Investigating determinants of innovation performance maturity in Malaysian private universities: a partial least squares structural equation modelling analysis

Ainin Zakiah Othman[1*], *Nur Balqishanis* Zainal Abidin[1]

[1]Faculty of Sciences, Department of Physical and Mathematical Science, 31900 Universiti Tunku Abdul Rahman, Kampar, Perak, Malaysia

Abstract. In response to the dynamic changes in the contemporary world, innovation has become imperative for Private Higher Education Institutions (HEIs) to keep pace with evolving institutions. While Total Quality Management (TQM) practices have been extensively examined in the context of determining factors supporting innovation performance, conflicting results from various studies necessitate a fresh perspective. This study adopts the Capability Maturity Model (CMM) to enhance the impact of TQM practices on Innovation Performance, introducing a novel hybrid theory termed TQM-CMM which is a combination of TQM and CMM to enhance the application of TQM practices by assessing its maturity level, addressing the issue of conflicting results observed in previous studies. The objective is to elucidate the interconnected relationships among key factors influencing innovation performance in private higher education institutions (HEIs). A survey conducted at Malaysian private HEIs, yielding 115 valid responses, reveals that two out of seven hypothesized correlates among the constructs were statistically significant at two-tailed tests, evidenced by t values exceeding 1.96 calculated from 10,000 bootstrapped samples. This research contributes valuable insights for academics and offers potential enhancements to university performance.

1 Introduction

In the modern dynamic higher education scene, the drive for innovation has become critical for Malaysian private HEIs to not only remain relevant but prosper in an era of rapid transitions. Key performance indicators (KPI) which are considered an effective assessment of the quality of the university's output based on their planning and performance improvement, are often used in HEIs for evaluation [1]. The interaction of innovation, quality management, and organizational maturity plays an essential part in defining educational institutions' success trajectories. This study examines the determinants of innovation performance at Malaysian private institutions using the collaborative lenses of Total Quality Management (TQM) and the Capability Maturity Model (CMM).

*Corresponding author: aininzach@1utar.my

TQM refers to initiatives made across every level of an organization to create and sustain an environment in which employees may constantly expand their capability to deliver instant items and/or services that consumers appreciate enormously [2]. TQM and innovation are two principles that work together to create organizational accomplishment which has been found in earlier research that TQM and innovation are determinants of organization performance [3]. However, previous studies have shown conflicting results, which is why there is no consensus on whether TQM features help to develop an environment and culture that supports innovation [3–5]. Consequently, CMM is employed to articulate development in organizations, including development, validation, and evaluation, to oversee decision-makers and institutions that aid these organizations [6]. CMM is a method that may be used to analyze an organization's maturity level across particular key aspects, with maturity levels indicating an organization's existing capabilities and desired state [7].

Structural Equation Modeling (SEM) is the preferred method for analyzing cause-effect relationship models with latent variables, particularly in gaining comprehensive insights into drivers like customer satisfaction, brand image, or corporate reputation [8]. Partial Least Square Structural Equation Modelling (PLS-SEM), a variance-based approach within structural equation modeling, offers greater accessibility and flexibility [9]. It adopts a causal-predictive perspective within SEM, prioritizing prediction in model estimation while also serving as a valuable tool for validating measurement models [10]. PLS-SEM is favored among researchers due to its relevance in addressing common modeling challenges such as handling restricted samples, non-normal data distributions, and assessing formative and reflective measurement, with a significant emphasis on its capability to accommodate small sample sizes and relax stringent distributional assumptions [11].

This study aims to explore the interconnected relationships among constructs that contribute to innovation performance in private HEIs, drawing on relevant theoretical foundations. The theoretical framework is constructed from existing literature, and a proposed conceptual framework will be introduced for empirical testing to validate the model.

2 Literature Review

Innovation is essential for organization performance and a primary driver of productivity development where Research and Development (R&D), product and process development, as well as marketing and organizational transformation, are all examples of innovation [12]. Innovation performance is the process through which a company achieves and maintains innovation through ongoing research into novel concepts with the potential for commercialization [13]. The concept underlying HEIs, according to [14], is to combine a person's general, intellectual, spiritual, and cultural abilities to equip them to be of enormous benefit to humanity. Individuals must therefore be able to fully utilize their cognitive, interpersonal, and behavioral skills to benefit both themselves and the broader society.

