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Assessing quality management practices: Comparative analysis of public and private universities using fuzzy inference system

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ABSTRACT

Aim: This study aims to examine how public and private universities implement quality management practices and identify areas requiring improvement.
Methodology: A purposive sample of 14 universities, representing both public and private sectors, was selected. Data were gathered from 28 department heads using questionnaires. The responses were analyzed through *t*-tests, means, and standard deviations. To capture subjective perceptions more effectively, the Fuzzy Inference System (FIS) was applied to model satisfaction levels across key quality management factors.
Findings: Results indicate that moderate satisfaction occurred in the case where leadership and process approaches were used less frequently, whereas the other case showed higher satisfaction because the evidence-based decision-making approach was more dominant. These findings highlight the gap in improvement processes and leadership, while highlighting the values of data-driven practices.
Practical Implications: The study provides recommendations for strengthening quality management in universities, including enhancing leadership capacity, adopting systematic improvement processes, and encouraging evidence-based decision-making. It also suggests that pursuing international accreditation through the Higher Education Commission could help universities align with global standards and enhance their institutional reputation.

1. Introduction

Quality management encompasses planning, assurance, formation, implementation, control, and improvement, as well as maintaining high standards in related tasks [1]. The term "quality management" extends to the entire process, technology, people, organizational culture, and stakeholders to achieve goals and cultivate a quality-centric culture, leading to enhanced customer satisfaction and institutional performance (ISO, 9001:2015, pp.2–3). This study uses a Fuzzy Inference System (FIS) to judge quality where evidence is mixed, ambiguous, or partly subjective - such as rubric-based teaching evaluations, student feedback, graduate outcomes, and accreditation criteria [2,3]. By translating common academic judgments (Excellent/Good/Fair/Poor; High/Medium/Low) into membership functions and rules agreed with quality-assurance staff, the FIS combines diverse indicators into a single, interpretable quality index and clear prompts for action. Authors show how this framework can be tuned to local priorities, integrate both numbers and narratives, and support decisions at course, programme, and institutional levels.

In quality management, organizational development is defined as structured operational procedures that are maintained, documented, and consistently applied across institutions [4]. To confirm these practices, the Higher Education Commission (HEC) critically evaluates universities and enables them to preserve quality through institutional performance evaluation criteria. International certification has also increased in importance, with standards like ISO 9001:2015 helping

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organizations to simplify, document, and streamline processes, making them more competitive and efficient [5]. At both international and national levels, ISO 9001:2015 has been widely adopted to increase productivity and quality. Othman et al. [6] highlighted that ISO 9001:2015 fosters competitiveness through innovation of technology, thereby improving competitiveness and institutional performance [7–9]. Responding to these global trends, the Higher Education Commission established a quality assurance agency on January 18, 2005, to raise standards of academic quality and align universities with international practices.

This study examines practices of quality management in private and public universities of Pakistan in light of ISO 9001:2015, with the objective of identifying opportunities and challenges in their adoption. It compares practices and offers practical suggestions personalized to both sectors based on the perception of Heads of Departments (HODs). The study was delimited to universities in the Islamabad Capital Territory, Khyber-Pakhtunkhwa, and Punjab that have not yet achieved ISO certification. Data were collected from department heads, focusing precisely on management practices in universities. Despite government initiatives, Pakistani universities continue to struggle in meeting global standards, underlining the importance of reforms by the Higher Education Commission and alignment with international accreditation systems. By comparing practices in private and public universities, the research offers practical suggestions for improvement. The findings are valuable not only for administration, HODs, and policy makers but also for international organizations like UNESCO and the World Bank, which support initiatives. Furthermore, the study highlights universities' readiness for ISO 9001:2015 by examining seven quality management principles: customer focus, leadership, engagement of people, process approach, improvement, evidence-based decision-making, and relationship management, providing evidence-based recommendations for increasing quality in both private and public universities.

2. Literature review

Quality management in higher education refers to a systematic approach through which universities ensure that their academic, administrative, and research activities meet defined standards of excellence. It involves continuous planning, monitoring, evaluation, and improvement to enhance institutional effectiveness and accountability. In the context of globalization and increasing competition among universities, quality management has become essential for building institutional reputation, achieving accreditation, and meeting the expectations of multiple stakeholders such as students, faculty, employers, and policymakers.

Quality management has also been changing with time, driven by the various changes in the needs of the organizations. Most higher learning institutions depend on quality management to align their courses and programs toward international standards and accreditation needs [10]. Higher education institutions play an important role in societal, economic, governmental, and scientific progress, as highlighted by institutionalists [11–13]. ISO 9001:2015, a widely recognized global quality management standard, is a common framework adopted by institutions worldwide. According to the International Organization for Standardization [14], more than one million companies and organizations globally are under ISO 9001. The incorporation of ISO 9001 within the educational system has been shown to enhance stakeholders' confidence. The University of Wolverhampton stands as the first university to receive ISO 9000 certification [15].

Research indicates that top management support, quality management philosophy, continuous improvement, and strategic planning are crucial elements (Sakthivel, 2007; [16–19]). Numerous aspects of higher education, including services and administration, research, and teaching, are essential for attaining quality [19]. In Pakistan, Iqbal et al. [20] conducted a study comparing the perceived quality of culture and service quality in public and private universities. The research revealed notable differences, with public universities scoring higher. The study noted a positive influence of quality culture on service quality in both types of institutions, particularly in private universities. This suggests that fostering a quality culture could lead to enhancements in organizational performance.

Similarly, Sunder and Antony [21] argue that quality excellence goes beyond meeting customer requirements, evolving into a management strategy that integrates and enhances processes for inherent excellence. Grounded in the principles of Deming, Juran, and Crosby, ongoing research continues to advance the understanding of quality excellence. Moreover, Latif [22] aimed to develop and validate the HiEduQual (Higher Education Service Quality) construct for evaluating service quality in higher education institutions. The study involved multiple stakeholders, including students, parents, teachers, and employers. The resulting scale comprises 37 items, covering determinants such as teacher quality, administrative services, knowledge services, activities, continuous improvement, and leadership quality. Recommendations include implementing transparency procedures through staff and student manuals, enhancing staff skills through collaborative seminars with regulatory bodies, and integrating indicators of quality teaching.

Another study used a mixed-method approach to investigate factors influencing the effectiveness of quality assurance at German higher education institutions [37]. By utilizing survey data, the study constructs an ordinary least squares regression model, which reveals that support from higher management and inter-institutional collaboration is crucial for perceived effectiveness. Additionally, the study finds that the role of quality managers as advocates for quality assurance positively impacts perceived effectiveness. At the same time, perceptions of it as an administrative burden or reliance on sanctions show negative correlations [23].

