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University Innovation in Malaysia Public Research Universities: An Empirical Analysis of Organizational Innovation and Innovation Resources

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Abstract:

Purpose: *This study examines the determinants of university innovation in Malaysia's public research universities. It investigates the direct relationships between organizational structure, organizational culture, and innovation leadership and their influence on university innovation, while assessing the moderating role of innovation resources.*
Design/methodology approach: *Drawing on Innovation Management, the Triple Helix Model, and the Resource-Based View (RBV), a conceptual framework was developed and tested using survey data from 191 research-active academic staff across five universities. Factor analysis and reliability tests validated the measures, followed by correlation and regression analyses.*
Findings: *Results show that organizational culture, innovation leadership, and innovation resources positively influence university innovation, whereas organizational structure demonstrates an inverse relationship. Innovation resources consistently exhibit an inverse moderating effect, indicating that excessive reliance on these resources can dilute the positive influence of structure, culture, and leadership.*
Practical implications: *Motivated by the evident performance gap in patent activities across Asia and the inconsistent linkage between organizational innovation and university innovation outcomes, the research highlights how internal organizational factors shape innovation performance.*
Originality value: *The findings underscore that while innovation resources are essential, universities must balance resource deployment with flexible structures, an innovation-oriented culture, and strategic leadership to achieve sustainable and impactful innovation outcomes.*

Keywords: *University innovation, organizational structure, organizational culture, innovation leadership, innovation resources.*

JEL Classification: *O31, I23, M10, O32, D23.*
Paper Type: *Research paper.*
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1. Introduction

Innovation is widely recognized as a critical driver of economic growth and societal progress. As emphasized by Tidd and Bessant (2020), innovation involves improving systems, processes, products, and services in commercially viable ways.

Classic economic theorists like Schumpeter (1954) identified innovation, along with entrepreneurship and market dynamism, as the core of economic transformation. In the corporate context, innovation has been defined as "endowing resources with new capacity to create wealth" (Drucker, 1985), highlighting how organizational resources can be leveraged to generate value and growth.

In today's knowledge-driven economy, the role of higher learning institutions (HLIs), especially public research universities, in innovation has become paramount. Recent studies (Trinh, 2023; Peng and Xu, 2024) argue that research universities are key engines of innovation, contributing not only to education and research but also to technological advancement, entrepreneurship, and regional development.

This expanded role of universities in fostering innovation and economic development is often described as the university's "third mission," beyond teaching and research (Reichert, 2019).

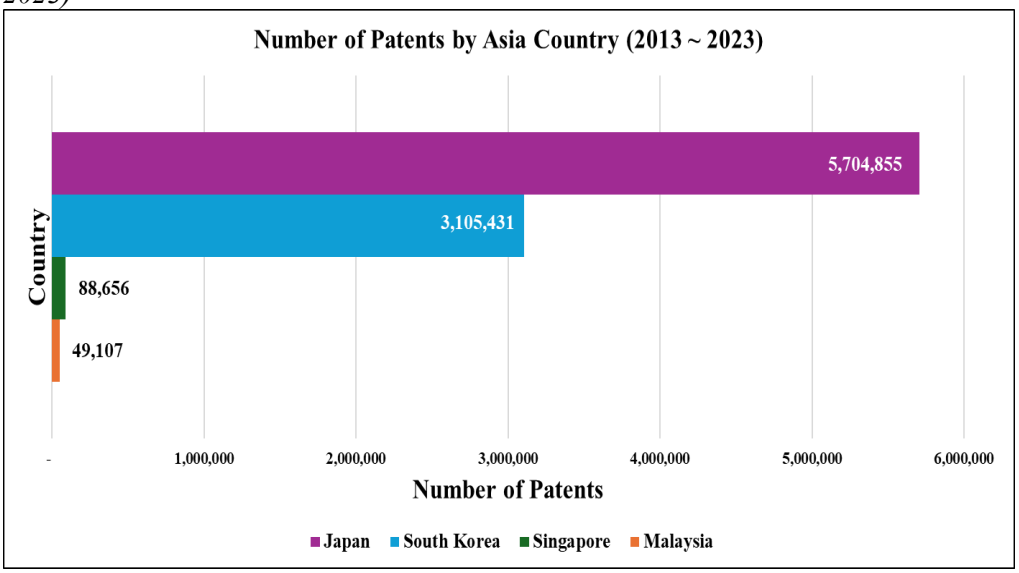
University innovation (UI) encompasses a broad spectrum of activities, including academic research and development, technology transfer, commercialization of research outputs, and the cultivation of entrepreneurial ventures (Etzkowitz and Leydesdorff, 2000; Guerrero *et al.,* 2024). By engaging in such innovation activities, universities can directly support industrial progress and national innovation ecosystems.

However, in many emerging economies, universities face challenges in realizing their innovation potential. Malaysia's public research universities (RUs), for example, are strategically positioned to drive the country's innovation agenda, but their innovation outputs still lag behind regional leaders.

Over the past decade, Malaysian institutions produced far fewer patent filings and high-impact innovations compared to innovation powerhouses like Japan and South Korea, and even trail smaller nations such as Singapore in patent activities (Figure 1).

This innovation performance gap indicates that simply establishing research universities is not sufficient; internal organizational factors and support mechanisms within these universities critically determine their innovation performance. Prior research on Malaysian universities has identified various constraints, such as bureaucratic structures, limited funding, and weak commercialization mechanisms that may hinder innovation outcomes (Abdullah, 2017; Rasli and Kowang, 2017).

Figure 1. *Overall Patents Record by Selected Asia Countries (From Year 2013 to 2023)*



Note: *Based on data collection from patent profiles in the Lens Database from 1st January 2013 to 31st December 2023*
Source: *Own study.*

Moreover, much of the literature has examined university innovation in terms of outputs, for example, the number of patents, spin-off companies, and research grants, or broad environmental factors, without fully addressing how internal organizational innovation practices contribute to these outcomes.

This represents a gap in knowledge, as organizational innovation within universities in how they structure and manage themselves to foster innovation is less studied and not well understood in the public university context.

In response to this gap, this study investigates the influence of key organizational innovation factors on university innovation in Malaysian public RUs. Specifically, focus on three internal factors, namely organizational structure, organizational culture, and innovation leadership, and examine their direct relationships with university innovation performance.

Furthermore, recognizing that universities operate with varying levels of resources, this study explores the role of innovation resources, both tangible and intangible, as a moderating factor that could strengthen or weaken the impact of organizational innovation factors on university innovation outcomes. By integrating perspectives from innovation management, the Triple Helix model of university, industry, and government relationship, and the Resource-Based View (RBV), this study aims to provide a comprehensive understanding of how internal organizational dynamics

and resource conditions together shape the university innovation capacity and innovation outcomes.

Ultimately, this research not only addresses a critical practical issue for Malaysian public research universities in their drive toward becoming more innovative institutions, but it also contributes to the theoretical discourse on university innovation management.

The following sections present the background and objectives of the research, a review of relevant literature, the methodology employed, findings of the study, a discussion of their implications, and recommendations for university administrators and policymakers striving to enhance university innovation performance in higher education.

1.1 Research Background

The essence of this study is the phenomenon of university innovation. It has become an important phenomenon in the transformation of public universities in Malaysia because the involvement now in the knowledge-based economy is more extensive, aligning with the need to generate their own income.