Total Quality Management (TQM), viewed as the second industrial revolution, emerged in the 1940s to elevate Japan's competitive quality, influenced by W. E. Deming's work in the 1950s [15,16]. The establishment of the Malcolm Baldrige National Award in 1987 and the promotion of Deming's management philosophy heightened its significance for organizations in strategic planning for global competitiveness [17]. TQM, an integrated management concept, aims to consistently improve goods, procedures, and services to exceed consumer expectations, emphasizing innovation, employee engagement, and rapid responses to changing needs [17,18]. Meanwhile, the Capability Maturity Model (CMM) focuses on continual process improvement, categorizing capability enhancement into five levels, providing organizations with a roadmap for progress [19,20]. Research indicates that CMM

outcomes can identify inhibitors to knowledge-sharing dynamics, aiding in the development of improvement agendas for Higher Education Institutions (HEIs) [21,22].

Numerous studies have extensively examined the determinants influencing innovation performance in HEIs and other organizations through TQM. However, the effectiveness of TQM practices in consistently influencing innovation performance has been shown to be variable, as supported by prior research [23]. While it has been acknowledged that the variables and practices of TQM undoubtedly contribute to quality improvement [24], challenges have persisted since 1994 due to the incomplete support for comprehensive integration of TQM practices by management [25]. This issue is indicative of a deficiency in the effective implementation of determinants, as highlighted in the study conducted by [24]. Therefore, the CMM emerges as an ideal model to complement TQM proposing a novel hybrid theory of TQM-CMM. CMM not only identifies the maturity level of determinants in organizations but also ensures their effective implementation at the highest level of maturity.

2.1 Research Hypotheses

The research delves into the critical constructs influencing innovation performance within private HEIs. Seven key constructs are identified, each hypothesized to have a significant impact on fostering innovation within these institutions. These enablers include leadership management commitment, people management, student focus, other stakeholder focus, quality system improvement, recognition and reward, and vision. Each of these constructs is explored in depth to understand its potential influence on innovation performance within the context of private HEIs.

Leadership Management Commitment

According to research in the literature on innovation and leadership, leaders appear to be one of the primary driving forces in expanding innovative production [26]. Researchers have urged for a study into how nonprofit leaders can stimulate innovation [27]. [28] strongly believes that without strong leadership support for innovation and quality management, no substantial change will occur in any higher education institution. In the context of intensified global competition, leaders must embrace innovation to introduce fresh concepts, recognizing that a lack of culture for idea generation and operational improvement can result in a loss of competitive advantage [29,30]. Several nations' findings reveal a substantial positive association between increased innovation and improved educational administration and leadership [31]. Consequently, the proposed alternate hypothesis is as follows:

H1: *Leadership management commitment has an impact on innovation performance.*

People Management

Effective people management, described as an art, is integral to TQM implementation, recognized as essential by top leaders who consider people the organization's most valuable asset [32–34]. People management approaches have been discovered to be highly associated with both productivity and innovation where experts appear to agree on the importance of people management techniques [35]. Positive TQM practices are significantly associated with effective people management [36]. The human aspect of innovation initiatives, including administrative and technical people, is critical to the success of many sorts of innovations [37]. Additionally, having individuals with the right skills and talents is emphasized for maximizing creativity and successful project implementation [38,39], with quality teaching staff playing a vital role in successful TQM implementation in vocational

schools by fostering high commitment and teamwork [40]. Therefore, the alternate hypothesis is formulated as follows:

H2: *People management has an impact on innovation performance.*

Student Focus

Globalization has driven HEIs to reevaluate instructional content, with a focus on research activities to enhance reputation and attract students, external funding, and marketability [41]. Placing students at the center of decision-making is emphasized to unlock their creative potential [42]. To diversify career paths and increase market vitality, students are encouraged to expand their innovation and entrepreneurship education, while TQM principles, treating students as "customers," ensure high-quality education through continuous improvement and satisfaction [38,43,44]. As a result, the alternate hypothesis is posited as follows:

