Evaluating the Impact of ICT Quality on User Satisfaction in Higher Education Administration

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***Abstract*—Digital transformation presents significant challenges for public institutions in conflict-affected developing countries, such as Yemen, particularly regarding Information and Communication Technology (ICT) quality and its impact on employee satisfaction. This study examines the influence of ICT quality, encompassing system, information, and service dimensions, on user satisfaction among administrative staff at Yemen's Ministry of Higher Education. Employing a quantitative research design, data were gathered from 291 staff members using a structured questionnaire. Rigorous psychometric assessments confirmed the reliability and convergent validity of the constructs (e.g., Cronbach's alpha > 0.70, Composite Reliability > 0.70, AVE > 0.50). Empirical analysis revealed a statistically significant positive correlation between ICT quality dimensions and user satisfaction. While Overall Quality (*M* = 3.876, *SD* = 0.209) was perceived highly, User Satisfaction (*M* = 3.267, *SD* = 0.692) showed higher variability. These results highlight the critical need for targeted training and orientation programs, especially for new employees, to improve ICT system utilization. Such initiatives are essential for aligning individual roles with organizational objectives, thereby enhancing overall user satisfaction and supporting seamless ICT integration within the ministry.**

***Keywords*—Information and Communication Technology (ICT) quality, user satisfaction, higher education administration, information systems, employee training**

I. Introduction

Recent global research highlights the critical role of high-quality Information and Communication Technologies (ICT) in enhancing organizational efficiency and improving user satisfaction, particularly within educational institutions in developing countries [1, 2].

Organizations continue to invest heavily in technology to collect, store, and process large volumes of data. However, they often struggle to convert this data into actionable insights for improved business operations, informed decision-making, and competitive advantages [3].

The ICT quality is defined as the perceived excellence of information and communication technology resources, including system reliability, information accuracy, timeliness, and responsiveness of support services. User satisfaction refers to the degree to which employees' expectations and needs are met by the ICT systems and services provided for administrative and academic purposes. In this context, the performance impact of Information and Communication Technology (ICT) is widely regarded as a crucial factor in the competitiveness of organizations in the emerging global market.

Recent global research has highlighted the crucial role of high-quality ICT systems in enhancing organizational efficiency and user satisfaction, particularly in educational institutions in countries such as Malaysia, Indonesia, and Jordan [4]. However, few studies have explored regions experiencing infrastructural constraints and political instability, such as Yemen. By drawing on current international literature, this study situates local findings within contemporary global trends, addressing calls for more diversified geographical evidence.

The effective use and implementation of ICTs have become a significant area of scientific research, demonstrating their necessity for achieving positive outcomes such as productivity growth, organizational expansion, efficiency, effectiveness, and competitiveness across various organizations [5]. The impact of ICT on organizational performance is recognized as a key factor for competitiveness in the global market [6].

In regions experiencing infrastructural constraints and political instability, such as Yemen, the role of ICT in enhancing organizational efficiency and user satisfaction remains underexplored [7]. Research on cancer in conflict-affected settings in the Middle East and North Africa (MENA) region, including Yemen, highlights a disparity between the growing cancer burden and research output, with insufficient training in data analysis and research design as significant barriers [8].

The ongoing armed conflict in Ukraine, for instance, has demonstrated the extensive health, social, and economic consequences for the civilian population, emphasizing the need for comprehensive mental health system reform [9].

Research in conflict-affected contexts faces considerable ethical challenges, including increased insecurity and the vulnerability of participants, as well as epistemological and methodological difficulties in acquiring knowledge from individuals who may be traumatized or distrustful [10].

The digitalization of sensitive research in these areas, particularly during crises like COVID-19, risks oversimplifying complex social phenomena and omitting crucial aspects of lived experiences related to violence or peacebuilding [11]. Moreover, limited internet access and unreliable electricity supply in rural areas of many

developing countries present major issues for online education, especially in sectors such as agriculture [12].