Public universities in Malaysia today should undertake university innovation to a strategic position and present themselves as important key drivers of sustainable technological advancement, research commercialization, and boost economic growth. In alignment with Malaysia's innovation policy commitment, the role of Malaysia's public universities has expanded beyond traditional educational functions to align with the evolving demands of the commercial sector, positioning them as key contributors to national economic development and competitiveness.

However, the true challenge lies in the effective implementation of organizational innovation internal strategies within university management and administrations that constrain their innovation performance.

1.2 Public Research University in Malaysia

Malaysia has designated five leading public universities as Public Research Universities (Rus), namely Universiti Malaya (UM), Universiti Sains Malaysia (USM), Universiti Kebangsaan Malaysia (UKM), Universiti Putra Malaysia (UPM), and Universiti Teknologi Malaysia (UTM).

These institutions are among the most prestigious in the country and have been entrusted with spearheading Malaysia’s aspirations to become a knowledge-based and innovation-driven economy. They receive concentrated funding for research and are expected to generate significant scientific outputs, advanced technologies, and innovative solutions that can be translated into industry and societal benefits.

Over the past decade, these RUs have indeed made progress in research publications and some technology development. For instance, all five are consistently ranked highly in the region for research excellence (QS Asia University Rankings, 2024).

They have established technology transfer offices, incubators, and research parks intended to facilitate the commercialization of research findings. The Malaysian government, through initiatives like the 10th-12th Malaysia Plans and the MyDIGITAL blueprint, has encouraged universities to contribute more directly to innovation and economic development. Despite these efforts, measurable innovation outputs from Malaysian universities remain modest on the global stage.

1.3 Key Challenges in University Innovation

Several structural and organizational challenges faced by Malaysian public RUs have been documented. First, funding constraints have become more acute; for instance, public funding for universities has been reduced in recent years, covering only around 70% of operational costs, with universities pressured to self-generate the remaining 30% (Abdullah, 2017; Noja *et al.,* 2024).

Limited financial resources directly affect the ability to support research, hire top talent, or invest in state-of-the-art laboratories and innovation infrastructure. Secondly, universities struggle with infrastructure and facilities maintenance and upgrades, which can impede cutting-edge research and deter collaborations (Rasli and Kowang, 2017; Ismail *et al.,* 2025).

Thirdly, bureaucratic and structural rigidities pose a significant hurdle. The management and governance systems in public universities are often hierarchical and procedure-bound. Decision-making can be slow, and departmental silos hinder interdisciplinary collaboration, which is a critical element for innovation. These bureaucratic processes also affect industry collaboration and engagement.

Whilst partnership with industry is touted as essential in line with the Triple Helix concept, in practice, Malaysian universities find it difficult to establish and sustain such collaborations due to misaligned incentives, complex administrative rules, and conflicts over intellectual property (Ramli *et al.,* 2013a).

Additionally, technology transfer and commercialization of research results remain challenging. Universities are mandated by the government to pursue commercialization of research, for example, via licensing patents or creating start-ups; however, these processes require significant time, funding, and business insight, and success is uncertain.

Finally, policy and regulatory changes can create uncertainty, such as frequent shifts in higher education policies or inconsistencies between government innovation policies and university policies, which can sometimes lead to confusion or a lack of

sustained focus on innovation programs. These challenges collectively suggest that enhancing university innovation is not merely a matter of injecting more funding or setting higher targets; instead, it requires internal changes in how universities are organized and managed for innovation (Norena-Chavez and Thalassinos, 2022).

1.4 Research Objectives

This research focuses on the internal organizational factors that could be leveraged to improve innovation outcomes in Malaysian public research universities. The study is guided by the following specific objectives:

RO1: Explain the relationship and influence between organizational structure and university innovation in the Malaysian public research universities.

RO2: Explain the relationship and influence between organizational culture and university innovation in the Malaysian public research universities.

RO3: Explain the relationship and influence between innovation leadership and university innovation in the Malaysian public research universities.

RO4: Measuring the effects of innovation resources as moderating variables on organizational innovation factors and university innovation in the Malaysian public research universities.

By addressing these objectives, the study seeks to uncover both the direct impact of organizational innovation practices and the conditional impact of resource context.

The overarching research question can be framed as:
How do organizational structure, culture, and leadership influence university innovation in Malaysian public RUs, and how does the level of innovation resources affect these relationships?

The insights from this inquiry will not only help diagnose the internal shortcomings or strengths of Malaysian RUs in fostering innovation but will also inform what strategic changes could be made to improve their university innovation outcomes.

2. Literature Review

2.1 University Innovation

The concept of university innovation (UI) has evolved as universities worldwide increasingly embrace a mission beyond traditional teaching and academic research. Often referred to as the “third mission,” this involves active contributions to innovation, technology transfer, and economic development. Universities become key nodes in innovation ecosystems, engaging with industry and government to

translate knowledge into tangible socio-economic benefits (Etzkowitz and Leydesdorff, 2000). UI can manifest in various forms, such as applied R&D projects that solve industrial problems, patents and licenses of university discoveries, creation of start-up companies or academic spin-offs, development of new products or processes in university labs, consultancy and advisory services to industry, and fostering entrepreneurship among staff and students (Guerrero *et al.,* 2024).

Triple Helix theory provides a framework for understanding this role by positing a close interaction between universities, industry, and government as a driver of innovation (Etzkowitz and Leydesdorff, 2000).

In the Triple Helix model, universities are no longer ivory towers but rather entrepreneurial institutions that collaborate with firms and policymakers to create and apply knowledge.

This model has informed innovation policy in Malaysia, where initiatives have aimed to strengthen university-industry linkages and encourage research commercialization. Recent work also discusses the Quadruple Helix, adding civil society and the public as a fourth strand in the innovation system (Carayannis and Campbell, 2021; Cai and Lattu, 2022).

This broader perspective highlights that societal engagement and public participation can further enhance the relevance and adoption of innovations emerging from universities. Ultimately, the literature suggests that a university's impact on innovation is a function of both its external engagements and its internal capacity to generate and support innovative activity.

2.2 Measuring University Innovation

Scholars differ on how to measure a university's innovation performance. Some emphasize outcome-based indicators; for example, Mansfield (1995) argued that metrics should go beyond commercialization revenue to include new knowledge production and technology development.

Common quantitative indicators include the number of patents filed or granted, the number of spin-off companies created, licensing income, the number of industry-funded research projects, or innovation awards won. Rothaermel *et al.* (2007) compiled a taxonomy of university entrepreneurship outcomes, highlighting patents, spin-offs, incubators, and research grants as key indicators.

These largely correspond to resources available or generated by the university, for example, patents as intellectual capital and grants as financial capital. Other researchers advocate a broader view, assessing the institutional environment that fosters innovation. For instance, organizational innovation factors like structure,

leadership, and culture have been proposed as important determinants of innovation success in universities (Kowang *et al.,* 2015; Mohammed *et al.,* 2021).

Kowang *et al.* (2015) developed an innovation management and performance framework specifically for Malaysian research universities, finding that an integrated strategy involving organizational structure, resource allocation, and leadership support is crucial. This suggests that internal processes and capabilities can be just as important as tangible outcomes when evaluating a university innovation.

In sum, effective university innovation requires both the means, such as resources and infrastructure, and methods, such as effective internal management practices. The present study aligns with this dual perspective by examining internal organizational factors in conjunction with resource conditions.

