensus definition reads: *"The process of planning, implementing, and controlling the efficient, effective flow and storage of raw materials, in-process inventory, finished goods, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements"* (Rassa Hayat, 2017). On a global scale, **Global Logistics** represents an *"antecedent demand driven by supply-and-demand globalization, giving rise to highly complex global distribution networks that necessitate specialized logistical expertise to enable producers to service their markets efficiently, consistently, and at minimum cost"* (Wafa, 2019).

Importance of Logistics

The logistics services sector plays a pivotal economic role across both developed and developing nations, driving foreign direct investment (FDI), non-oil exports, and global market competitiveness. Its significance extends beyond its intrinsic industry boundaries; logistics serves as a critical foundational pillar for enterprises of all scales globally. A well-structured logistics framework actively minimizes operational waste, reduces inventory shrink, and lowers the total cost of goods produced.

Taxonomy of Logistics Operations

- **Supply Chains**: Interconnected networks spanning from raw material extraction to final end-user delivery, linking multiple operational functions and enterprise entities. Supply chains encompass all activities associated with the flow and transformation of goods from raw states to end-consumers, accompanied by bidirectional information flows to capture a sustainable competitive advantage. They dynamically structure logistics services—such as transport, warehousing, loading, and discharge—to bridge spatial disparities across operational zones, requiring fully integrated logistics management strategies.
- **Reverse Logistics**: The backward flow of surplus goods, capital equipment, information, and funds via a reverse supply chain initiating from the consumer back to the supplier. Its primary objective is capturing logistics value-add through recycling, re-use, and feedback loop utilization, while fulfilling regulatory environmental objectives (Rushton, 2006).
- **Logistics Sprawl**: The spatial migration of warehousing facilities and freight terminals from urban cores toward suburban peripheries. Driven by expanded footprint requirements and soaring inner-city real estate prices, this phenomenon introduces challenges such as increased haulage distances, heightened vehicular emissions, and inflated transport costs (Rodrigue et al., 2024).

- **Materials Management & Physical Distribution**: Logistics operations bifurcate into **Materials Management**—governing inbound supply flows from raw material origins to production sites (comprising demand forecasting, master production scheduling, procurement, inventory control, and transport)—and **Physical Distribution**, which manages outbound flows to final demand centers (Hashish, 2025).

Rafa Industrial Company

Water constitutes the most critical natural resource on Earth, vital to all living organisms and essential for human survival. Recognizing healthy water as a cornerstone of human vitality and development, Rafa Water Company leads in the bottled pure water industry from source to consumer. The company aims to provide consumers with pure drinking water compliant with rigorous quality standards. To deliver uncompromised quality, Rafa established its bottling plant within a protected, pollution-free zone encompassing one of the cleanest natural groundwater sources in the Kingdom of Saudi Arabia.

As a prominent national entity in Saudi Arabia's packaged drinking water sector, Rafa Water Company has established its market presence through an uncompromising focus on health, purity, and standard compliance. Sourcing from a protected, contaminant-free aquifer grants its products superior purity and strengthens consumer trust. Rafa's strategic vision focuses on bottling leadership through innovative, sustainable operations, providing accessible, high-quality drinking water at equitable prices. Its corporate mission emphasizes constant market presence by delivering dependable products across all operational contexts and geographic locations (Rafa Company, 2024).

Water Distribution Efficiency

According to the Ministry of Environment, Water and Agriculture (2021), water distribution efficiency represents a crucial cornerstone of Saudi Arabia's resource management strategy, given the Kingdom's arid climate and escalating water demands across domestic, industrial, and agricultural sectors. In recent years, the Kingdom has developed an integrated framework designed to optimize distribution efficiency and curb water loss by modernizing transmission infrastructure, implementing smart monitoring technologies, and enforcing strict quality benchmarks.

The State has adopted strategic initiatives prioritizing seawater desalination as its primary supply source, while concurrently reinforcing distribution network infrastructure to guarantee reliable, sustainable supply. Key initiatives—including leakage mitigation, pumping station efficiency upgrades, and smart meter rollouts—have significantly driven distribution performance and customer service standards. These measures directly advance Saudi Vision 2030 objectives regarding efficient natural resource management and long-term sustainability (Rafa Company, 2024).

