

**Uncertainty-based evaluation of accounting information system implementation:
Challenges, success factors and effectiveness in manufacturing organizations**

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Abstract

The increasing reliance on Accounting Information Systems (AIS) in modern organizations highlights the need to understand critical success factors (CSFs), challenges, and their implications for organizational performance. This study aims to investigate the demographic characteristics of AIS users, examine key organizational and technical challenges, and identify determinants of AIS effectiveness. A quantitative research design was employed, with primary data collected through structured questionnaires. Using random sampling, data were gathered from 855 AIS users across manufacturing organizations, ensuring representation of different experience levels and age groups. Descriptive statistics were applied to analyze demographic characteristics, while Pythagorean fuzzy set (PFS) analysis was utilized to assess uncertainty in CSFs, challenges (CAIS), and AIS effectiveness (EAIS). The results reveal that the majority of respondents are male (62.3%) and younger professionals aged 20–30 years (42.1%), with most having 2–7 years of AIS experience. Findings indicate that high user competence (mean = 4.38) and strong top management support (mean = 4.41) are the most influential CSFs, with top management support showing no uncertainty ($\pi = 0$). Conversely, insufficient data quality and security ($\pi = 0.99$), high maintenance cost ($\pi = 1.00$), and interdepartmental coordination ($\pi = 1.00$) emerged as the most uncertain challenges. Regarding AIS effectiveness, information quality ($\mu = 1$, $\pi = 0$) proved most certain, whereas organizational efficacy ($\pi = 1.00$) remained ambiguous. This study provides practical implications for enhancing AIS adoption through training, data governance, and interdepartmental collaboration. Future research could extend to longitudinal studies or cross-industry comparisons to validate findings across broader contexts.

Keywords: Critical Success Factors, Accounting Information System, Pythagorean Fuzzy, Effectiveness, Degrees of Uncertainty

JEL Classification: M15, M41, M49

1. Introduction

An accounting information system (referred to as an accounting system) can be defined as "the integration of personnel, documentation, and protocols employed by a corporation to meet the AIS need for financial data (Faccia & Petratos, 2021). Individuals, information, and technological tools are integrated into information systems within the realm of accounting, holding a significant role in the process of decision-making. These approaches enhance efficiency through the evaluation of factors such as pertinence, timeliness, understanding, and accurate representation in financial reports (Duan et al., 2023). Whereas, Accounting Information Systems offer standardized forms, documentation, and analyses that leverage information technology to furnish managerial financial information, thereby enhancing organizational operations and strategic decision-making (Al-Matari et al., 2022). Yoshikuni et al. (2023) & Zhang et al. (2024) demonstrates the noteworthy benefits that Accounting Information Systems (AIS) features that foster innovation have on an organization's degree of innovation. Similarly, Zhen & Zhen (2023) reveals that technological improvements increase complexity and need higher levels of knowledge to manage efficiently, they have a negative effect on the performance of accounting information systems. Nofel et al. (2024) emphasized that entities encounter substantial obstacles in the deployment of Accounting Information Systems (AIS) attributable to the escalating complexity of cyber-attacks, which jeopardize the integrity, confidentiality and accessibility of financial information. Moreover, Vo Van et al. (2024) elucidated that such impediments obstruct seamless transactions and precise financial reporting. On the other hand, Nguyen et al. (2025) elucidated that the challenges associated with the deployment of cloud accounting, a variant of Accounting Information Systems, encompass the apprehensions regarding elevated expenses and the necessity for a comprehensive reformation of prevailing organizational processes. Metalia et al. (2023) emphasized that the critical success factors for the successful implementation of accounting information systems encompass the significant impact of these systems on improving the precision and dependability of financial statements. Andi et al. (2024) posited that the Critical Success Factors (CSF) exert a substantial impact on the degree of innovation manifested within organizations, emphasizing the imperative of employing an Accounting Information System (AIS) that promotes innovation in order to augment overall innovative performance. In a comparable manner, Nguyen et al. (2024) elucidated that the critical determinants of success for the deployment of accounting information systems encompass robust managerial endorsement, which integrates dedication, allocation of resources, active involvement, and proficient leadership in the management of change. According to Hadiyat et al. (2023), the critical success factors encompass user engagement, internal governance, and organizational ethos, all of which exert a favorable impact on the efficacy of accounting systems, especially within lending institutions. Lutfi (2023) further delineated critical determinants influencing the efficacy of accounting information systems (AIS), which encompass system quality, service quality, information quality, and internal control quality; these constructs exert a substantial impact on both the utilization of AIS and the satisfaction of its users, thereby

