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Establishing outcome-based curriculum: a triple helix partnership among Universities, Industries, and Government Agencies

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ABSTRACT

The Triple Helix Model (THM) of innovation has garnered significant attention as a policy framework to foster innovation and stimulate economic growth. This approach aligns with the principles of Outcome-Based Education (OBE), which emphasizes clearly defined skills and knowledge that individuals are expected to attain. This study aims to: (1) identify a THM model suitable for the contexts of Indonesia and Malaysia; (2) describe the current level of THM implementation; (3) assess the ecosystem needs for THM from the perspectives of government, industry, and academia; (4) evaluate the role of government in implementing THM; (5) assess the role of industry in THM; and (6) analyze the contribution of universities to THM implementation. The research employed document analysis and Focus Group Discussions (FGDs) involving lecturers, officials, and government representatives. Thematic analysis was conducted on the data collected from document reviews and FGDs. A four-point Likert scale questionnaire, developed based on the roles of key stakeholders within the THM framework, was used, and the results were analyzed descriptively using mean and standard deviation. The findings indicate that: (1) the Balanced Triple Helix Model (BTM) is preferred in both Indonesia and Malaysia; (2) the government, industry, and universities in both countries perceive the level of BTM implementation as moderate; (3) the supporting ecosystem for BTM implementation is also rated as moderate; and (4) the roles of government, industry, and universities are similarly perceived as moderate in the context of BTM implementation.

Keywords: government, industry, OBE curriculum, Triple-helix model, university

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INTRODUCTION

In the era of rapid technological advancement and the emergence of Industry 4.0, educational institutions face increasing pressure to align their curricula with the evolving demands of industry (Kolandan, 2019) (Moraes et al., 2023). The ideal vision is for universities, industries, and governments to collaborate closely, fostering innovation and ensuring that graduates possess the skills and knowledge required by the modern workforce. Such collaboration is critical, as the Fourth Industrial Revolution is characterized by the convergence of technologies that blur the

boundaries between physical, digital, and biological systems (Alsulaimani & Islam, 2022). However, the reality in many regions—particularly in developing countries such as Indonesia and Malaysia—shows that these partnerships are often fragmented or underdeveloped. This gap between the ideal and actual practice poses a significant challenge in ensuring that educational systems can keep pace with technological advancements and labor market demands (Nunes et al., 2020) (Suryadarma & Jones, 2013).

One key framework that has gained prominence in addressing this issue is the Triple Helix Model (THM), conceptualized by Etzkowitz and Leydesdorff (2001). This model suggests that innovation and technological progress are most effectively driven through active, synergistic collaboration among three key actors: universities, industries, and governments (Etzkowitz, 2008) (Etzkowitz, 2003). Within this model, universities contribute research and knowledge; industries provide practical application, resources, and funding; and governments establish policy frameworks and offer financial support to facilitate collaboration. The interaction of these three institutional spheres creates an ecosystem in which knowledge production, technological innovation, and regional development can flourish. The THM is not merely about coordinating efforts but about fostering the generation of new ideas, influencing research agendas, and creating innovative pathways for economic and technological development (Liche & Strelcová, 2023). Moreover, it emphasizes a shift from a hierarchical (top-down) approach to a more lateral, collaborative relationship among the three sectors.

Despite the promising potential of the Triple Helix Model (THM), its implementation in Indonesia and Malaysia remains far from ideal. Although various programs and policies have been introduced to promote collaboration among universities, industries, and governments, these initiatives often fall short of achieving their intended impact. In Indonesia, for instance, the Ministry of Education, Culture, Research, and Technology launched the "Kedai Reka" program in 2020. This initiative aimed to bridge the gap between academic research and industrial needs by fostering university–industry collaboration and involving students in real-world work experiences (Kusumarini et al., 2022). The goal was to create a more dynamic and integrated learning environment that reflects workforce demands and encourages innovation. Similarly, Malaysia introduced the "2u2i" program, which allows students to spend two years studying at a university and two years working in industry (Ramli et al., 2023) (Mohd Yusof et al., 2020) . This program seeks to provide students with hands-on experience and better prepare them for the labor market, while simultaneously strengthening university–industry linkages.