Overall, the reviewed studies emphasize that effective quality management in higher education requires strong leadership, continuous improvement mechanisms, stakeholder engagement, and alignment with international standards such as ISO 9001:2015. While many universities worldwide have adopted these practices, but evidence from Pakistan remains limited, specifically in comparing public and private institutions. This gap underlines the need for the present study, which seeks to build on these insights and provide a conceptual framework for understanding how practices of quality management can be enhanced in Pakistani universities. The literature reviewed above guided the development of the study's conceptual framework by identifying key dimensions like leadership, customer focus, improvement, stakeholder engagement, relationship management, evidence-based decision-making, and alignment with international quality standards.

H01a: As perceived by HODs, there is no statistically significant difference between private and public universities regarding the customer focus.

H01b: As perceived by the HODs, there is no statistically significant difference between private and public universities regarding leadership.

H01c: According to the HODs, there is no statistically significant difference between private and public universities for people's engagement.

H01d: HODs perceived that no significant difference in the process existed between private and public universities.

H01e: HODs believe there is not much difference in the level of improvement between private and public universities.

Ho1f: The perception among the HODs is that there is no significant difference in evidence-based decision-making between private and public universities.

H01g: As HODs perceive, no statistically significant difference in relationship management between private and public universities.

3. Theoretical framework of the study

Quality management practices encompass aspects like customer satisfaction, strong leadership, continuous improvement, a process-driven approach, teamwork, building strong relationships, and evidence-based decision-making. The ISO 9001:2015 standard incorporates these practices to ensure effective quality management, as mentioned in Fig. 1 below:

Table 1.

Bhosale and Kamath [24] have developed a fuzzy inference system to evaluate teaching performance to motivate teachers to improve their work. According to the authors, their research showed improvement in teaching quality, adequacy, satisfaction, efficiency, and innovation. Similarly, El Alami and De Arriaga [25] designed an Intelligent E-learning System (ILS) in a multi-agent environment known as NEOCAMPUS2.

4. Research methodology

4.1. Research design

A systematic approach is used in quantitative research to study social phenomena through numerical and statistical data [26]. A quantitative descriptive research design was employed to objectively examine the perception of heads of department (HODs).

4.2. Sample design

The HODs were selected through a simple random sampling method, with two HODs randomly chosen from each university. The conclusions drawn from this sample apply only to the larger population from which the sample was properly selected [27]. The sample for the study consisted of twenty-eight HODs, ensuring coverage of different perspectives and departments across universities randomly.

4.3. Measures

Data were collected using a self-developed questionnaire, with variables falling under the seven practices of ISO 9001, such as customer satisfaction (8 items), leadership (9 items), continuous improvement (6 items), process approach (8 items), people involvement (7 items), relationship management (5 items), and decision-making based on evidence

Fig. 1. Theoretical Framework.

Table 1
Quality Management Practices.

Quality Management Practices	Description
i. Customer Focus	To satisfy customer needs and exceed expectations
ii. Leadership	Demonstrate dedication, fostering an environment that encourages adherence to the university's quality policy.
iii. Engagement of People	Involve people's participation and cooperation in program reviews and decisions. Encourage open communication and knowledge exchange for university excellence and problem-solving.
iv. Process Approach	Allocate resources for effective and efficient management, ensuring process coherence, and consistent outputs.
v. Improvement	Deal with training and development. An effective institute emphasizes continuous improvement.
vi. Evidence-based Decision-Making	Involve the examination and analysis of facts and information to achieve desired results.
vii. Relationship Management	Sustain success by managing relationships with interested parties, establishing mutually beneficial relationships.

Reference (ISO 9001:2015).

(5 items). The quality management scale utilized a five-point Likert scale, ranging from 1 to 5 (from strongly disagree to agree strongly). The Likert scale is a commonly used psychometric tool for assessing attitudes and perceptions, where respondents are presented with a series of statements and asked to indicate their level of agreement [28].

4.4. Reliability and validity

Face validity was established through a panel of experts, including individuals with Ph.D. degrees in management studies, teaching experience in management subjects at BBA and MBA levels, and scholars in management, quality management, ISO 9001, and social sciences. The validation process involved five experts assessing the questionnaire for content validity, with a psychometric expert checking for common errors such as confusing, leading, and double-barreled items in the survey instrument. To ensure the questionnaire was what it was intended for, construct validity was checked using factor analysis. This involves principal component analysis with varimax rotation, performed in SPSS. Additional statistical tests included the Kaiser-Mayer Olkin (KMO) test, which validates suitability with values exceeding 0.5, and Bartlett's test of sphericity, indicating the usefulness of user data for factor analysis with a low p-value below 0.05. Items with loadings below 0.4 were excluded, and constructs with eigenvalues of less than one were eliminated during the assessment. After pilot testing, the refined questionnaire demonstrated a reliability of 0.727, as measured by Cronbach's Alpha. Mean, standard deviation, and *t*-tests were used for data analysis in SPSS.

5. Results and fuzzy logic analysis

In addition to statistical analysis, Fuzzy Logic was introduced as a supplementary tool to interpret the findings. Fuzzy Logic provides a mathematical framework for dealing with uncertainty and vagueness in human judgment, making it suitable for analyzing perceptions of quality management practices. The process involves defining membership functions for each variable (e.g., customer satisfaction, leadership, etc.), fuzzifying the input data, applying fuzzy inference rules to process the relationships, and finally defuzzifying the results to generate crisp output values. The output of Fuzzy Logic analysis was interpreted to provide nuanced insights into the levels of quality management practices among universities, complementing the results of traditional statistical tests.

Responses of HODs

Table 2 presents the mean scores and standard deviations for statements related to customer focus, comparing public and private sector universities. The *t*-tests revealed a significant difference in the overall customer focus rating, with HODs from public sector universities rating it higher than those from private sector universities ($t = 2.187$, $p = 0.038$). This implies that public-sector universities may place a higher priority on customizing services compared to private-sector universities.

Table 3 displays the mean scores and standard deviations for statements concerning leadership. The *t*-tests indicate that there are no significant differences between public and private sector universities regarding perceptions of leadership.

Table 4 presents the mean scores and standard deviations for statements regarding the engagement of people. The *t*-tests revealed no significant differences between public and private sector universities in this regard.

Table 5 presents the mean scores and standard deviations for statements concerning the process approach. The *t*-tests indicate no significant differences between public and private sector universities regarding the process approach.

Table 6 displays the mean scores and standard deviations for statements regarding improvement. The *t*-tests indicate no significant differences between public and private sector universities in this regard.

Table 7 presents the mean scores and standard deviations for statements concerning evidence-based decision-making. The *t*-tests reveal no significant differences between public and private sector universities regarding evidence-based decision-making.

Table 8 presents the mean scores and standard deviations for statements regarding relationship management. The *t*-tests indicate a significant difference in the overall rating, with HODs from public sector universities rating relationship management higher than those from private sector universities ($t = 3.274$, $p = .003$).

Table 9 illustrates the overall mean scores and standard deviations for quality management practices as perceived by Heads of Departments (HODs) in public and private sector universities. The *t*-test results reveal a significant difference between the sectors, with public sector HODs (mean = 2.84, SD = 0.15) rating quality management practices significantly higher than private sector HODs (mean = 2.61, SD = 0.17) at a

Table 2
HODs' Responses about Customer Focus.