Water Distribution Efficiency in Saudi Arabia: Significance, Benefits, and Network Coverage

Optimizing water distribution efficiency is paramount to managing Saudi Arabia's water resources under hyper-arid climatic conditions and natural supply scarcity. Improving distribution efficiency guarantees sustainable supply delivery to residential populations and commercial sectors while curbing Non-Revenue Water (NRW) losses caused by pipe leakage or aged infrastructure. Furthermore, efficient distribution raises service delivery standards, reduces operational overheads, and optimizes the consumption of desalinated water—the Kingdom's primary water source (Salman, 2020).

Key benefits of optimized water distribution efficiency include:

- **Non-Revenue Water (NRW) Reduction**: Achieved by replacing aging pipe networks and deploying active acoustic leak detection systems.
- **Supply Reliability**: Enhanced through upgraded booster pumping stations and strategic bulk storage reservoirs.
- **Environmental & Operational Sustainability**: Realized by relieving production stress on desalination plants and fragile groundwater aquifers.

- **Water Quality Assurance**: Maintained through real-time digital telemetry networks and smart water meters.
- **Operational Cost Optimization**: Driven by energy efficiency gains and reduced volumetric water waste (Salman, 2020).

Water distribution networks cover the vast majority of Saudi Arabia's regions. Utility authorities actively upgrade infrastructure across the Central Region (Riyadh), Western Region (Makkah and Madinah), Eastern Province, and the Northern and Southern regions. Distribution challenges vary regionally based on population density, topographical terrain, and distance from coastal desalination facilities. Mega-projects—including high-capacity desalinated water transmission pipelines, strategic mega-reservoirs, and automated smart metering systems—have substantially elevated network distribution performance and customer service quality nationwide.

These comprehensive initiatives align directly with Saudi Vision 2030 goals to optimize natural resource utilization, ensure water security for future generations, and enhance urban quality of life across Saudi cities.

6. Research Methodology

Research Type & Approach

This study adopts a **descriptive-analytical approach**, selected for its suitableness for research aimed at investigating the impact of logistics systems on improving water distribution efficiency and service quality. This method relies on collecting field data from the target population and subjecting it to statistical analysis to derive objective findings that explain the relationships between the study variables (Al-Harbi, 2021).

Target Population and Sample

Target Population:

The study population comprises all administrative staff operating within departments directly involved in decision-making or decision-support functions at Rafa Water Company in Makkah. This encompasses Human Resources, Procurement and Contracts, Quality and Performance, and Information Technology (as a system-supporting entity). Based on internal corporate statistics for 2025, the target population totals approximately 50 administrative personnel.

Study Sample:

A simple random sample was drawn from the administrative staff working in decision-making and decision-support departments at Rafa Water Company in Makkah. The final sample size comprised $N = 50$ respondents, representing an acceptable proportion of the study population to ensure adequate statistical representation and allow for a reasonable degree of generalization.

Data Collection Instruments

A survey questionnaire served as the primary data collection instrument, owing to its alignment with the descriptive-analytical approach and its effectiveness in gathering precise data from sample respondents. The questionnaire was structured around the study's objectives and core dimensions to measure respondents' perceptions regarding the impact of logistics systems on water distribution efficiency and service quality.

A closed-ended electronic questionnaire was administered, structured into two main sections:

- **Section One:** Captured demographic variables (Gender, Age, Educational Qualification, Years of Administrative Experience, and Job Title).
- **Section Two:** Comprised statements categorized under three primary axes designed to measure the study variables using a **5-point Likert Scale** (*Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree*).

Numerical values assigned to each response option for statistical analysis and interpretation are detailed in **Table 1**.

Table 1: 5-Point Likert Scale Scoring Matrix

Response Category	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Assigned Score	5	4	3	2	1

7. Data Analysis and Hypothesis Testing

Descriptive Analysis: Demographic Data

1. Gender

Table 2: Sample Distribution by Gender

Category	**Frequency (f)**	**Percentage (%)**
Male	40	80%
Female	10	20%
Total	**50**	**100%**

Data in Table 2 (and Figure 1) indicate that the majority of sample respondents are male ($n = 40$, 80%), whereas female respondents account for 20% ($n = 10$). This distribution reflects a higher male representation within the sample, which aligns with prevailing workforce demographics in logistics and water distribution operations.