H3: *Student Focus has an impact on innovation performance.*

Other Stakeholder Focus

Stakeholder engagement is crucial in fostering sustainability-oriented innovations in the public sector, with a focus on both substantive contributions (enhancing knowledge for better outcomes) and figurative aspects (ensuring legitimacy and support from affected actors) [45]. The engagement of stakeholders to identify data-driven solutions is achievable, but it necessitates resources [46]. The emphasis on managing stakeholders, promoting equality, and facilitating active participation, collaboration, and knowledge sharing enhances innovation creation, as highlighted by [45,47,48]. [49] emphasizes the relevance of stakeholder orientation even further, discovering that it may greatly enhance the number of patents and citations per patent. The study by [50] underscores the importance of enhancing university lecturers' innovation capabilities by incorporating input from various stakeholders, including government, local communities, and collaborations with other educational institutions. Consequently, the proposed alternate hypothesis is as follows:

H4: *Other stakeholder's focus has an impact on the innovation performance.*

Quality System Improvement

The study by [51] affirms the idea that innovations generated using a quality improvement strategy might be more geared towards process improvement, especially in the public sector. In the dynamic business environment, organizations must harmonize innovation and quality assurance to achieve long-term success in the face of rapid technological changes. This is emphasized by studies such as [52,53], highlighting the importance of well-established quality systems. In the global market characterized by challenges and constant economic shifts, mere production is insufficient where contemporary principles emphasize that quality, as a dynamic factor, is essential for productivity and competitiveness, compelling business organizations to prioritize innovation in response to evolving customer demands [54]. Hence, the alternate hypothesis is posited as follows:

H5: *Quality system improvement has an impact on influencing innovation performance.*

Recognition and Reward

The function of rewards in encouraging innovation has gotten a lot of attention in both theory and practice and it is clearly documented that incentives have a favorable influence on stimulating creativity [55]. Rewards can be both monetary (bonuses and incentives) and non-monetary (additional vacations or other presents). Setting up a reward structure provides several internal personal benefits, such as improved pride, peer recognition, stronger self-confidence, more job satisfaction, and enhanced self-accomplishment [56]. Recognition, including timely appreciation through promotions and awards, is crucial for acknowledging employees' contributions to organizational well-being, as highlighted by [57]. Setting up a reward structure provides several internal personal benefits, such as improved pride, peer recognition, stronger self-confidence, more job satisfaction, and enhanced self-accomplishment [56]. Therefore, the alternate hypothesis is formulated as follows:

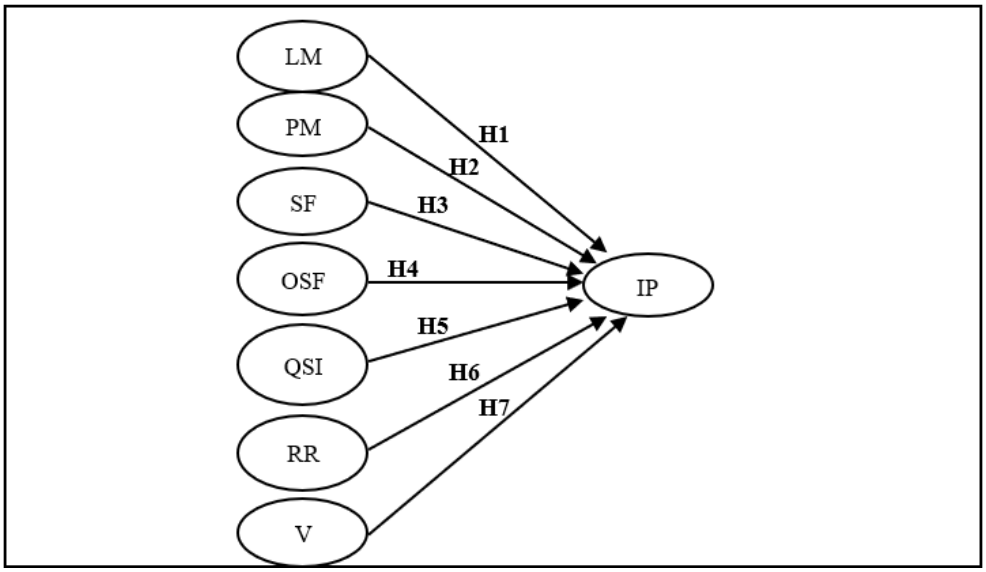
H6: *Recognition and reward have an impact on innovation performance.*

