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A Comparative Analysis of Research and Development Based Incubator in Thailand, Brazil and Indonesia

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ABSTRACT: Research and development (R&D)-based business incubators serve a strategic function in bridging the divide between scientific innovation and market application. In Indonesia, however, these incubators have yet to reach their full potential. Existing strategic models have not yielded satisfactory outcomes in fostering innovation-driven startups. To address this issue, the present study conducts a benchmarking analysis of R&D-based incubator models in Thailand and Brazil—two emerging economies that, while facing structural challenges similar to Indonesia, exhibit diverse institutional responses and incubation frameworks. Utilizing a Systematic Literature Review (SLR) approach, this research identifies the models employed in each country and examines the influence of external environmental factors. The findings are categorized into two main dimensions: incubation model structures and the external environment, analyzed through the PESTLE framework. Thailand implements an augmented Stage-Gate model, Brazil adopts a Business Model Canvas (BMC)-oriented approach, and Indonesia applies a traditional three-stage incubation model. Significant structural gaps were identified in political, economic, and legal aspects, particularly in the Indonesian context. This study offers targeted recommendations to address these disparities and enhance the effectiveness of R&D-based incubators in Indonesia. To the best of the author's knowledge, this is the first study to utilize a Systematic Literature Review to compare R&D-based incubator models across emerging economies, thereby providing a robust and transparent foundation for policy and strategic development.

KEYWORDS: Business Incubator, Business Model, Research and Development, Startup, Systematic Literature Review

I. INTRODUCTION

Indonesia is a large country rich in natural resources and has great potential for R&D (Research and Development) and innovation development (World Economic Forum (WEF), 2019). R&D contributes to improve the economy and competitiveness of the global market industry in the form of increased innovation, to produce new products and services (World Bank, 2024). In addition, according to the United Nations Environment Program (UNEP, 2021), R&D also contributes to achieving sustainable development goals in increasing the green economy and renewable energy to reduce carbon emissions and overcome climate change.

Despite the high potential for R&D advancement in Indonesia, the actual development and utilization of R&D outputs remain constrained by various challenges that hinder their effective implementation. Based on Southeast Asian Development Solutions (SEADS) (2023), the most common challenges faced by R&D startups: limited access to early-stage funding sources and lack of support and guidance from existing incubators. The allocation of Indonesia's R&D expenditure in 2020 was very low compared to other countries, especially ASEAN (Association of Southeast Asian Nations) countries. The research budget accounts for only 0.28 percent of the Gross Domestic Product (GDP), placing Indonesia among the lowest in the ASEAN region (World Bank, 2023). R&D startups that received early-stage funding often experience difficulties in the product commercialization stage, ultimately leading to the failure of the startup. The inability of startups to survive during the commercialization process, often referred as the "Valley of Death" can occur because startups only rely solely on the initial funding they have to operate, while at the same time, revenue has not been obtained significantly (SEADS, 2023). The role of startups that can operate effectively is essential in order to industrialize R&D outputs in Indonesia.

Research from NBIA (2010) states that businesses fostered in business incubators have a survival rate of 87% after five years, proving that incubation programs are effective in increasing the chances of startup success. R&D-based incubators serve as strategic mechanisms to bridge the gap between scientific innovation and market-oriented products and services. Although business incubators play an important role in supporting the startup growth process, incubators with a focus on R&D outputs in Indonesia have not been able to carry out their functions optimally.

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Incubators based on R&D outputs have not found the right model as a fundamental tool, the strategic model that has been implemented so far has not been able to provide satisfactory results. Currently, there are 385 business incubators in Indonesia, but it turns out that existing incubators have not been able to guide on R&D-based startups properly. To address this gap, benchmarking is needed to analyse the existing R&D-based incubator models and external factors in other countries are needed to portray more effective and innovative models that are used to develop R&D-based incubators and how the ecosystem affects the incubator process.

Brazil and Thailand represent emerging economies with high potential for innovation-driven development but differ in their approaches to building and managing R&D-based incubation systems; these countries share similar structural challenges yet offer diverse institutional responses and incubation models (Intarakumnerd et al, 2012; Silva et al, 2025). Despite their relevance, there is a lack of systematic comparative studies focusing on R&D incubators in these nations. Therefore, Brazil and Thailand are used as a reference for designing a suitable business incubator ecosystem and model reference.