2.3 Organizational Structure

Organizational structure refers to the formal arrangement of roles, responsibilities, and authority in an organization. Key structural attributes include the hierarchy or chain of command, degree of centralization in opposition to decentralization in decision-making, departmentalization between silos against cross-functional integration, and mechanisms for coordination and communication.

In corporate innovation literature, it has long been recognized that a flexible, organic structure is more conducive to innovation than a rigid, mechanistic structure (Burns and Stalker, 1961).

Flexible structures typically feature decentralized decision-making, flatter hierarchies, open communication channels, and dynamic teams that can adapt quickly, and these characteristics support creativity, quick execution of new ideas, and interdepartmental collaboration.

In contrast, very hierarchical or bureaucratic structures may stifle innovation by introducing delays, discouraging risk-taking, and isolating teams. Mintzberg (1993) noted that excessive formalization and centralization can impede the free flow of knowledge and ideas needed for innovation. In the context of universities, organizational structure encompasses how faculties, research centers, and administrative units are organized and governed.

Universities traditionally have quite hierarchical structures, for example, multiple layers from department heads to deans to vice-chancellors, and can be siloed by disciplines.

Prior studies indicate that structural reforms in universities, such as creating interdisciplinary institutes, empowering smaller research units, or streamlining

administrative approvals, can enhance their university innovation performance (Kowang *et al.,* 2015; Jones *et al.,* 2024).

2.4 Organizational Culture

Organizational culture is the collection of values, beliefs, norms, and practices that are shared within an organization. A culture that supports innovation is often characterized by openness to change, encouragement of new ideas, tolerance for risk and failure, collaboration, and a continuous learning ethos. In corporate settings, research has shown strong links between culture and innovation performance.

For example, Naranjo-Valencia *et al.* (2011) found that companies with an adhocracy or entrepreneurial culture tend to innovate more, whereas those with a hierarchical, control-oriented culture often resist change and prefer imitation over innovation. Within universities, culture can be reflected in how faculty and administrators value entrepreneurial activities, interdisciplinary research, and knowledge sharing.

Some universities maintain a conservative or traditional academic culture that prioritizes individual academic achievements and may undervalue commercialization or collaborations, potentially dampening innovation output.

On the other hand, universities that have fostered an innovation culture through leadership traits, incentive structures such as awards or promotions for innovation and patents, and supportive policies that create an environment where staff feel empowered to pursue novel projects and work across boundaries. Prior literature indicates that elements like academic freedom, combined with mission orientation towards solving real-world problems, contribute to an innovation-friendly culture in universities (Melewar and Akel, 2005; Zahra and Nambisan, 2011).

2.5 Innovation Leadership

Leadership plays a pivotal role in steering organizations toward innovation. Innovation leadership refers to leaders who facilitate and drive innovation through vision, inspiration, and by creating conditions for innovation to flourish. These leaders champion new initiatives, secure necessary resources, and remove obstacles that impede creative work.

In corporate environments, transformational leadership styles are those that motivate employees to exceed their usual performance and to embrace change, and are often linked to higher innovation (Jung *et al.,* 2008). Adjei (2013) emphasizes the growing necessity for managerial leadership that actively adapts and transforms organizations through innovation, especially in dynamic environments.

Within universities, leadership operates at multiple levels, from top executives like Vice Chancellors or Presidents who set strategic priorities and resource allocations, while middle-level leaders like deans, directors of research centers, or project leaders directly influence the research and innovation activities.

Leadership also matters in fostering an internal culture for innovation, for example, in how supportive the faculty is of commercialization projects or interdisciplinary research that might not immediately yield publications.

Mokhber *et al.* (2018) found that leadership's effect on innovation is amplified when there is organizational support for innovative behavior, indicating that a leader's actions, combined with institutional support mechanisms, result in better university innovation outcomes.

2.6 Innovation Resources

Innovation resources refer to the tangible and intangible assets that an organization can draw upon to support innovation. In a university setting, key innovation resources include financial support, skilled human capital, physical infrastructure, advanced technological tools, and intellectual capital.

The Resource-Based View of the firm, proposed by Barney in 2000 (Barney, 2000), explains that organizations gain a competitive advantage through resources that are valuable, rare, inimitable, and well organized, known as the VRIO framework. Applied to universities, innovation capability is shaped by the resources they possess or can access.

For instance, adequate research funding and highly skilled scientific talent provide the essential capacity to drive innovation. However, RBV also implies that it’s not just the number of resources, but how they are managed and aligned with strategy that matters (Grant, 1991).

In Malaysia's context, public RUs operate under budget constraints and rely on government funding, which has been tightening, making the effective use of limited resources critical. Studies have highlighted that, beyond baseline funding, other forms of support, such as administrative support for patenting, mentorship for startups, or networking platforms, are counted as innovation resources that can make a difference (Rothaermel *et al.,* 2007; Abou-Moghli and Abou, 2024).

Innovation resources are examined in this study as a moderator. As a moderator, innovation resources shape the extent to which organizational factors translate into innovation. Strong leadership and a supportive culture may have a limited impact if resources are insufficient, since resources provide the foundation for ideas to be executed.

When resources are abundant, they can amplify the effect of good practices, enabling collaborative cultures to pursue more projects. At the same time, excessive resource availability may create diminishing returns, leading to complacency or inefficiency. This study investigates these dynamics within the Malaysian university context.

2.7 Conceptual Framework

The conceptual framework for this study is developed from the comprehensive literature review. The framework is based on a concept where organizational innovation, namely structure, culture, and leadership, has a direct effect on university innovation.

In addition, it assesses the moderating effect of innovation resources on the relationship between organizational innovation and university innovation.

The conceptual framework of organizational innovation consists of 3 independent variables, which are organizational structure, organizational culture, and innovation leadership. Followed by the moderating variable, innovation resources.

Meantime, dependent variables in the conceptual framework focus on university innovation in terms of research, innovation, and commercialization outcomes.

Figure 2 represents the organizational innovation conceptual framework of this study. Meanwhile, each of the variable's independent and moderating consists of a specific program or mechanism unit that fosters innovation and is measured by capturing their challenges, influence, and value as shown in Table 1.