Yemen's state administrative system continues to face significant structural and managerial challenges, resulting in a workplace environment that lacks efficiency and effectiveness in service delivery [13, 14]. Furthermore, the absence of a clearly articulated and standalone national Information and Communication Technology (ICT) policy has hindered progress, leaving Yemen lagging in ICT adoption and facing persistent implementation challenges [15].

This study offers a valuable contribution by extending established information systems theories to the critically under-researched context of higher education administration within a conflict-affected nation. Focusing on Yemen's Ministry of Higher Education, we provide a nuanced analysis of the relationship between ICT quality and user satisfaction amidst acute infrastructural and organizational challenges. Our findings yield a focused and empirically driven framework for enhancing administrative functions in environments where conventional models may prove inadequate, thereby advancing theoretical understanding and providing actionable insights for policy and practice interventions.

II. Literature Review

The Republic of Yemen has developed an Information and Communication Technology (ICT) policy that aims to implement ICT projects through strategic plans [14]. Despite being one of the least developed countries worldwide, Yemen has outlined various ICT projects to achieve its policy goals [15]. However, Yemen's government has not clearly articulated its ICT policy as a standalone component within its broader national policy. This absence of a well-defined and organized ICT policy has caused Yemen to lag in ICT adoption and face numerous challenges [16].

While some policies and strategies have been approved by the Yemeni government to support education in public and private institutions, a comprehensive, explicit ICT policy remains lacking. Studies from 2019 to 2023 indicate that Yemen lacks an adequate governance framework for innovation and ICT, which is essential for development. Additionally, the country's strategic plans for reconstruction and development are still evolving within a framework of sustainable development policies [17]. Yemen's higher education sector faces numerous barriers to ICT adoption, including poorly developed infrastructure, insufficient ICT equipment, and unreliable connectivity [18]. These difficulties are compounded by broader structural constraints and sociopolitical instability.

Specifically, a significant portion of the Yemeni population lacks personal laptops, with approximately 30% of participants in a study reporting no personal laptops. Higher Education Institutions (HEIs) in Yemen also face shortages in smart classrooms, consistent electricity, internet access, administrative frameworks, and scientific research incentives, making them unsuitable for technology-based education [18].

Research from 2019 to 2023 emphasizes that HEIs in developing countries, including Yemen, lag behind their Western counterparts in technology adoption for research, teaching, and collaboration [19]. Higher education in Yemen is a labor-intensive sector, where organizational performance is closely related to staff capacity and engagement. Civil unrest and political instability have contributed to a lack of organizational commitment among academic staff, hindering improvements in service quality and the adoption of new technologies [20].

The literature consistently associates improved service quality in higher education with environments that encourage staff engagement and organizational commitment [14]. Employee disengagement has been shown to adversely impact organizational performance and weaken overall service quality in higher education.

A lack of organizational commitment is often associated with poor service outcomes [21]. Studies from 2019 to 2023 further suggest that job satisfaction has a significant positive effect on organizational commitment and students' perception of service quality, with organizational commitment partially mediating this relationship [22].

While the DeLone and McLean model traditionally focuses on system, information, and service quality dimensions, recent research highlights the importance of contextual quality factors in developing nations. In Yemen's higher education context, two additional quality dimensions require consideration [23]:

Physical Infrastructure Quality encompasses the tangible technological foundation supporting ICT operations, including network reliability, hardware adequacy, laboratory facilities, and power supply stability. Research demonstrates that the quality of physical infrastructure significantly influences user satisfaction, particularly in resource-constrained environments where infrastructure limitations directly impact system accessibility and performance [24].

Institutional Culture Quality refers to the organizational environment's readiness for technology adoption, including digital literacy levels, change management practices, leadership support, and collaborative norms. Studies demonstrate that institutional culture moderates the relationship between technical quality and user satisfaction, with supportive cultures enhancing ICT effectiveness even when technical resources are limited [25].