Statement	Sector	Mean	*SD*	t-value	Sig
University management assesses HOD satisfaction regularly.	Public	3.57	0.85	1.472	0.153
	Private	3.00	1.17		
University management resolves HOD's complaints.	Public	3.35	1.49	0.544	0.591
	Private	3.07	1.26		
University management arranges counseling support for HODs.	Public	2.57	1.50	0.634	0.532
	Private	2.21		1.47	
HODs are involved in decision-making.	Public	2.57	1.22	0.282	0.781
	Private	2.42	1.45	1.45	
University officials are easily available to the HODs.	Public	2.50	1.50	0.784	0.440
	Private	2.07	1.38		
University management arranges services for HODs' career development.	Public	2.50	1.34	0.687	0.498
	Private	2.14	1.40		
University management has a system for taking HODs' views.	Public	2.50	1.22	1.102	0.281
	Private	2.00	1.17		
HODs are awarded for performing well.	Public	2.57	1.45	0.970	0.341
	Private	2.07	1.18		
Overall HODs' responses about customer focus	Public	2.76	0.52	2.187	.038
	Private	2.37	0.41		

Note. df= 26 N = 28(public=14; private=14).

Table 3
HODs' Responses to Leadership.

Statement	Sector	Mean	*SD*	t-value	Sig
The leadership has a clear vision.	Public	2.50	1.40	0.302	0.765
	Private	2.35	1.08		
The leadership has a clear mission and purpose.	Public	2.57	1.12	0.144	0.887
	Private	2.50	1.40		
The university sets clear and specific objectives.	Public	2.57	1.39	0.414	0.889
	Private	2.50	1.28		
The university has a policy to improve quality and maintain standards.	Public	2.50	1.09	0.310	0.759
	Private	2.35	1.33		
University management ensures enough resources are allocated adequate resources to support quality improvement efforts.	Public	2.57	1.15	0.147	0.884
	Private	2.50	1.40		
Departments are involved Long-term planning.	Public	2.50	1.40	0.132	0.896
	Private	2.42	1.45		
University senior management actively leads to highly visible leadership in maintaining an environment that supports quality improvement.	Public	2.57	1.55	0.657	0.517
The university clearly identifies job requirements and expectations very clearly.	Private	2.21	1.31		
	Public	2.50	1.23	0.138	0.891
	Private	2.42	1.45	0.130	0.898
Decision-making is based on accurate and factual information in the university.	Public	2.57	1.39	0.604	0.551
	Private	2.50	1.50		
Overall teachers' responses about leadership.	Public	2.53	.49		
	Private	2.42	.54		

Note. df= 26 N = 28(public=14; private=14)

Table 4
HODs' Responses to the Engagement of People.

Statement	Sector	Mean	*SD*	t-value	Sig
University management forms various teams to solve HODs/ teachers' problems.	Public	3.14	1.56	−0.937	0.357
	Private	3.07	1.38		
HODs/teachers are involved in course reviews.	Public	3.42	1.78	−0.105	0.918
	Private	3.21	1.31		
HODs/teachers are involved in program reviews.	Public	3.14	1.70	−0.443	0.669
	Private	3.00	1.66		
Departments at the university have collaboration with international universities.	Public	2.57	1.28	−0.144	0.886
	Private	2.50	1.09		
Departmental meetings of the staff are regularly conducted to address quality problems of the academic program.	Public	2.50	1.22	−0.106	0.917
	Private	2.42	1.34		
Each course's contents are developed after discussions with external staff with expertise in that area.	Public	2.57	1.22	0.144	0.887
	Private	2.50	1.40		
Overall HOD responses about the engagement of people	Public	2.89	0.58	0.479	0.636
	Private	2.78	0.59		

Table 5
HODs' Responses to the Process Approach.

Statement	Sector	Mean	SD	t-value	Sig
The university has a transportation facility.	Public	3.28	1.13	1.387	0.177
	Private	2.57	1.55		
The university has strong central support for research activities.	Public	2.57	1.50	0.270	0.789
	Private	2.42	1.28		
The university offers sufficient medical facilities.	Public	2.57	0.75	0.179	0.859
	Private	2.50	1.28		
The university has sufficient financial resources.	Public	2.28	0.75	−0.320	0.752
	Private	2.42	1.28		
The university has sufficient hostel facilities for students.	Public	2.28	1.13	−0.467	0.645
	Private	2.50	1.28		
The university has reliable internet access.	Public	2.28	1.32	−0.467	0.645
	Private	2.50	1.09		
The university has a sufficient library facility and is well-equipped.	Public	2.50	0.94	−0.193	0.848
	Private	2.57	1.01		
The university has sufficient cafeteria services to meet the needs of students and staff.	Public	2.50	1.01	0.360	0.722
	Private	2.35	1.08		
Overall HODs responses to the process approach	Public	2.53	0.31	0.440	0.663
	Private	2.48	0.33		

Note. df= 26 N = 28(public=14; private=14).

Table 6
HODs' Responses to Improvement.

Statement	Sector	Mean	*SD*	t-value	Sig
University management develops training programs for HODs/ teachers.	Public	2.21	1.47	0.149	0.883
	Private	2.14	1.02		
HODs and teachers are given opportunities to enhance their qualifications.	Public	2.50	1.69	0.126	0.901
	Private	2.42	1.28		
The university supports continuous professional development for HODs and teachers.	Public	2.57	1.82	0.577	0.569
	Private	2.21	1.42		
The university allocates sufficient funding for research activities.	Public	2.35	1.54	0.263	0.794
	Private	2.21	1.31		
HODs and teachers are encouraged to conduct research studies.	Public	2.21	1.25	−0.299	0.767
	Private	2.35	1.27		
Market research is conducted before launching the university's proposed program.	Public	2.57	1.55	0.603	0.522
	Private	2.21	1.57		
The university has an effective system that allows faculty to provide suggestions to management on how to improve quality.	Public	2.57	1.22	1.333	0.194
	Private	2.00	1.07		
HODs responded positively to the improvement.	Public	2.42	0.79	0.802	0.430
	Private	2.22	0.52		

Note. df= 26 N = 28(public=14; private=14).

statistically significant level ($t = 3.657$, $p = .001$). This suggests that, according to the perceptions of HODs, public sector universities may have more robust and effective quality management practices in place compared to private sector universities.

Table 7
HODs' Responses to Evidence-Based Decision Making.

Statement	Sector	Mean	*SD*	t-value	Sig
A manual of the quality assurance system exists at the university.	Public	3.42	1.28	.587	.562
	Private	3.14	1.29		
Details of the staff involved in quality assurance and control arrangements are available.	Public	3.64	1.00	.699	.491
	Private	3.35	1.15		
Transfers in and out of programs or courses to facilitate teachers are clearly recorded.	Public	3.50	1.40	-0.434	.668
	Private	3.71	1.20		
The records of all resources are up to date and available.	Public	4.00	1.24	1.755	.091
	Private	3.07	1.54		
Detail of learning activities is available to the teachers.	Public	3.35	1.21	−1.254	.221
	Private	3.85	.86		
Overall HODs responses about evidence-based decision making	Public	3.58	.45	.714	.482
	Private	3.42	.68		

Note. df= 26 N = 28(public=14; private=14).