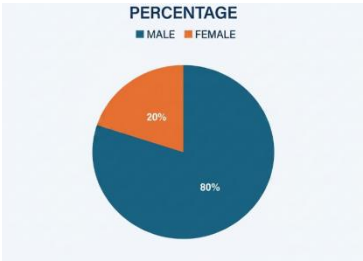

Figure (1) Gender Data Analysis

2. Age

Table 3: Sample Distribution by Age Group

Age Category	**Frequency (f)**	**Percentage (%)**
Under 25 years	4	8%
25–34 years	19	38%
35–44 years	26	52%
45 years and above	1	2%
Total	**50**	**100%**

Results in Table 3 (and Figure 2) show that the **35–44 age group** constitutes the largest proportion of respondents ($n = 26$, 52%), followed by the **25–34 age group** ($n = 19$, 38%). Respondents under 25 years account for 8%, while those aged 45 and above represent 2%.

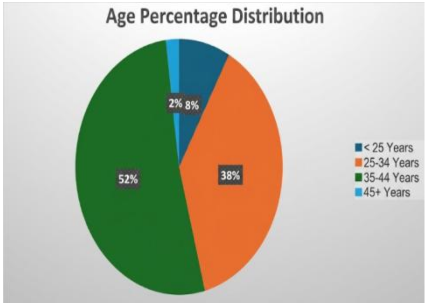

Figure (2) Age Group Based Dintra Analysis

3. Educational Level

Table 4: Sample Distribution by Educational Attainment

Educational Level	Frequency (f)	Percentage (%)
High School	2	4%
Diploma	8	16%
Bachelor’s Degree	37	74%
Master’s Degree	3	6%
Doctorate (Ph.D.)	0	0%
Total	**50**	**100%**

Results in Table 4 (and Figure 3) reveal that most respondents hold a **Bachelor’s degree** ($n = 37$, 74%), indicating that tertiary education is the predominant qualification among staff. Diploma holders represent 16% ($n = 8$), Master's degree holders account for 6% ($n = 3$), high school graduates represent 4%, and no respondents held a doctorate.

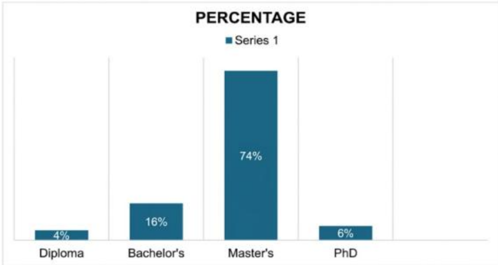

Figure (3) Data Analysis Based on Educational Level

4. Years of Administrative Experience

Table 5: Sample Distribution by Years of Administrative Experience

Experience Category	Frequency (f)	Percentage (%)
Under 3 years	4	8%
3–5 years	17	34%
6–10 years	27	54%
Over 10 years	2	4%
Total	**50**	**100%**

Results in Table 5 (and Figure 4) demonstrate that the majority of respondents possess **6–10 years of experience** ($n = 27$, 54%), followed by those with **3–5 years** ($n = 17$, 34%). Those with less than 3 years account for 8%, and those with over 10 years represent 4%. This profile indicates a moderate-to-high level of professional experience, enhancing respondents' ability to accurately evaluate logistics operations based on direct exposure to daily water distribution workflows.