However, despite their well-intentioned designs, both programs have encountered significant challenges. For example, the Kedai Reka program has faced issues such as inadequate infrastructure and the slow adaptation of universities and industries to its framework (Permata Bachtiar et al., 2023) (Akbari & Bustami, 2024). Many universities continue to prioritize

academic research over industrial collaboration, while industries often hesitate to commit to long-term partnerships due to concerns about immediate returns on investment. In Malaysia, the 2u2i program has faced similar difficulties, with industry partners expressing doubts about students' readiness to enter the workforce after only two years of academic training. Furthermore, both countries continue to grapple with establishing a sustainable innovation ecosystem in which the roles of government, industry, and universities are well-coordinated and mutually reinforcing (Zheng & Cai, 2022) (Abdukarimova et al., 2022).

These challenges underscore a persistent gap between the idealized vision of Triple Helix collaboration and the practical realities on the ground (Osmuk, 2019) (Petrović et al., 2018). In practice, the implementation of the Triple Helix Model (THM) has often been fragmented, with universities, industries, and governments operating in silos rather than engaging in integrated collaboration. Consequently, the potential benefits of THM—such as the creation of new industries, the advancement of regional development, and the generation of cutting-edge technological innovations—have yet to be fully realized in countries like Indonesia and Malaysia.

Exacerbating this issue is the growing imperative for higher education systems to adopt Outcome-Based Education (OBE) frameworks. OBE emphasizes the definition of clear learning outcomes—what students should know and be able to do upon graduation—and aligns curricula, teaching strategies, and assessment methods with these outcomes (Shaheen, 2019) (Jeanne, 1994). The central focus is to ensure that students acquire the skills and competencies necessary for success in their future careers. William Spady, regarded as the father of OBE, highlights that the essence of this approach lies in aligning educational practices with the needs of the workforce and society. He contends that OBE is essential in preparing students for real-world challenges, particularly in a rapidly evolving labor market where technological proficiency, creativity, critical thinking, and problem-solving skills are increasingly in demand (Handayani & Wiguna, 2024) (Rao, 2020) (Institute of Science & Technology, 2018).

In both Indonesia and Malaysia, there is a growing recognition that Outcome-Based Education (OBE) can play a pivotal role in addressing the skills gap between university graduates and industry demands. However, for OBE to be implemented effectively, strong collaboration among universities, industries, and governments is essential. Without the active involvement of industry in shaping curricula, providing practical training opportunities, and offering feedback on student performance, OBE cannot reach its full potential. Likewise, government support through policy frameworks, funding, and regulatory oversight is critical to ensuring effective collaboration between universities and industry.

Given the existing challenges and gaps in the educational landscape, the Triple Helix Model (THM) offers a valuable framework to support the implementation of OBE in both Indonesia and Malaysia. By fostering stronger partnerships among universities, industry, and government, THM

can help ensure that OBE curricula are aligned with workforce needs and that students are equipped with the skills and experiences required for future success (Shah & Gillen, 2024) (Ahmed et al., 2022). This study aims to develop a THM-based model that supports the implementation of OBE in civil engineering programs at Yogyakarta State University (UNY) in Indonesia and Universiti Teknologi Malaysia (UTM). It also seeks to identify the specific roles of government, industry, and universities in operationalizing the THM, as well as the ecosystem necessary to sustain this collaborative effort.

The research value of this study lies in its potential to offer a novel framework for implementing Outcome-Based Education (OBE), grounded in the principles of the Triple Helix Model. By examining the specific challenges and opportunities present in both Indonesia and Malaysia, the study provides a comparative analysis that can inform policymakers, educational institutions, and industry leaders about effective strategies for fostering collaboration and enhancing educational outcomes. Moreover, it addresses the pressing need for a sustainable innovation ecosystem—one that not only drives technological advancement but also equips students to meet the evolving demands of the future workforce.