This study seeks to address this gap by conducting a systematic literature review (SLR) to analyze the external factors influencing R&D business incubators and examine the incubation models adopted in Indonesia, Brazil, and Thailand. Based on the research problems above, the objectives of this study are (1) Identify R&D-based business incubator models in Brazil, Thailand and Indonesia. (2) Identify gaps between R&D-based business incubator models in Brazil, Thailand and Indonesia. (3) Provide advice on the appropriate R&D-based business incubator ecosystem to be implemented in Indonesia.

II. METHODS

This study uses a descriptive research approach, in which information relevant to the research topic is examined and organized according to a scientific writing framework, utilizing data obtained from secondary sources.

This research used the Systematic Literature Review (SLR) method to minimize bias and provide a comprehensive overview of the various types of R&D-based business incubator models implemented across different countries (Xiao and Watson 2019). Additionally, the method aims to identify existing gaps related to external factors in the contexts of certain countries

Search Process: In searching the literature, researchers used *Scopus* and *sciencedirect* as a literature source and traced using a Boolean search.

Search Keywords: In searching the literature, researchers used Boolean operations:

("business incubator" OR "startup incubator" OR "incubator") AND ("research and development" OR "R&D" OR "innovation") AND (strategy OR model OR development OR "best practices" OR "success factors") AND (evaluation OR performance OR effectiveness)

A. Eligibility Criteria :

- Primary Research
- published in English or indonesian in the last 10 years
- for which the full text was available, from any country
- Concern discussing business incubator in a certain country

B. Level 1 Screening

- Is the Article internationally reputable?
- Is the Article included in the business, management, or economics group?
- Does the paper meet the Eligibility Criteria?
- Does the Article meet the inclusion criteria?

C. Inclusion Criteria

- The literature focuses on discussing incubators based on R&D output or Technology incubators.
- The literature focuses on discussing incubator models or external factors in a certain country.

D. Level 2 Screening

- Does not the article meet the exclusion criteria (a) or (b)?

E. Exclusion Criteria (a) :

- An article does not discuss the concept of an incubator model or framework relevant to the context of a certain country.
- An article does not address the role of an incubator model as a framework supporting business operations.

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F. Exclusion Criteria (b) :

- An article does not discuss external conditions (Political, social & cultural, technological, legal, or environmental) that may influence the existence or development of incubators in a certain country.
- An article does not discuss how incubators manage to respond to external conditions in a country.

G. Level 3 Screening

- Is the whole article related to business incubators and external factors in a certain country?
- Does the article pass proofreading?

III. RESULTS

An initial screening using research-relevant keywords resulted in 372 articles. The first screening excluded 248 articles that did not meet the predefined criteria, followed by the second screening, which narrowed the selection to 19 articles. Upon a more in-depth review of the article's content, only four articles had the information needed and were thus selected as sources for this study. The articles used for further analysis consisted of 1.07% of the initial number of articles, or four papers from an initial total of 372 papers, which is more than the sample size used in the study by Yang et al. (2018) who used 0.34% of articles from the total number of research databases.