ultimately contributing to the system's overall success. Furthermore, Diavastis (2024a) investigated the impact of the deployment of Accounting Information Systems (AIS) within the hospitality sector, revealing that user satisfaction significantly contributes to its effectiveness, which is recognized as an essential determinant of success. Findings of Zohry & Al-Dhubaibi (2024) reveal that system competence positively affects both information quality and AIS effectiveness, while information quality enhances AIS effectiveness and overall business performance. For instance, Karthikeyan & Saraswathy (2024a) underscored the determinants that impact the efficacy of accounting information, encompassing regulatory structures, technological innovations, managerial expertise, and organizational ethos. Whereas, the critical success factors for the effectiveness of implementing accounting information systems (AIS) include appropriate technology selection, efficient integration of systems, robust data security measures, and integrated management practices (Salih et al., 2022). Al-Hashimy & Jinfang (2024) articulated that the effectiveness of an Accounting Information System (AIS) pertains to its capacity to augment a corporation's operational efficiency through the optimization of financial processes, the improvement of data precision, and the facilitation of strategic decision-making. Karthikeyan & Saraswathy (2024) stated that the effectiveness of an Accounting Information System (AIS) is influenced by factors such as regulatory frameworks, technological advancements, managerial competence, and organizational culture. Al-Hashimy & Jinfang (2024) deduced that the implementation of Accounting Information Systems (AIS) substantially augments organizational efficacy through the enhancement of system quality, information quality, service quality, and system utilization. These indicators play a pivotal role in the optimization of business operations and the facilitation of decision-making processes. While, Rapina et al. (2023) emphasized that an effective implementation of Accounting Information Systems (AIS) can profoundly influence the efficacy of accounting procedures and the integrity of financial reports, consequently facilitating enhanced decision-making and augmenting the overall performance of the organization. By arguing others Zwaied et al. (2023) concerned about the only reliability of the data used in the study, which could affect the validity of the AIS effectiveness. In the light of the previous studies, the following research questions are pointed out:

- (i) *What are the Challenges of Accounting Information System implementation?*
- (ii) *What are the Critical Success Factors of Accounting Information System implementation?*
- (iii) *What are the Effectiveness of Accounting Information System implementation?*

2. Methods and Materials

2.1 Methodology

In this study sample size is determined by using $n = \frac{z^2 pq}{d^2}$ (Cochran, 1963; Bolarinwa, 2020) formula. Where, $z = 1.96$ (95% confidence interval), $p = 50\%$ (value of p is unknown), $q = 1 - p$,

$d = 5\%$. $n = \frac{(1.96)^2 \cdot 0.5 \cdot 0.5}{(0.05)^2} = 384$. According to the calculation by using formula the minimum sample size of this study is 384. A sample size that is too small may not correctly reflect the population, whereas a very high sample size might be resource-intensive and may pose undue hazards to participants (Gumpili & Das, 2022). In this study, a survey questionnaire was sent to 1000 AIS packages users (accounts, finance and banking, production and human resource department) from 50 manufacturing companies Dhaka, Chattogram, Mymensingh divisions in Bangladesh. Out of 1000 respondents 950 responses were collected and among 950 responses 95 responses were used in pilot test that is 10% (Teresi et al., 2022) of total sample size and 855 responses were analyzed. So, the sample size of this study is 855. A simple random technique (Lutfi, 2022; Diavastis et al., 2024) is employed here. The primary sources (Zohry & Al-Dhubaibi, 2024; Hadiyat et al., 2023 & (Murthy et al., 2023) are utilized to collect quantitative data and data were collected by using KoboToolbox (online) through self-administered (Fu et al., 2024) and Structured Questionnaires (Diez-Busto et al., 2023). The data collection period was 1st May 2025 to 30th August 2025. Statistical Package for the Social Sciences (SPSS) 26 (Zohry & Al-Dhubaibi, 2024) as employed in the present investigation to perform descriptive statistical analyses concerning the demographic and general datasets, which quantified indicators including mean, median, mode, standard deviation, and variance, among others. The Pythagorean fuzzy (Wu et al., 2022; Catak, 2024 & Wan et al., 2021) is used to measure the Challenges, Critical Success Factors and Effectiveness of Accounting Information System through a manual calculation. For this study, the questionnaire (Mamakou et al., 2024) is designed including two sections like; Demographic Information (Usher et al., 2025) and core questions which includes Challenges of implementing Accounting Information System (Qatawneh, 2023b), Critical Success Factors (CSF) of the Effectiveness of implementing Accounting Information System (Hashem & Hashem, 2023). Demographic information are collected by dichotomous and core data are collected by using a 7-point (Murthy et al., 2023) Likert scale which represent 1=Strongly Disagree, 2=Somewhat Disagree, 3=Disagree, 4=Neutral, 5= Somewhat Agree, 6=Agree, 7=Strongly Agree.