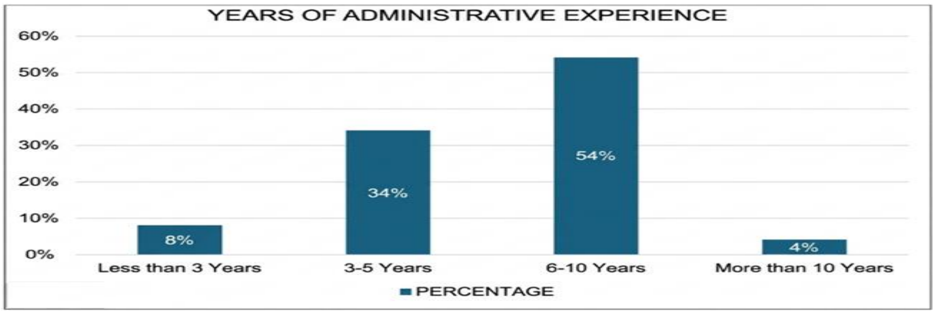

Figure (4) Data Analysis Based on Years of Administrative Experience

5. Job Title

Table 6: Sample Distribution by Organizational Level / Job Title

Organizational Designation	Frequency (f)	Percentage (%)
Senior Management	3	6%
Administrative Employee	32	64%
Supervisor	7	14%
Department Manager	8	16%
Total	**50**	**100%**

Data in Table 6 (and Figure 5) show that administrative staff form the majority of respondents ($n = 32$, 64%), representing the operational cadre interacting directly with daily systems and protocols. Department managers represent 16% ($n = 8$), supervisors account for 14% ($n = 7$), and senior management represents 6% ($n = 3$). This organizational spread ensures balanced input across operational and managerial tiers.

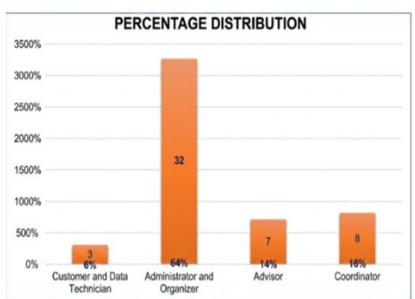

Figure (5) Analysis of Data by Job Title

Analysis of Questionnaire Axes

Table 7: Descriptive Response Frequencies Across Survey Axes

Item	Evaluation Statements	Evaluation Levels

1	Logistics systems contribute to organizing water distribution processes more efficiently.	—	—	—	10%	90%
2	Logistics systems help reduce water loss during distribution operations.	—	—	—	10%	90%
3	Logistics systems contribute to enhancing the delivery speed of water to consumers.	—	—	—	18%	82%
4	Logistics systems support effective distribution route planning.	—	—	2%	26%	72%
5	Logistics systems contribute to optimizing available resource utilization.	—	—	2%	22%	74%
Axis 2	**Impact of Logistics Systems on Provided Service Quality**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	Logistics systems contribute to elevating the quality of water services provided.	—	—	2%	14%	82%
2	Logistics systems help minimize operational errors in service delivery.	—	—	1%	22%	76%

3	Logistics systems contribute to boosting customer service satisfaction levels.	—	—	6%	10%	84%
4	Logistics systems support rapid dispatch response to fault and breakdown reports.	—	—	2%	12%	86%
5	Logistics systems contribute to maintaining uninterrupted service continuity.	—	—	2%	8.2%	89.8%
Axis 3	**Efficiency of Logistics System Implementation within the Company**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	The company possesses adequate IT infrastructure to deploy logistics systems.	—	—	1%	1%	96%
2	Staff receive sufficient training on operating logistics systems.	—	—	—	16.3%	83.7%
3	Executive management supports the implementation and development of logistics systems.	—	—	—	16.3%	83.7%
4	The company faces limited operational challenges when implementing	—	—	2%	16.3%	81.6%

	logistics systems.					

Combined results from Table 7 indicate high overall agreement regarding the central role played by logistics systems in water distribution. Data show strong consensus on their capacity to optimize distribution efficiency by streamlining workflows, mitigating non-revenue water losses, and accelerating delivery. Service quality metrics similarly reflect positive responses regarding fault response speed, uninterrupted supply continuity, and overall end-user satisfaction. Additionally, findings confirm robust IT infrastructure within the company, while highlighting areas for targeted optimization, particularly in staff technical training and operational contingency management.

