

Challenges Faced by University Spin-Off Company to Commercialization and Internationalization
(*Cabaran yang Dihadapi Syarikat Spin-Off Universiti terhadap Pengkomersilan Dan Pengantarabangsaan*)

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ABSTRACT

University spin-offs play a vital role in turning scholarly research into innovations that are ready for the market, making a substantial contribution to the economic growth of both the country and the world. However, commercialization and internationalization present significant obstacles for these endeavors. In addition to other obstacles to market expansion, this study looks at the main challenges faced by Universiti Teknologi Malaysia (UTM) spin-off companies, with a focus on financial capability and entrepreneurial abilities. In order to determine the main challenges, the study examines responses from a subset of UTM spin-offs using a quantitative research methodology backed by a literature review and primary data collection. According to the results, UTM spin-offs still have difficulty turning research into practical applications, assembling capable management teams, and obtaining sufficient funding, even though they typically exhibit an above-average commercialization rate. Limitations in internationalization are mostly ascribed to internal organizational inefficiencies, market dynamics, and technological gaps. These observations, supported by statistical analysis such as regression and correlation, have applications for improving university spin-offs' preparedness for the global market. The study offers insightful suggestions for enhancing financial support networks, strategic planning, and entrepreneurial training for academics, university administrators, and legislators in order to increase the worldwide competitiveness of academic based businesses.

Keywords: University spin-off, Commercialization, Internationalization

ABSTRAK

Syarikat spin-off universiti memainkan peranan penting dalam menukarkan penyelidikan akademik kepada inovasi yang bersedia untuk pasaran, sekali gus menyumbang kepada pembangunan ekonomi di peringkat nasional dan antarabangsa. Walau bagaimanapun, syarikat syarikat ini sering berdepan cabaran besar dalam aspek pengkomersialan dan pengantarabangsaan. Kajian ini meneliti halangan utama yang dihadapi oleh syarikat spin-off dari Universiti Teknologi Malaysia (UTM), dengan fokus khusus terhadap kemahiran keusahawanan dan keupayaan kewangan, serta halangan lain yang mengganggu pengembangan pasaran. Menggunakan pendekatan penyelidikan kuantitatif yang disokong oleh kajian literatur dan pengumpulan data primer, kajian ini menganalisis maklum balas daripada syarikat spin-off UTM yang terpilih untuk mengenal pasti isu utama yang dihadapi. Dapatan kajian menunjukkan bahawa walaupun syarikat spin-off UTM secara amnya mencatat tahap pengkomersialan yang melebihi purata, mereka masih menghadapi kesukaran untuk menterjemah hasil penyelidikan kepada aplikasi industri, membentuk pasukan pengurusan yang berdaya saing, serta memperoleh pembiayaan yang mencukupi. Dari sudut pengantarabangsaan, kekangan utama termasuk jurang teknologi, dinamik pasaran, dan ketidakcekapan dalaman organisasi. Dapatan ini, yang disokong oleh analisis statistik seperti korelasi dan regresi, memberi implikasi praktikal dalam meningkatkan kesiapsiagaan antarabangsa syarikat spin-off universiti. Kajian ini memberikan cadangan bernilai kepada ahli akademik, pihak pengurusan universiti dan pembuat dasar dalam memperkukuh latihan keusahawanan, sistem sokongan kewangan dan perancangan strategik bagi meningkatkan daya saing global syarikat berasaskan akademik.

Kata kunci: Spin-off Universiti, Pengkomersialan, Pengantarabangsaan

INTRODUCTION

One of the quintessential considerations for technology transfer has been the commercialization of newly created intellectual property (IP). Spin-offs have demonstrated their vast economic contributions, particularly in developed economies such as the USA (Perez-Hernandez, Calderon, & Noriega, 2021). Spin-offs provide both direct and indirect effects: direct effects include increasing competitiveness and contributing to the tax base, and indirect effects include improving technology transfer channels, boosting local economic development, increasing venture capital activities in regions, and enhancing networking activities among regional entities.

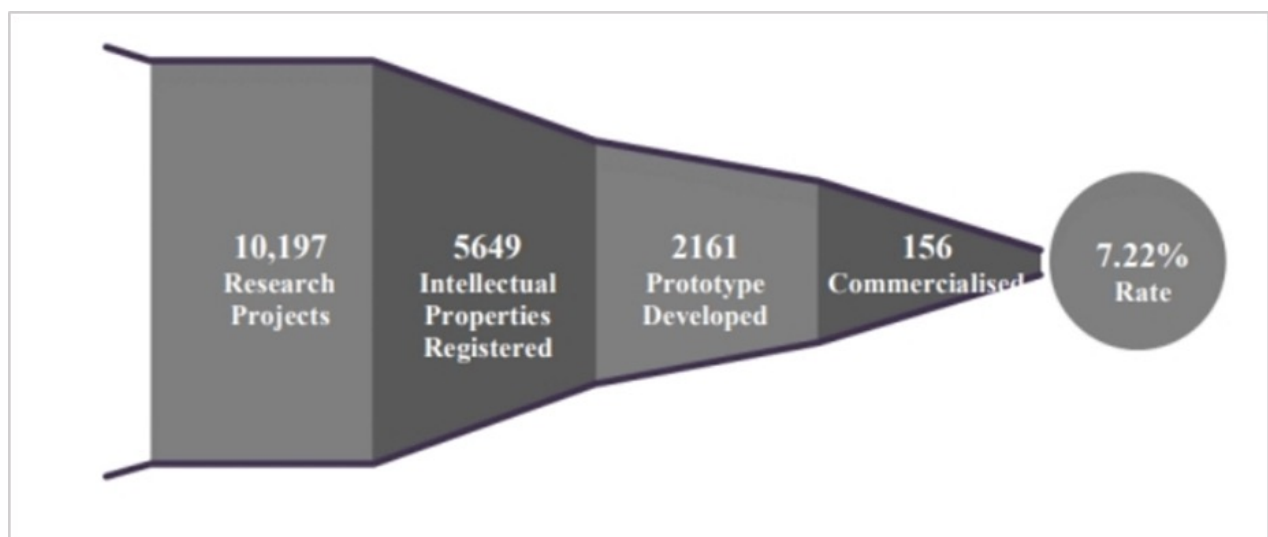
Universities have evolved into research partners in emerging technology fields and thus serve as innovation sources. These companies have proven to be major economic contributors, especially in advanced economies such as the United States (Perez-Hernandez, Calderon, & Noriega, 2021). These spin-offs generate several benefits, both direct and indirect: direct benefits include enhanced national competitiveness and increased tax revenues; indirect benefits include reinforcing technology transfer channels and stimulating local economic development, which elevates university image and provides the basis for networks of collaboration among businesses, promotes the use of high technology, and ultimately increases the effectiveness of innovation and regional prosperity.