2.2 Items of Measurements

The items Challenges of Accounting Information Systems (CAIS) include 1. Limited Technological Capabilities (LTC (Nilaish et al., 2024), 2. Insufficient Data Quality and Security (IDQS) (Mustafa et al., 2024), 3. Lack of Skilled Personnel (LSP) (Al-Matari et al., 2022; Kareem et al., 2021), 4. Inadequate Technical Expertise (ITE) (Fullana & Ruiz, 2021; Pimentel et al., 2021), 5. Cost & Complexity of Implementation (CCI) (Akteer et al., 2024; Wang et al., 2025). 6. Resistance to Change (ReC) (Perray-Redslob & Morales, 2022; Riley et al., 2022) 7. High Maintenance Cost (HMC) (Al-Hashimy & Jinfang, 2024). The Critical Success Factors (CSF) consist of 1. Organizational Structure (OS) (Nguyen et al., 2024; Al-Hattami, 2024), 2. Organizational Culture (OC) (Muti et al., 2022; Qatawneh, 2023; Nilaish et al., 2024; Magboul et al., 2024), 3. Top Management Support (TMS) (Darma et al., 2024) (Pedroso & F. Gomes, 2024),

4. Effective Data Management (EDM) (Nassani et al., 2023), 5. Regulatory Compliance (RC) (Han et al., 2023; Chen et al., 2024), 6. Interdepartmental Coordination (IC) (Al-Hashimy et al., 2023), 7. Risk Management (RM) (Hashem & Hashem, 2023), 8. Education and Training (ET) (Al-Hattami, 2025), 9. User Competence (UC) (Rapina & Mustamin, 2024), 10. User Involvement (UI) (Putra & Wigantini, 2025). And the Effectiveness of Accounting Information Systems (EAIS) include 1. Accuracy and Reliability (AR) (Tumbelaka et al., 2024), 2. System Quality (SyQ) (Wijayanti & Terzaghi, 2024; (Zohry & Al-Dhubaibi, 2024), 3. Information Quality (IQ) (Papiorek & Hiebl, 2023) (Halimuzzaman et al., 2024), (Zohry & Al-Dhubaibi, 2024), 4. Service Quality (SQ) (Wijayanti & Terzaghi, 2024) 5. Organizational Efficacy (OE) (Fitri Anggraeni & Winarningsih, 2021) (Sunarta & Dwi Astuti, 2023), 6. Comprehensive Financial Reports (CFR) (Ashraf, 2024), 7. Easiness and Flexibility (EF) (Yoshikuni et al., 2023b) and 8. Reduction of Data Redundancy (RDR) (AIS) (Hadiyat et al., 2023; X. Wang & Zhu, 2025).

3. Results and Discussion

3.1 Gender of the Respondents

The gender of 384 respondents of this research is classified as under:

Table 1. Gender of the Respondents

	Frequency	Percent
Male	533	62.3
Female	322	37.7
Total	855	100

The gender distribution of respondents in the study. Out of a total of 855 participants, 533 (62.3%) are male, while 322 (37.7%) are female. This indicates that males constitute a larger proportion of the sample, with nearly two-thirds of the respondents being male and just over one-third being female (Table 1).

3.2 Age of the Respondents

The description of the age ranges of the respondents is categorized in Table 2. As a percentage of the entire sample (N=855), the age distribution of the respondents is shown in the table. For example, 42.1% of respondents are between the ages of 20 and 30, 20.9% are between the ages of 30 and 40, and 18.1% are between the ages of 40 and 50. The group with the lowest representation, 5.5%, is respondents between the ages of 50 and 60, while a lesser percentage, 13.3%, are under the age of 20. This suggests that a large portion of the respondents are younger (Table 2).

Table 2. Age of the Respondents

	Frequency	Percent
Less than 20	114	13.3
20-30	360	42.1
30-40	179	20.9
40-50	155	18.1
50-60	47	5.5
Total	855	100.0

3.3 Educational Qualification of Respondents

The educational qualifications of all the respondents of the respondents of this study are summarized in the following table:

Table 3. Educational Qualification of the Respondents

	Frequency	Percent
Graduate	426	49.8
Post Graduate	358	41.9
Others	71	8.3
Total	855	100.0

The comprehensive summary of the educational qualifications held by 855 participants in the study. Approximately one-half of the respondents (49.8%) are identified as graduates, whereas a noteworthy portion (41.9%) has attained postgraduate qualifications. A lesser fraction (8.3%) is classified under the "Others" category, which may encompass diplomas, certifications, or educational levels that are lower than a university degree. This distribution elucidates that a predominant majority of the respondents possess advanced educational qualifications, with the combined total of graduates and postgraduates exceeding 90% of the overall sample (Table 3).

3.4 AIS Experience

AIS experience of the respondents is stated in the following table:

Table 4. AIS Experience

	Frequency	Percent
Less than 2	214	25.0
2-7	282	33.0
7-12	182	21.3
12-17	146	17.1
17-22	31	3.6
Total	855	100.0

The predominant experience bracket is observed to be between 2-7 years, which comprises 33.0% of the total respondents (282 individuals). Subsequently, individuals with less than 2 years of experience constitute 25.0% (214 individuals). Participants possessing 7-12 years of experience account for 21.3% (182 individuals), whereas those with 12-17 years represent 17.1% (146 individuals). The cohort with the least experience comprises individuals with 17-22 years, representing a mere 3.6% (31 individuals). In total, the dataset encompasses 855 participants, effectively distributed across the aforementioned experience categories (Table 4).

3.5 Descriptives Analysis

The descriptive statistics of the study that includes the mean, median, mode, std. deviation and variance which help to identify the most representative or typical value of dataset are stated in tables.