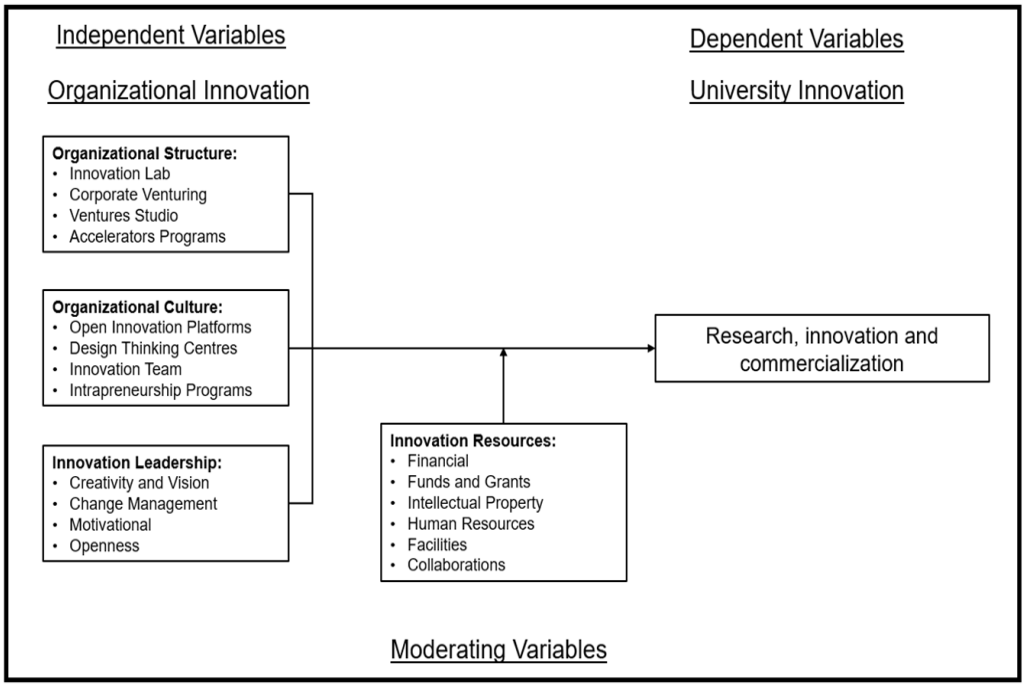
3. Research Methodology

3.1 Research Design and Approach

This study employs a quantitative, cross-sectional field survey design to examine the relationships among the variables of interest. A quantitative approach is suitable given the aim to test hypothesized relationships and measure the strength of associations between specific factors (Zikmund *et al.,* 2003; Creswell and Creswell, 2018).

This study used a structured questionnaire to collect primary data from respondents at a single point in time (cross-sectional). The design is explanatory, as it seeks to confirm whether variations in organizational factors correspond to variations in innovation outcomes in the sampled universities. Before performing hypothesis testing, the validity and reliability of the measurement instruments were established through factor analysis and reliability tests using Cronbach's alpha, in accordance with standard survey research practices (Field, 2024).

Figure 2. *Conceptual Framework*



Source: *Own study.*

Table 1. *Variables and Measurement Categories*

Variables	Mechanisms (Programs)	Measurement Categories
Organizational Structure (Independent Variable)	• Innovation Lab • Corporate Venturing • Ventures Studio • Accelerators Programs	• Silo's Structure • Bureaucracy • Resource Limitation • Cognitive Biases • Hierarchy Structure • Rigid Command
Organizational Culture (Independent Variable)	• Open Innovation Platforms • Design Thinking Centres • Innovation Team • Intrapreneurship Programs	• Resource Supportive • Recognition Encouragement • Learning Oriented • Risk Averse • Entrepreneurial Development
Innovation Leadership (Independent Variable)	• Creativity and Vision • Change Management • Motivational Leadership • Openness	• Intrapreneurial Leadership • Trust Value • Visionary Leadership • Inspirational Leadership • Inclusive Leadership
Innovation Resources	• Financial • Funds and Grants	• Financial Control • Financial Accessibility

(Moderating Variable)	• Intellectual Property • Human Resources • Facilities • Collaborations	• External Financial Support • Budget Adequacy • Institutional Support
University Innovation (Dependent Variable	**Outputs:** • Research • Innovation • Commercialization	• Research Excellence • Commercialization Engagement • Organizational Innovation • Innovation Culture

Source: *Own study.*

3.2 Population and Sampling Design

The target population for this research consisted of academic staff in the five Malaysian public research universities who are actively involved in research and innovation activities. This includes professors, associate professors, and lecturers who engage in R&D, patenting, commercialization, or related innovation initiatives.

According to statistics from the Ministry of Higher Education (MOHE), the total academic staff across the five research universities (RUs) is approximately 9,000 as of 2023. From this population, about 345 individuals are directly affiliated with innovation or research centers and are regularly engaged in innovation-driven projects.

This subgroup constituted the sampling frame, as their involvement enhances the relevance and accuracy of responses concerning university innovation performance. A probability sampling strategy was employed for the ideal sample size. In general, various methods are available for determining the sample size of a research study. Corresponding to this study, the Yamane Taro method has been adopted, selecting a sample size of 185.

3.3 Research Instrument and Measure

The research employed a survey-based approach, as surveys are widely recognized as one of the most effective methods for collecting primary data, as suggested by Zikmund (2003) and Kothari (2004). A structured questionnaire was developed to facilitate the collection of data, aimed at explaining and predicting the phenomena under study. The survey method was selected due to its efficiency, cost-effectiveness, and ability to provide insights into population-level phenomena within a relatively short timeframe.

The questionnaire consists of 6 sections. Section A (General Information) concentrated on the demographic profile of the respondents. Section B (Organizational Structure) focuses on organizational structure. Section C (Organizational Culture) focuses on organizational culture. Section D (Innovation

Leadership) focuses on innovation leadership. Section E (Innovation Resources) focuses on innovation resources, and Section F (University Innovation) focuses on university innovation performance. Each of the variables contains 20 questions.

The five-point Likert scale is used (1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree) (Bertram, 2007; Norman, 2010; Munshi, 2014).

Table 2. *Range of scale*

Scale	Level of Agreement/Importance
1	Strongly Disagree/Not Important
2	Disagree/Less Important
3	Neutral/Moderate Important
4	Agree/Important
5	Strongly Agree/Very Important

Source: *Own study.*

3.4 Analysis Methods

In this study, a structured quantitative approach was employed to examine the relationships among variables using statistical techniques facilitated by the Statistical Package for the Social Sciences (SPSS) Windows Version. The analysis method was systematically designed to ensure both the validity and reliability of the research instrument, as well as the consistency of hypothesis testing.

To begin, factor analysis was conducted to confirm the construct validity of the measurement items. This technique ensures that the items used in the questionnaire appropriately represent the underlying constructs. The construct validity check is a critical step in verifying that the theoretical dimensions are empirically supported through item loading patterns.

Following the validation, reliability analysis was performed using Cronbach's Alpha to assess the internal consistency of the survey items. A high Cronbach's Alpha value (typically ≥ 0.70) indicates that the items within each construct reliably measure the same underlying concept, thereby enhancing the credibility of the results.

Subsequently, a series of statistical tests was carried out to analyse the relationships among the variables. The correlation analysis was first employed to determine the strength and direction of the linear relationships between the independent variables and the dependent variable, according to Pallant (2007).

This test serves as a preliminary examination of whether significant associations exist before proceeding to regression analysis.

To examine direct effects, a simple regression analysis was conducted. This test assesses the impact of each independent variable on the dependent variable, university innovation, independently.