A. Thailand Business Incubator Model

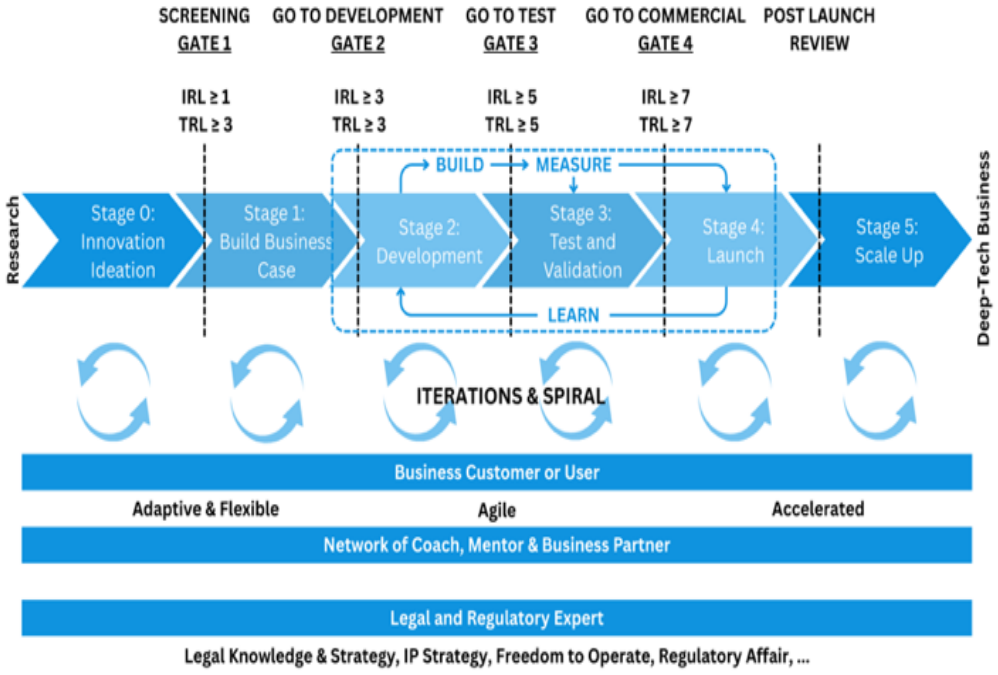

Figure 1 Thailand Business Incubator Model (Kruachottikul P et al. , 2023)

The incubation model used in Thailand utilizes the Augmented Stage-Gate Framework by incorporating elements of Agile Development, Lean Startup, and Design Thinking, with the objective of accelerating the transformation of academic research into commercialization. Specifically tailored for academic settings in developing countries, this model addresses challenges related to limited resources and infrastructural constraints. The incubation process comprises six primary stages: (1) Innovation Ideation, (2) Building the Business Case, (3) Development, (4) Testing and Validation, (5) Launch, and (6) Scale-Up. These are interspersed with five evaluation gates that function as Go/No-Go decision points, ensuring that each startup satisfies predefined criteria before advancing to the next stages.

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In the initial stages, incubator actively engages in scouting promising academic research, collaborating with researchers to identify potential business opportunities and enhance market understanding using the Business Model Canvas. Startups that pass the selection process receive comprehensive support through bootcamps, mentoring, and coaching, involving both academic and industry experts. The model emphasizes an iterative and flexible approach, encouraging startups to rapidly do a market validation by developing Minimum Viable Products (MVPs) and conducting sandbox testing to obtain user feedback in realistic environments. During the incubation period, startups are granted access to initial funding, Intellectual Property (IP) management strategies, and regulatory guidance to ensure legal compliance of their innovations. Upon successful completion of the trial and validation phases, the model supports startups in identifying the best commercialization strategy, such as spin-offs, licensing agreements, or joint ventures, and provides assistance in the scale-up process to foster broader market adoption.

A key strength of this model lies in its application of the Triple A System, Adaptive, Agile, and Accelerated, which enables startups to respond dynamically to market and technological changes while mitigating the risk of failure. The effectiveness of this approach is evidenced by several successful case studies in Thailand. This model shows how a structured, data-driven, and collaborative incubation framework can significantly enhance the conversion of academic research into commercially applicable innovations within the Thai context.

B. External Factor Affecting Thailand's Incubator

Thailand has several policies that facilitate funding for research and development (R&D). One of the key policies supporting this innovation ecosystem is Thailand's Bayh-Dole Act, which aims to boost the commercialization of academic research outputs. This policy can help increase government funding opportunities and regulatory support for researchers and technology startups. As a developing country, Thailand continues to rely significantly on traditional business sectors. However, in recent years, there has been an increasing trend of investment in research and innovation. In 2018, Thailand allocated 1.11% of its Gross Domestic Product (GDP) to R&D. While there is great potential in deep-tech innovation, there are still challenges in obtaining adequate funding, so research-based startups need to rely on a combination of funding from the government, private investors, and academic grants.