In other words, a university spin-off is an

independent company established to commercialize newly developed technology transferred from academic research. Typically spun off from university intellectual property, these spin-offs rather strategically facilitate the conversion of innovation into products and services that can generate value.

Many universities in Malaysia have actively sought commercialization through spin-off businesses. For instance, BioApps Sdn Bhd, OleoPharma Sdn Bhd, and Flexilicate Sdn Bhd are among the businesses that Universiti Malaya has started (UM Centre of Innovation and Enterprise, 2022). In a similar vein, UTM has fostered spin-offs in a variety of fields, such as sustainable resources, health and wellness, and frontier materials (PR Newswire, 2021). These programs support national development goals by reflecting universities' larger efforts to encourage entrepreneurship and innovation among researchers and students.

A key factor in converting scholarly discoveries into useful products for society is commercialization. With a reported commercialization rate of 7.22%, UTM outperforms the national average, demonstrating its solid technological and engineering base. Between 2010 and 2019, UTM recorded 5,649 intellectual property (IP) filings from 10,000 research projects, with 2,161 identified as commercial-ready. Only 156 IPs, however, achieved commercialization and saw sales of more than RM20,000. This figure illustrates the difficulties in transitioning from research to revenue, which is commonly known as the "middle innovation trap" (Abd Jamil & Shamsir, 2020).



Source : (Abd Jamil & Shamsir, Escaping the Middle Innovation Trap: Case Studies of Two Successful Spin-off Companies from a Malaysian Research University, 2020)

FIGURE 1. Projection of UTM's commercialization rate

This study's main goal is to investigate the difficulties UTM's spin-off businesses encounter when attempting to commercialize and expand internationally. In order to determine the internal and external obstacles to market expansion, the study looks into how financial resources and entrepreneurial abilities affect these initiatives. This study advances knowledge about how colleges can better assist their spin-off ecosystems in attaining sustainable growth through empirical analysis and theory-based investigation.

LITERATURE REVIEW

Resource-Based View

The Research-Based View (RBV) theory offers

a comprehensive framework for understanding the challenges encountered by university spin-off companies in their journey towards commercialization and internationalization. By emphasizing the role of resources, capabilities, and networks in shaping firms' competitive advantage and performance, the RBV theory provides valuable insights into how university spin-offs can leverage their unique assets, such as research expertise and intellectual property, to overcome obstacles and achieve success in the marketplace. Through an analysis of difficult-to-imitate attributes that enable competitive advantage, the RBV theory highlights the importance of market-oriented motivations, practices, and collaborations with industry partners in enhancing spin-off companies' ability to navigate funding constraints, market entry barriers, and organizational challenges.