Vision

Aside from making a contribution to entrepreneurial university theory, the study suggests vision as a valuable instrument for establishing an innovation ecosystem [58]. A well-defined and disruptive innovation vision, as highlighted by [59], is crucial for success, and the work of [60] suggests that innovators' visions can align community perspectives, fostering a common vision. Creating radical innovations involves integrating advanced technological and market knowledge with future visions, necessitating both the reuse of existing knowledge and the exploration of new knowledge in an uncertain environment, which demands specific sense-making dynamics for successful execution [61]. Studies, including those by [62–65], consistently emphasize that the vision of HEIs significantly influences their innovation capabilities, shaping innovative approaches and leadership goals [66]. Hence, the alternate hypothesis is posited as follows:

H7: *Vision has an impact on the innovation performance.*

Hence, the proposed research model is as shown in Figure 1.



Note: IP: Innovation Performance, LMC: Leadership Management Commitment; PM: People Management; OSF: Other Stakeholder Focus; QSI: Quality System Improvement; SF: Student Focus; RR: Recognition and Reward; V: Vision.

Fig. 1. Research Model

3 Research Methodology

3.1 Data Collection

This study applied a quantitative research approach. The data collected data via questionnaire comprises 7 constructs and 7 items in the demography section. A five-point Likert scale was utilized in all items on each construct which was adopted from CMM, specifically [0] Undefined [1] Initial [2] Define [3] Managed [4] Well managed [5] Optimized for all sections in the questionnaire.

A sample size used in this study was determined by using G-power analysis as suggested by [67] equated to 90 samples. There were a few ways to distribute the questionnaire to reach a suitable amount of sample size where a non-probabilistic sampling technique was implemented including convenience sampling and snowballing sampling. The questionnaire was sent through email and other social media.

The research approach was specifically tailored for the academicians from Malaysian private universities. A pilot study of the questionnaire was initially conducted on a small scale, involving 9 respondents. The purpose of the Pilot study was to assess the viability and applicability of important research components [68]. A total of 129 respondents participated but only 115 respondents were valid for the study.

3.2 Methodology

In this paper, the data analysis process plays a vital role in seeking the achievement of the objectives of the study. Data analysis in this study is initiated by sorting out the information from the Google form using Microsoft Excel followed by the application of descriptive analysis, validity, and reliability test by using IBM Statistical Package for the Social Sciences (SPSS). Moreover, the data analysis in this study advances to a more intricate level by

employing Partial Least Square Structural Equation Modelling (PLS-SEM) using Smart PLS 4.0 software to analyze the inner and outer models. The result of whether the alternate hypotheses are accepted or rejected is determined in the inner model including employing reliability and convergent validity that were assessed within the outer model. Figure 2 shows the research design employed for PLS-SEM.

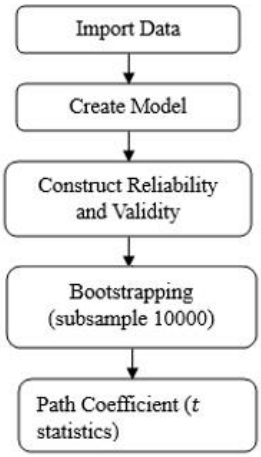


Fig. 2. Research Design for PLS-SEM.

Import Data

In this step, the data from Microsoft Excel in comma-separated values (CSV) format into SmartPLS 4.0 software. This data typically includes information on the variables, such as observed indicators, latent constructs, and any other relevant information that is gathered from the data collected.

Create Model

After importing the data, the PLS-SEM model will be created within SmartPLS. This involves specifying the relationships between latent constructs and their observed indicators, as well as any paths between constructs.