Table 5. Descriptive Statistics (Indicators)

Indicators	Mean	Median	Mode	Std. Deviation	Variance
Limited Technological Capabilities (LTC)	4.01	4.00	4.00	1.56	2.40
Insufficient Data Quality and Security (IDQS)	3.93	4.00	4.00	1.50	2.25



Lack of Skilled Personnel (LSP)	4.01	4.00	4.00	1.54	2.36
Inadequate Technical Expertise (ITE)	4.00	4.00	5.00	1.58	2.52
Cost & Complexity of Implementation (CCI)	4.00	4.00	3.00	1.62	2.63
Resistance to Change (ReC)	4.04	4.00	3.00	1.65	2.71
High Maintenance Cost (HMC)	3.92	4.00	2.00	1.85	3.44
Organizational Structure (OS)	4.00	4.00	2.00	1.90	3.61
Organizational Culture (OC)	4.00	4.00	4.00	1.81	3.28
Top Management Support (TMS)	4.41	4.00	4.00	1.77	3.14
Effective Data Management (EDM)	4.07	4.00	4.00	1.31	1.73
Regulatory Compliance (RC)	4.06	4.00	3.00	1.85	3.42
Interdepartmental Coordination (IC)	3.91	4.00	4.00	1.75	3.06
Risk Management (RM)	4.02	4.00	2.00	1.87	3.51
Education and Training (ET)	4.06	4.00	3.00	1.85	3.42
User Competence (UC)	4.38	4.00	6.00	1.81	3.28
User Involvement (UI)	4.24	4.00	5.00	1.72	2.97
Accuracy and Reliability (AR)	3.91	4.00	3.00	1.64	2.69
System Quality (SyQ)	3.90	4.00	3.00	1.77	3.13
Information Quality (IQ)	4.13	4.00	6.00	1.72	2.96
Service Quality (SQ)	4.07	4.00	6.00	1.70	2.89
Organizational Efficacy (OE)	3.84	4.00	3.00	1.68	2.81
Comprehensive Financial Reports (CFR)	4.00	4.00	4.00	1.71	2.93

Easiness and Flexibility (EF)	4.01	4.00	6.00	1.97	3.89
Reduction of Data Redundancy (RDR)	4.03	4.00	3.00	1.65	2.75

Most of the indicators have a mean, median, and mode around 4.00, indicating a general consensus of agreement or importance among respondents. Standard deviations range from 1.31 to 1.97, reflecting varying levels of consistency in responses. Variance values align with standard deviations, showing the spread of data for each indicator. Notable findings include high user competence (mean = 4.38) and top management support (mean = 4.41), suggesting their perceived importance, while indicators like organizational efficacy (mean = 3.84) and system quality (mean = 3.90) indicate slightly lower levels of agreement (Table 5).

3.6 Pythagorean Fuzzy Analysis

Let X be a universe of discourse. A fuzzy set A based on X can be characterized by the set of pairs which is defined as (Zadeh, 1965):

$$A = \{\langle x, \mu(x) \rangle \mid x \in X\}$$

where $\mu(x): X \rightarrow [0, 1]$ is the membership function (MF) of A , which describes the membership degree of each element x to the fuzzy set A . The closer $\mu(x)$ is to 1, the more likely x belongs to A .

The degree of membership is calculated as (Zadeh, 1965; Klir & Yuan, 1995; Ross, 2005):

$$\mu(x) = \frac{x - \text{Lower Value}}{\text{Upper Value} - \text{Lower Value}}$$

$$0 \leq \mu(x) \leq 1$$

$$\mu(x) = \text{Membership Degree}$$

The hesitancy degree or uncertainty degree $\pi(x)$ (Yager & Abbasov, 2013) can be calculated as:

$$\pi(x) = \sqrt{1 - \mu(x)^2}$$

$$\text{where, } \pi(x) = \text{Hesitancy/Uncertainty Degree}$$

In this study, the Pythagorean fuzzy is used to make decision in ranking the Challenges, Critical Success Factors and Effectiveness of AIS. Mean values of indicators of Challenges of AIS (CAIS), Critical Success Factors of AIS (CSF), Effectiveness of AIS (EAIS) are used to calculate the fuzzy sets.

3.6.1 Challenges of AIS (CAIS)

Challenges of AIS (CAIS) consist of 7 indicators or items like; LTC, IDQS, LSP, LTE, ReC and HMC that are considered as members of Pythagorean fuzzy set here. Let us consider the mean value of all members to prepared a fuzzy set from the Table 6:

Table 6. Means of Indicators (CAIS)

Indicators	Mean
Limited Technological Capabilities (LTC)	4.01
Insufficient Data Quality and Security (IDQS)	3.93
Lack of Skilled Personnel (LSP)	4.01
Inadequate Technical Expertise (ITE)	4.00
Cost & Complexity of Implementation (CCI)	4.00
Resistance to Change (ReC)	4.04
High Maintenance Cost (HMC)	3.92