Thailand's social conditions show that the innovation ecosystem is still in its early stages. Most technological innovations still originate from universities and academic institutions, but do not have a strong connection to market needs. In contrast, academic professionals prioritize doing research, scholarly publication, and prototype development rather than advancing products to a stage of commercialization. This shows that the adoption of technology from academia to industry is still difficult due to the lack of awareness and direct needs from consumers. This gap between academic research and industry requires a more integrated approach to ensure the success of technology commercialization. In addition, there also needs to be a paradigm shift in the academic world so that researchers can focus on innovations that can be commercialized.

Chulalongkorn University Technology Center (UTC) established to bridge academic research with commercialization as an initiative to build a deep-tech ecosystem in Thailand. In practice, the Triple Helix-based innovation model (government, private sector, and academia) is the main approach in building a strong technology ecosystem. However, there are still challenges in developing technology infrastructure and regulations in this sector.

Legal aspects play a significant role in the success of innovation in Thailand, especially in terms of intellectual property rights (IPR) protection, technology regulation, and licensing requirements for research-based products. Strict regulations and the process of technology are the determining factor. One of the main challenges faced by R&D startups is the complex licensing and regulatory process, so they need to design IPR and regulatory compliance strategies from the early stages to accelerate the commercialization process and avoid legal obstacles later on. The Stage-Gate system used in R&D startup incubation helps to ensure compliance with legal aspects. Moreover, in terms of sustainability and environmental impact, Thailand has shown increasing awareness. Research innovation in Thailand aims for economic sustainability with a focus on academic-based technologies that can be applied in various industries, including those related to the environment and sustainability.

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C. Brazilian Business Incubator Model

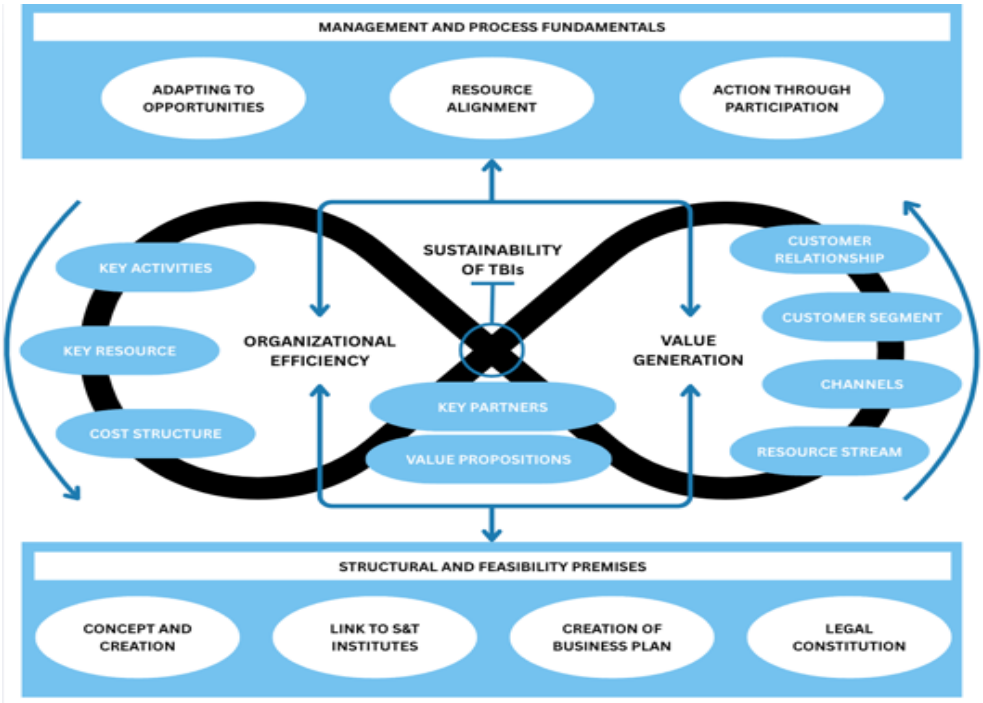

Figure 2 Brazilian Business Incubator Model (Lobosco et al. , 2019)

The incubation model implemented in Brazil is based on the Business Model Canvas (BMC) framework proposed by Osterwalder and Pigneur (2011) and has been adapted specifically to suit the country's Technology-Based Incubators (TBIs). BMC serves as a strategic tool that visually depicts critical components including customer segments, value propositions, revenue streams, and key activities. Incubators primarily target technology-driven startups with high growth potential as their core customer segment. The value propositions encompass funding support, research infrastructure, expert mentoring, and integrated networks bridging academia and industry.