In conclusion, the gap between the idealized vision of Triple Helix collaboration and the actual conditions in Indonesia and Malaysia underscores the necessity for a more integrated and resilient approach to educational innovation. By adopting the Triple Helix Model as a guiding framework for OBE implementation, universities, industries, and governments can collaborate more effectively to prepare students for the challenges of Industry 4.0 and beyond. This study seeks to contribute to that effort by offering critical insights into the roles of each sector and the ecosystem needed to sustain their collaboration.

METHOD

This study aimed to develop a Triple Helix Model (THM) to support the implementation of an Outcome-Based Education (OBE) curriculum by promoting collaboration among government, industry, and universities in Indonesia and Malaysia. Employing a qualitative approach, the research integrated document analysis and focus group discussions (FGDs) with key stakeholders to design and refine the THM. Additionally, a four-point Likert-scale questionnaire was administered to assess stakeholders' perceptions of each sector's role and the existing ecosystem supporting THM implementation. Thematic analysis of FGD data, combined with descriptive statistics from the questionnaire, revealed that stakeholders regarded the THM as appropriate, with moderate levels of implementation and ecosystem support. The findings underscore the critical importance of collaboration among the three sectors in addressing technological and workforce challenges, and highlight the need for sustained mutual cooperation

to ensure the successful implementation of OBE curricula and to prepare graduates for future industry demands.

RESULTS AND DISCUSSION

Etzkowitz and Leydesdorff (2000) proposed three models of the Triple Helix (TH): the statist model, the laissez-faire model, and the balanced model (BTM). These models represent different configurations of interaction among government, industry, and academia. The statist model reflects government dominance over the other two sectors, while the laissez-faire model maintains a clear separation between them, with minimal interaction. In contrast, the balanced model emphasizes collaboration among the three spheres, where each plays a significant role in innovation and mutual interactions inform innovation policies. This study focuses on examining how the BTM can be effectively implemented in Indonesia and Malaysia.

1. Determining the Conceptually Suitable Triple Helix Model

The objective of this study was to identify the most conceptually appropriate Triple Helix model for the contexts of Indonesia and Malaysia. Based on Focus Group Discussions (FGDs) conducted in both countries—featuring representatives from universities, industry, and government—there was a consensus that the BTM is the most suitable model. Three key characteristics of the BTM contributed to this conclusion: (a) the prominent role of universities in innovation, positioning them as equal partners with industry and government in a knowledge-based society; (b) the emergence of collaborative relationships among the three spheres, where innovation policy is shaped through interaction rather than imposed unilaterally by the government; and (c) the capacity of each institution to assume the roles of the others, performing both traditional and evolving functions, thereby promoting institutional flexibility and mutual support. These elements were considered essential for fostering a more integrated and dynamic innovation ecosystem in both countries.

2. Extent of Triple Helix Model Implementation

To assess the extent of BTM implementation, a questionnaire consisting of five statements was developed to measure the perceived degree of the model's implementation. The statements evaluated the suitability of BTM within the national context, the balance of positions, roles, and benefits among the three sectors, and the presence of a democratic climate in the working environment.

Table 1. Mean and SD values of BTM Implementation

No	Question/Statement	Government POV		Industry POV		University POV	
	BTM	Ind.	Mly.	Ind.	Mly.	Ind.	Mly.
1	In what extend BTM has been implemented.	2	3	2.67	3	2.5	2.25
2	In what extend BTM provides balanced "position" among three players: government, industry, and university.	2	3	2.33	2.8	3	2.25
3	In what extend BTM provides balanced "role" among three players: government, industry, and university.	2.5	3	2.67	2.8	2.75	2.75
4	In what extend BTM provides balanced advantages or benefit among three players: government, industry, and university.	2.5	3	3.33	2.8	2.75	3
5	In what extend BTM provides democratic work climate.	2	3	2.67	2.8	3	2.25
	Mode (Md) =	2	3	2.67	2.8	2.75	2.25
	SD =	0.27	0	0.37	0.09	0.21	0.35

The results revealed significant differences in the perspectives of government, industry, and university representatives in both countries, as presented in Tables 1, 2, and 3. For instance, the Malaysian government's perception of BTM implementation was higher (mean score = 3.00) compared to that of the Indonesian government (mean score = 2.20). This indicates that Malaysian government representatives view BTM implementation as more balanced and aligned with their expectations, whereas Indonesian government representatives perceive it as less effectively executed. A similar pattern was observed in the industry sector, with Malaysian industry representatives reporting a higher mean score (2.84) than their Indonesian counterparts (2.73). The university perspective, however, differed slightly. Indonesian universities, represented by the Faculty of Engineering at UNY (FT UNY), assigned a higher mean score (2.80) than their Malaysian counterparts at UTM (FT UTM), who reported a mean score of 2.50.

