

Governance Framework of Publicly Funded Lab-to-Market R&D Grants

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ABSTRACT

Malaysia continues to face challenges in translating publicly funded research into market-ready innovations, particularly within the Technology Readiness Level (TRL) 4–9 spectrum. Despite substantial public investment in research and development (R&D), many projects fail to progress beyond the prototype stage, resulting in weak commercialisation outcomes and suboptimal returns on public investment. Existing studies have primarily focused on commercialisation barriers, researcher capability, and industry collaboration, with limited attention given to the governance of publicly funded lab-to-market R&D grants. This study aims to develop an integrated governance framework for publicly funded lab-to-market R&D grants. To achieve this aim, this study examines the legal, administrative and financial governance of nine funding schemes from the Ministry of Higher Education (MOHE), the Ministry of Science, Technology and Innovation (MOSTI) and the Ministry of Investment, Trade and Industry (MITI) and their agencies. The study conducts doctrinal, policy and comparative analysis to identify governance shortfalls as well as similarities, differences and unique features in the governance of the selected funding schemes. The findings are used to develop an integrated governance framework that aligns governance mechanisms with lab-to-market deliverables and performance indicators, including TRL progression, technology transfer, commercialisation outputs, fund utilisation, compliance, fulfilment of project deliverables, and timely project completion. The proposed framework contributes to innovation governance literature and supports Malaysia's RDICE agenda by strengthening commercialisation performance and maximising the economic and societal value of publicly funded R&D investments.

Keywords—Law; Governance; Framework; Lab-to-Market; Publicly Funded Research; Commercialisation.

INTRODUCTION

Publicly funded lab-to-market R&D grants are government-funded schemes designed to support the transition of research outputs into commercially viable products, technologies, services, and processes (Nitu, 2025; Saleem, 2021). Unlike fundamental research grants that primarily generate new knowledge, lab-to-market R&D grants focus on the commercialisation phase of innovation, particularly within the Technology Readiness Level (TRL) 4–9 spectrum where technologies move from prototype validation to market deployment (Ravikumar & Aarthi, 2026; Ishak et. al., 2025; Dikweni et. al., 2023). These funding schemes are intended to bridge the well-documented “valley of death,” a critical stage where many promising innovations fail due to insufficient funding, weak market validation, limited industry engagement, and inadequate commercialisation support (Silvestri et. al., 2026; Nielsen et. al., 2023). In Malaysia, multiple Ministries and their agencies have introduced specialised funding schemes to support different stages of the lab-to-market continuum, creating a diverse but fragmented public innovation funding landscape. (Abidin 2022; Ajabge et. al., 2015)

The Prototype Development Research Grant Scheme (PRGS) administered by the Ministry of Higher Education (MOHE) focuses on transforming university research outputs into functional prototypes and serves as an important bridge between fundamental research and applied innovation (OECD 2025; (MOHE, 2023). Another funding scheme administered by MOHE is Malaysia Laboratories for Academia-Business Collaboration (MyLAB). MyLAB promotes collaboration between universities and industry partners, thereby strengthening

industry relevance and facilitating the commercialisation of research outputs (MASTIC, 2023). Together, PRGS and MyLAB schemes represent the academic and collaborative components of Malaysia's lab-to-market ecosystem.

At the technology development stage, the Ministry of Science, Technology and Innovation (MOSTI) administers the Applied Innovation Fund (AIF) and Technology Development Fund (TeD), which support technology validation, product development, pilot production, and commercialisation activities (MASTIC, 2024). These schemes are designed to accelerate the advancement of technologies towards market readiness and are aligned with national science, technology, and innovation priorities. Complementing these initiatives is the National Technology and Innovation Sandbox (NTIS), which provides a regulatory and testing environment that enables innovators to validate technologies under real-world conditions before commercial deployment (MOSTI, 2024). NTIS is coordinated by the Malaysian Research Accelerator for Technology & Innovation (MRANTI), an agency under MOSTI. NTIS represents an important evolution in innovation governance by integrating funding support with regulatory facilitation and technology validation.