The revenue model in Brazil is diversified, consisting of government grants, incubation fees, partnerships with private companies, and, in some cases, royalty sharing agreements. Brazilian incubators depend significantly on collaborations with universities and research institutions, which provide essential resources, including laboratories and academic expertise. These partnerships are crucial in enabling startups to leverage advanced research and convert it into marketable innovations. By adopting the BMC framework, Incubators in Brazil can operate in a more structured and transparent manner, clarify revenue streams, and build closer relationships with the innovation ecosystem. Moreover, the BMC facilitates balanced operational costs and the value they provide to startups, aiding incubators in achieving long-term financial sustainability (Lobosco et al. , 2019).

D. External Factors affecting Brazilian Incubators

The political environment in Brazil has played a supportive role in the establishment of R&D-based incubators, particularly through the enactment of the Innovation Law by the Brazilian government in 2004 which outlines strategic planning that is conducive to the advancement of scientific, technological, and innovation capabilities. One of its key components is the creation of an enabling environment for strategic partnerships between universities, technological institutions, and private enterprises. The law also facilitates mechanisms for structuring networks and international projects related to technological research. Furthermore, it promotes technology entrepreneurship initiatives, including the development of business incubators and science parks (Fernandes C.C. et al., 2017). However, given the significant influence of government policy and regulation on access to funding, this dependence poses a potential risk for incubators that rely heavily on public financing. Such incubators are particularly vulnerable to policy shifts and political instability, which may occur unpredictably and hinder long-term sustainability (Lobosco et al., 2019).

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Financial resources in Brazil's incubator are typically sourced from funding institutions, however, due to the limited number of such institutions within the country, cultivating strong relationships with funders is considered essential. Incubators that maintain close ties with research centers and universities often rely on public funding such as banks. The extent of formal agreements established between incubators and universities is also a significant factor in securing government support, incubators that depend on government support are more likely to attract funding from multiple sources. In Brazil, it is common practice for a single research project to receive funding from two or more agencies. Incubators that have already secured support from one source often granted easier access to additional financial resources (Fernandes C.C. et al., 2017). In addition, Brazilian incubators can access alternative financing streams, including: (1) funding from educational institutions or universities; (2) private investment; and (3) internal funding mechanisms (Lobosco et al., 2019).

For R&D-based incubators, maintaining positive relationships with funding agencies, universities, research centers, and other relevant stakeholders is particularly advantageous. Considering the limited number of funding institutions in Brazil, the relationship between incubators and these financial entities becomes a critical factor that must be sustained over time. Moreover, incubators that are affiliated with universities often maintain connections with research centers. Strong connection with universities and research centers provide incubators with access to knowledge, technological advancements, and valuable networking (Fernandes C.C. et al., 2017). As many as 72% of Business Incubators in Brazil have formal ties with universities or research centers, which allows incubators to attract entrepreneurs (Lobosco et al., 2019).

Brazil has a number of renowned research centers and universities that support the development of technology-based startups. Collaboration with academic institutions can help incubators provide access to laboratories, research, and experts. This is important as not all incubators have adequate infrastructure (Lobosco et al., 2019). Brazil's legal framework supports innovation through policies that facilitate the creation of technology startups. However, protecting intellectual property rights remains a challenge, although incubators often assist startups with managing patents and copyrights. Innovation no longer only depends on the internal side of research and development, but is also influenced by external factors which are considered important, such as universities, research organizations, and collaboration with various actors. However, there are differences in interests between universities and industry, universities prioritize academic publications, while industry focuses on protecting the outputs. (Fernandes C.C et al 2017)