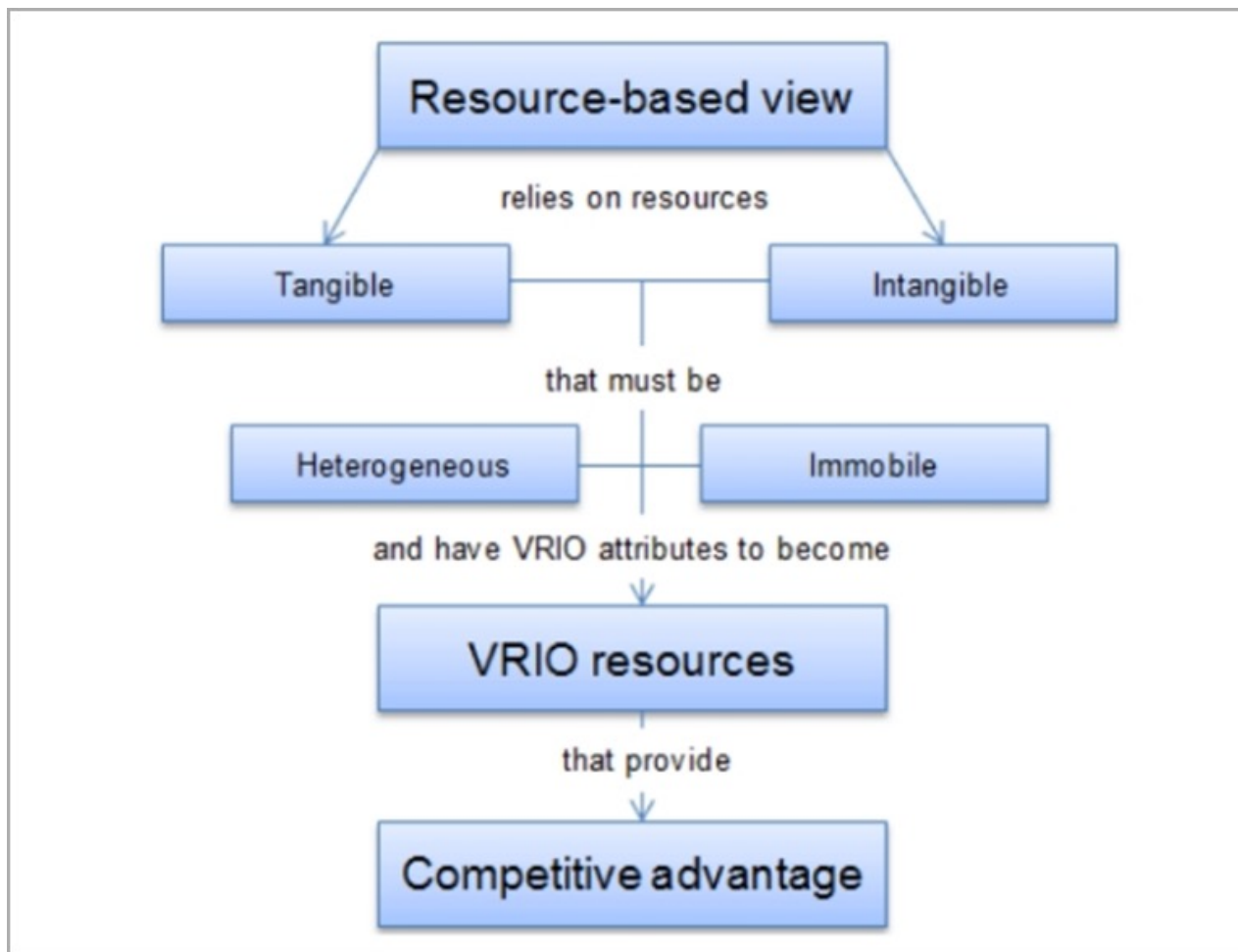


FIGURE 2. RBV and Key Points

By applying the RBV framework, universities and policymakers can develop tailored strategies to support the commercialization and internationalization efforts of spin-off companies, ultimately fostering innovation and economic growth.

Independent Variables

Capabilities play a pivotal role in addressing the challenges faced by university spin-off companies in their journey towards commercialization and internationalization. Derived from the university's academic work and resources, these capabilities enable the creation and commercialization of new businesses based on research and intellectual property. University spin-off companies possess various resources that facilitate their internationalization process, including financial and human capital, technological innovation, networks, and support from the parent university. Human capital resources, such as experience and skills diversity, are vital for navigating the complexities of international markets. Leveraging technological and innovative capabilities derived from research intensive environments allows spin-offs to develop unique products or services with global appeal. Networks, both within the entrepreneur's sphere and through university-industry collaborations, facilitate internationalization efforts. Additionally, institutional support and resources provided by the parent university's ecosystem play a crucial role in facilitating spin-off internationalization. While internationalization presents challenges such as legal and regulatory requirements and currency fluctuations, strategic planning and careful navigation

of these challenges are essential for successful international expansion.

Entrepreneurial skills play a vital role in the success of university spin-off companies, encompassing both soft skills like teamwork and communication, and hard skills such as financial management and technical proficiency. These skills are essential for building effective project teams, nurturing customer relationships, mastering technology, and managing business operations. The Resource-Based View (RBV) theory suggests that the absence of entrepreneurial abilities within universities can lead to diminished returns on research and development investments. However, student spin-off companies can enhance entrepreneurial activity within universities, thereby augmenting the returns on academic research efforts and fostering socio-economic development. Successful university spin-offs are closely linked to the entrepreneurial skills of academic entrepreneurs, highlighting the significance of developing these skills among researchers for the commercialization and internationalization of spin-off ventures. Addressing skill gaps in areas like marketing, finance, networking, and leadership is crucial for overcoming challenges and maximizing the success of university spin-off companies.

Furthermore, financial ability is paramount for university spin-off companies to effectively commercialize and internationalize their operations. This encompasses securing early-stage financing, making prudent financial decisions, and raising successive funding rounds to support growth and development. However, university spin-offs face numerous financial