Construct Reliability and Validity

The first assessment will be the reliability and validity of the measurement model involving Cronbach's Alpha and Composite Reliability while the reliability assessment and Average variance extracted (AVE) will be used to assess convergent validity. Reliability measures the consistency of the measurements, while validity assesses whether the measurements are capturing the constructs they are intended to measure.

Bootstrapping (10000 samples)

Bootstrapping is a resampling technique used to assess the robustness and significance of the estimated parameters in the model. By resampling the data multiple times (e.g., 10,000 times), a distribution of parameter estimates can be generated, and confidence intervals and p-values can be evaluated for each parameter.

Path Coefficient *t* values

After bootstrapping, the path coefficients in the model can be examined and their corresponding t values. Path coefficients represent the strength and direction of the

relationships between constructs in the model, while t values indicate the significance of these relationships. Significant t values (typically above 1.96 for a 95% confidence level) suggest that the corresponding path coefficients are significantly different from zero.

4 Results and discussion

4.1 Descriptive analysis of demographic profile

Table 1. Demographic profiles of respondents.

Variables	Answer	Frequency	Percent (%)
Gender	Female	63	54.8
	Male	52	45.2
Ethnicity	Chinese	27	23.5
	Indian	17	14.8
	Malay	59	51.3
	Others	12	10.4
Education level	Bachelor's degree	3	2.6
	Doctorate Degree	68	59.1
	Master's degree	44	38.3
Designation	Professor	11	9.6
	Associate Professor	24	20.9
	Assistant Professor	15	13.0
	Senior Lecturer	16	13.9
	Lecturer	48	41.7
	Assistant Lecturer	1	0.9
Years of services	2 years and below	16	13.9
	More than 10 years	66	57.4
	More than 2 to 5 years	13	11.3
	More than 5 to 10 years	20	17.4
Total		115	100.0

The data collected from a meticulous month-long survey of 115 academicians in selected private universities in Malaysia, presented in Table 1, reveals a balanced gender distribution with 54.8% female and 45.2% male participants. However, a notable ethnic disparity is evident, with Malay academicians comprising 51.3% of the total, while Chinese, Indian, and other ethnicities collectively contribute 48.7%. The educational level is predominantly at the doctoral level (59.1%), emphasizing the high academic qualifications of the respondents. The table also highlights diverse professional designations, ranging from Professor to Assistant Lecturer, showcasing the hierarchical positions within the academic community. Experience levels vary, with 57.4% having over 10 years of service, 13.9% with 2 years or less, 11.3%

falling within 2 to 5 years, and 17.4% with more than 5 to 10 years of service, providing a comprehensive understanding of the academic landscape in private universities in Malaysia.

The survey for this study was disseminated to numerous private universities in Malaysia, although only a few consented to participate. Additionally, some academicians expressed reluctance in disclosing the specific universities with which they are affiliated. Consequently, a concession was made to permit respondents to disclose only the regional affiliations of their respective universities. As such, Table 2 presents a succinct summary of the information pertaining to the universities included in this study.

Table 2. Descriptive analysis on the universities participated in the study.

No.	University	Region	Frequency
1.	Albukhary International University	North	2
2.	Curtin University Malaysia	East	1
3.	Heriot-Watt University Malaysia	West	1
4.	Infrastructure University Kuala Lumpur	West	5
5.	MAHSA University	West	1
6.	Multimedia University	West	11
7.	Monash University Malaysia	West	1
8.	University of Southampton Malaysia	South	1
9.	Taylor's University	West	14
10.	University of Kuala Lumpur	West	3
11.	University of Tun Abdul Razak	West	2
12.	University of Selangor	West	5
13.	University of Cyberjaya	West	4
14.	University of Nottingham Malaysia	West	2
15.	University of Reading Malaysia	South	2
16.	University of Tunku Abdul Rahman	North	12
17.	University of Technology PETRONAS	North	5
18.	Xiamen University Malaysia	West	2
19.	Asia Metropolitan University	South	4
20.	Universiti Tenaga Nasional	West	1
21.	Others	North	7
		South	12
		East	1
		West	13
		n/a	3
	Total		115

4.2 Reliability Assessments and Convergent Validity

Table 3. Cronbach's Alpha, Composite Reliability, and AVE.