3.6.1.1 Degree of Membership

Here, the upper value = 3.93, lower value = 3.90. We considered the membership range as $3.92 \leq x \leq 4.40$

$$\mu(x) = \frac{x - \text{Lower Value}}{\text{Upper Value} - \text{Lower Value}}$$

$$1. \mu(x)_{LTC} = \frac{4.01-3.92}{4.04-3.92} = \frac{0.09}{0.12} = 0.75$$

$$2. \mu(x)_{IDQS} = \frac{3.93-3.92}{4.04-3.92} = \frac{0.01}{0.12} = 0.08$$

$$3. \mu(x)_{LSP} = \frac{4.01-3.92}{4.04-3.92} = \frac{0.09}{0.12} = 0.75$$

$$4. \mu(x)_{ITE} = \frac{4.00-3.92}{4.04-3.92} = \frac{0.08}{0.12} = 0.67$$

$$5. \mu(x)_{CCI} = \frac{4.00-3.92}{4.04-3.92} = \frac{0.08}{0.12} = 0.67$$

$$6. \mu(x)_{ReC} = \frac{4.04-3.92}{4.04-3.92} = \frac{0.12}{0.12} = 1$$

$$7. \mu(x)_{HMC} = \frac{3.92-3.92}{4.04-3.92} = \frac{0}{0.12} = 0$$

So, $A_{CAIS} = \{(LTC, 0.75), (IDQS, 0.08), (LSP, 0.75), (LTE, 0.67), (CCI, 0.67), (ReC, 1), (HMC, 0)\}$

3.6.1.2 Degree of Uncertainty

$$1. \pi(LTC) = \sqrt{1 - (0.75)^2} = \sqrt{1 - 0.56} = \sqrt{0.44} = 0.66$$

$$2. \pi(IDQS) = \sqrt{1 - (0.08)^2} = \sqrt{1 - 0.0064} = \sqrt{0.99} = 0.99$$

$$3. \pi(LSP) = \sqrt{1 - (0.75)^2} = \sqrt{1 - 0.56} = \sqrt{0.44} = 0.66$$

$$4. \pi(ITE) = \sqrt{1 - (0.67)^2} = \sqrt{1 - 0.45} = \sqrt{0.55} = 0.74$$

$$5. \pi(CCI) = \sqrt{1 - (0.67)^2} = \sqrt{1 - 0.45} = \sqrt{0.55} = 0.74$$

$$6. \pi(ReC) = \sqrt{1 - (1)^2} = \sqrt{1 - 1} = \sqrt{0} = 0$$

$$7. \pi(HMC) = \sqrt{1 - (0)^2} = \sqrt{1 - 0} = \sqrt{1} = 1$$

Table 7. Degrees of Uncertainty of CAIS

Indicators	$\pi(x)$
Limited Technological Capabilities (LTC)	0.66
Insufficient Data Quality and Security (IDQS)	0.99
Lack of Skilled Personnel (LSP)	0.66
Inadequate Technical Expertise (ITE)	0.74
Cost & Complexity of Implementation (CCI)	0.74
Resistance to Change (ReC)	0
High Maintenance Cost (HMC)	1

The above table shows the descriptive statistics on the degrees of uncertainty ($\pi(x)$) associated with factors influencing Challenges of Accounting Information System (CAIS). Each indicator is assigned a value between 0 and 1, indicating the level of uncertainty. Factors like "Insufficient Data Quality and Security" (0.99) and "High Maintenance Cost" (1) exhibit the highest uncertainty, highlighting critical challenges in implementation. Moderate uncertainty is noted for "Inadequate Technical Expertise" (0.74), "Cost & Complexity of Implementation" (0.74), and "Limited Technological Capabilities" (0.66). In contrast, "Resistance to Change" (0) demonstrates no uncertainty, implying clear expectations. These insights underline areas requiring strategic focus

to mitigate uncertainty in CAIS deployment (Table 7).

3.6.2 Critical Success Factors of AIS (CSF)

The Critical Success Factors (CSF) consist of 10 items like; Organizational Structure (OS), Organizational Culture (OC), Top Management Support (TMS), Effective Data Management (EDM), Regulatory Compliance (RC), Interdepartmental Coordination (IC), Risk Management (RM), Education and Training (ET), User Competence (UC) and User Involvement (UI) that are considered as the elements of Pythagorean fuzzy set in this study. The mean value of these items is utilized to calculate the member functions of fuzzy set (Table 8).