Enhancing knowledge management capabilities, including updated technology, adequate structure, and supportive culture, can also improve service quality in HEIs through increased organizational commitment [26].

Moreover, e-leadership, organizational commitment, and service quality influence school performance, highlighting the importance of leadership in cultivating a committed and high-quality service environment [27].

III. Research Model and Hypotheses

This study develops a conceptual model (Fig. 1) based on the DeLone and McLean Information System (IS) Success Model to examine Information and Communication Technology (ICT) quality within higher-education administration in Yemen. ICT quality is defined through three first-order dimensions: System Quality (SQ), Information Quality (IQ), and Service Quality (ServQ). These dimensions together form the organization's overall ICT quality framework. The structural model uses a disaggregated approach, proposing each quality dimension as a direct

predictor of User Satisfaction (US).

Additionally, Infrastructure Quality (INFQ) and Institutional Culture Quality (ICQ) are included as key contextual factors. They are expected to have both direct and moderating effects on user satisfaction. The revised conceptual model (Fig. 1) clearly illustrates these relationships, with solid lines indicating direct effects and dashed lines representing moderating roles.

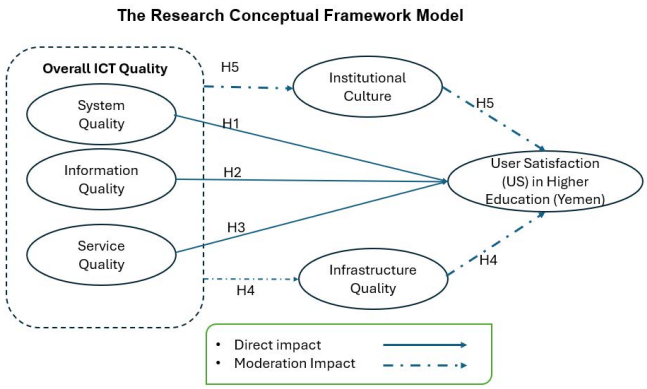

Fig. 1. Conceptual model.

A. Construct Definitions and Hypotheses

This research proposes a comprehensive model to examine the determinants of User Satisfaction (US) with Information and Communication Technology (ICT) services, extending established Information Systems Success frameworks.

The model is built upon five distinct quality dimensions, each theorized to directly and positively influence US:

1) System Quality (SQ): Perceived reliability and usability of the ICT system.
2) Information Quality (IQ): Perceived accuracy and relevance of the information output.
3) Service Quality (ServQ): Perceived competence and responsiveness of ICT support.
4) Infrastructure Quality (INFQ): Stability and adequacy of the physical and technical environment.
5) Institutional Culture Quality (ICQ): Organizational climate and leadership support for ICT.

In addition to these direct effects, the model introduces contextual contingency hypotheses (HM1, HM2), asserting that both Infrastructure Quality (INFQ) and Institutional Culture Quality (ICQ) positively moderate the association between Overall ICT Quality (OQ) and User Satisfaction (US). This approach offers a nuanced understanding of how organizational context increases or reduces the impact of core ICT quality on user perception.

B. Methodological and Estimation Considerations

For empirical analysis, Overall ICT Quality (OQ) is treated as a conceptual aggregate of SQ, IQ, and ServQ for moderation analysis and reporting purposes. In contrast, structural estimation employs the disaggregated direct paths (H1–H5) to reduce collinearity. Moderation analysis involves mean-centering OQ, INFQ, and ICQ, generating interaction terms (OQ×INFQ, OQ×ICQ), and estimating hierarchical models. Reliable inferences are ensured via 5000 bootstrap resamples and heteroskedasticity-consistent standard errors, with multicollinearity monitored (*VIF* < 5).

The primary estimation strategy applies multiple linear regression with standardized coefficients. Robustness checks may include PLS-SEM when OQ is treated as a second-order latent construct. The additional contribution of INFQ and ICQ will be examined using ΔR^2 and f^2 statistics. Practical control variables (e.g., tenure, department) will be included to improve interpretability and eliminate spurious associations.