Malaysia's innovation ecosystem also includes funding schemes specifically designed to support entrepreneurship and commercialisation. The CIP Spark/CIP Sprint programme administered by Cradle Fund, another agency under MOSTI. CIP Spark/CIP Sprint provides funding for proof-of-concept development, prototype refinement, market validation, and start-up growth (MASTIC, 2023). This funding scheme shifts the focus from research institutions to entrepreneurs and technology-based ventures, thereby strengthening the commercialisation pathway for innovation-driven enterprises. Similarly, the Commercialisation of R&D Fund (CRDF) administered by the Malaysian Technology Development Corporation (MTDC), supports the commercialisation of publicly funded research through spin-off companies and technology-based firms (MTDC, 2015; MTDC, n.d.). Like MRANTI and Cradle Fund, MTDC is another agency that operates under the purview of MOSTI. These funding schemes provided MRANTI, Cradle Fund and MTDC play an important role in translating publicly funded research into marketable products and commercially sustainable businesses.

At the industry-facing end of the lab-to-market spectrum, the Collaborative Research in Engineering, Science and Technology (CREST) R&D&C&I Grant and the Domestic Investment Accelerator Fund (DIAF) provide mechanisms for industrial deployment and commercial scale-up (MASTIC, 2023; MIDA, 2024). The CREST is an agency under the Ministry of Investment, Trade and Industry (MITI) that facilitates collaborative research, talent development, and commercialisation within Malaysia's Electrical and Electronics (E&E) sector. The CREST grant adopts a demand-driven model requiring collaboration between industry and universities, with significant industry co-investment to ensure market relevance and commercial viability (CREST, n.d.). In contrast, DIAF, administered through Malaysian Investment Development Authority (MIDA), another agency under MITI, focuses on technology adoption, industrial upgrading, automation, and competitiveness enhancement (MIDA, n.d.). These schemes demonstrate how public funding can be used not only to support innovation creation but also to facilitate large-scale industrial implementation and economic impact.

Collectively, these funding schemes form a comprehensive lab-to-market funding ecosystem spanning prototype development, technology validation, commercialisation, start-up formation, regulatory testing, and industrial deployment. However, despite pursuing similar objectives of technology transfer and commercialisation, they operate under different governance arrangements. The effectiveness of lab-to-market R&D grants depends not only on the availability of funding but also on the governance structures that regulate how grants are assessed, monitored, administered, and evaluated. Governance encompasses legal, administrative, and financial mechanisms that guide project selection, milestone monitoring, intellectual property management, reporting obligations, compliance requirements, and accountability systems. Effective governance is therefore essential to ensure that publicly funded R&D projects produce intended deliverables and achieve measurable commercialisation outcomes.

Problem Statement

Malaysia has invested substantially in publicly funded research and development (R&D) to strengthen innovation, enhance industrial competitiveness, and generate economic and societal value. To facilitate the

translation of research outputs into market-ready innovations, various Ministries and public funding agencies have introduced specialised lab-to-market R&D grant schemes spanning different stages of the commercialisation pathway (Noor, 2024; Abidin, 2022). Collectively, these schemes provide support across the entire lab-to-market continuum, ranging from prototype development and technology validation to commercialisation, regulatory testing, industrial deployment, and scale-up.

Despite the existence of this extensive funding ecosystem, Malaysia continues to experience difficulties in converting publicly funded research into commercially successful products, technologies, and enterprises (Shahidan et. al., 2025). Many projects fail to progress beyond prototype development, while others encounter delays in technology validation, market adoption, regulatory approval, or industrial deployment (Rahim et. al., 2021). As a result, the returns generated from public R&D investment remain below expectations, particularly within the Technology Readiness Level (TRL) 4–9 spectrum where commercialisation outcomes are expected to materialise (Zolkepli, 2025; EPU, 2015).

The persistence of these challenges suggests that the issue extends beyond technical capability and market readiness. Existing studies have largely focused on researcher competencies, entrepreneurial capability, technology transfer barriers, and industry collaboration (Ting et. al., 2019; Subramonian & Rasiah, 2016). However, limited attention has been given to the governance arrangements that regulate the assessment, administration, monitoring, accountability, and performance management of publicly funded lab-to-market R&D grants. Consequently, an important dimension of commercialisation performance remains insufficiently examined.