Table 8. Means of Indicators (CSF)

Indicators	Mean
Organizational Structure (OS)	4.00
Organizational Culture (OC)	4.00
Top Management Support (TMS)	4.41
Effective Data Management (EDM)	4.07
Regulatory Compliance (RC)	4.06
Interdepartmental Coordination (IC)	3.91
Risk Management (RM)	4.02
Education and Training (ET)	4.06
User Competence (UC)	4.38
User Involvement (UI)	4.24

3.6.2.1 Degree of Membership

Here, the upper value = 4.06, lower value = 3.89. We considered the membership range as $3.91 \leq x \leq 4.41$

$$\mu(x) = \frac{x - \text{Lower Value}}{\text{Upper Value} - \text{Lower Value}}$$

$$1. \mu(x)_{OS} = \frac{4.00 - 3.91}{4.41 - 3.91} = \frac{0.09}{0.50} = 0.18$$

$$2. \mu(x)_{OC} = \frac{4.00-3.91}{4.41-3.91} = \frac{0.09}{0.50} = 0.18$$

$$3. \mu(x)_{TMS} = \frac{4.41-3.91}{4.41-3.91} = \frac{0.50}{0.50} = 1$$

$$4. \mu(x)_{EDM} = \frac{4.07-3.91}{4.41-3.91} = \frac{0.16}{0.50} = 0.32$$

$$5. \mu(x)_{RC} = \frac{4.06-3.91}{4.41-3.91} = \frac{0.15}{0.50} = 0.30$$

$$6. \mu(x)_{IC} = \frac{3.91-3.91}{4.41-3.91} = \frac{0}{0.50} = 0$$

$$7. \mu(x)_{RM} = \frac{4.02-3.91}{4.41-3.91} = \frac{0.11}{0.50} = 0.22$$

$$8. \mu(x)_{ET} = \frac{4.06-3.91}{4.41-3.91} = \frac{0.15}{0.50} = 0.30$$

$$9. \mu(x)_{UC} = \frac{4.38-3.91}{4.41-3.91} = \frac{0.47}{0.50} = 0.94$$

$$10. \mu(x)_{UI} = \frac{4.24-3.91}{4.41-3.91} = \frac{0.33}{0.50} = 0.66$$

So, $A_{CSF} = \{(OS, 0.18), (OC, 0.18), (TMS, 1), (EDM, 0.32), (RC, 0.30), (IC, 0), (RM, 0.22), (ET, 0.30), (UC, 0.94), (UI, 0.66)\}$

3.6.2.2 Degree of Uncertainty

$$1. \pi(OS) = \sqrt{1 - (0.18)^2} = \sqrt{1 - 0.03} = \sqrt{0.97} = 0.98$$

$$2. \pi(OC) = \sqrt{1 - (0.18)^2} = \sqrt{1 - 0.03} = \sqrt{0.97} = 0.98$$

$$3. \pi(TMS) = \sqrt{1 - (1)^2} = \sqrt{1 - 1} = \sqrt{0} = 0$$

$$4. \pi(EDM) = \sqrt{1 - (0.32)^2} = \sqrt{1 - 0.10} = \sqrt{0.90} = 0.95$$

$$5. \pi(RC) = \sqrt{1 - (0.30)^2} = \sqrt{1 - 0.09} = \sqrt{0.91} = 0.95$$

$$6. \pi(IC) = \sqrt{1 - (0)^2} = \sqrt{1 - 0} = \sqrt{1} = 1$$

$$7. \pi(RM) = \sqrt{1 - (0.22)^2} = \sqrt{1 - 0.05} = \sqrt{0.95} = 0.97$$

$$8. \pi(ET) = \sqrt{1 - (0.30)^2} = \sqrt{1 - 0.09} = \sqrt{0.91} = 0.95$$

$$9. \pi(UC) = \sqrt{1 - (0.94)^2} = \sqrt{1 - 0.88} = \sqrt{0.12} = 0.34$$

$$10. \pi(UI) = \sqrt{1 - (0.66)^2} = \sqrt{1 - 0.44} = \sqrt{0.56} = 0.75$$

Table 9. Degrees of Uncertainty of CSFs

Indicators	$\pi(x)$
Organizational Structure (OS)	0.98
Organizational Culture (OC)	0.98
Top Management Support (TMS)	0
Effective Data Management (EDM)	0.95
Regulatory Compliance (RC)	0.95
Interdepartmental Coordination (IC)	1
Risk Management (RM)	0.97
Education and Training (ET)	0.95
User Competence (UC)	0.34
User Involvement (UI)	0.75

The values of degrees of uncertainty ($\pi(x)$) associated with critical success factors (CSFs) closer to 1 indicate higher certainty or confidence, while values closer to 0 suggest greater uncertainty. Key factors such as Organizational Structure (OS), Organizational Culture (OC), Risk Management (RM), and Effective Data Management (EDM) exhibit high certainty, with $\pi(x)$ values above 0.95. In contrast, Top Management Support (TMS) shows complete uncertainty ($\pi(x) = 0$), while User Competence (UC) has a relatively low certainty ($\pi(x) = 0.34$). Interdepartmental Coordination (IC) achieves maximum certainty ($\pi(x) = 1$), highlighting its critical importance. User Involvement (UI) displays moderate certainty at 0.75. Overall, the table provides insight into the varying levels of confidence in these CSFs, emphasizing areas requiring more focus or improvement (Table 9).

6.6.3 Effectiveness of AIS (EAIS)

The effectiveness of AIS includes 8 items such as AR, SyQ, IQ, SQ, OE, CFR, EF, RDR and these are the element of Pythagorean fuzzy set in this study. For calculating member functions of fuzzy set, the mean value is utilized (Table 10).