E. Indonesian Business Incubator Model

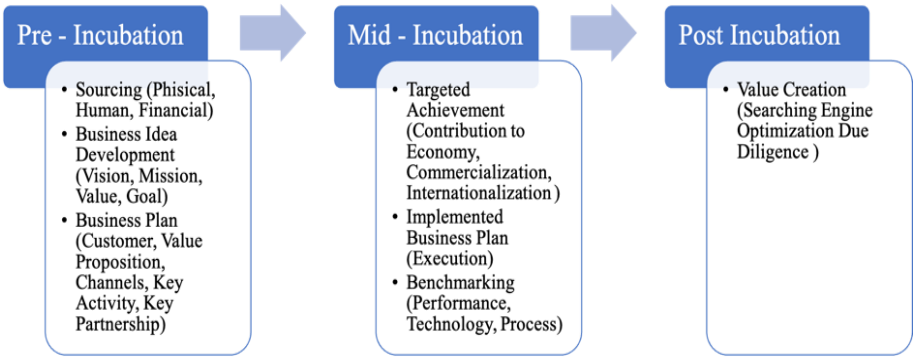

Figure 3 Indonesian Business Incubator Model (Amelia T.N. et al 2018)

Based on the figure shown, the Indonesian government incubator uses an incubation implementation model with 3 stages consisting of the pre-incubation, Mid-incubation, and post-incubation stages with seven business model topics as a requirement for the evaluation process. These topics include sourcing, business idea development, business plan, target achievement, implemented business plan, benchmarking, and value creation. Each topic contains several sub topics. To guide the implementation, a classification framework is often employed to simplify processes, provide clear instructions, and offer a structured scheme for managing a business incubator effectively. The pre-incubation stage focuses on identifying potential resources, formulating the incubator's strategic direction, and planning its operational and managerial processes. The incubation stage involves nurturing and

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accelerating the growth of startup through targeted milestones, business models, and continuous evaluation. Finally, the post-incubation stage aims to generate sustained value from the incubated businesses, particularly in relation to stakeholder engagement and broader economic impact.

F. External Factors Affecting Indonesian Incubators

Government-led startup incubation in Indonesia benefits from strong regulatory support. However, the sustainability of incubation programs remains vulnerable to potential policy shifts or reductions in government budget allocations, given their high dependency on state budget. The contribution of the creative economy to Indonesia's GDP has shown a continuous upward trend, reaching approximately IDR 1,000 trillion in 2018, although compared to other upper middle income countries, Indonesia's R&D investment still lags behind. The government incubator in Indonesia has been supported by fluctuating allocations from the state budget, which reflects the government's strong commitment to the development of digital startups. However, the incubation model remains highly dependent on public funding, which makes the program's sustainability vulnerable to potential budget cuts. Moreover, the limited involvement of private investment in the government Incubator presents a significant barrier for startups seeking accelerated growth, because of limited funding access.

The Indonesian incubator has successfully increased startup participation in its incubation programs. However, the post-incubation success rate remains relatively low; only approximately 35% of incubated startups remain active after completing the program. This indicates that post-incubation support is still insufficient and requires reinforcement through long-term mentoring initiatives. On the other hand, Incubator offers various networking and educational events to support startup development, offering a total of 26 events that startups can participate in. Despite these incubation efforts, the distribution of Indonesia's startup ecosystem remains heavily concentrated in major urban centers, while other regions continue to face limited access to incubation services and investment opportunities, resulting in unequal benefits for startups in less-developed areas

Indonesian incubator has provided technological support to startups by facilitating access to cloud computing services, offering both software and hardware resources for startups in need, and conducting various digital technology training programs through events. From a legal perspective, Indonesia's incubator has provided various forms of support to startups, including assistance with intellectual property rights (IPR) registration, professional certification, and legal consultations regarding business regulations, export requirements for international expansion, and intellectual property protection. These initiatives are aimed at helping startups navigate the complex licensing procedures and bureaucratic hurdles in Indonesia, which often hinder their business expansion. Furthermore, the protection of IPR for technology-based startups remains relatively weak, posing risks of plagiarism or idea theft, particularly during the early stages of business development.