Table 8
HODs' Responses to Relationship Management.

Statement	Sector	Mean	*SD*	t-value	Sig
HODs/teachers have regard for each other's opinions.	Public	3.00	1.56	.687	.498
	Private	2.64	1.15		
The department has effective links with other institutions.	Public	3.57	.85	2.575	.011
	Private	2.64	.92		
Detail regarding the availability of all learning resources is communicated to HODs/teachers.	Public	2.78	1.47	-0.142	.888
	Private	2.85	1.16		
University strives to establish long-term relationships with HODs/ teachers.	Public	2.78	1.25	1.486	.149
	Private	2.14	1.02		
University has an effective communication flow of information between departments.	Public	3.57	1.15	1.965	.060
	Private	2.64	1.33		
Overall HODs responses about relationship management	Public	3.14	.46	3.274	.003
	Private	2.58	.44		

Note. df= 26 N = 28(public=14; private=14).

Table 9
Overall HODs' Responses to Quality Management Practices.

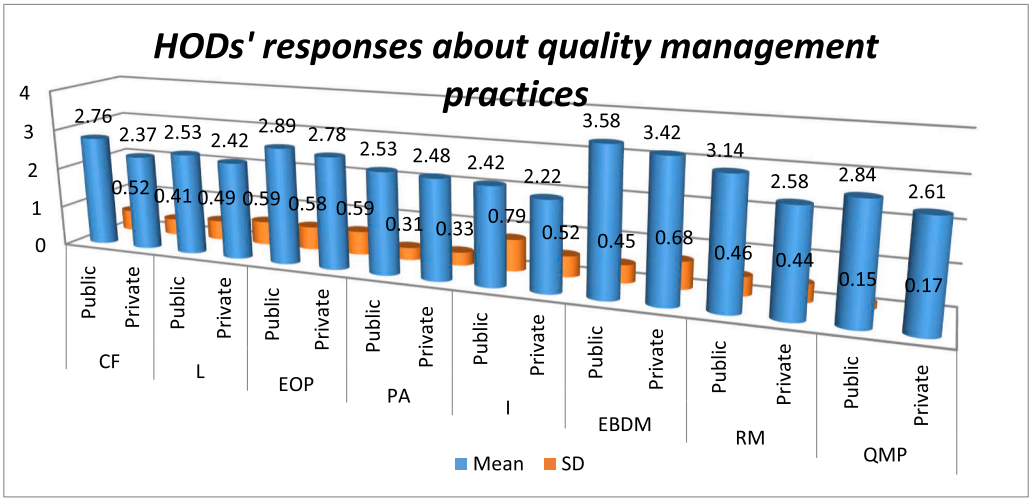
Sector	Mean	*SD*	t-value	Sig
Public	2.84	.15	3.657	.001
Private	2.61	.17		

Note. df= 26 N = 28(public=14; private=14).

Fig. 2.

In the above figure, the results indicate that public sector HODs rated customer focus significantly higher than private sector HODs (2.76 vs. 2.37, $t = 2.187$). No significant differences were found in leadership, engagement of people, process approach, and improvement practices. However, public sector HODs rated evidence-based decision-making and relationship management significantly higher than private sector HODs (3.58 vs. 3.42, $t = 3.274$; 3.14 vs. 2.58, $t = 3.657$).

The proposed approach is based on fuzzy logic and describes a model that allows us to evaluate and estimate the actual weight of each factor



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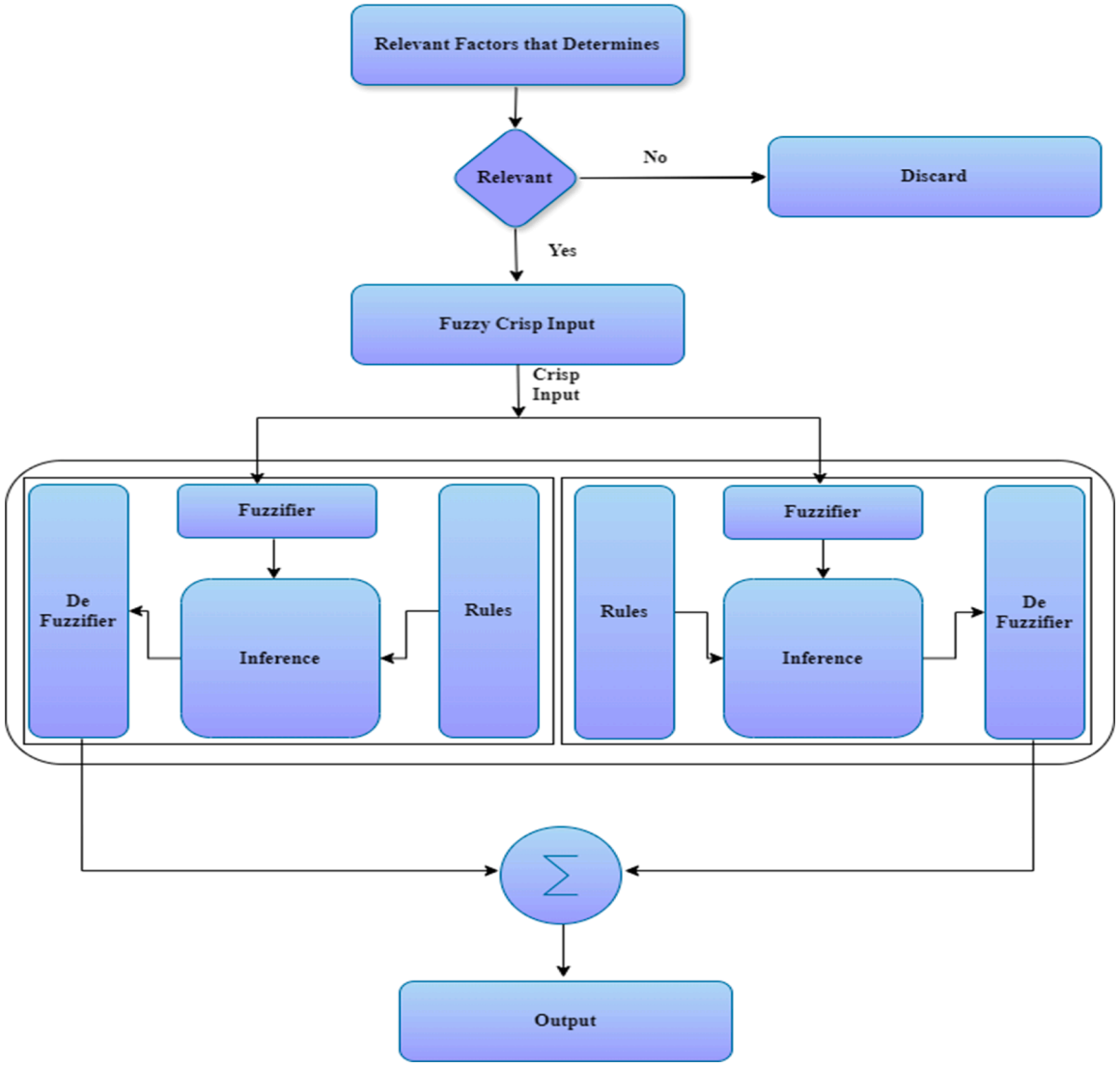