A closer examination of the selected grant schemes reveals significant variations in governance structures across funding agencies. While financial governance is relatively standardised through Treasury regulations and public finance procedures (MOF, 2016), legal and administrative governance remain fragmented across Ministries and agencies. Existing funding schemes often employ different success indicators, making it difficult to compare performance across agencies or assess the overall contribution of public R&D funding to national innovation objectives. Significant differences exist in areas such as commercial readiness assessment, project monitoring, milestone management, intellectual property ownership, licensing arrangements, reporting obligations, compliance requirements, and enforcement mechanisms. Consequently, projects with similar commercialisation objectives may be subject to different governance expectations depending on the funding source.

Such fragmentation may result in duplication of processes, inconsistent performance measurement, weak inter-agency coordination, reduced accountability, and inefficiencies in grant administration. Effective governance of lab-to-market R&D grants requires the integration of three interdependent dimensions: i) legal governance, which governs intellectual property rights, contractual arrangements, compliance obligations, and accountability; ii) administrative governance, which regulates project assessment, monitoring, reporting, and enforcement; and iii) financial governance, which governs funding allocation, utilisation, procurement, and financial accountability. However, these dimensions currently operate in isolation across different funding schemes and agencies.

Malaysia's Research, Development, Innovation, Commercialisation and Economy (RDICE) roadmap, a strategic national initiative led by MOSTI to transform Malaysia into an innovation-driven economy, emphasises the need to strengthen the entire innovation value chain and improve the economic impact of publicly funded research (Bernama, 2024; ASM 2022). The absence of an integrated governance framework limits the ability to systematically evaluate the effectiveness of publicly funded lab-to-market R&D grants.

Accordingly, there is a critical need to develop an Integrated Governance Framework for Publicly Funded Lab-to-Market R&D Grants that harmonises legal, administrative, and financial governance across schemes such as PRGS, MyLAB, AIF, TeD, CIP Spark/CIP Sprint, CRDF, CREST, NTIS, and DIAF. Such a framework is necessary to improve coordination among funding agencies, strengthen accountability, standardise governance practices, enhance fulfilment of project deliverables, improve utilisation of public funds, accelerate commercialisation outcomes, and ultimately maximise the economic and societal value generated from Malaysia's publicly funded R&D investments.

LITERATURE REVIEW

The international literature on lab-to-market commercialisation has increasingly recognised that the successful translation of research outputs into marketable products, services and technologies depends not only on scientific quality, but also on effective commercialisation processes, institutional support, intellectual property management, industry collaboration and governance structures (Ribeiro, 2025; Miškinis, 2024). A recurring theme in this literature is the existence of the “Valley of Death,” a critical gap between research discovery and market deployment where many promising technologies fail to progress beyond laboratory development. Islam (2017) conceptualises the Valley of Death as a structural disconnect between technology-push research activities and market-pull commercialisation requirements. According to Islam, successful commercialisation requires an integrated value chain comprising researchers, intermediaries, industry actors, investors, and end-users working within a coordinated innovation ecosystem. The study further argues that intermediary institutions play a crucial role in bridging technological development and market demand, thereby facilitating the transition of emerging technologies from laboratory research to commercial application.

Recent studies further demonstrate that successful lab-to-market translation increasingly depends on collaborative and ecosystem-based approaches. Ravikumar and Aarthi (2026) emphasise the importance of university-government-industry partnerships in translating academic research into scalable innovation. Hemmatian et al. (2022) find that R&D collaborations and non-patent intellectual property policies significantly influence technology transfer performance, suggesting that commercialisation governance extends beyond patent ownership and includes broader knowledge transfer and collaborative governance arrangements. Wan et al. (2026) similarly demonstrate that industry-university-research cooperation generates significant financial and innovation benefits, reinforcing the need for integrated governance across innovation actors.

In the Malaysian context, Zaki and Hashim (2023) examine the commercialisation process within research institutions and highlight the importance of structured procedures, institutional support, and coordination between researchers and commercialisation units. Their findings demonstrate that commercialisation success depends on the ability of research institutions to systematically manage research outputs and align them with market opportunities. Similarly, Moktar (2018) focuses on early-stage business models for university technology commercialisation and emphasises the importance of value proposition development, industry engagement, and market positioning in moving technologies from laboratory settings to commercial markets.

Rosdi et al. (2021) further argue that successful innovation and commercialisation depend on the availability of comprehensive support services within the innovation ecosystem. Their study identifies technology support services, market support services, financial support services, know-how support services, and leadership support services as critical enablers of commercialisation success. The authors observe that despite substantial public investment in research and innovation, Malaysia continues to face challenges such as weak industry linkages, fragmented support systems, limited access to commercialisation expertise, and low rates of industry adoption of publicly funded research outputs. Importantly, the study highlights the need for stronger governance, coordination, and collaboration among universities, government agencies, industry, and support institutions to improve commercialisation outcomes.