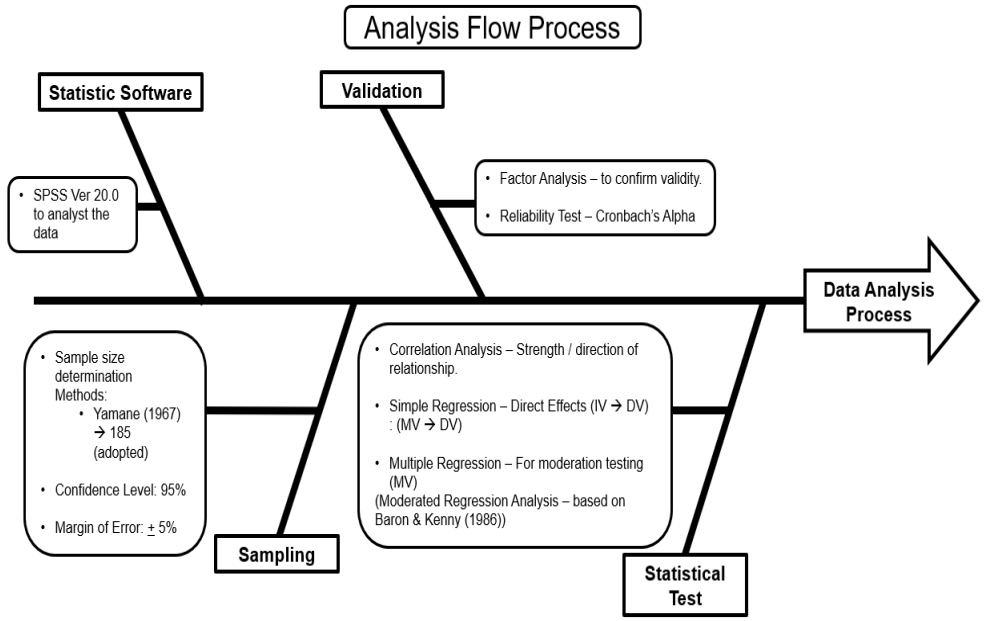
Finally, to assess the moderating effect of innovation resources, multiple regression analysis was used, specifically employing the Moderated Regression Analysis (MRA) technique as proposed by Baron and Kenny (1986) and also other researchers such as Anderson (1986) and Frazier *et al.* (2004).

This method involves the inclusion of interaction terms to determine whether the relationship between the independent variables and the dependent variable is strengthened or weakened by the presence of the moderator variable.

In summary, the analytical process in this study follows a rigorous, step-by-step statistical protocol to ensure the empirical soundness of the findings. The combined use of factor analysis, reliability testing, correlation, simple regression, and moderated regression analysis provides a robust methodological foundation for evaluating the proposed hypotheses and understanding the dynamics of university innovation within the context of Malaysian public research universities.

For ease of illustration, Figure 3 illustrates the overall analytical process flow, depicted through a fishbone diagram. These visual representations enhance the clarity of the research framework and methodological approach.

Figure 3. *Analysis Process Flow*



Source: *Own study.*

4. Results

4.1 Respond Rate

A total of 345 questionnaires were disseminated using email, personal meetings, and QR codes, allowing respondents to complete and submit their responses online through Google Forms. Although a total of 345 individuals were approached, only 191 responses were received, resulting in a response rate of 55%.

This sample size is deemed appropriate for maintaining a 95% confidence interval with a 0.05 margin of error, and achieving the sample size characteristic (185), thereby ensuring the reliability of the findings.

The demographic profiles of the respondents are a standard methodological practice in research, as they offer valuable insights into the composition of the sample. A summary of the respondents' demographic characteristics is reported in Figure 4.

Figure 4. *Demographic Profile*

Variable	Frequency	Percentage	Chart
Gender			
Male	108	57%	
Female	83	43%	
Age			
31 - 40 years old	20	10%	
41 - 50 years old	108	57%	
51 years old and above	63	33%	
Education			
Master's Degree	90	47%	
Doctorate Degree	101	53%	
Field of Research			
Engineering	139	73%	
Applied Science	21	11%	
Technology	20	10%	
Business Management	11	6%	
Years of Experience			
Below 5 years	1	1%	
6 - 10 years	48	25%	
11 - 15 years	34	18%	
16 - 20 years	38	20%	
More than 20 years	70	37%	

Source: *Own study.*

4.2 Validity Test

Table 3. *Validity Test Results*

Test	Results				
	Organizational Structure	Organizational Culture	Innovation Leadership	Innovation Resources	University Innovation
Kaiser-Meyer-Olkin (KMO)	0.501	0.515	0.498	0.450	0.685
Bartlett's Test of Sphericity (p-value)	0.000	0.000	0.000	0.000	0.000

Source: *Own study.*

Organizational Structure:
Interpretation: The KMO value is considered weak, falling below the recommended threshold of 0.6. However, Bartlett's Test of Sphericity (p-value) indicated that the correlation among variables was statistically significant, thus confirming the suitability of the dataset for factor analysis.

Organizational Culture:
Interpretation: The KMO value indicates a marginal adequacy, falling below the recommended parameters of 0.6. However, Bartlett's Test of Sphericity (p-value) indicated that the correlation among variables was statistically significant ($p < 0.001$), thus confirming that the correlation matrix is suitable for factor analysis.

Innovation Leadership:
Interpretation: The KMO value, suggesting that the data may not be ideally structured for factor extraction, falls below the recommended threshold of 0.6. However, review the Bartlett's Test of Sphericity (p-value), confirming that the correlation matrix is not an identity matrix. This significant result justifies the application of factor analysis despite the relatively low KMO value, indicating that relationships among variables exist and can be statistically analyzed.

Innovation Resources:
Interpretation: The KMO value is considered weak, falling below the recommended threshold of 0.6. Despite this, the Bartlett's Test of Sphericity yields a statistically significant ($p < 0.001$) result, confirming that the correlation matrix is not an identity matrix. This significant result justifies the application of factor analysis despite the relatively low KMO value, indicating that relationships among variables exist and can be statistically analyzed.

4.3 Reliability Test

Instrument reliability refers to the ability of a measurement tool to consistently yield stable and dependable results across repeated applications. One of the most widely

used methods for evaluating Alpha values indicates stronger internal consistency and, therefore, greater reliability.

Malhotra (2010) suggests that in the context of marketing and social science research, a Cronbach's Alpha reliability is through internal consistency, commonly measured using Cronbach's Alpha. This coefficient reflects the degree of positive correlation among the items within a given scale, with values ranging from 0.00 to 1.00.

A higher Cronbach's value above 0.60 is generally deemed acceptable for establishing the reliability of a measurement instrument. Similarly, Hair et al. (2018) note that a Cronbach's Alpha value between 0.60 and 0.70 is considered acceptable, particularly in exploratory research.

Table 4. *Reliability Test Result (Cronbach's Alpha)*

Variables	Items	Cronbach's Alpha
Organizational Structure	20	0.778
Organizational Culture	20	0.807
Innovation Leadership	20	0.936
Innovation Resources	20	0.851
University Innovation	20	0.959

Source: *Own study.*

Based on Table 4, the Cronbach's Alpha reliability values for all the variables are found to be above 0.778 ($\alpha > 0.60$). This implies that the data measurement tools are statistically significant to proceed with further analysis.

4.4 Correlation Analysis

According to Pallant (2020), the Pearson correlation coefficient is described as a measure of the strength and direction of the linear relationship between two continuous variables. The correlation coefficient (r) ranges from -1 to +1, where:

Direction: A positive correlation (+r) indicates that as one variable increases, the other also increases, whereas a negative correlation (−r) means that as one variable increases, the other decreases.

Strength: The magnitude of r indicates the strength of the relationship. Pallant (2020) references Cohen's (2005) guidelines for interpreting correlation strength (Table 5):

Table 5. *Correlation Value and Relationship*

Correlation parameters value	Strength of Relationship
r = 0.10 to 0.29 / r = -0.10 to -0.29 (Small Correlation)	Weak Relationship
r = 0.30 to 0.49 / r = -0.30 to -0.49 (Medium Correlation)	Moderate Relationship

r = 0.50 to 1.00 / r = -0.50 to -1.00 (Large Correlation) | Strong Relationship

Note: *The statistical significance of a correlation is determined by the p-value, typically set at $p < 0.05$ or $p < 0.01$. A significant correlation suggests that the observed relationship is unlikely to have occurred by chance.*

Source: *Own study based on Pallant (2020).*

The strength of these relationships is commonly interpreted based on Cohen's guidelines, as cited in Pallant (2020), which categorize correlation coefficients into different levels of magnitude to facilitate a more precise understanding of their practical implications.