	Cronbach's alpha	**Composite reliability (rho_c)**	**Average variance extracted (AVE)**
Leadership Management Commitment	0.947	0.962	0.863
Other Stakeholder Focus	0.944	0.960	0.857
People Management	0.888	0.930	0.816
Quality System Improvement	0.935	0.953	0.836
Recognition Reward	0.918	0.948	0.858
Student Focus	0.913	0.939	0.794
Vision	0.932	0.957	0.881

In Table 3, two distinct reliability measures, namely Cronbach's alpha and Composite Reliability (rho_c), have been employed across various constructs. However, particular attention is directed towards Cronbach's Alpha values, which serve as a focal point in this study. According to [69], Cronbach's alpha has a straightforward interpretation; a score of 0.70 or higher is typically regarded as satisfactory. 0.90 denotes high consistency, 0.80-0.89 shows good consistency, 0.70-0.79 indicates acceptable consistency, 0.65-0.69 indicates moderate consistency, and 0.5 indicates unsatisfactory consistency. Whereby, the thresholds of Composite Reliability (rho_c) which are another type of internal consistency reliability apart from Cronbach's alpha are the same as the Cronbach's alpha itself [70]. Notably, almost all constructs manifest Cronbach's Alpha values surpassing 0.9, indicative of an exceptionally reliable measurement. The sole exception is the "People Management" construct, which, while slightly below the 0.9 threshold, still attains a commendable value exceeding 0.85, thereby reinforcing its overall reliability.

The preferred threshold for convergent validities is emphasized to be above 0.70, with values falling below 0.50 considered dismissible [71] such that convergent validities were represented by the AVE. Upon scrutinizing the data presented in Table 3, it becomes evident that all seven constructs demonstrate convergent validities exceeding 0.70 meeting the validity criterion. As a result, all seven constructs examined in this study emphasize reliability and validity, particularly highlighted based on the established criteria.

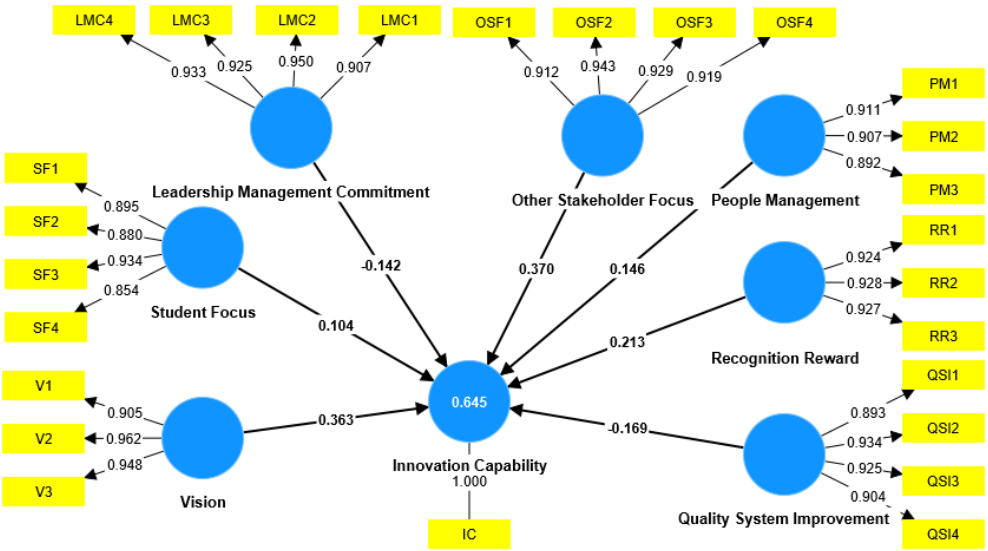


Fig. 3. PLS-SEM algorithm showing path coefficients and R-squared value.

Figure 3 shows the path coefficients of the original sample which are further sorted in Table 4.

4.3 Assessment of the Structural Model

Path coefficient

Table 4. Path Coefficient of the model.