While these Malaysian studies provide important insights into university technology commercialisation, support services, and business model development, they do not sufficiently examine the governance of publicly funded lab-to-market R&D grants as a distinct legal, administrative, and financial governance problem. In particular, the existing Malaysian literature gives limited attention to how governance mechanisms influence Technology Readiness Level (TRL) progression, prototype validation, intellectual property commercialisation, licensing, start-up formation, and market deployment. Consequently, there remains a significant research gap in understanding how the governance architecture of public funding instruments affects commercialisation performance and public return on investment.

International literature provides broader insights into technology commercialisation and publicly funded R&D governance. Olawore et al. (2022) identify market readiness, organisational capability, funding availability, technological capability, and external collaboration as key determinants of successful technology

commercialisation. Kusmintarti (2022) highlights the importance of intellectual property management in transforming research outputs into economic value. Cunningham and Link (2022), in their study of US federally funded research and development centres, demonstrate the importance of assessing the economic and societal returns of publicly funded R&D. Armstrong et al. (2019) similarly argue that stronger governance mechanisms are required to maximise the return on investment from publicly funded research.

The governance framework literature further supports the need for a more structured and coordinated approach to lab-to-market commercialisation. Shaikh et al. (2024) argue that translational research and development models provide systematic pathways for moving technologies from research to market through validation, development, testing, and commercial alignment. Islam (2017) similarly demonstrates that successful commercialisation requires coordinated value chain governance linking technology creators, intermediaries, investors, manufacturers, and market actors. These studies suggest that commercialisation success is not merely a function of technological excellence but also depends on the effectiveness of governance arrangements across the innovation ecosystem.

More recently, Ali et al. (2025) proposed a theory-driven framework for Malaysia's Research, Development, Innovation, Commercialisation and Economy (RDICE) ecosystem. The study identifies five complementary theoretical foundations underpinning innovation ecosystems: National Innovation System Theory, Mission-Oriented Innovation Theory, Knowledge-Based Economy Theory, Innovation Value Chain Theory, and Integrated Governance Theory. The authors argue that Malaysia's innovation performance continues to be constrained by fragmented governance, duplicated initiatives, weak policy coordination, and low commercialisation rates. They further advocate the development of integrated governance structures capable of coordinating innovation actors, funding mechanisms, commercialisation pathways, and economic outcomes within a unified ecosystem.

Despite these contributions, several important research gaps remain. First, the existing literature largely focuses on commercialisation success factors, support services, technology transfer mechanisms, business models, or innovation ecosystems, while relatively little attention has been given to the governance framework of publicly funded lab-to-market R&D grants. Second, although studies acknowledge the Valley of Death and the importance of support services, there is limited analysis of how legal governance, administrative governance, and financial governance collectively influence commercialisation outcomes. Third, Malaysian literature remains underdeveloped in examining the fragmented governance of public R&D funding across Ministries and agencies, particularly between the Ministry of Higher Education (MOHE), Ministry of Science, Technology and Innovation (MOSTI), and Ministry of Investment, Trade and Industry (MITI). Finally, existing studies did not provide an integrated governance framework capable of linking upstream research translation, prototype development, technology validation, scaling, and market deployment within a single governance architecture.

This study contributes to the current body of knowledge by shifting the focus from commercialisation barriers, support services, and institutional processes towards the governance of publicly funded lab-to-market R&D grants. Building upon the Valley of Death framework proposed by Islam (2017), the commercialisation support ecosystem identified by Rosdi et al. (2021), and the integrated innovation governance perspective advanced by Ali et al. (2025), this study examines commercialisation governance through three interconnected dimensions: legal governance, administrative governance, and financial governance. The study further contributes by comparing the governance approaches of MOHE, MOSTI and MITI, thereby identifying similarities, differences and unique features within Malaysia's public lab-to-market R&D funding ecosystem.