Table 10. Means of Indicators (EAIS)

Indicators	Mean
Accuracy and Reliability (AR)	3.91
System Quality (SyQ)	3.90
Information Quality (IQ)	4.13
Service Quality (SQ)	4.07
Organizational Efficacy (OE)	3.84
Comprehensive Financial Reports (CFR)	4.00
Easiness and Flexibility (EF)	4.01
Reduction of Data Redundancy (RDR)	4.03

3.6.3.1 Degree of Membership

Here, the upper value = 4.01, lower value = 3.98. We considered the membership range as $3.84 \leq x \leq 4.13$

$$\mu(x) = \frac{x - \text{Lower Value}}{\text{Upper Value} - \text{Lower Value}}$$

$$1. \mu(x)_{AR} = \frac{3.91-3.84}{4.13-3.84} = \frac{0.07}{0.29} = 0.24$$

$$2. \mu(x)_{SyQ} = \frac{3.90-3.84}{4.13-3.84} = \frac{0.06}{0.29} = 0.21$$

$$3. \mu(x)_{IQ} = \frac{4.13-3.84}{4.13-3.84} = \frac{0.29}{0.29} = 1$$

$$4. \mu(x)_{SQ} = \frac{4.07-3.84}{4.13-3.84} = \frac{0.23}{0.29} = 0.80$$

$$5. \mu(x)_{OE} = \frac{3.84-3.84}{4.13-3.84} = \frac{0}{0.29} = 0$$

$$6. \mu(x)_{CFR} = \frac{4.00-3.84}{4.13-3.84} = \frac{0.16}{0.29} = 0.55$$

$$7. \mu(x)_{EF} = \frac{4.01-3.84}{4.13-3.84} = \frac{0.17}{0.29} = 0.59$$

$$8. \mu(x)_{RDR} = \frac{4.03-3.84}{4.13-3.84} = \frac{0.19}{0.29} = 0.66$$

So, $A_{EALS} = \{(AR, 0.24), (SyQ, 0.21), (IQ, 1), (SQ, 0.80), (OE, 0), (CFR, 0.55), (EF, 0.59), (RDR, 0.66)\}$

3.6.3.2 Degree of Uncertainty

1. $\pi(AR) = \sqrt{1 - (0.24)^2} = \sqrt{1 - 0.06} = \sqrt{0.94} = 0.97$
2. $\pi(SyQ) = \sqrt{1 - (0.21)^2} = \sqrt{1 - 0.04} = \sqrt{0.96} = 0.98$
3. $\pi(IQ) = \sqrt{1 - (1)^2} = \sqrt{1 - 1} = \sqrt{0} = 0$
4. $\pi(SQ) = \sqrt{1 - (0.80)^2} = \sqrt{1 - 0.64} = \sqrt{0.36} = 0.60$
5. $\pi(OE) = \sqrt{1 - (0)^2} = \sqrt{1 - 0} = \sqrt{1} = 1$
6. $\pi(CFR) = \sqrt{1 - (0.55)^2} = \sqrt{1 - 0.30} = \sqrt{0.70} = 0.84$
7. $\pi(EF) = \sqrt{1 - (0.59)^2} = \sqrt{1 - 0.35} = \sqrt{0.65} = 0.81$
8. $\pi(RDR) = \sqrt{1 - (0.66)^2} = \sqrt{1 - 0.44} = \sqrt{0.56} = 0.75$

Table 11. Degrees of Uncertainty of EAIS

Indicators	$\pi(x)$
Accuracy and Reliability (AR)	0.97
System Quality (SyQ)	0.98
Information Quality (IQ)	0
Service Quality (SQ)	0.60
Organizational Efficacy (OE)	1
Comprehensive Financial Reports (CFR)	0.84
Easiness and Flexibility (EF)	0.81
Reduction of Data Redundancy (RDR)	0.75

The degrees of uncertainty associated with various indicators of an Effectives of Accounting Information System (EAIS), represented by their respective probabilities ($\pi(x)$). The results indicate high levels of accuracy and reliability ($\pi=0.97$) and system quality ($\pi=0.98$), suggesting strong confidence in these attributes. Information quality ($\pi=0$) shows no certainty, while service quality ($\pi=0.60$) exhibits moderate reliability. Organizational efficacy is fully assured ($\pi=1$), while comprehensive financial reports ($\pi=0.84$), easiness and flexibility ($\pi=0.81$), and reduction of data redundancy ($\pi=0.75$) indicate considerable, though not absolute, certainty in these areas (Table

11).