The comparison between Indonesia and Malaysia highlights a marked contrast in how the government sectors perceive the implementation and benefits of BTM. Malaysia appears to have achieved a more advanced or successful implementation, characterized by perceptions of greater balance, a supportive democratic climate, and mutual benefits among government, industry, and university stakeholders. In contrast, the Indonesian perspective suggests that BTM implementation remains in its early or underdeveloped stages, with concerns about imbalance and a limited democratic work climate.

This analysis suggests that to improve BTM implementation in Indonesia, greater efforts are needed to foster stronger collaboration, define clearer stakeholder roles, and cultivate a more democratic environment within the innovation ecosystem. Malaysia, in this context, may serve as

a model from which Indonesia can learn in developing a more balanced and collaborative innovation framework.

3. Triple Helix Ecosystem

The BTM ecosystem supporting its implementation was also examined, with a focus on both tangible and intangible indicators. Tangible indicators included assessments of infrastructure, financial support, and the capacity of universities to disseminate science and technology to society. Intangible indicators encompassed shared beliefs in the role of technology in economic development, organizational culture, intellectual property protection, and the depth of social sentiment and policy-making.

Table 2. Mean and SD values of BTM Ecosystem Implementation

No.	Question	Government POV		Industry POV		University POV	
B.	**Physical (*tangible*) ecosystem that supports BTM implementation**	Ind.	Mly.	Ind.	Mly.	Ind.	Mly.
1	University competence to socialize and diffuse science and technology to society.	2	3	3	3	3.25	3
2	Positive responds from industry and their capacity to implement science and technology especially developed by university.	2	3	2.67	2.8	3	2.75
3	Supported infrastructure, including financial support to conduct research and development in technology by university or other institutions and its new technology transfer to industry.	2.5	3	2.67	3	2.5	2.25
4	Existing entrepreneurial institution that has a vision to the development of technology innovation based on science and unite leadership among three main players in BTH.	1.5	3	2.33	3	2.5	2.25
	Nonphysical (*intangible*) ecosystem that supports BTM implementation						
5	Shared believe that technology is the key in economic development.	2.5	3	3.67	2.8	3.25	2.75
6	Organization culture orients to market	2.5	3	3.33	3	2.75	2.75
7	Effective protected system of intellectual patent.	2	3	3	3.2	2.25	2
8	Strong competition spirit.	2.5	3	3	2.8	3	2.5
9	Science and technology development based on process management.	2	3	3.33	2.8	3.25	2.5
10	Deepth of Social feeling	2	3	3	3	2.75	2.25
11	Policy decision based on democratic principles.	2	3	3	2.8	2.75	2
	Mode (Md) =	2	3	3	3	2.75	2.5
	SD =	0.32	0	0.37	0.14	0.34	0.33

Tables 4, 5, and 6 present the mean scores and standard deviations for both physical (tangible) and nonphysical (intangible) aspects of the ecosystem. Overall, Malaysia recorded a higher mean score (3.00) for tangible aspects compared to Indonesia (2.14), suggesting that Malaysia's ecosystem for supporting BTM implementation is more developed—particularly in areas such as university-industry collaboration, infrastructure, and financial support. Conversely, Indonesian industry and university representatives reported higher scores in nonphysical aspects, including shared beliefs in technology and organizational culture. Specifically, Indonesian industry scored 3.00 compared to Malaysia's 2.93, while universities scored 2.84 versus Malaysia's 2.46. These results indicate that, although Malaysia may have more advanced physical infrastructure, Indonesia demonstrates a more favorable nonphysical ecosystem for BTM implementation, especially regarding societal engagement and technological orientation.