Detailed Analysis — Axis One: Role of Logistics Systems in Improving Water Distribution Efficiency

Table 8: Descriptive Statistics — Axis One

Item	Statement	Mean (μ)	Standard Deviation (σ)
1	Logistics systems contribute to organizing water distribution processes more efficiently.	3.90	0.303
2	Logistics systems help reduce water loss during distribution operations.	3.90	0.303
3	Logistics systems contribute to enhancing the delivery speed of water to consumers.	3.82	0.388
4	Logistics systems support effective distribution route planning.	3.70	0.505
5	Logistics systems contribute to optimizing available resource utilization.	3.70	0.544
Overall	**Overall Axis Mean**	**3.80**	—

Statistical analysis yields an overall grand mean of $\mu = 3.80$ for Axis One, demonstrating a high level of agreement regarding the pivotal role of logistics systems in enhancing water distribution efficiency. The highest individual mean scores ($\mu = 3.90, \sigma = 0.303$) were recorded for items pertaining to operational organization and non-revenue water loss mitigation, reflecting strong consensus. Remaining items similarly demonstrated high mean values ($\mu = 3.70 - 3.82$), with slightly higher variance observed in route planning and resource allocation metrics. Overall, these findings substantiate the importance of integrated logistics management in driving water distribution performance across utility operations.

Axis Two: Impact of Logistics Systems on Service Quality

Table 9: Descriptive Statistics — Axis Two

Item	Statement	Mean (μ)	Standard Deviation (σ)
1	Logistics systems contribute to elevating the	3.78	0.507

	quality of water services provided.		
2	Logistics systems help minimize operational errors in service delivery.	3.74	0.487
3	Logistics systems contribute to boosting customer service satisfaction levels.	3.78	0.545
4	Logistics systems support rapid dispatch response to fault and breakdown reports.	3.84	0.422
5	Logistics systems contribute to maintaining uninterrupted service continuity.	3.88	0.385
Overall	**Overall Axis Mean**	**3.80**	—

Descriptive analysis for Axis Two yields an overall grand mean of $\mu = 3.80$, reflecting a high level of agreement regarding the positive impact of logistics systems on service quality. The highest mean rating was observed for Item 5, *"Logistics systems contribute to maintaining uninterrupted service continuity"* ($\mu = 3.88, \sigma = 0.385$), followed closely by Item 4, *"Logistics systems support rapid dispatch response to fault and breakdown reports"* ($\mu = 3.84, \sigma = 0.422$). These results signify broad consensus regarding the essential role logistics play in ensuring continuous supply and swift incident resolution. The remaining items similarly demonstrated high mean values ranging from $\mu = 3.74$ to $\mu = 3.78$ with minimal variance, further substantiating the constructive role of logistics frameworks in optimizing service delivery and bolstering customer satisfaction.

Axis Three: Implementation Efficiency of Logistics Systems within the Company

Table 10: Descriptive Statistics — Axis Three

Item	**Statement**	**Mean (μ)**	**Standard Deviation (σ)**
1	The company possesses adequate IT infrastructure to deploy logistics systems.	3.94	0.314
2	Staff receive sufficient training on operating logistics systems.	3.84	0.370
3	Executive management supports the implementation and development of logistics systems.	3.82	0.438
4	The company faces limited operational challenges when implementing logistics systems.	3.76	0.657

Overall	**Overall Axis Mean**	**3.84**	—

Descriptive statistics for Axis Three indicate an overall grand mean of $\mu = 3.84$, indicating a high level of respondent agreement concerning the company's organizational and technological readiness to implement logistics systems. The highest mean score was recorded for Item 1, *"The company possesses adequate IT infrastructure to deploy logistics systems"* ($\mu = 3.94, \sigma = 0.314$), pointing to robust consensus regarding technological infrastructure preparedness. This was followed by Item 2, *"Staff receive sufficient training on operating logistics systems"* ($\mu = 3.84, \sigma = 0.370$). Conversely, Item 4, *"The company faces limited operational challenges when implementing logistics systems"*, yielded the lowest mean within this axis ($\mu = 3.76$) alongside a noticeably higher standard deviation ($\sigma = 0.657$), indicating greater variance in respondents' perceptions regarding the extent of operational deployment challenges.