This rigorous specification maintains the theoretical integrity of the D&M framework, explicitly integrating infrastructure and culture to provide policy-relevant guidance for improving user satisfaction in fragile higher-education environments.

IV. Methodology

This study utilizes quantitative research methods to objectively examine social behaviors and provide numerical data. Quantitative research focuses on objectifying facts and events to make them measurable, quantifiable, and expressible. The primary data collection method employed is a quantitative survey.

The data for this investigation will be sourced from Yemen's higher education system. The research population includes all staff members who use Information and Communication Technology (ICT) for communication with residents. Specifically, the study population comprises all employees working for Yemen's Ministry of Higher Education's ICT program.

The number of people or items that must be included in a sample drawn from a population for the data to be representative of the population is referred to as the sample size in statistics. The sample size is calculated using Krejcie and Morgan's Eq. (1) as follows:

$$\frac{S=X_2NP(1-p)}{d_2(N-1)+X_2P(1-P)} \quad (1)$$

X_2 is the table value of the chi-square for one degree of freedom at the acceptable confidence level (3.841), where s is the sample size required. Where d is the degree of precision represented as a proportion (0.05), P is the population proportion (which is assumed to be 0.50 as this would yield the maximum sample size), and N is the population size. There are 291 individuals in the sample. The relationship between the independent and dependent variables was examined in the study using SPSS.

To achieve the research objective, the respondent profile and the study's designated variables were described using descriptive statistical analysis. The mean and standard deviation are presented by the descriptive analysis. Prior to inferential testing, preliminary tests were conducted. The purpose of these tests was to assess the profile of the respondents, the validity and reliability of the model applied, and other tests such as convergent validity, normality, and reliability. The correlation test was subsequently utilized.

Respondents' Profile: The study used respondent profiles for two primary purposes: to identify the respondents' diverse backgrounds and to ensure that the respondents were selected randomly. As indicated in Table 1, 72.3% of the participants (n = 210) were classified as male, while 27.7% were classified as female (n = 81). The result indicates that the

majority of respondents were men.

Table 1. Gender distribution of respondents

Gender	Frequency (F)	Percentage (P)
M	210	72.3%
F	81	27.7%
T	291	100

M = Male, F = Femal, T = Total, F = Frequency, and P = Percent.

Also, Table 2 reveals that the age levels of the participants were divided into four categories, where 8.5% of the participants ranged between 17–25 years old (n = 24). Additionally, 16.4% of the participants ranged between 26–30 years old (n = 47), 22.6% ranged between 31–40 years old (n = 65), and finally, 52.5% of the participants were above 41 years old (n = 155). This confirms that most of the respondents are above 41 years old.

Table 2. Age distribution of respondents

Age Category (Years)	Frequency	Percent
17–25	24	8.5%
26–30 years	47	16.4%
31–40 years	65	22.6%
41 and above	155	52.5%
Total	291	100

Table 3 also reveals that the participants hold bachelor's degrees, with 49.1% (n = 142), while those holding master's degrees comprise 35.4% (n = 105), and for the Ph.D. level, there are 15.5% (n = 44). This confirms that all the participants were educated.

Table 3. Education level

Degree	Frequency	Percent
Bachelor	142	49.1%
Master	105	35.4%
PhD	44	15.5%
Total	291	100

Table 4 showed that 7.6% of participants had been with the company for 1–3 years (n = 22), 12.2% had been with the company for 4–6 years (n = 35), and 80.2% had been with the company for over seven years (n = 234). The majority of those surveyed had more than seven years of experience.

Table 4. Experience

Year	Frequency	Percent
1–3 years	22	7.6%
4–6 years	35	12.2%
More than 7 years	234	80.2%
Total	291	100

V. Result and Discussion

A. Normality Test

The primary data collection instrument was a structured questionnaire, carefully developed by adapting items from established and validated sources relevant to ICT and user satisfaction research. Each construct, including service quality and user satisfaction, was measured using multiple items rated on a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Content validity was ensured through the adaptation of items from previous literature. In contrast, the reliability and convergent validity of the questionnaire were rigorously confirmed using Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE) indices.