Table 6 shows the summary of the variable's correlation relationship. The findings reveal that organizational structure is negatively correlated with university innovation ($r = -0.236$, $p = 0.001$), suggesting that rigid or hierarchical structures may hinder innovation within universities. However, a moderate positive correlation exists between organizational structure and organizational culture ($r = 0.360$, $p < 0.001$), implying that structural instruments are embedded within the cultural context of an institution.

Additionally, organizational structure has a weak but significant positive correlation with innovation leadership ($r = 0.230$, $p = 0.001$), indicating that organizational structure aspects may have some influence on leadership effectiveness in fostering university innovation.

Organizational culture exhibits strong positive correlations with innovation leadership ($r = 0.628$, $p < 0.001$) and innovation resources ($r = 0.631$, $p < 0.001$), emphasizing the essential role of a supportive and adaptive resources and leadership in organizational culture for innovation.

Moreover, organizational culture is positively correlated with university innovation ($r = 0.475$, $p < 0.001$), reinforcing the idea that an innovation-driven culture with supportive resources and leadership is a key driver in enhancing research and development outcomes within universities' innovation performance and activities.

Table 6. *Correlation Relationship Test Results between Variables*

Variables	Organizational Structure	Organizational Culture	Innovation Leadership	Innovation Resources	University Innovation
Organizational Structure	1	0.360**	0.230**	-0.005	-0.236**
Organizational Culture	0.360**	1	0.628**	0.631**	0.475**
Innovation Leadership	0.230**	0.628**	1	0.789**	0.425**
Innovation Resources	-0.005	0.631**	0.789**	1	0.493**
University	-0.236**	0.475**	0.425**	0.493**	1

Innovation					

Note: *** correlation is significant at the 0.01 level (2-tailed).*
Source: *Own study.*

Innovation leadership demonstrates a strong correlation with innovation resources ($r = 0.789$, $p < 0.001$), suggesting that effective leadership significantly enhances resource availability and utilization for innovation. Furthermore, innovation leadership positively correlates with university innovation ($r = 0.425$, $p < 0.001$), indicating that strong leadership in the organization is crucial for fostering innovative activities within universities.

Likewise, innovation resources also show a moderate positive correlation with university innovation ($r = 0.493$, $p < 0.001$), signifying that sufficient and well-managed resources contribute to the success of innovation efforts.

4.5 Regression Analysis

The relationship between variables and the moderating effect can be expressed in a series of simple regression and multiple regression analyses.

Simple Regression:
Simple regression analysis is conducted to examine the effects of the independent variables. The findings reveal varied levels of influence across the examined predictors:

Table 7. *Simple Regression Test Results*

Model Summary	**Variables**			
	Organizational Structure	**Organizational Culture**	**Innovation Leadership**	**Innovation Resources**
R^2	0.056	0.226	0.180	0.243
Significance (p-value)	0.001	< 0.001	< 0.001	< 0.001
Coefficients (Regression)	-0.489	0.850	0.573	0.793
Coefficients (Beta)	-0.236	0.475	0.425	0.493

Source: *Own study.*

The regression analysis of organizational structure on university innovation indicates that a more rigid organizational structure is associated with a decrease in university innovation, suggesting that excessive bureaucracy, silos, and cognitive biases may hinder innovation outcomes by reducing organizational structure flexibility and collaboration between departments or university faculties.

In contrast, the regression analysis of organizational culture revealed a strong and statistically significant positive effect on university innovation. This indicates that a supportive and dynamic organizational culture enhances innovation performance in

organizational capacity. Similarly, innovation leadership suggests that effective leadership practices, such as promoting open communication, driven goals, and encouraging collaborative initiatives, play a crucial role in shaping university innovation outcomes.

Subsequently, the regression analysis of innovation resources demonstrated the strongest statistical significance. Hence, accessibility to resources such as funding, infrastructure, people capability, technology advancement, and knowledge systems corresponds with greater university innovation performance.

Multiple Regression (Moderating Effect):
This study applied multiple regression analysis to assess the moderating effect of innovation resources in the relationship between organizational innovation and university innovation. The multiple regression results are presented in Table 8.

Table 8. *Multiple Regression Test Results (Moderating Effect)*

Model Summary	**Innovation Resources in the Relationship between Variables**		
	Organizational Structure	**Organizational Culture**	**Innovation Leadership**
R2	0.322	0.426	0.419
R2 (Adjusted)	0.311	0.417	0.409
Coefficients Integration (Beta)	-0.610	-1.311	-0.957
Significance (p-value)	0.011	< 0.001	< 0.001

Source: *Own study.*

From Table 8, the organizational structure model yields $R^2 = 0.322$ (adjusted $R^2 = 0.311$), and its interaction term is inverse and significant (Beta = -0.610, p = 0.011). The organizational culture model shows $R^2 = 0.426$ (adjusted $R^2 = 0.417$), and its interaction term is also inverse and statistically significant (Beta = -1.311, $p < 0.001$). Similarly, the innovation leadership model indicates $R^2 = 0.419$ (adjusted $R^2 = 0.409$), and its interaction term is inverse and significant (Beta = -0.957, $p < 0.001$).

5. Discussion

Addressing RO1: Relationship and influence between organizational structure and university innovation:

The first research objective in this study is about the relationship between organizational structure and university innovation in Malaysian public research universities. From the objective, the hypothesis is developed:

"There is a relationship between organizational structure and university innovation".Write here

The correlation and regression results indicate a clear inverse relationship between organizational structure and university innovation, that highly structured, hierarchical frameworks tend to suppress innovation. Structural rigidity expressed as multiple hierarchical layers, centralized authority, bureaucratic procedures, and disciplinary silos develops slowly, slows decision-making, reduces interdisciplinary interaction, and constrains opportunities for experimentation.

Moving toward more decentralized, adaptive arrangements would therefore improve the speed of decisions, lower transactional barriers between units, and foster the cross-fertilization of ideas that underpins creativity and applied research translation.

Situating these findings in the governance realities of Malaysian public research universities clarifies the mechanisms at work. Formal innovation mechanisms such as labs, corporate venturing, venture studios, and accelerators are explicitly intended to stimulate entrepreneurship and industry engagement, but their agility is often neutralized by overarching centralized control and lengthy approval chains.

As Da Wan (2020) observes, autonomy reforms have not always produced institutional flexibility because bureaucratic legacies persist.

Apparent contradictions in the literature, such as Kowang *et al.* (2015), who reported a positive link between structure and innovation, are reconcilable when one considers measurement. Kowang's respondents emphasized supportive, enabling structures, whereas the broader public RU context is dominated by rigid, accountability, and heavy arrangements that inhibit the collaboration and nimbleness required for innovation.