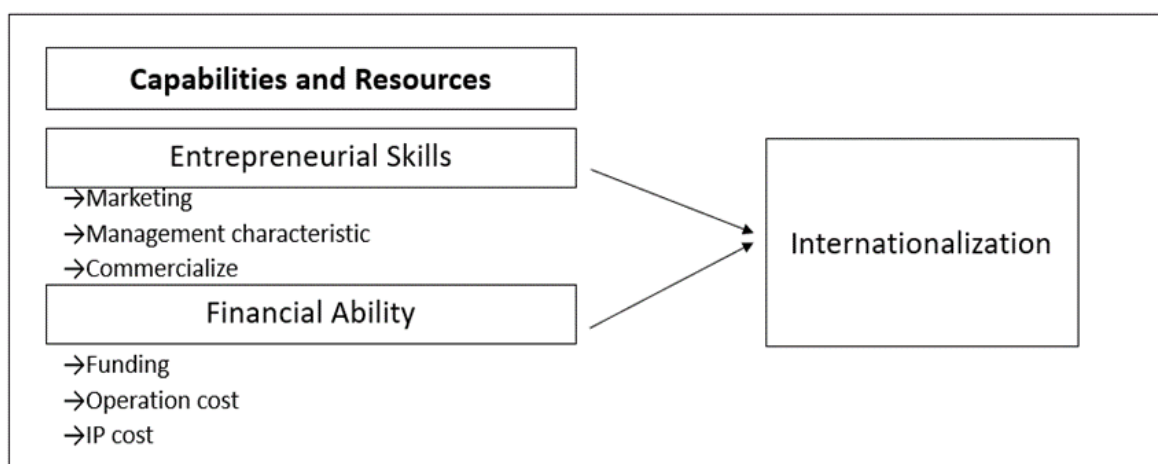


FIGURE 3. The Framework of challenges faced by University Spin-off company to internationalization

challenges, including securing adequate funding, managing operational costs, and addressing the costs associated with intellectual property (IP). These challenges can hinder their ability to invest in research and development, market entry, and international expansion. To overcome these obstacles, university spin-offs must strategically allocate resources, leverage university resources and industry partnerships, explore various funding options, and carefully manage IP costs. Additionally, government support and initiatives can play a crucial role in alleviating financial constraints and facilitating the successful commercialization and internationalization of university spin-off companies.

Dependent Variable

Commercialization and internationalization are crucial processes for university spin-off companies, enabling them to expand their operations and reach new markets, both domestically and internationally. Leveraging their unique position at the intersection of academia and industry, university spin-offs possess comparative advantages such as access to intellectual capital assets, academic talent, and a strong absorptive capacity. These advantages facilitate their ability to rapidly acquire external knowledge and establish international connections, supporting earlier and rapid internationalization efforts. However, successful internationalization requires university spin-off companies to navigate key processes such as market identification, market entry decisions, and the development of comprehensive entry plans, including partnerships, product adaptation, and securing funding.

The framework for the challenges of university spin-off companies to commercialization and internationalization can be summarized as the challenges faced by university spin-off companies during commercialization and internationalization are closely related to the resources and capabilities they possess. According to the Resource-Based View (RBV) theory, the competitive advantage of an academic spin-off depends on the unique resources and capabilities it has access to (Widding, 2011). These resources and capabilities can influence the success of spin-off companies in overcoming challenges and achieving their goals.

The objectives of this study are as follows:

- i. To examine the relationship between entrepreneurial skills of top and middle management in UTM spin-off companies and their internationalization performance.
- ii. To assess the impact of financial ability on the commercialization and internationalization

outcomes of UTM spin-off companies.

- iii. To analyze the broader challenges encountered by UTM spin-off companies in their efforts to commercialize innovations and expand internationally.

METHODOLOGY

This study adopts a quantitative research methodology to investigate the key challenges faced by spin-off companies at Universiti Teknologi Malaysia (UTM) in their efforts toward commercialization and internationalization. The research design is guided by Saunders' "Research Onion" model, incorporating a structured and systematic approach to ensure methodological rigor.

Anchored in a positivist research philosophy, the study emphasizes objectivity and empirical measurement. A deductive approach is employed, wherein hypotheses are formulated based on theoretical constructs and tested using statistical methods. Data were collected through a census sampling strategy, targeting all 32 registered UTM spin-off companies to ensure comprehensive coverage and enhance the generalizability of findings.

Data collection was conducted via a structured questionnaire, comprising both closed- and open ended questions. The instrument was designed to capture measurable insights into entrepreneurial competencies, access to financial resources, market expansion strategies, and perceived performance. The questionnaire was administered to top and middle management representatives within the spin-offs, ensuring responses from key decision-makers with firsthand knowledge of operational challenges.

The collected data were analyzed using descriptive statistics, correlation analysis, and other inferential techniques to explore the nature and strength of relationships among the key variables. This analytical approach allowed the study to identify statistically significant patterns and draw evidence-based conclusions.

Recognizing potential limitations such as response bias and the dynamic nature of spin-off environments, measures were taken to enhance the study's validity and reliability. These included pre-testing the questionnaire, applying consistent data collection procedures, and employing validated analytical tools.

Overall, the methodology provides a robust, objective, and empirically grounded framework for uncovering the realities confronting UTM spin-

TABLE 1. Demographic information

Variables		Frequency	%
What industry of your spin-off company	Biotechnology	10	15.2
	Cosmetic	17	25.8
	Engineering	9	13.6
	Research and Development	19	28.8
	Technology and Management system	11	16.7
Gender	Female	37	56.1
	Male	29	43.9
Age	25 - 30 years	20	30.3
	31 - 40 years	26	39.4
	41 - 50 years	14	21.2
	51 - 60 years	5	7.6
	60 years and above	1	1.5
Affiliation	Faculty's Members	32	48.5
	Staff	34	51.5
Faculty's name	Azman Hashim International Business School	5	7.6
	Faculty of Built Environment and Surveying	4	6.1
	Faculty of Chemical and Energy Engineering	1	1.5
	Faculty of Civil Engineering	2	3.0
	Faculty of Computing	8	12.1
	Faculty of Electrical Engineering	6	9.1
	Faculty of Management	4	6.1
	Faculty of Mechanical Engineering	3	4.5
	Faculty of Science	8	12.1
	Faculty of Sciences and Humanities	2	3.0
	Malaysia-Japan International Institute of Technology	9	13.6
	Razak Faculty of Technology and Informatics	9	13.6
	School of Professional and Continuing Education	5	7.6
Position in UTM	Admin staff	8	12.1
	Lecturer	19	28.8
	Researcher	23	34.8
	Senior lecturer	16	24.2