Prior to statistical analysis, the dataset underwent normality testing to determine the distribution characteristics of the collected data. Normality was assessed using skewness and kurtosis statistics, following the guidelines proposed by Hair, Sarstedt, Ringle, and Mena [cite reference if available]. Acceptable ranges for skewness are typically between −1 and +1, and for kurtosis, between −2 and +2. The variables related to ICT quality and user satisfaction within Yemeni higher education exhibited satisfactory ranges for both measures. Specifically, skewness values ranged from 0.501 to 1.112, and kurtosis values ranged from 0.209 to 2.312 (refer to Table 5 for detailed values). These results confirm that the data adequately met the assumptions of normality for subsequent parametric analyses.

Table 5. Results of skewness and kurtosis for normality test

Constructs	Skewness	Kurtosis Statistic
Services Quality	0.501	2.312
User Satisfaction	1.112	0.209

B. Construct Reliability

As depicted in Fig. 2, the Reliability & Validity Dashboard, both latent constructs ICT Quality and User Satisfaction demonstrate strong internal consistency and convergent validity, satisfying established psychometric thresholds. Specifically, Cronbach's alpha coefficients were 0.793 for ICT Quality and 0.835 for User Satisfaction. Similarly, the Composite Reliability (CR) values were 0.813 for ICT Quality and 0.784 for User Satisfaction. Furthermore, the Average Variance Extracted (AVE) values were 0.609 for ICT Quality and 0.574 for User Satisfaction. All reported values for Cronbach's alpha and composite reliability exceed the generally accepted threshold of 0.70, while all AVE values surpass the 0.50 criterion. These findings collectively confirm the satisfactory internal consistency and convergent validity of the measurement model, thus supporting the suitability of these constructs for subsequent structural analysis.

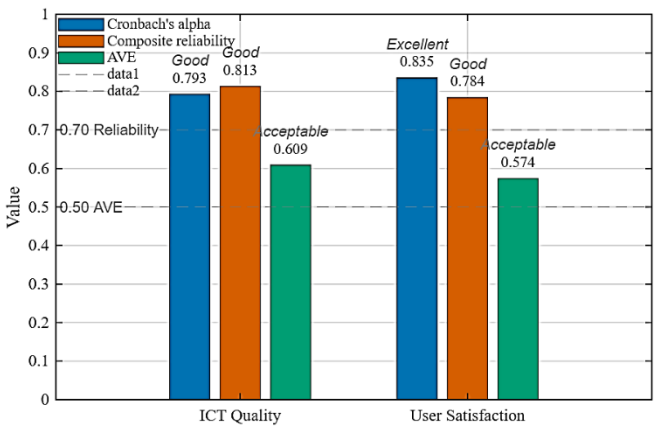

Fig. 2. Construct reliability and validity assessment.

As shown in Table 6 and Fig. 2 of the reliability dashboard above, both constructs demonstrated strong psychometric characteristics. ICT Quality achieved good internal consistency with Cronbach's alpha (α = 0.793) and composite reliability (CR = 0.813), both exceeding the 0.70 threshold. User Satisfaction exhibited excellent reliability with Cronbach's alpha (α = 0.835) and good composite reliability (CR = 0.784). The convergent validity assessment revealed

acceptable AVE values for both constructs: ICT Quality (AVE = 0.609) and User Satisfaction (AVE = 0.574), both exceeding the 0.50 minimum requirement.

Table 6. Reliability and convergent validity

Constructs	Cronbach's Alpha (≥0.7)	Composite Reliability (≥0.7)	Average Variance Extracted (AVE) (≥0.5)
Quality	0.793	0.813	0.609
User Satisfaction	0.835	0.784	0.574

These results confirm that both measurement instruments provide consistent and valid evaluations of their respective constructs, with User Satisfaction demonstrating superior internal consistency (excellent level) compared to ICT Quality (good level). The adequate convergent validity ensures that each construct accounts for more variance in its indicators than measurement error, establishing a solid basis for hypothesis testing.