Structural bottlenecks also include resource and incentive misalignments that reinforce silos. National assessment regimes, for example, MyRA by the Ministry of Higher Education, that reward discrete outputs such as publications and grants, can encourage faculty competition for metrics rather than cross-disciplinary projects, while centralized intellectual property rules and under-resourced technology transfer offices slow patenting, licensing, and spin-off activity (Asma *et al.,* 2022; Woźniak *et al.,* 2023).

Empirical work on incubators and innovation units shows that when structures are backed by both tangible inputs, such as funding and facilities, and intangibles, for example, a mentorship network and industrial collaboration, entrepreneurial outcomes improve markedly (Liow and Wong, 2021; Ismail *et al.,* 2025).

Practically, Malaysian RUs should pursue ambidextrous designs that preserve accountability but devolve decision rights, invest in TTO capacity and industry linkages, and pair structural reform with leadership development and culture-building to strengthen the university innovation ecosystem.

Addressing RO2: Relationship and influence between organizational culture and university innovation:

The second factor of this research focuses on the analysis of organizational culture, guided by the hypothesis that organizational culture is significantly associated with university innovation. The empirical findings support this hypothesis, demonstrating that organizational culture has a notable influence on innovation within universities.

The findings affirm that organizational culture acts as a key driver of institutional advancement, providing the foundation for effective innovation strategies and practices within higher education institutions.

Organizational culture mechanisms such as open innovation platforms, design thinking centres, innovation teams, and intrapreneurship programs serve as structural pathways for fostering experimentation, interdisciplinary collaboration, and entrepreneurial mindsets among academics and students.

These initiatives transform universities into dynamic innovation ecosystems where knowledge sharing and creativity thrive, aligning with prior studies emphasizing that culture shapes both the precursors and results of innovation activities (Barney, 1986; Aboramadan *et al.,* 2020; Abou-Moghli *et al.,* 2024).

Conversely, rigid hierarchical and bureaucratic structures restrict risk-taking and experimentation, constraining innovation initiatives such as AI integration in teaching and research. This aligns with Kowang *et al.* (2015), who found that collaboration, communication, and recognition dimensions of culture significantly affect innovation performance, with reward and recognition systems playing pivotal roles in encouraging innovative behaviour. The current regression results further reinforce that strengthening supportive cultural mechanisms leads to measurable innovation outcomes within universities.

Consistent with previous literature, the findings underscore that organizational culture is an essential internal determinant influencing strategic innovation outcomes. Scholars such as Barney (1986) describe culture as a strategic resource and contingency factor that shapes both decision-making processes and performance outcomes, while Abou-Moghli (2024) emphasizes culture's impact on strategic decisions and innovation effectiveness.

Despite existing innovation enabling programs, cultural barriers such as limited recognition and weak institutional recognition often undermine their success. Hence, strategically nurturing organizational culture through cross-functional collaboration, reward alignment toward intellectual property and entrepreneurial outcomes, and adaptive governance that normalizes prudent risk-taking is vital. This adaptive model bridges strategic intent and operational practice, ensuring that cultural

transformation strengthens innovation capacity within Malaysian public research universities.

Addressing RO3: Relationship and influence between innovation leadership and university innovation:

The third factor of this study examines the role of leadership traits, specifically innovation leadership, in influencing university innovation. Within the context of this research, innovation leadership refers to the capacity of university leaders to cultivate, facilitate, and manage an organizational environment that encourages and sustains innovation.

Innovation leadership in universities typically operates through four key mechanisms, which are creativity and vision, change management, motivation, and openness. These mechanisms collectively enhance innovative capacity by fostering experimentation, collaboration, and adaptability.

Nonetheless, their effectiveness is often hindered by enduring institutional barriers such as bureaucratic structures, rigid hierarchies, and limited autonomy issues that are particularly evident within Malaysian public research universities (Ismail *et al.,* 2025; Liow and Wong, 2021). Addressing these challenges is essential to fully leverage leadership's potential in driving sustainable innovation.

From a theoretical perspective, these results align with prior studies that identify leadership as a critical enabler of innovation in higher education (Mohar and Jain, 2011; Mupa, 2015; Da Wan *et al.,* 2020; and Riza *et al.,* 2025). Innovation-oriented leadership fosters environments that encourage research collaboration, interdisciplinary engagement, and continuous learning, all of which are vital for enhancing institutional innovation performance.

In summary, the regression analysis establishes innovation leadership as a significant determinant of university innovation. The evidence reinforces the need for leadership strategies that inspire creativity, empower academic communities, and promote knowledge exchange.

A multi-factor analytical approach in future research would provide deeper insights into the interconnected elements that collectively shape innovation performance in higher education institutions.

Addressing RO4: Moderating effect of innovation resources on organizational innovation factors and university innovation:

The fourth research objective addresses innovation resources as a moderator variable influencing the relationship between organizational innovation (structure, organizational culture, and leadership) and university innovation.

Organizational structure alone has a weak link to university innovation, but this link becomes meaningfully positive when innovation resources are available. Empirical and regional examples show that well-defined governance or faculty arrangements fail to produce innovation outcomes if funding, facilities, and specialized personnel are lacking (Kowang *et al.,* 2015; Rasli and Kowang, 2017).

Studies cited in the document (Iranmanesh *et al.,* 2021; Gustina *et al.,* 2024) suggest that structural features such as formalization and linking mechanisms only yield stronger innovation performance when paired with resource capabilities. Malaysian cases and national schemes, for example, FRGS, PRGS, LRGS, and TRGS, are used to illustrate how targeted grants and infrastructure help overcome bureaucratic rigidity and turn structure into tangible outputs (MOHE, 2023; World Bank, 2020).

Meanwhile, organizational culture's positive effects on innovation are amplified by both tangible and intangible resources. Cultural values like openness, experimentation, and cross-disciplinary collaboration translate into measurable innovation outcomes when supported by technology transfer offices, research infrastructure, collaborative platforms, and human capital (Chen *et al.,* 2025; Compagnucci *et al.,* 2024).

The document emphasizes that intangible assets, for instance, intellectual capital, networks, and relational resources, play a crucial role in converting cultural aspirations into sustained innovation (Jayabalan *et al.,* 2022; Valencia-Arias *et al.,* 2023). Thus, it is recommended that university management pursue resource mobilization and alignment strategies on government grants, industry partnerships, and international linkages alongside cultural initiatives to realize the full potential of cultural change.

Finally, regarding innovation leadership, found leadership behaviours such as vision, support, and inclusivity are necessary but substantially more effective when supported by an orchestrated bundle of resources. The interaction between leadership and resources produces large gains in explained variance, demonstrating that resources operationalize leadership intent into outputs (Mohar, 2010; Kowang *et al.,* 2015).

In addition, without robust governance, leaders risk losing control of resource management, resulting in waste, duplication, or failure to channel resources into the most strategic areas. Krieger *et al.* (2024) highlight that heterogeneous funding schemes can be double-edged, in that they strengthen innovation when well-integrated but generate inefficiencies when poorly coordinated.

Similarly, Laufer *et al.* (2025) stated that, as a caution, leadership must be accompanied by both infrastructural support and effective resource governance to avoid disorganization. Thus, innovation resources as moderators must be not only adequate but also strategically aligned and effectively managed.

6. Recommendations and Conclusions

6.1 Contribution and Implications

This study introduces several general implications for university innovation and organizational innovation within Malaysian public research universities. First, theoretically, it extends innovation management frameworks by empirically confirming that innovation resources moderate the relationship between organizational structure, culture, and leadership, and their collective influence on university innovation.