Alternate Hypothesis	The causal relationship of the construct	Path Coefficient (β)	Standard deviation	t values	p values	Decision on causal relationship
H1	LMC -> IP	-0.142	0.144	0.982	0.326	Rejected
H2	OSF -> IP	0.37	0.135	2.738**	0.006	Accepted
H3	PM -> IP	0.146	0.123	1.188	0.235	Rejected
H4	QSI -> IP	-0.169	0.156	1.084	0.279	Rejected
H5	RR -> IP	0.213	0.125	1.71	0.087	Rejected
H6	SF -> IP	0.104	0.109	0.953	0.341	Rejected
H7	V -> IP	0.363	0.108	3.371**	0.001	Accepted

Note: IP: Innovation Performance, LMC: Leadership Management Commitment; PM: People Management; OSF: Other Stakeholder Focus; QSI: Quality System Improvement; SF: Student Focus; RR: Recognition and Reward; V: Vision.

The results depicted in Table 4 reveal that hypotheses 2 and 7 demonstrate statistical significance, as evidenced by t values surpassing 1.96 at the two-tailed test with a significance level of 5%. All the above tests were conducted using Smart PLS 4.0, which facilitated the bootstrapping procedure allowing the generation of t-statistics, which is the primary focus of this study for conducting significance testing. H2 was accepted in this study which was also supported by [50] emphasising the need to incorporate various stakeholders to boost innovation competencies among lecturers in HEIs which will in turn be beneficial towards innovation performance. Meanwhile, H7 was accepted in this study aligned with the study by a few researchers claiming that HEIs' vision is a crucial aspect of their innovation capacities [64,65].

Furthermore, leadership management commitment, people management, student focus, quality system improvement, and recognition and reward result in an insignificant influence on innovation performance rejecting H1, H3, H4, H5, and H6. This result proves the indication by few researchers regarding how previous research has yielded conflicting findings which in turn there is no agreement on whether TQM elements aid in the development of an environment and culture that nurtures innovation [3–5]. Numerous factors might lead to this accomplishment, including the fact that the lack of government support for private universities forces them to cope with the complexities of innovation on their own, without the assistance and resources frequently provided by government-backed institutions. This will also indicate on the unsupported H5 in which fewer funds are available to private HEIs resulting in difficulties in conducting recognition and rewards among academicians According to [72] leadership style has an impact on management innovation, with a more initiating style being connected with the amount to which new managerial practices are used. This emphasis on leadership styles has a different impact on innovation performance and may contribute to a reason why H1 is not supported which is due to the styles of leadership commitment implied in the private HEIs along with the reason why H3 is not supported related to the way top management managed people in the private HEIs.

Meanwhile, [43] states that the governance structure at private universities under the coordination of private institutions requires further development, particularly in data and information management for the process of continuous quality improvement which reinforces the reason H4 is not supported in this study. Moreover, educators are expected to

constantly evolve their teaching conceptions, foster the urge for innovation, alter established teaching models, optimize teaching techniques, and enhance teaching quality as stated by [73] which may be lacking in the private HEIs leading to the rejected H6.

Therefore, it can be summarized that the way the constructs are implemented would hinder its result in impacting the innovation performance which also leads to the main concern of this study regarding the importance of not only determining the determinants affecting innovation performance but also in identifying the maturity levels of each construct involve. More future research must be conducted in various backgrounds of HEIs (e.g. public HEIs, Top 10 HEIs in Malaysia or internationally) to strengthen the findings on what may indicate the effective maturity level of TQM constructs to conclusively influence innovation performance.

5 Conclusions

In summary, the study reveals that only Other Stakeholder Focus and Vision among the seven examined constructs significantly contribute to innovation performance in private universities, aligning with the literature on stakeholder involvement and the pivotal role of institutional vision. Conversely, Leadership Management Commitment, People Management, Student Focus, Quality System Improvement, and Recognition and Reward exhibit insignificant impacts on innovation performance, echoing mixed findings in the existing literature. The study emphasizes the importance of understanding the maturity levels of each construct and their implementation in influencing innovation performance, highlighting the need for further research across diverse higher education institutions to conclusively identify effective maturity levels for TQM constructs in driving innovation.

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