Position in university spin-off company	Middle management	36	54.5
	Top management	30	45.5
Years of spin-off company establishment	2011-2013	5	7.6
	2014-2016	16	24.2
	2017-2019	15	22.7
	2020-2022	19	28.8
	2023 and above	11	16.7

off companies. It supports evidence-based policy recommendations and strategic interventions aimed at enhancing commercialization and internationalization outcomes.

RESULTS AND DISCUSSIONS

The industries in which Universiti Teknologi Malaysia (UTM) spin-off companies operate are diverse, with the highest concentrations in research and development (28.8%) and cosmetics (25.8%). These are followed by technology and management systems (16.7%), biotechnology (15.2%), and engineering (13.6%). Male participation is 43.9%, while female participation is 56.1%. Participants between the ages of 31 and 40 make up the largest percentage (39.4%), followed by those between the ages of 25 and 30 (30.3%). Faculty members (48.5%) and staff (51.5%) make up nearly equal numbers of respondents, with the majority hailing from MJIT and the Razak Faculty of Technology and Informatics. The largest groups are lecturers (28.8%) and researchers (34.8%). Compared to top management (45.5%), middle management (54.5%) is more prevalent in the spin-offs. The majority of spin-offs were founded

between 2020 and 2022 (28.8%), followed by 2014–2016 (24.2%) and 2017–2019 (22.7%), indicating rapid expansion and diverse demographics in UTM's spin-off ecosystem.

Next, Table 2 presents the reliability of key variables in the study of Universiti Teknologi Malaysia (UTM) spin-off companies, focusing on capabilities and resources, entrepreneurial skills, financial ability, and internationalization challenges. Each variable's reliability is measured using Cronbach's alpha (α), based on the number of items used for evaluation. The capabilities and resources variable, measured with eight items, achieved a reliability score of $\alpha = 0.84$, indicating strong internal consistency. Entrepreneurial skills, assessed with seven items, had a reliability score of $\alpha = 0.85$, also reflecting strong internal consistency. Financial ability, evaluated with ten items, showed the highest reliability score of $\alpha = 0.89$, signifying excellent internal consistency. Internationalization challenges, measured with eight items, had a reliability score of $\alpha = 0.87$, indicating strong consistency as well. Overall, the reliability coefficients suggest that the measures used in this research are reliable instruments for assessing the respective constructs among UTM spin-off companies.

TABLE 2. Reliability of capabilities and resources, entrepreneurial skills, financial ability and internationalization challenges among Universiti Teknologi Malaysia (UTM) spin-off companies

Variables	Total Item	Reliability (α)
Capabilities and resources	8	0.84
Entrepreneurial skills	7	0.85
Financial ability	10	0.89
Internationalization challenges	8	0.87

Furthermore, Table 3 shows the results of the normality test for all key variables. Capabilities and resources have a mean of 3.18, a 5% trimmed mean of 3.20, variance of 0.86, and standard deviation of 0.93. The skewness (0) and kurtosis (-0.81) suggest a near-normal distribution. Entrepreneurial skills have a mean of 3.00, skewness of -0.07, and kurtosis of -0.89, indicating a fairly normal but slightly flat distribution. Financial ability reports a mean of 3.13, skewness of -0.09, and kurtosis of -0.84, while internationalization challenges have a mean of 3.10, skewness of 0.01, and kurtosis of -0.82. All variables fall within the -2 to +2 range for skewness and kurtosis, supporting the assumption of normality and justifying the use of parametric tests.

Financial ability has a mean score of 3.13, with a 5% trimmed mean of 3.14, suggesting minimal

influence from outliers. Variance and standard deviation are both 0.98 and 0.99, respectively, showing moderate variability. The skewness of -0.09 and kurtosis of -0.84 indicate a nearly symmetrical and slightly flatter distribution. The internationalization challenges variable has a mean score of 3.10, with a 5% trimmed mean of 3.11, also indicating minimal impact from extreme values. Variance and standard deviation are 0.97 and 0.99, respectively, with a skewness of 0.01 and kurtosis of -0.82, suggesting a nearly symmetrical and slightly spread-out distribution. The normality of data for all variables, with skewness and kurtosis within the -2 to +2 range, confirms the suitability for parametric statistical analysis in subsequent investigations.

TABLE 3. Normality test of capabilities and resources, entrepreneurial skills, financial ability and internationalization challenges among Universiti Teknologi Malaysia (UTM) spin-off companies

Variables	Mean	5% Trimmed Mean	Variance	Standard Deviation	Skewness	Kurtosis
Capabilities and resources	3.18	3.20	0.86	0.93	0.04	-0.81
Entrepreneurial skills	3.11	3.12	0.98	0.99	-0.07	-0.89
Financial ability	3.13	3.14	0.98	0.99	-0.09	-0.84
Internationalization challenges	3.10	3.11	0.97	0.99	0.01	-0.82

A Pearson correlation test was conducted to examine the relationships between capabilities and resources, entrepreneurial skills, financial ability, and internationalization challenges among Universiti Teknologi Malaysia (UTM) spin-off companies. The correlation coefficients and significance levels reveal strong negative relationships in all cases. The correlation coefficient between capabilities and resources and internationalization challenges is $r = -0.79$ ($p = 0.00$), indicating that as the capabilities and resources of the spin-off companies increase, the internationalization challenges they face decrease. Similarly, entrepreneurial skills have a strong negative correlation with internationalization challenges, with a coefficient of $r = -0.85$ ($p = 0.00$), suggesting that higher levels of entrepreneurial skills are associated with fewer internationalization challenges.