Fig. 3. Data Flow diagram of simulation.

only for the competitive landscape. The proposed model is more advanced and gives us an accurate figure for measurement, estimation, and evaluation. Thus, using this system helps us to make any policy in decision-making. Intelligent techniques are versatile in competitive factors classification and estimation. Prominent techniques like fuzzy logic play a significant role in the classification of competitive factors and help develop various continuous control schemes. This work presents the effectiveness of the fuzzy logic concept in classifying competitive factors. The following is a Flow chart representing the proposal methodology. Fig. 3 is a representation of the proposed methodology on how the flow of work is performed. This shows the study of all factors relevant to the proposed model. Data discarded all irrelevant factors except competitive factors. Only competitive factors will be processed and will be used for the evaluation of weight through FIS. $A \cap B \cap C \cap D \cap E \cap (a, b, c, d, e, f) = \min[\mu A\ (a), \mu B\ (b), \mu C\ (c), \mu D(d), \mu E\ (e), \mu F\ (f)]$ (1)

Fig. 3 shows the dataflow diagram; relevant data was processed, and irrelevant data was discarded. The relevant data is converted into crip values to process in fuzzy. After the implementation of fuzzy rules, the results were whether the quality management system exists in universities. Fig. 4 shows the input parameters for the quality management assessment. Figs. 5 and 6,7 show the relationship of input and output in different parameters.

Fig. 4 shows that with two membership functions per input (Low/High), the rule base acts like a simple priority grid: QMS drops when any

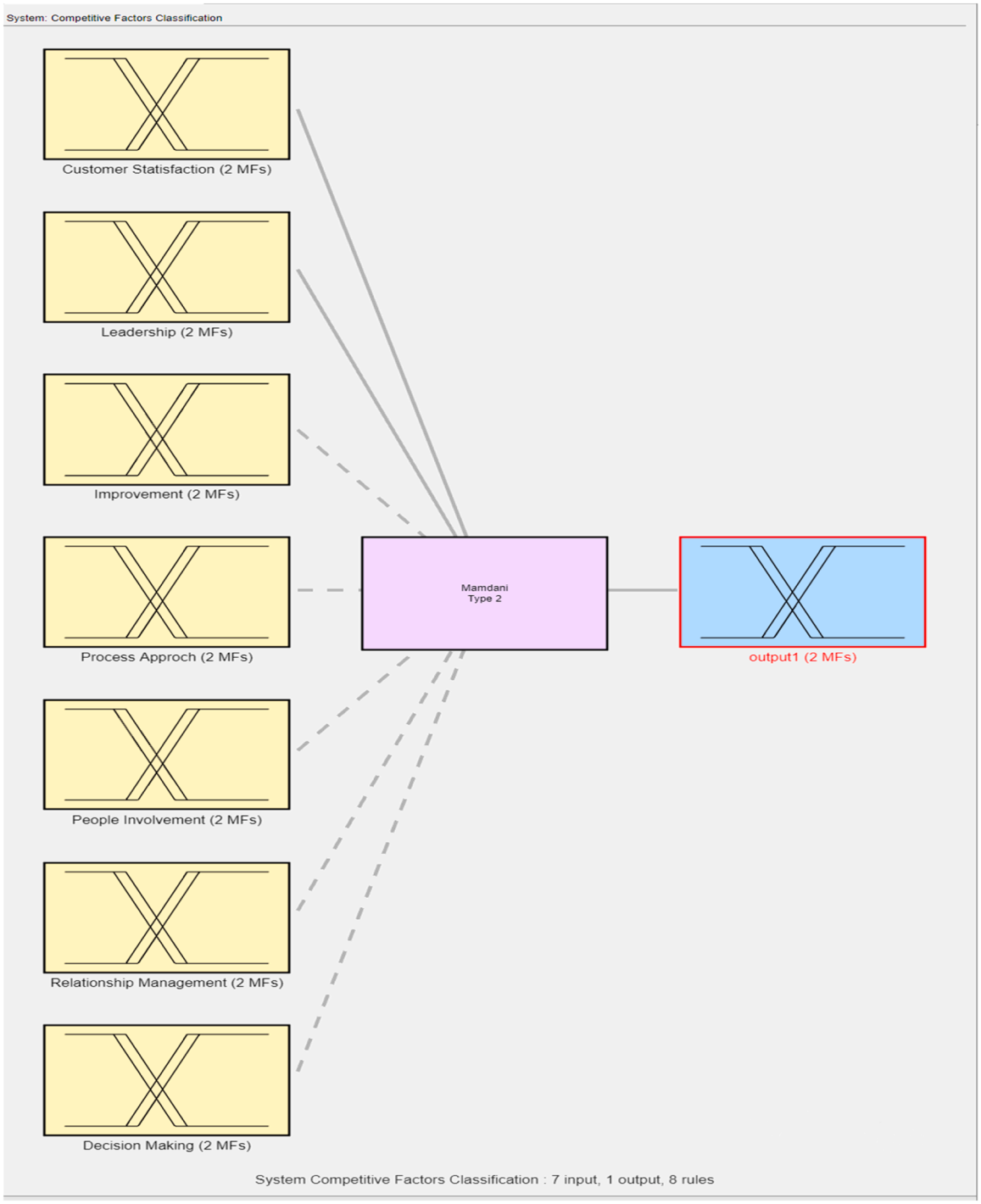

Fig. 4. Input Parameter for Assessment.