Grounded in the resource-based view (RBV) and dynamic capability perspectives, the findings reveal that resources alone do not guarantee innovation; rather, they shape how internal organizational factors translate into innovative outcomes (Khanra *et al.,* 2022).

The study strengthens the perspectives of Kowang *et al.* (2015) and Rasli and Kowang (2017) by illustrating that innovation resources magnify the impact of other organizational innovation elements, and deepen understanding of open innovation (Chesbrough, 2003) and Triple Helix collaborations (Etzkowitz *et al.,* 2000) in the Malaysian higher education context.

Secondly, practically, the study offers valuable implications for university leaders and policymakers. It emphasizes the need for effective resource orchestration over accumulation, advocating the alignment of resources with innovation goals and phased investment to prevent overload.

Universities are encouraged to develop adaptive organizational structures, nurture innovation-driven cultures, and strengthen leadership capacity. At the policy level, promoting cross-sector collaboration, particularly through university, industry, and government linkages that can enhance university innovation outcomes, in line with Malaysia's aspiration under the Malaysia Commercialization Year 2030 (MCY2030).

6.2 Limitations

While this study yields valuable contributions to the understanding of university innovation, several limitations must be acknowledged to contextualize its findings and inform future research directions. The research was confined to five Malaysian public research universities, relying primarily on the perceptions of internal respondents.

This focus may limit the generalizability of findings to other types of institutions, such as private universities, technical colleges, or non-research-oriented entities. Moreover, the exclusive use of quantitative methods, mainly correlation and

regression analysis, may have constrained deeper exploration of contextual and operational complexities influencing innovation.

Additionally, self-reported data on constructs such as leadership style and culture may have introduced social desirability or institutional bias. The absence of qualitative triangulation, such as interviews, document analysis, or case studies, limits the understanding of deeper institutional processes.

Lastly, mediating factors like organizational agility, absorptive capacity, digital readiness, or stakeholder engagement were not included in the model, even though these are increasingly relevant in post-digital and post-pandemic higher education contexts. Future research addressing these methodological and conceptual gaps will enhance the robustness and applicability of university innovation studies.

6.3 Recommendations

Based on the findings, this study recommends a holistic approach to enhancing university innovation. Universities should implement structural reforms promoting flexibility and interdepartmental collaboration, foster a culture that values creativity and experimentation, and cultivate innovation-oriented leadership through targeted training and succession planning. Innovation resources, including both tangible and intangible, should be strategically allocated to strengthen research, commercialization, and collaborative initiatives.

At the systemic level, stronger engagement within the Triple Helix (university–industry–government) and Quadruple Helix (adding societal participation) frameworks is crucial. These collaborative models ensure that innovation outcomes are not only economically beneficial but also socially inclusive.

Furthermore, universities should institutionalize monitoring systems with clear innovation performance indicators, enabling continuous assessment and improvement. Collectively, these strategies will align organizational innovation capabilities with Malaysia’s innovation-driven national agenda and strengthen higher education’s contribution to knowledge commercialization and economic growth.

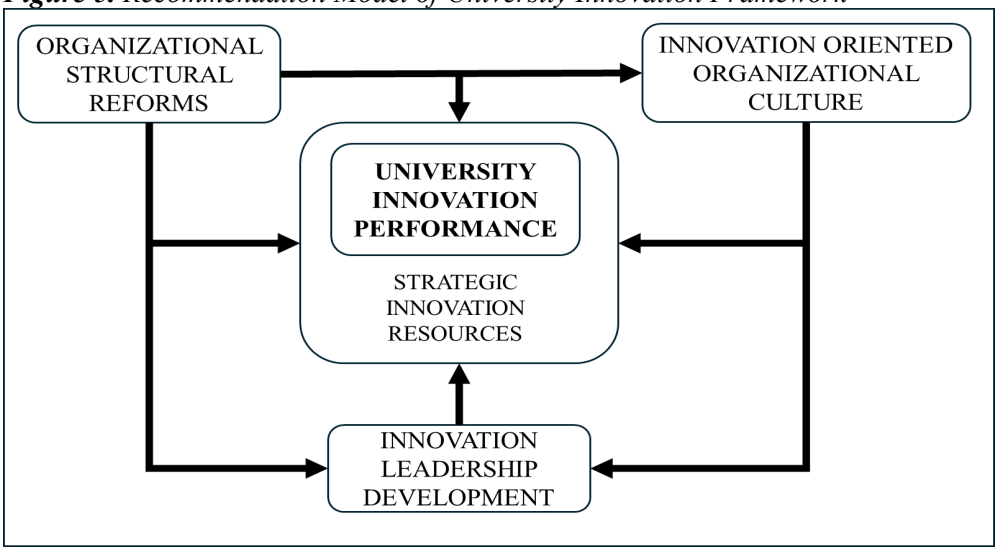
6.4 Conclusion

The evidence and findings from this study indicate that to enhance university innovation outcomes, Malaysia's public research universities should adopt a holistic and integrated strategy that aligns organizational reforms, innovation-oriented culture, leadership, and resources.

As such, Figure 5 presents an integrated model framework design based on this study's findings. This model illustrates a holistic strategy to strengthen the

university's innovation sphere within the university's organizational structure and elevate overall innovation performance.

Figure 5. *Recommendation Model of University Innovation Framework*



Source: *Own study.*

The first cornerstone of Organizational Structural Reforms is promoting autonomy, reducing bureaucratic constraints, and encouraging collaboration, network, and knowledge sharing. Such reforms create the structural flexibility necessary for rapid and effective innovation processes.

Following, closely linked, is an Innovation-Oriented Organizational Culture that develops phenomena of openness, shared vision, and entrepreneurial mindset. By embedding strategic initiatives and nurturing creativity, culture provides the normative environment in which university innovation can be positively enhanced.

An equally important dimension is Innovation Leadership Development. This is to ensure that university leadership cultivates visionary and adaptive leaders capable of orchestrating change management, strategic mobilising resources, decision making, and sustaining innovation momentum within teams through motivation. These leaders not only set strategic direction, but also maintain focus when resources and opportunities are abundant or decline.

At the heart of the model framework is Strategic Innovation Resources. This includes financial support, institutional research facilities, technology accessibility, and availability of human capital.

Strategic Innovation Resource acts as a moderate and reinforces the effects of structure, culture, and leadership. Their presence ensures that strategic ambitions are

backed by tangible and intangible capabilities, transforming potential into measurable university innovation outcomes.

In sum, by demonstrating the interconnected pathway among these four dimensions, the model shall underscore that university innovation success is not the product of isolated interventions. Instead, it required a holistic and strategically orchestrated approach, where organizational structural flexibility, cultural innovation readiness, strong strategic leadership, and the strategic deployment of innovation resources operate in synergy to drive either short-term or long-term competitive advantage and sustainable university innovation within Malaysian public universities and other higher learning institutions (HLIs) as a whole benefit.

This research advances innovation management theory by incorporating resource-driven moderation into existing models, while offering actionable insights for institutional and policy reforms. Although certain methodological limitations exist, the study lays a foundation for future exploration of mediating factors and broader institutional comparisons.

Ultimately, the proposed integrated framework positions Malaysian public research universities to lead in national innovation capacity, contributing meaningfully to the country's transition toward an innovation-led economy by 2030.

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