Additionally, financial ability shows a significant negative correlation with internationalization

challenges, with a coefficient of $r = -0.86$ ($p = 0.00$), implying that greater financial capacity helps mitigate the complexities and obstacles of internationalization. These strong negative correlations suggest that improvements in capabilities and resources, entrepreneurial skills, and financial ability are likely to reduce the difficulties associated with international expansion. Consequently, all hypotheses (H1, H2, and H3) are accepted, confirming significant negative relationships between the examined variables and internationalization challenges among UTM spin-off companies. This indicates that enhancing these areas is crucial for facilitating the global reach and success of these companies.

Table 5 presents performance measures assessing the degree of multicollinearity in the study. Tolerance values range from 0.31 to 0.44, all above the minimum threshold of 0.20, indicating no significant multicollinearity. The Variance Inflation Factor (VIF)

TABLE 4. Pearson correlation analysis to determine the relationship between capabilities and resources, entrepreneurial skills and financial ability with internationalization challenges among Universiti Teknologi Malaysia (UTM) spin-off companies

Variables	Internationalization Challenges	
	Sig.	Pearson Correlation
Capabilities and resources	0.00	-0.79
Entrepreneurial skills	0.00	-0.85
Financial ability	0.00	-0.86

values range from 2.29 to 3.20, all below the critical value of 5. According to Pallant (2007) and Hair et al. (2011), VIF values above 5 and tolerance values below

0.20 signal multicollinearity issues. Therefore, the study confirms that multicollinearity is not a concern in this investigation.

TABLE 5. Multicollinearity analysis of capabilities and resources, entrepreneurial skills and financial ability

Variables	Collinearity Statistics	
	Tolerance	VIF
Capabilities and resources	0.44	2.29
Entrepreneurial skills	0.37	2.73
Financial ability	0.31	3.20

TABLE 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.92	0.85	0.84	0.39

The ANOVA table from the multiple regression analysis indicates that the model significantly explains the variability in the dependent variable, which is the internationalization challenges faced by Universiti Teknologi Malaysia (UTM) spin-off companies. The regression segment shows an F-statistic of 117.01 with

a p-value of 0.00, highlighting the model's statistical significance. These results confirm that the regression model is highly effective in identifying the factors influencing internationalization challenges for UTM spin-off firms.

TABLE 7. ANOVA

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	53.62	3	17.87	117.01	0.00
	Residual	9.47	62	0.15		
	Total	63.09	65			

The multiple regression analysis reveals that capabilities and resources significantly and negatively impact internationalization challenges among Universiti Teknologi Malaysia (UTM) spin-off companies. With an unstandardized coefficient of $B = -0.26$, this means that a one-unit increase in capabilities and resources leads to a 0.26-unit decrease in internationalization challenges, assuming other factors remain constant. The standardized beta coefficient of $\beta = -0.25$ suggests a moderate negative relationship. This is supported by a t-value of -3.30 and a p-value of 0.00, indicating statistical significance. Therefore, enhancing capabilities and resources can effectively reduce the internationalization challenges faced by these companies.

Similarly, entrepreneurial skills show a significant negative impact on internationalization challenges, with an unstandardized coefficient of $B = -0.38$. This means that a one-unit increase in entrepreneurial skills results in a 0.38-unit decrease in internationalization challenges, with all other factors held constant. The standardized beta coefficient is $\beta = -0.38$, reflecting a strong negative relationship. The t-value is -4.72, and the p-value is 0.00, further confirming the statistical significance. Improving entrepreneurial skills can thus substantially alleviate

the internationalization challenges for UTM spin-off companies.

Financial ability also significantly negatively impacts internationalization challenges, with an unstandardized coefficient of $B = -0.38$. This indicates that a one-unit increase in financial ability leads to a 0.38-unit decrease in internationalization challenges, assuming other variables are constant. The standardized beta coefficient is $\beta = -0.38$, indicating a strong negative relationship. With a t-value of -4.35 and a p-value of 0.00, the statistical significance of this impact is confirmed. Enhancing financial ability is crucial in reducing the internationalization challenges for these companies.

In summary, the multiple regression analysis shows that capabilities and resources, entrepreneurial skills, and financial ability all significantly and negatively impact internationalization challenges among UTM spin-off companies. The unstandardized and standardized coefficients, along with significant t-values and p-values, indicate that improvements in these areas can effectively mitigate the challenges associated with international expansion. This underscores the importance of developing these internal factors to facilitate smoother internationalization processes for the spin off companies.