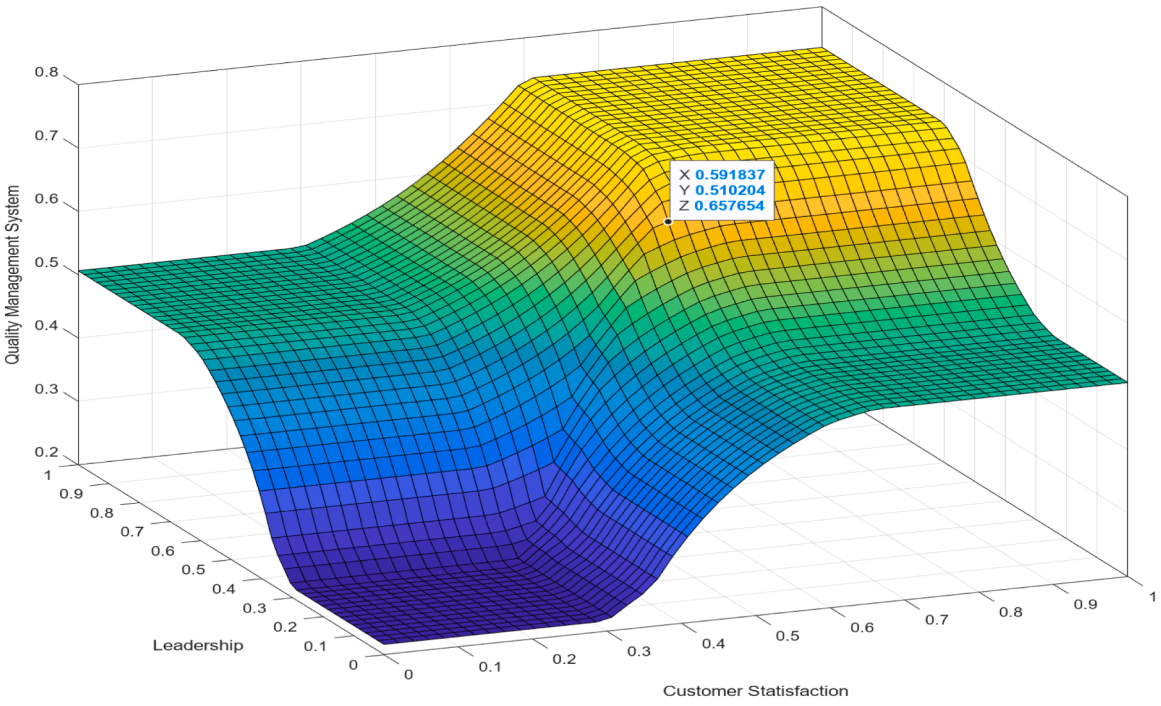

Fig. 5. Output of Leadership and Customer Satisfaction.

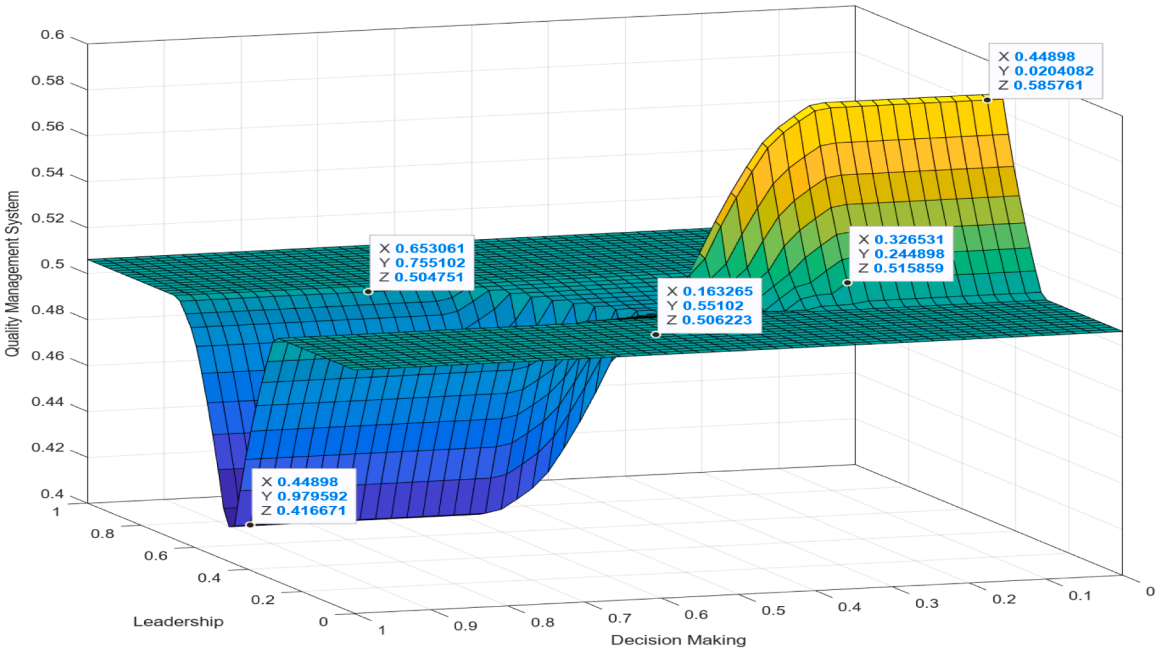

Fig. 6. Output of Leadership and decision-making.

foundational input (e.g., leadership, process approach) is low, and rises when key pairs are high (leadership+decision-making; process+improvement). Every output can be traced to a specific rule, which helps with auditability. Decision cue: use the rule trace to explain "why" a programme scored as it did to QA committees and accreditors.

Fig. 5 shows that the surface climbs steadily when both leadership and customer satisfaction sit in the mid-to-high range, then levels off near the top. Around $L \approx 0.59$, CS≈0.51 → QMS≈0.66, When leadership is low, QMS stays muted even if satisfaction improves—service fixes alone can't overcome weak governance. Decision cue: improve student-facing services and management practices in tandem (clear goals, faculty support), not one without the other.

Fig. 6. Shows that when decision-making improves from low to moderate, provided leadership is at least mid-range. Where leadership is weak, new tools and committees deliver smaller gains (a shallow slope). With stronger leadership, the same change produces a sharper lift (the ridge on the surface).

Fig. 7 shows that these two work as a pair. Strong process discipline without an active improvement culture plateau; ad-hoc improvement without process discipline falls into a trough. The best results come when both are present (the yellow ridge). Typical ridge points include Proc≈0.43, Impr≈0.10 → QMS≈0.63, and Proc≈0.18, Impr≈0.41 →