8. Results, Recommendations

Presentation and Discussion of Findings

- **Strong Positive Correlation**: A strong, statistically significant positive correlation ($r = 0.894$) was established between the implementation of logistics systems and the optimization of water distribution efficiency.
- **Direct Operational Contributions**: Logistics systems contribute directly to mitigating Non-Revenue Water (NRW) losses, streamlining distribution workflows, and accelerating service delivery lead times. This finding aligns with Ahmed (2026), whose study titled *"The Logistical Role of Qatari Ports in Enhancing Competitiveness"* demonstrated that logistics system efficiency directly enhances operational organization, minimizes waste, and elevates overall operational performance, thereby accelerating service delivery and strengthening operational sustainability.
- **Core Pillar of Service Quality**: Empirical findings confirm that logistics systems serve as a critical cornerstone for enhancing service quality through rapid incident dispatch response and guaranteed service continuity. This result corroborates Palomero-González et al. (2021), who evaluated water distribution network sector efficiency and established that logistics system effectiveness directly drives performance efficiency and service quality by accelerating fault response and sustaining continuous operations, thereby enhancing service reliability and infrastructure sustainability.
- **Technological Infrastructure Readiness**: Rafa Water Company possesses a robust IT infrastructure that effectively supports the deployment and operation of advanced logistics management systems.

9. Conclusion

- The statistical results demonstrate broad consensus among respondents regarding the pivotal role of logistics systems across the water distribution sector.
- Empirical data prove that logistics systems directly optimize water distribution efficiency by streamlining operational workflows, minimizing physical water loss, and accelerating last-mile delivery.
- Findings confirm that logistics systems represent an essential element in boosting service quality by driving rapid incident response times, ensuring uninterrupted service continuity, and increasing end-user satisfaction.
- Empirical evidence indicates that the company maintains a solid technological foundation supporting the efficient and effective execution of logistics operations.
- Despite overall high readiness, specific operational domains require further development—notably targeted employee training programs and mitigating operational deployment challenges.

- Capital investment in modern logistics systems constitutes a fundamental strategic pillar for driving operational performance and service quality in the water sector.
- Clear opportunities exist to enhance system efficiency by expanding human resource capabilities and establishing robust monitoring and evaluation mechanisms to maintain sustainable improvements.

10. Recommendations

6. **Strengthen Training and Development Programs**: Formulate and implement continuous professional development programs to elevate administrative and operational staff competency in operating advanced logistics systems, while sharpening their technical and managerial skill sets.
7. **Develop Performance Monitoring and Evaluation Frameworks**: Establish a periodic supervisory and auditing framework to measure logistics system performance, identify operational bottlenecks, and pinpoint structural strengths, thereby ensuring continuous workflow optimization.
8. **Invest in Emerging Smart Technologies**: Expand the integration of Industry 4.0 technologies—specifically Artificial Intelligence (AI) algorithms and Internet of Things (IoT) telemetry—to enhance demand forecasting accuracy, reduce volumetric water waste, and optimize overall operational throughput.
9. **Mitigate Operational Implementation Challenges**: Develop proactive operational strategies to address deployment bottlenecks identified in the study—such as training deficits or inter-departmental misalignments—ensuring seamless system execution.
10. **Enhance Inter-Departmental Integration**: Foster cross-functional integration and improve communication channels between operational units and logistics divisions to align workflows and expedite administrative and field-level decision-making.
11. **Promote Logistics Awareness and Organizational Culture**: Cultivate an enterprise-wide organizational culture that underscores the strategic role of logistics systems in driving service quality and overall corporate performance.