TABLE 8. Summary of multiple regression analysis impact of capabilities and resources, entrepreneurial skills and financial ability on internationalization challenges among Universiti Teknologi Malaysia (UTM) spin-off companies

Variable	Unstandardized B	Standardized Beta	t	p
Capabilities and resources	-0.26	-0.25	-3.30	0.00
Entrepreneurial skills	-0.38	-0.38	-4.72	0.00
Financial ability	-0.38	-0.38	-4.35	0.00

* $p < .05$ (significant at the 0.01 level, 2-tailed)

Entrepreneurial Skills and Financial Capacity

Entrepreneurial skills play a crucial role in the internationalization process of businesses, particularly for spin-offs and start-ups. These skills encompass a broad range of competencies, including decision-making, networking, negotiation, and financial management. Effective decision-making is essential as it allows entrepreneurs to navigate the complexities of entering foreign markets, making strategic choices about where and how to expand. Networking is equally important, as building relationships with international partners, customers, and stakeholders can facilitate

smoother market entry and expansion. Negotiation skills are vital in securing favorable terms and conditions in international deals, which can significantly impact the success of international ventures. Lastly, financial management skills enable entrepreneurs to effectively allocate resources, manage cash flow, and make informed investment decisions, all of which are critical for sustaining international operations.

Competencies in marketing, finance, and technology are also crucial for navigating the commercialization process. In the realm of marketing, understanding diverse international markets and tailoring marketing strategies to meet the needs of

different regions can determine the success of a product or service abroad. Financial competence involves not only securing initial funding but also managing ongoing financial operations to ensure stability and growth. This includes budgeting, financial forecasting, and managing financial risks associated with international ventures. Technological competence, on the other hand, involves leveraging advanced technologies to gain a competitive edge, improve operational efficiency, and meet the technological demands of international markets. Together, these competencies enable businesses to effectively commercialize their offerings on a global scale.

Effective management teams are vital for the successful commercialization and internationalization of spin-offs. A well-rounded management team brings diverse skills and experiences, fostering innovative solutions and strategic thinking. Such teams can adeptly handle the challenges of international expansion, from navigating regulatory requirements to managing cross-cultural teams. Their collective expertise in various areas, including strategic planning, operations, and human resources, ensures that the business is well-equipped to handle the complexities of internationalization. Additionally, effective management teams can attract investors and build credibility with international partners, further facilitating the internationalization process.

Financial capacity is another critical factor influencing the internationalization of spin-offs. Adequate funding is necessary to invest in innovation, market development, and international expansion. Without sufficient financial resources, spin-offs may struggle to develop and refine their products or services to meet the demands of international markets. Financial capacity also determines a company's ability to enter and sustain operations in foreign markets, covering costs such as market research, marketing campaigns, and establishing local operations. Moreover, financial resources are essential for overcoming initial barriers to entry, such as regulatory compliance and establishing distribution channels.

Spin-offs often face significant challenges in securing sufficient financial resources, which can hinder their commercialization and internationalization efforts. Limited access to funding can result from various factors, including the perceived high risk associated with new ventures, lack of collateral, and limited track record. This financial constraint can impede the ability of spin-offs to invest in necessary market research, develop competitive products, and effectively market their offerings on a global scale. Additionally, insufficient financial capacity can lead to

an inability to sustain operations in foreign markets, resulting in potential withdrawal and loss of market presence. Therefore, addressing financial constraints and securing adequate funding is essential for spin-offs to successfully commercialize their innovations and expand internationally.

Challenges in Commercialization

Spin-offs face numerous challenges in the commercialization process, which can significantly impact their ability to bring innovative products and services to market. One of the primary challenges is technological and market barriers. These barriers involve aligning research outcomes with industry needs and overcoming inherent technological limitations. Often, the advanced technologies developed within academic or research settings may not immediately align with market demands or industry standards. This misalignment necessitates additional development to ensure that the innovations are practical, scalable, and commercially viable. Furthermore, technological limitations, such as the need for further refinement or integration with existing systems, can delay commercialization. Overcoming these barriers requires significant effort, resources, and often collaboration with industry partners to tailor the technology to meet market needs effectively.

Regulatory and compliance issues present another significant challenge for spin-offs. Navigating the complex landscape of regulatory requirements is essential for bringing products to market, especially in highly regulated industries such as healthcare, pharmaceuticals, and environmental technologies. Compliance with local, national, and international regulations can be a daunting task, requiring substantial knowledge of the regulatory environment and often involving extensive documentation, testing, and certification processes. Failure to meet these requirements can result in delays, increased costs, and even the inability to enter certain markets. Therefore, spin-offs must invest in understanding and adhering to regulatory standards to ensure smooth and timely commercialization.

Management and leadership also play a critical role in the commercialization efforts of spin-offs. Effective management teams are crucial for driving the strategic direction, operational efficiency, and overall success of the commercialization process. However, securing such teams can be challenging for spin-offs, which may have limited resources and visibility compared to more established companies. Strong leadership is needed to navigate the complexities of

bringing a product to market, including making strategic decisions, managing resources, and building a cohesive organizational culture. The absence of experienced management can lead to strategic missteps, inefficient operations, and ultimately, failure to commercialize successfully. Thus, attracting and retaining skilled leaders and managers is a key challenge that spin-offs must address.

Financial constraints are a pervasive challenge for spin-offs during commercialization. Accessing sufficient funding is often one of the most significant hurdles, as new ventures typically require substantial capital to develop their products, conduct market research, and launch marketing campaigns. Traditional funding sources, such as venture capital and bank loans, may be difficult to secure due to the perceived high risk associated with new and unproven technologies. Additionally, managing financial resources effectively is crucial to ensure sustainability and growth. Spin-offs must strategically allocate funds to cover various expenses, including research and development, regulatory compliance, marketing, and operational costs. Inadequate funding can lead to stalled development, delayed market entry, and an inability to compete effectively in the marketplace.