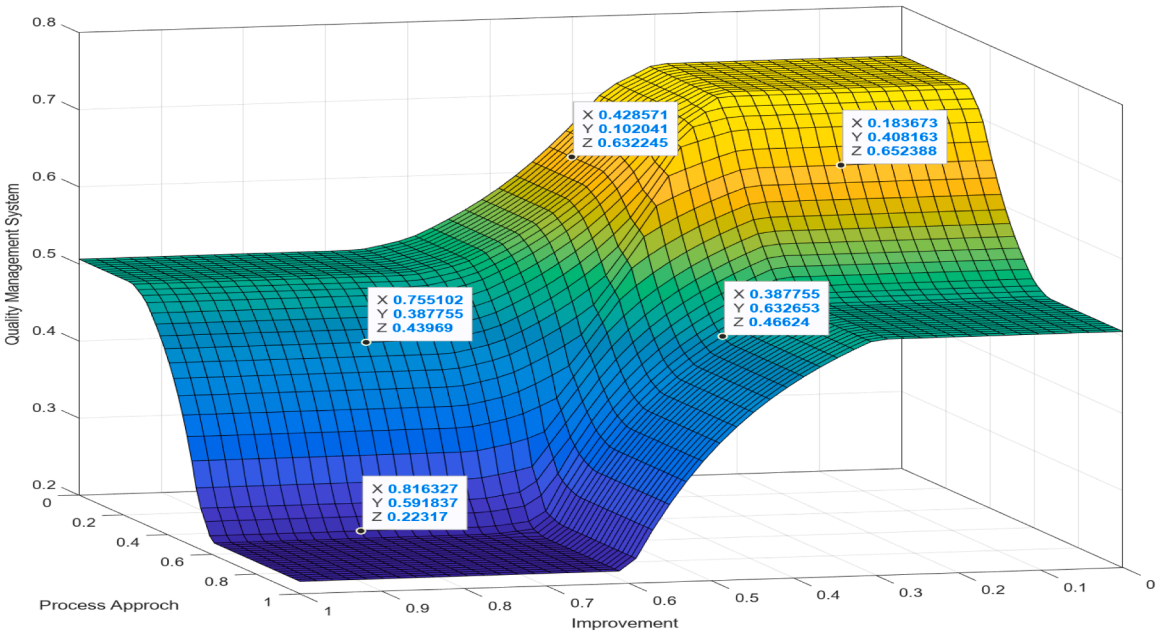

Fig. 7. Output of process approach and improvement.

QMS≈0.65—neither factor needs to be maxed out, but they must show up together. Decision cue: roll out process redesign and continuous-improvement routines side by side (e.g., PDSA in course reviews), not as separate initiatives.

6. Discussion

Evaluating quality management practices in universities involves examining the effectiveness of systems and processes aimed at maintaining and improving educational standards, research quality, administrative efficiency, and student satisfaction. The goal is to pinpoint areas needing improvement and ensure universities fulfill their mission of delivering high-quality education and services. This study focused on assessing quality management models in Higher Education, highlighting the significance of quality and exploring quality assurance practices in different countries. Qualitative methods, including purposive and snowball sampling, were employed, and interviews were conducted with council members and education ministry officials. Findings revealed that institutions shoulder significant quality management responsibilities due to limitations in bureaucratic structures [29]. The initial research hypothesis aimed to determine if there was a statistically significant difference in customer focus between private and public universities, as perceived by Heads of Departments (HODs). The mean score for customer focus among public sector HODs was notably high, indicating satisfaction, whereas private sector HODs showed dissatisfaction, with a low rating for customer focus. This discrepancy likely stems from the public sector's government control contrasting with the private sector's leadership. Both public and private sector HODs expressed dissatisfaction with leadership practices, aligning with prior research [30,31]. (Table 2). The study found no statistically significant difference in the perception of leadership between private and public universities, as reported by Heads of Departments (HODs). Results also highlighted top management commitment as a major challenge in both public and private universities regarding quality management, a sentiment echoed by O'Mahony and Garavan [32]. Moturi and Mbithi [33] emphasized the criticality of management commitment, shared trust, resource provision, and organizational culture for successful ISO 9001 implementation. However, the study indicated doubts among HODs regarding university leadership's ability to maintain quality, consistent with Djerdjour and Patel's [31] observation that top management in developing countries lacks commitment to quality. Rasool [34] further suggested a greater involvement of the industry in student practical training and curriculum development. (Table 3).

Regarding the engagement of people, there was no statistically significant difference between private and public universities, as perceived by HODs. Both sectors' HODs reported a moderate mean score for engagement, indicating satisfaction. However, there is still room for improvement, particularly in terms of departmental collaboration with international universities and professional bodies involved in program reviews, both in public and private universities. (Table 4). According to Moturi and Mbithi [33], these factors are key to success. Employee involvement is also seen as important [35]. Regarding the process approach, there was no significant difference in how private and public universities are perceived by the heads of departments. HODs from both sectors were dissatisfied with the process approach. This finding aligns with Iqbal, Jalal, and Mahmood's [36] observation about a shortage of physical facilities but is inconsistent with the findings of Hameedullah [37], who found that both sectors of public and private universities were satisfied with internet services. This inconsistency is like Hameedullah's [37] observation that government libraries are badly managed. Furthermore, Mai [38] indicates that effective resource management increases satisfaction among the recipients. (Table 5).

There was no statistically significant difference in the perception of improvement between private and public universities, as reported by HODs. The overall mean score for improvement among HODs in both sectors was low. This could be attributed to a lack of management encouragement towards research, continuous professional development, training, and a proper system for suggesting quality improvement. A similar finding was reported by Rasool [34], who emphasized the need for improvement in the quality of private-sector universities. The Higher Education Commission should provide equal opportunities for faculty development and allocate funds accordingly. Universities are primarily important in providing services to enhance the contribution of society through research, learning, and service activities [39]. Quality management (QM) should be a priority for universities to enhance the quality of learning, which can, in turn, improve degree results and student satisfaction, as shown in Table 6.

There was no statistically significant difference in the perception of evidence-based decision-making between private and public universities, as perceived by stakeholders. Overall, HODs agreed with the

documentation and evidence, possibly due to the Higher Education Commission and Institutional Performance Evaluations (IPEs) self-assessment process. This finding is consistent with Ahmed's [40] conclusion that there is a 77 % agreement rate among department heads regarding documentation (Table 7). Similarly, there was no statistically significant difference in the perception of relationship management between private and public universities as perceived by stakeholders. Public sector HODs reported a moderate mean score, while private sector HODs reported a low mean score for relationship management. This mixed picture may be attributed to differences in communication setups and organizational hierarchies. Akuegwu and Ntukidem [41] found that public universities had better conditions of service and staff relationships, as indicated by their higher mean values (Table 8).

Overall, these principles suggest a moderate potential for both public and private universities to move toward implementing ISO 9001 quality management. There was a significant difference in perception between public and private sector HODs, with the public sector slightly higher in terms of adopting and promoting ISO 9001:2015. This difference may be due to factors like higher qualifications of teachers and HODs' job security, and government funding in the public sector compared to the private sector universities.

Beyond summarizing empirical findings, these results raise important questions about the underlying causes of weak ratings in continuous improvement and leadership across both sectors. Limited state funding, rigidity of bureaucracy, and a hierarchical organizational culture may constrain management commitment and the ability to sustain ongoing initiatives for improvement. These constraints weaken staff limit innovation in teaching and research, motivation, and reduce universities' capacity to respond effectively to emerging societal and academic needs. Leadership weaknesses arise from limited faculty autonomy, hierarchical decision-making, and political influence, which discourage accountability and innovation despite HEC's Quality Enhancement Cells.

They also hinder cross-departmental accountability and collaboration, which are essential for long-term quality enhancement.

Differences between private and public universities can also be partly explained by variations in governance support, while private institutions depend heavily on external sponsorships and tuition fees. To address these challenges, universities may need to adopt more participatory governance models that encourage collaborative practices of quality management, empower staff and faculty, and allocate resources strategically. Such models could help balance accountability with innovation, foster a stronger culture of continuous improvement, and overcome weaknesses of leadership. To ensure effective implementation, actions should be prioritized. The first priority should be developing strong management competencies and leadership through professional development programs. The second should focus on staff training, sustained funding for research, and innovation to maintain continuous improvement over time. The third party should be establishing a system of participatory governance that involves administrative staff and faculty in quality-related decision-making. This order ensures sustainability, training sustains long-term quality culture, governance embeds accountability, and leadership builds direction.