Environmental aspect generally encompasses regulations concerning sustainability, environmental impact, and support for startups focusing on green innovation. However, based on the article used, there is no direct information indicating how Indonesia's incubation program contributes to environmental or sustainability-related goals. Nevertheless, according to the reference used in this study, there is a startup engaged in environmentally friendly practices *(Bekraf, 2019)*. This suggests that Indonesia's incubation does offer some level of support for green innovation, although in practice, environmentally sustainable or renewable energy-based startups have not appeared to be a main priority within the current incubation model.

G. Identification of the Gaps between Thailand, Brazil and Indonesia

Based on the results of this study, several gaps occur in the model and ecosystem that affect the performance of R&D-based incubators between Brazil, Thailand, and Indonesia. Overall, other reference countries have external factors that are more positively supportive of the sustainability of R&D-based incubators. Meanwhile, compared to R&D-based incubators in Indonesia, these external factors are less supportive in the political, economic, and legal aspects.

The first gap identified is in terms of Politic, the development of R&D-based incubators in Thailand and Brazil has been supported by the government through the existence of the innovation law in both countries which seeks to promote technological entrepreneurship initiatives and the creation of business incubators and science parks. In contrast, although the Indonesian government has provided intervention through funding support and the establishment of legal frameworks to regulate incubator programs, such efforts are frequently overshadowed by other governmental priorities, leading to the perception that incubator programs are not treated as a significant policy focus.

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The second gap that has been identified is in terms of economic aspect, Thailand has a huge potential in deep-tech innovation, there is an increasing trend of investment in research and innovation, they allocated 1.33% of its GDP for R&D. In Brazil, Most local governments are channeling funding to incubators and providing incentives. Although most incubators are dependent on public funding sources, there is a diversification of funding sources that incubators can use. Indonesia also has a high dependency on public funding, but there is a limited funding source and involvement of private investment which presents a significant barrier. At the same time, Indonesia has shown a continuous upward trend of investment in R&D, reaching 0.28 % of its GDP, but it is still considered very low compared to Thailand and other ASEAN countries (World Bank, 2023).

The last gap that has been identified is the legal aspect in terms of regulations and laws for the existing R&D-based incubator. Even though there is a complex licensing and regulatory processes in all three countries, in Thailand, the Stage-Gate system helps startups in ensuring compliance with legal aspects. The legal framework in Brazil supports innovation through policies. In comparison, Intellectual Property Rights protection for technology startups in Indonesia is still weak, so there is a risk of plagiarism or theft of business ideas which can be harmful to startups, especially in the early stages of development.

IV. CONCLUSIONS AND RECOMMENDATIONS

This study reveals significant differences in the development and performance of R&D-based business incubators across Thailand, Brazil, and Indonesia. Furthermore, it provides strategic recommendations derived from a comprehensive analysis of the gaps identified between Indonesia and the comparator countries. Indonesia faces significant external challenges that hinder the optimal performance of its incubator ecosystem. Three major gaps have been identified in the political, economic, and legal aspects; these structural gaps indicate that the external ecosystem for R&D-based incubators in Indonesia requires strategic enhancement.

The first recommendation in political aspect, Indonesian government should strengthen its commitment to R&D-based incubator by enacting a comprehensive innovation law that prioritizes technological entrepreneurship and support for incubator programs, similar to the approaches taken by Thailand and Brazil. This would ensure that incubators receive sustained policy attention and are integrated into the broader national innovation agenda. Second, it is recommended that Indonesia also increase its R&D investment to at least approach the regional benchmarks, while also promoting diversification of funding sources, thereby reducing the overreliance on public funding. The final recommendation comes from the legal aspect, Indonesia should focus on strengthening the regulatory environment for startups by enhancing the enforcement of intellectual property rights. Establishing a structured legal framework would help early stage startups navigate legal complexities and protect their innovations.

Future research is encouraged to expand the scope of the literature review in order to obtain a more comprehensive understanding of the subject matter. Additionally, employing alternative theoretical frameworks and business models may offer deeper insights into the dynamics of the R&D-based incubator ecosystem.

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