REFERENCES

Arabic References

1. Ahmed, A. M. S. M. (2026). The logistical role of Qatari ports in enhancing competitiveness: A case study of Hamad Port (2017–2024). *Journal of Humanities and Natural Sciences*, 7(1), 18. https://doi.org/10.53796/hnsj71/18
2. Bourtal, A. (2020). Activating dry port logistics: Door-to-door transport system. *Scientific Journal of Sovereignty and Globalization*, Yahia Fares University of Medea, Algeria.
3. El-Khouly, M. (2018). *Research methods in art education*. Alam Al-Kutub.
4. El-Enezi, S. M. F., & Ibrahim, M. A. (2025). The importance of implementing logistics at Jeddah Port. *Scientific Journal of Commercial and Environmental Studies*, 16(2), 2811–2832. http://search.mandumah.com/Record/1622504
5. Hussein, R. J., & Abou-El-Seoud, T. Z. A. (2014). The role of spatial dimension for water and energy distribution of comprehensive rural development (Case study: Fayoum City Region). *Journal of Urban Research*, 14(1), 25–38. https://doi.org/10.21608/jur.2014.92460
6. Hashish, M. A. A. A. (2025). Geographical dimensions of logistics services: A study in transport geography. *Journal of the Faculty of Arts, Port Said University*, 33(33), 279–332. https://doi.org/10.21608/jfpsu.2025.384972.1439
7. Ibrahim, M. M. A. (2020). The experience of the Arab Academy for Science, Technology and Maritime Transport in qualifying Arab cadres in logistics and international transport under global changes. Faculty of Commerce, Mansoura University.
8. Al-Harbi, A. H. (2021). The use of the quasi-experimental approach in educational media studies: A critical analytical view (2008–2020). *Journal of Research in Specific Education Fields*, 7(36), 1–32. https://journals.ekb.eg/article_171973.html
9. Rassa Hayat, & Faqih, A. H. (2017). The reality of logistics in Arab world ports. *Al-Mi'yar*, (18).
10. Rafa Water Company. (2024). *Rafa Water*. https://rafawater.com
11. Saudi Vision 2030. (2020). *National Industrial Development and Logistics Program (NIDLP)*. Council of Economic and Development Affairs.
12. Saudi Vision 2030. (2023). *Saudi Vision 2030 Official Portal*. https://www.vision2030.gov.sa/ar/

13. Abdel-Kareem, K. A., Al-Suhaibi, S. H., Ibrahim, M. A., & Hafez, A. I. A. (2023). The extent of applicability of the Advanced Cargo Information (ACI) system on improving the performance of King Abdulaziz Port in Dammam, KSA: Lessons learned from the Egyptian experience. *Scientific Journal of Commercial and Environmental Studies*, 14(3), 545–607. http://search.mandumah.com/Record/1444651
14. Obeidat, D., Adas, A., & Abdel-Haq, K. (2020). *Scientific research: Concept, tools, and methods* (20th ed.). Dar Al-Fikr Publishers and Distributors.
15. Wafa, M. H. (2019). Logistics services: Concept and development. *Humanities, Peer-Reviewed Scientific Dissertation Journal*, 4(5).
16. Ministry of Environment, Water and Agriculture. (2021). *National Water Report: Water resource management and distribution efficiency enhancement in Saudi Arabia*. Ministry of Environment, Water and Agriculture.
17. Ministry of Transport and Logistics Services. (2022). *Logistics sector report in the Kingdom of Saudi Arabia*. Ministry of Transport and Logistics Services.

English References

18. Al-Saadi, A. (2021). Logistics performance and supply chain development in Saudi Arabia: Opportunities and challenges. *Journal of Transport and Supply Chain Management*, 15(1), 1–12.
19. Grigg, N. S. (2024). Water distribution systems: Integrated approaches for effective utility management. *Water*, 16(4), 524. https://doi.org/10.3390/w16040524
20. Mala-Jetmarova, H., Sultanova, N., & Savic, D. (2018). Lost in optimisation of water distribution systems? A literature review of system design. *Water*, 10(3), 307. https://doi.org/10.3390/w10030307
21. Palomero-González, J. A., Almenar-Llongo, V., & Fuentes-Pascual, R. (2021). Evaluating the efficiency of water distribution network sectors using the DEA-Weight Russell directional distance model: The case of the city of Valencia (Spain). *Sustainability*, 13(19), 10546. https://doi.org/10.3390/su131910546
22. Salman, A., & Al-Omran, A. (2020). Water resources management and distribution efficiency in Saudi Arabia. *Arabian Journal of Geosciences*, 13(12), 1–12. https://doi.org/10.1007/s12517-020-05510-9
23. Stewart, R. A., Willis, R., Giurco, D., Panuwatwanich, K., & Capati, G. (2010). Smart water metering and intelligent water networks: A review. *Water*, 2(4), 809–834. https://doi.org/10.3390/w2040809