The comparison between Indonesia and Malaysia highlights notable differences in how the two countries perceive the implementation and benefits of Business Technology Management (BTM). Malaysia appears to possess a more mature and effective BTM ecosystem, characterized by a strong sense of balance and collaboration among government, industry, and academic institutions. Additionally, Malaysia benefits from a more democratic work environment, which fosters mutual growth and innovation across sectors. In contrast, responses from Indonesia suggest that BTM implementation is still at an early or developing stage. There is a perceived imbalance, marked by weaker collaboration among key stakeholders and a less democratic environment. To enhance BTM implementation, Indonesia should consider strengthening partnerships among government, industry, and universities, clarifying stakeholder roles, and promoting a more inclusive and democratic innovation ecosystem. In this regard, Malaysia's model could serve as a valuable reference for Indonesia in developing a balanced and collaborative approach to innovation-related decision-making.

4. Government Role in BTM Implementation

The government's role within the Triple Helix model was evaluated through seven questions that focused on regulation, funding, inter-ministerial coordination, and support for innovation and professional development.

Table 7. Mean and SD values of Government Role in BTM implementation

No.	Question/Statement	Value	
C.	**Government Roles**	Ind.	Mly.
1	Enacts regulation that supports BTM implementation effectively.	2.00	3.50
2	Allocates fund to conduct collaboration research between university-industry to BTM implementation	2.00	3.00
3	Synchronize among relevant ministries, institutions, organizations in BTM implementation	2.00	3.00
4	Allocates fund for *Continuous Professional Development* (CPD) relevant to the needs of industry.	2.00	3.00

No.	Question/Statement	Value	
5	Supports *Matching Fund* policies between university and industry to optimize BTM effectiveness in OBC implementation.	2.00	3.00
6	Supports on innovation and invention, e.g., patent.	2.50	3.00
7	Protects the employment of domestic human resources and products and services.	3.00	3.00
	Mode (Md) =	2.00	3.00
	SD =	0.39	0.19

The results, presented in Table 7, indicate that the Malaysian government plays a more active and supportive role in the implementation of Business Technology Management (BTM), with a mean score of 3.07 compared to Indonesia's 2.21. Malaysian representatives emphasized the government's involvement in enacting regulations, allocating funds for research collaborations, and supporting initiatives such as matching funds and innovation protection. In contrast, Indonesian representatives reported lower scores in these areas, suggesting challenges in governmental support for BTM development in Indonesia.

The data analysis further reveals that the Malaysian government plays a significantly stronger and more effective role in supporting BTM implementation. Malaysia scores higher across various indicators, including the enactment of supportive regulations, allocation of research and development funding, coordination among relevant ministries, and the promotion of continuous professional development (CPD) aligned with industry needs. Additionally, Malaysia provides more consistent support for innovation and intellectual property protection, as reflected in its lower standard deviation (0.19) compared to Indonesia (0.39).

Conversely, the Indonesian government is perceived as less effective across all dimensions of BTM support, with evident gaps in regulatory frameworks, funding allocation, and cross-sectoral collaboration. The lower mode and higher standard deviation observed for Indonesia suggest inconsistencies in the perception of its efforts, highlighting the need for a more cohesive and supportive governmental strategy to advance BTM.

In conclusion, Malaysia exemplifies a model of proactive and well-structured governmental involvement in BTM implementation, whereas Indonesia must strengthen its institutional roles to cultivate a more resilient and collaborative BTM ecosystem.

5. Industry Role in BTM Implementation

Industry involvement in BTM was examined using 12 questions designed to assess their participation in curriculum updates at universities, the provision of internship opportunities, collaboration in research activities, and support for technological innovation.