C. Descriptive Statistics

Descriptive statistics were calculated to provide a concise overview of respondents' perceptions regarding ICT Quality and User Satisfaction, using a 5-point Likert scale. As shown in Fig. 3 and Table 7, the Overall Quality (OQ) construct recorded a high mean score of 3.876 (SD = 0.209). This value, being notably above the neutral midpoint of the Likert scale, indicates a generally positive perception of the ICT environment among the ministry staff. Conversely, User Satisfaction (US) produced an average score of 3.267 (SD = 0.692), reflecting a moderate yet positive sentiment towards the ICT services offered. The comparatively larger standard deviation noted for User Satisfaction suggests a greater heterogeneity in user responses regarding satisfaction, a phenomenon commonly observed in assessments of public-sector ICT initiatives.

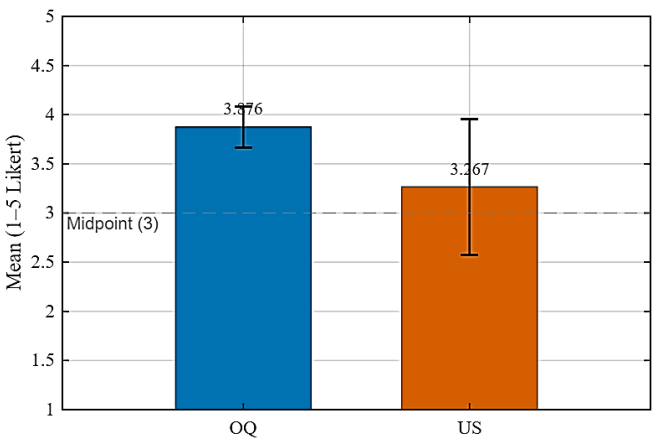

Fig. 3. Descriptive statistics of overall quality and user satisfaction (mean ± SD).

Table 7. Descriptive statistics for study variables

H	RH	Std. Beta	Std. Error	t-value	p-value	Decision
H1	OQ → US	0.121	0.034	2.890	0.005	Supported

The high OQ mean, coupled with a comparatively lower US mean, emphasizes a familiar expectation-performance gap: while infrastructure and information services are considered technically sound, translating this quality into consistently high satisfaction remains difficult. Bridging this gap should therefore be a strategic priority in Yemen's higher education ICT roadmap.

D. Direct Effect Test

As shown in Table 8, the direct effect analysis examined the relationship between ICT quality and user satisfaction using linear regression techniques. Regression coefficients range from −1 to +1, where values closer to +1 indicate strong positive associations and values closer to −1 suggest negative relationships. This analysis specifically tested H1: Overall Quality positively influences User Satisfaction among employees at Yemen's Ministry of Higher Education.

The regression analysis revealed a statistically significant positive relationship between overall ICT quality and user satisfaction (β = 0.121, t = 2.890, p = 0.005), providing empirical support for H1. The standardized beta coefficient of 0.121 indicates that for every one-unit increase in perceived ICT quality, user satisfaction increases by 0.121 units, representing a small to medium effect size according to Cohen's conventions. The t-value of 2.890 substantially exceeds the critical threshold of ±1.96 (α = 0.05), while the p-value of 0.005 demonstrates strong statistical significance (p < 0.01), providing sufficient evidence to reject the null hypothesis of no relationship.

Table 8. Hypothesis testing results

Variable	N	Min	Max	Mean	Std. Deviation
(OQ)	291	1.00	5.00	3.876	0.209
(US)	291	1.00	5.00	3.267	0.692

Note: p < 0.01; OQ = Overahas a positive influence onll Quality; US = User Satisfaction.