Challenges in Internationalization

Internationalization presents a host of challenges for businesses, particularly spin-offs and start-ups, as they attempt to expand their operations beyond domestic markets. One significant challenge is market entry barriers, which involve identifying and penetrating international markets. The process of entering a new market requires comprehensive research to understand the local consumer preferences, competitive landscape, and cultural nuances. Identifying the right market involves assessing the demand for the product or service, the competitive environment, and the potential for growth. Penetrating these markets is further complicated by the need to establish a presence, whether through local partnerships, distribution channels, or direct investment. Companies must navigate different business practices, consumer behaviors, and market dynamics, which can vary significantly from their home country. Successfully overcoming these barriers requires strategic planning, local expertise, and often, significant financial investment.

Technological challenges also play a crucial role in the internationalization process. Adapting technologies to meet international standards and market needs is essential for successful global expansion. Different countries may have varying

technical standards, certification requirements, and consumer expectations. For instance, a technology that is widely accepted in one market may need modifications to comply with the regulatory standards of another. Additionally, local market needs may require customization of the product or service to ensure it resonates with the target audience. This process often involves additional research and development, localization efforts, and sometimes, redesigning core components to meet local specifications. Addressing these technological challenges is critical to ensuring that the product or service is competitive and compliant in the international markets.

Organizational constraints are another major challenge in the internationalization journey. Building and managing international networks and operations require substantial organizational capacity and resources. Establishing a foothold in a new market often necessitates setting up local offices, hiring local talent, and creating a supply chain infrastructure. Managing these operations across different geographies poses logistical and managerial difficulties, including coordinating across time zones, navigating cultural differences, and maintaining consistent quality and service standards. Additionally, fostering effective communication and collaboration within a geographically dispersed team can be challenging. Companies must develop robust organizational structures and processes to support international operations, which can strain existing resources and capabilities.

Legal and regulatory issues add another layer of complexity to internationalization efforts. Understanding and complying with international regulations and standards is critical for entering and operating in foreign markets. Each country has its own set of laws and regulations governing business operations, including labor laws, environmental regulations, tax codes, and industry specific standards. Non-compliance with these regulations can result in legal penalties, financial losses, and reputational damage. Companies must invest in legal expertise to navigate the regulatory landscape, often requiring the hiring of local legal counsel or compliance specialists. This process can be time-consuming and costly, but it is essential to ensure that the business operates within the legal frameworks of the target markets.

IMPLICATIONS

This study on Universiti Teknologi Malaysia (UTM) spin-off companies provides valuable insights into the factors influencing internationalization challenges,

viewed through the Resource-Based View (RBV) theory. According to RBV, a firm's internal resources and capabilities are crucial for achieving competitive advantage, especially in complex international markets. The findings underscore the importance of enhancing capabilities and resources to mitigate internationalization challenges. Spin-offs that invest in technological advancements, human resources, and operational efficiencies are better prepared to handle the complexities of global expansion. This suggests a need for universities and policymakers to strengthen internal capabilities through targeted training, development programs, and infrastructure support.

Entrepreneurial skills emerge as another critical resource from the study, with a significant negative correlation to internationalization challenges. RBV highlights entrepreneurial skills as intangible assets that drive innovation, strategic decision-making, and adaptability. Thus, fostering an entrepreneurial culture within universities through curriculum development, mentorship, and real-world experiences is vital for equipping spin-offs to overcome international barriers. Additionally, the study points out the importance of financial ability in reducing internationalization challenges. Financial resources are essential for funding operations, managing risks, and sustaining growth, making access to venture capital, grants, and strategic partnerships crucial. This indicates that universities and government bodies should focus on establishing financial support mechanisms and connecting spin-offs with potential investors.

Overall, the study suggests that UTM spin-offs and similar entities should adopt a resource based approach to internationalization by leveraging their core competencies and resources for a sustainable competitive advantage. For policymakers and educational institutions, this means designing policies and programs that support capability development, entrepreneurial skills, and financial access. Tailored support initiatives, such as international business training and financial resource facilitation, alongside industry collaborations, can significantly enhance the internationalization efforts of spin-offs.

CONCLUSION

This study concludes by highlighting the importance of internal capabilities, financial resources, and entrepreneurial skills in addressing the internationalization challenges faced by spin-off companies from Universiti Teknologi Malaysia (UTM). Enhancing these internal strengths may

facilitate the process of entering international markets, as the quantitative analysis shows a significant negative relationship between these factors and internationalization barriers.

From a theoretical standpoint, the results support the Resource-Based View (RBV), which holds that companies can gain a competitive advantage abroad by implementing effective internal capabilities and resource configurations. By offering empirical proof of the direct relationship between financial strength and capabilities and international success, this study adds to the expanding body of literature, especially when it comes to university spin-offs in developing nations.

Practically speaking, the study provides policymakers, ecosystem stakeholders, and university administrators with insightful information. It emphasizes how important it is to foster an atmosphere that encourages the growth of entrepreneurs, improves access to resources, and provides organized financial assistance. To succeed globally, UTM spin-offs must make strategic investments in areas like operational scalability, localized product adaptation, and market intelligence.

In order to ensure long-term success in global markets, future research should focus more on the precise instruments, frameworks, or institutional support systems that can assist spin-offs in better utilizing their internal strengths.

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