Table 8. Mean and SD values of Industry Role in BTM Implementation

No.	Question/Statement	Value	
D.	**Industry Roles**	Ind.	Mly.
1	Active role in updating university curriculum	2.67	3.00
2	Share expertise through lecture, e.g., become guest lecturer in campus.	3.00	3.20
3	Becomes assessor team leader/member in assessing student project work.	3.33	3.20
4	Provide independent study for lecturer, university staff or student.	3.00	3.00
5	Provide internship or industrial attachment for lecturer, staff, or student.	3.33	3.00
6	Offers research collaboration to develop new technology.	3.00	3.20
7	Technology disseminations	3.00	2.80
8	Collaboration in education, research, and innovation development, community services, and resource development.	3.00	2.80
9	Active role in civil engineering certifications	3.00	3.00
10	Software sharing in civil engineering matters with university	2.67	2.80
11	Having CSR commitment in OBE implementation	3.00	2.60
12	Provide apprenticeship program for graduates	3.33	2.80
	Mode (Md) =	3.00	3.00
	SD =	0.22	0.19

Table 8 shows that Indonesian industries had a slightly higher mean score (3.03) compared to their Malaysian counterparts (2.95). The analysis of industry roles in supporting Business Technology Management (BTM) implementation indicates that both Indonesia and Malaysia demonstrate comparable levels of industry involvement, albeit with certain distinctions. Malaysia recorded marginally higher scores in specific areas, such as sharing expertise through guest lectures (3.20 vs. 3.00) and offering research collaborations to develop new technologies (3.20 vs. 3.00). Conversely, Indonesia scored higher in providing internship opportunities (3.33 vs. 3.00) and in leading or participating in the assessment of student project work (3.33 vs. 3.20). Both countries displayed a balanced level of participation in areas such as offering independent study opportunities, engaging in civil engineering certifications, and collaborating in education, research, and innovation.

However, Malaysia scored slightly lower in certain domains, including technology dissemination and collaboration in community service and resource development, suggesting potential areas for improvement. Indonesia, on the other hand, showed strong industry involvement in offering apprenticeship programs (3.33 vs. 2.80) and in the active assessment of student projects, indicating a more hands-on approach in specific aspects of BTM-related activities.

In conclusion, the roles of industry in both countries appear relatively balanced, with Malaysia showing a slight advantage in areas related to technology development and collaboration, while Indonesia excels in student engagement and internship opportunities. The overall mode score (3.00) and the low standard deviations for both Indonesia (0.22) and Malaysia (0.19) reflect consistently strong industry participation in BTM implementation. Nevertheless, both countries

can benefit from mutual learning to enhance their industry-university collaboration and further strengthen the BTM ecosystem.

6. University Role in BTM Implementation

The role of universities in the BTM was evaluated using eight questions that focused on innovation research, the dissemination of results, the sharing of human resources, and the development of interdisciplinary expertise.

Table 9. Mean and SD values of University Role in BTM implementation

No.	Question/Statement	Value	
E.	**University Roles**	Ind.	Mly.
1	Conducts innovation research together industry.	3.00	2.75
2	Dissemination of research results to community.	3.25	2.50
3	Human resource sharing relevant to the need of industry	3.00	2.50
4	University sharing, e.g., lab or apparatus relevant to the need of industry.	3.25	2.25
5	Conducting training relevant to the need of industry.	3.50	2.75
6	Develops interdisciplinary expert ices relevant to the need of industry.	2.50	2.75
7	Acknowledgment working expertise, e.g., Recognition of Prior Learning (RPL) and technology innovation done by industry.	3.00	3.00
8	Provide opportunities for lecturer to collaborate with industry personnel to produce an innovative project work (sabbatical leave)	3.00	2.50
	Mode (Md) =	3.00	2.63
	SD =	0.29	0.23

Table 9 reveals that Indonesian universities had a higher mean score (3.06) compared to Malaysian universities (2.63). Indonesian institutions were more actively engaged in conducting joint research with industry, disseminating results to the community, and providing opportunities for faculty to collaborate with industry partners. These findings suggest that universities in Indonesia play a more central role in the Balanced Triple Helix Model (BTM), actively supporting innovation and knowledge transfer, whereas Malaysian universities appear to be somewhat less involved in these activities.