The 95% confidence interval [0.054, 0.188] confirms the reliability of this finding, as it does not include zero, further supporting the positive relationship. This result aligns with the DeLone and McLean IS Success Model, showing that enhanced ICT quality dimensions, including system reliability, information accuracy, and service responsiveness, directly contribute to improved user satisfaction in higher education administrative contexts. The finding is particularly important given Yemen's challenging ICT infrastructure environment, suggesting that even modest quality improvements can produce meaningful satisfaction gains among ministry staff.

E. Discussion and Implications

The 95% confidence interval [0.054, 0.188] confirms the reliability of this result, as it does not include zero, further supporting the positive relationship. This outcome aligns with the DeLone and McLean IS Success Model, showing that improved ICT quality dimensions including system reliability, information accuracy, and service responsiveness directly contribute to increased user satisfaction in higher education administrative contexts. The finding is especially important given Yemen's challenging ICT infrastructure environment, suggesting that even modest quality enhancements can produce meaningful satisfaction gains among ministry staff.

1) Key findings and theoretical contributions

The standardized beta coefficient of 0.121 indicates that a one-unit increase in perceived ICT quality results in a 0.121-unit improvement in user satisfaction, representing meaningful practical significance in resource-constrained environments. This effect size corresponds with established

research in developing countries, where modest quality improvements generate substantial satisfaction gains due to baseline infrastructure limitations.

The findings confirm the universal applicability of core IS success principles across diverse institutional contexts, challenging assumptions that conflict environments significantly alter technology adoption patterns. Even under Yemen's challenging conditions, including infrastructure disruption and institutional instability, well-designed ICT systems provide meaningful user value.

2) Practical implications

The empirical results produce critical implications for administrators and policymakers:

- Strategic Investment Justification: The significant relationship ($p < 0.01$) offers quantitative evidence supporting ICT infrastructure prioritization over alternative initiatives [1, 9].
- Quality Focus: Results emphasize concentrating on system reliability, information accuracy, and service responsiveness to maximize satisfaction outcomes.
- Performance Benefits: User satisfaction mediates the relationship between ICT quality and organizational performance improvements, including enhanced decision-making and operational efficiency.

3) Future research directions

Future research directions should incorporate environmental quality dimensions beyond the core DeLone and McLean constructs. Physical infrastructure quality may be measured through indicators such as network uptime, hardware adequacy, and facility conditions, while institutional culture quality could evaluate digital readiness, leadership support, and change management effectiveness.

VI. Conclusion

This study empirically confirms that ICT quality has a significant impact on user satisfaction within Yemen's Ministry of Higher Education ($\beta = 0.121$, $p = 0.005$). These findings highlight the strategic importance of effective data integration, information accessibility, and coherent ICT policies for administrative efficiency. Practically, the research supports the implementation of targeted training programs for new staff to enhance system utilization and satisfaction. However, limitations include cross-sectional design, single-ministry focus, potential self-report bias, and unmeasured contextual factors. Future research should use longitudinal designs across multiple institutions, incorporate qualitative methodologies, and examine mediating factors like organizational culture and technology readiness to deepen understanding of ICT success in complex developing nation environments.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Mohammed S. A. Basheer contributed to the conception and design of the study, supervised the overall research process, and drafted the initial manuscript. Ali Ameen conducted the data collection, performed the CFD simulations, and contributed to manuscript writing. Abdulbasit A. Darem carried out data analysis and interpretation, prepared figures and tables, and critically revised the manuscript. Nor Shahida Mohd Shah provided guidance on methodology, validated the results, and contributed to the literature review. Mohamed Hamood Alsamhi assisted in data interpretation, technical validation, and manuscript revision. Divya Midhunchakkaravarthy co-supervised the research work, provided methodological guidance, and reviewed the manuscript for accuracy and completeness. Abdu Saif contributed to the study design, assisted in data collection, and reviewed the manuscript for important intellectual content. All authors read and approved the final version of the manuscript.

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