Conclusion

The study's findings revealed that both public and private sector universities do not effectively practice leadership, process approach, and improvement. Additionally, in the private sector, customer focus and relationship management were found to be lacking. Overall, the perceptions of Heads of Departments (HODs) indicate that quality management practices were only moderately practiced in both sectors. This suggests that while some practices of quality management were being implemented, there is a significant need for improvement in both public and private universities.

Recommendations

In this regard strategic recommendations are provided for both private and public sector universities to increase overall practices of quality management.

Short-Term (Immediate Actions)

- ISO standard awareness should be imparted, highlighted the need of practices of quality management complying with these standards.
- Top management should be precisely targeted through workshops, conferences, and seminars on ISO 9001 certification.
- For seeking support meetings should be held for HODs to discuss problems also.
- Immediate improvement should be made in service like research support, healthcare, cafeteria amenities, internet facilities, along with ensuring libraries are well-stocked with current resources.

Medium-Term (Capacity Building and Motivation)

- A strong evaluation system for both academic and administrative staff should be implemented, linked to promotions and incentives.
- Special prizes for HODs who contribute to low-cost research projects should be introduced as motivational factors.
- Intentional training programs for HODs on ISO processes should be provided to build capacity and alignment with quality standards.

Long-Term (Sustainability and Strategic Growth)

- Institutional Performance Evaluations (IPEs) should be encouraged, and universities should transition to ISO certification for continuous improvement. This not only enhances internal quality but also aids in improving international accreditation.
- Leadership styles should be explored, especially their influence on the adoption of ISO 21,001:2018, to optimize leadership strategies for effective quality management in academic institutions.
- Longitudinal studies should be conducted to record changes in quality management over time, including exploration of effects on student outcomes (academic performance, satisfaction, and employability), and integration of emerging standards with attention to cultural factors in adoption.
- Comparative studies with ISO-certified universities should be undertaken to benchmark practices and identify transferable lessons.
- Qualitative research involving in-depth interviews should be conducted to explore resistance to quality improvement within academic institutions.
- Multi-criteria analyses should be employed, integrating academic performance, student satisfaction, and social impact into evaluation frameworks to holistically assess quality management effectiveness.

Limitations

Although this study provides valuable insights, certain limitations should be acknowledged. The small and geographically limited sample, focused on universities in Punjab, Khyber-Pakhtunkhwa, and the Islamabad Capital Territory, may have introduced bias and limited the generalizability of the findings to educational contexts or other regions. Furthermore, the cross-sectional design restricts the ability to detect how quality management practices evolve over time, potentially overlooking institutional changes or long-term effects. Regardless of these restrictions, the study offers an important foundation for future research, emphasizing the need for longitudinal and larger investigations to spread and validate these findings.

Ethics approval and consent to participate

All participants were informed of the purpose, scope, and objectives

of the study. They were assured of the confidentiality and anonymity of their responses, and their participation was entirely voluntary. Consent was obtained from each respondent before participation, ensuring that they fully understood their rights, including the right to withdraw at any time without consequence. The consent process complied with ethical research standards and institutional guidelines.

Consent for publication

We confirm that we have reviewed the final version of the manuscript and approved its submission for publication. We understand that the manuscript will be publicly accessible, and we accept the journal's policies on publication and copyright.

Competing interests

Authors have no conflict of interest.

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Authors' contributions

Author 1 wrote the idea and collected the questionnaire-based dataset. Author 2 analyzed the results and proofread an article. Author 2 set fuzzy sets implementation, methodology, funding and proofread the article, author 4 analyzed the dataset, collected the questionnaire-based dataset, and proofread the article.

CRediT authorship contribution statement

Sunble Bibi: Writing – original draft, Investigation, Data curation, Conceptualization. **Muhammad Adnan Maqbool:** Writing – review & editing, Visualization, Validation, Formal analysis. **Muhammad Imran:** Writing – original draft, Software, Funding acquisition. **Norah Almusharraf:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Formal analysis.

Declaration of competing interest

The authors declared no conflict of interest.

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Appendix A

Questionnaire for Heads of Departments
Quality Management Practices
Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree
Customer Focus

No.	Statement	1	2	3	4	5
1	University management assesses HODs' satisfaction regularly.					
2	University management promptly resolves HODs complaints.					
3	University management arranges counselling support for HODs.					
4	HODs are involved in decision-making.					
5	University officials are easily available to HODs.					
6	University arranges services for HODs career development.					
7	University has a system for taking HODs views.					
8	HODs are awarded for performing well.					

Leadership

No.	Statement	1	2	3	4	5
1	The leadership has a clear vision.					
2	The leadership has a clear mission.					
3	The university leadership has clear objectives.					
4	The university has policies to improve quality and maintain standards.					
5	University allocates resources for quality improvement.					
6	Long-term planning is done at the departmental level.					
7	Senior management provides visible leadership for quality improvement.					
8	University identifies job specifications clearly.					
9	Decision-making is based on factual information.					

Engagement of People

No.	Statement	1	2	3	4	5
1	University forms teams to solve HODs problems.					
2	HODs are involved in course reviews.					
3	HODs are involved in program reviews.					
4	Departments collaborate with international universities.					
5	Departmental staff meetings address quality problems regularly.					
6	Course content is developed after discussions with external experts.					

Process Approach

No.	Statement	1	2	3	4	5
1	University has transportation facilities.					
2	University provides central support for research.					
3	University has sufficient medical facilities.					
4	University has sufficient financial resources.					
5	University has sufficient hostel facilities.					
6	University provides adequate internet access.					
7	University has a sufficient library facility.					
8	University has sufficient cafeteria services.					

Improvement

No.	Statement	1	2	3	4	5
1	University develops training programs for HODs.					
2	HODs are provided opportunities to improve qualifications.					
3	Continuous professional development is supported.					
4	Sufficient research funds are allocated.					
5	HODs are encouraged to conduct research studies.					
6	Market research is conducted for proposed programs.					
7	Faculty can suggest improvements to management.					

Evidence-Based Decision-Making

No.	Statement	1	2	3	4	5
1	A manual of the quality assurance system exists.					
2	Staff details for quality assurance are available.					
3	Transfers of programs/courses are clearly recorded.					
4	Records of all resources are up to date.					
5	Details of learning activities are available to teachers.					

Relationship Management

No.	Statement	1	2	3	4	5
1	HODs respect each other's opinions.					
2	Department has effective links with other institutions.					
3	Learning resources are communicated to HODs.					
4	University strives for long-term relationships with HODs.					
5	University ensures effective communication flow between departments.					

Data availability

Data will be made available on request.

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