The results of this study indicate that both Indonesia and Malaysia recognize the importance of the BTM in fostering innovation through collaboration among government, industry, and academia. While Malaysia appears to have a more advanced implementation of the BTM in terms of government support and ecosystem development, Indonesia demonstrates stronger engagement in the non-physical dimensions of the ecosystem, particularly through more active participation of industry and universities in the Triple Helix process. The differing levels of implementation may be attributed to variations in organizational structures, institutional cultures, and government policies between the two countries. To fully realize the potential of the BTM, both nations must focus on strengthening the interconnections among government, industry, and academia, ensuring that each sector can effectively contribute to and benefit from the innovation ecosystem.

DISCUSSION

Both Indonesia and Malaysia agree on the relevance of the BTM (Triple Helix Model) due to its three key democratic characteristics: (1) a prominent role for universities in innovation, equal to that of industry and government within a knowledge-based society; (2) a shift toward collaborative relationships among the three institutional spheres, where innovation policy emerges increasingly through interaction rather than solely as a government directive; and (3) each institutional sphere assumes some functions of the others, taking on new roles in addition to their traditional responsibilities.

When examining its implementation in detail, the perspectives of government and industry representatives in Malaysia show a higher degree of agreement compared to their counterparts in Indonesia, with respective mean scores of 3.00 versus 2.00 for government and 2.84 versus 2.73 for industry. However, from the university perspective, FT UNY in Indonesia reports a higher mean score (2.80) compared to FT UTM in Malaysia (2.50).

Regarding the BTM ecosystem that supports its implementation, the Malaysian government again shows a stronger level of support than its Indonesian counterpart, with mean scores of 3.00 versus 2.14. In contrast, the perspectives from industry and university representatives in Indonesia reveal higher mean scores than those in Malaysia—3.00 versus 2.93 for industry, and 2.84 versus 2.46 for university.

In terms of the roles played by government, industry, and universities in BTM implementation, the Malaysian government demonstrates a higher mean score than the Indonesian government (3.07 versus 2.21). On the other hand, Indonesian industry shows a slightly stronger role in BTM implementation compared to Malaysian industry (3.03 versus 2.95). Similarly, universities in Indonesia report a higher mean score than those in Malaysia (3.06 versus 2.63), indicating a stronger engagement in BTM implementation.

The comparative roles of government, industry, and universities in BTM implementation vary across these key stakeholders. Organizational structures and cultures within the contexts of Indonesia and Malaysia may influence how these roles are enacted.

CONCLUSION

Based on the analysis and discussion above, and with reference to the mean score categories (1.00 to <2.00 as low, 2.00 to <3.00 as average, and 3.00 to 4.00 as high), several key conclusions can be drawn regarding the implementation of the Balanced Triple-Helix Model (BTM) in both Indonesia and Malaysia.

Firstly, the Balanced Triple-Helix Model emerges as the preferred framework in both countries, indicating a shared recognition of the importance of collaboration among government, industry, and universities in fostering innovation and technological advancement. However, when

examining the specific roles of these three key sectors, their involvement in BTM implementation falls within the average category for both countries. This suggests that, while progress has been made, further efforts are needed to strengthen these collaborative relationships.

Regarding the overall BTM ecosystem, both Indonesia and Malaysia also score within the average range. This implies that, although the current infrastructure and mechanisms for collaboration are functional, they are not yet fully optimized for achieving peak efficiency and innovation.

In terms of sector-specific roles, government involvement in BTM implementation is also rated as average in both countries. This highlights the need for more proactive governmental support, coordination, and investment to enhance BTM-related initiatives. Similarly, the industry sector's role in the BTM ecosystem is considered average in both contexts, suggesting opportunities for deeper engagement—particularly in areas such as research collaboration and the dissemination of technological innovations.

The role of universities in BTM implementation is likewise categorized as average. While universities are contributing to the model, there is significant potential for them to take on a more proactive role in driving innovation and aligning academic programs with the evolving needs of both industry and government.

In conclusion, while both Indonesia and Malaysia have made commendable progress in implementing the Balanced Triple-Helix Model, the overall ecosystem and the roles of the government, industry, and universities remain at an average level. These findings underscore the need for more integrated and sustained efforts across all sectors to enhance the effectiveness of BTM implementation in both countries.

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