3.7 Discussion

The analysis of demographic characteristics reveals that the majority of respondents are male (62.3%) and within the younger age bracket of 20–30 years (42.1%), followed by 30–40 years (20.9%). This finding is consistent with the increasing digital adaptability of younger professionals in adopting Accounting Information Systems (AIS), as they tend to be more technology-oriented compared to older generations (Acharya et al., 2022). In terms of AIS experience, most respondents fall within the 2–7 years range (33.0%), suggesting that while many users are relatively early in their careers, they still possess adequate familiarity with AIS usage. The descriptive statistics highlight several critical organizational and technical challenges. High user competence (mean = 4.38) and strong top management support (mean = 4.41) are identified as the most influential success factors, reaffirming prior studies that emphasize managerial commitment and user expertise as vital determinants of AIS effectiveness (Diab & Metwally, 2020). The Pythagorean fuzzy analysis provides further insights into uncertainty levels. For AIS challenges (CAIS), "Insufficient Data Quality and Security" ($\pi = 0.99$) and "High Maintenance Cost" ($\pi = 1.00$) emerged as areas of greatest uncertainty, echoing recent research that stresses the need for stronger data governance and cost management in digital accounting systems (Milošević et al., 2025; Sekhi et al., 2025). Among critical success factors (CSFs), "Top Management Support" shows no uncertainty ($\pi = 0$), reflecting its recognized and consistent role across contexts. On the other hand, "User Competence" ($\pi = 0.34$) demonstrates relatively low uncertainty, underscoring that employee skills are widely acknowledged as pivotal in AIS success (Wan et al., 2021; Zhang et al., 2025). Interdepartmental Coordination (IC) belong highest uncertainty value ($\pi = 1$) (Ivanovic et al., 2025). Regarding AIS effectiveness (EAIS), "Information Quality" ($\mu = 1, \pi = 0$) emerges as the most certain success dimension, emphasizing that reliable and timely information remains the cornerstone of AIS performance (Tran Thanh Thuy, 2025). However, "Organizational Efficacy" ($\pi = 1.00$) indicates persistent ambiguity in translating AIS usage into overall organizational performance. This aligns with recent findings that while AIS improves operational efficiency, its direct effect on broader organizational outcomes often depends on contextual and managerial factors (Abrate et al., 2022; Alharasis, 2024).

The findings provide several practical implications. Organizations should prioritize strengthening top management support and enhancing user competence through continuous training, as these are critical drivers of AIS success. Organizations should increase the interdepartmental communication and collaboration to increase the successful use of AIS. Investment in data quality and security, alongside cost-effective system maintenance, is essential to reduce uncertainty and improve reliability. By addressing high-cost barriers, ensuring robust data governance, and fostering employee involvement, organizations can maximize the effectiveness of AIS, leading to better decision-making, operational efficiency, and sustained competitive advantage in an

increasingly digital business environment. Key findings of this study on the basis of results and discussion are stated as under:

1. The analysis conducted on a sample of 855 participants, predominantly male (62.3%) and within the age range of 20-30 (42.1%), revealed that although robust support from top management (4.41) was evident, challenges such as resistance to change (4.04) and issues pertaining to cost and complexity (4.00) were substantial, with the dimensions of system, information, and service quality being assessed as moderately to highly significant (3.90-4.13).
2. The study found various essential challenges faced in the execution of Accounting Information Systems (AIS) where High Maintenance Cost (HMC) is the most challenging issue followed by Insufficient Data Quality and Security (IDQS), Inadequate Technical Expertise (ITE) and Cost & Complexity of Implementation (CCI).
3. The major Critical Success Factors (CSFs) of AIS within manufacturing organization is Interdepartmental Coordination (IC) followed by Organizational Structure (OS) and Organizational Culture (OC).
4. Principal attributes of AIS effectiveness as discerned in the study include Organizational Efficacy (OE), System Quality (SyQ) and Accuracy and Reliability (AR).

The major recommendations on the basis of findings are stated as under:

1. To alleviate the burden of high maintenance costs and to bolster data quality and security, organizations are advised to consider the adoption of cloud-based AIS solutions.
2. It is essential for organizations to promote enhanced interdepartmental coordination, thereby ensuring alignment among departments and fostering a collaborative environment conducive to the implementation of AIS.
3. It is of paramount importance to cultivate an organizational culture that is amenable to change while ensuring its alignment with technological adoption.
4. Managerial personnel should direct their efforts towards enhancing the quality of the system while providing comprehensive user training to ensure that employees are proficient in navigating and utilizing the system effectively.

4. Conclusion

This study highlights the critical factors and challenges influencing the effectiveness of Accounting Information Systems (AIS) in organizational settings. The demographic analysis reveals that younger professionals, who are more technologically adaptable, dominate AIS usage, and most users have moderate experience, indicating both familiarity and potential for further skill development. The findings confirm that strong top management support and high user competence are the most influential success factors, underscoring the importance of leadership commitment

and employee expertise in driving AIS performance. The Pythagorean fuzzy analysis provides nuanced insights into uncertainty. High maintenance costs and insufficient data quality and security remain major challenges, reflecting the need for effective cost management strategies and stronger data governance. While information quality is found to be the most certain outcome of AIS effectiveness, organizational efficacy remains uncertain, highlighting the contextual complexity of translating system usage into broader performance improvements. Practically, organizations must strengthen managerial support, invest in training to enhance user skills, and foster interdepartmental collaboration to reduce uncertainty and ensure successful implementation. By focusing on cost efficiency, robust data security, and employee involvement, organizations can optimize AIS outcomes, thereby improving decision-making, operational efficiency, and competitive advantage in the digital era.

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