Most importantly, the study proposes an Integrated Governance Framework for Publicly Funded Lab-to-Market R&D Grants in Malaysia that integrates intellectual property governance, grant assessment, monitoring, reporting, milestone-based funding, TRL progression, regulatory readiness, and commercialisation performance within a coherent lifecycle governance model. Theoretically, the study extends existing innovation governance literature by conceptualising lab-to-market grants as governance instruments rather than merely funding mechanisms. Practically, it provides a policy-oriented framework for strengthening coordination, accountability, commercialisation outcomes, and public return on investment within Malaysia's RDICE ecosystem.

METHODOLOGY

This study adopts a qualitative analysis approach to examine the governance of publicly funded lab-to-market R&D grants in Malaysia and to develop an Integrated Governance Framework that incorporates legal, administrative, and financial governance dimensions. The methodology is exploratory in nature, as it seeks to identify governance gaps, evaluate existing governance practices, and formulate a best-practice framework capable of improving the delivery and performance of publicly funded lab-to-market R&D grants.

The study focuses on nine major Malaysian lab-to-market R&D funding schemes, namely: i) Prototype Development Research Grant Scheme (PRGS); ii) Malaysia Laboratories for Academia-Business Collaboration (MyLAB); iii) Applied Innovation Fund (AIF); iv) Technology Development Fund (TeD); v) CIP Spark/CIP Sprint; vi) Commercialisation of R&D Fund (CRDF)); vii) National Technology and Innovation Sandbox (NTIS); viii) CREST R&D&C&I Grant; and ix) Domestic Investment Accelerator Fund (DIAF). These funding schemes administered by various agencies (MTDC, Cradle, MRANTI, CREST, MIDA) under three ministries (MOHE, MOSTI, MITI) were selected because collectively they represent the full lab-to-market pathway, encompassing prototype development, academia-industry collaboration, technology validation, start-up commercialisation, regulatory testing, industrial deployment, and commercial scale-up.

Data for the study are derived primarily from secondary sources, including legislation, policy documents, grant manuals, funding guidelines, government circulars, intellectual property policies, and relevant academic literature. These materials are analysed using qualitative content analysis, whereby governance provisions are examined according to the three governance dimensions and the corresponding deliverables and performance indicators of lab-to-market R&D grants.

The doctrinal analysis examines the legislation, regulations, ministries directives, funding agreements, and other legal instruments. The analysis focuses on legal governance issues such as intellectual property ownership and exploitation, contractual arrangements, compliance obligations, accountability mechanisms, dispute resolution, and enforcement provisions. The objective is to identify the legal structures that influence the management and performance of publicly funded lab-to-market R&D grants.

The policy analysis examines the funding policies, guidelines and standard operating procedures (SoP) applicable to the selected funding schemes. Particular attention is given to provisions relating to project assessment, funding allocation, milestone management, monitoring, reporting, commercialisation requirements, industry participation, and performance evaluation. The purpose of this analysis is to examine how existing governance arrangements shape the delivery of lab-to-market R&D outputs and influence innovation and commercialisation outcomes.

The study further employs a comparative governance analysis to systematically compare governance practices across the selected schemes. The comparison is undertaken across three governance dimensions: i) legal governance, including intellectual property ownership, licensing arrangements, contractual obligations, compliance requirements, and accountability mechanisms; ii) administrative governance, including project assessment, selection criteria, monitoring systems, reporting requirements, performance measurement, and enforcement procedures; and iii) financial governance, including funding models, disbursement mechanisms, matching grant requirements, fund utilisation, procurement controls, and financial accountability. The comparative analysis seeks to identify governance similarities, differences and unique features across the Malaysian lab-to-market R&D funding ecosystem. The findings from the doctrinal, policy, and comparative analyses are subsequently synthesised to develop a proposed Integrated Governance Framework for Publicly Funded Lab-to-Market R&D Grants.

Governance Of Publicly Funded Lab To Market R&D Grants

A. Prototype Development Research Grant Scheme (PRGS)

Legal Governance

The Prototype Development Research Grant Scheme (PRGS) operates within the legal and regulatory framework governing publicly funded research in Malaysian higher education institutions and serves as one of the Ministry of Higher Education's (MOHE) primary mechanisms for bridging the gap between laboratory research and pre-commercialisation activities. The governance of PRGS is primarily administered through MOHE research grant guidelines, institutional governance frameworks, funding agreements, and university compliance procedures. As the principal objective of PRGS is to transform research findings into functional and commercially exploitable prototypes, intellectual property (IP) governance constitutes a central feature of the scheme.

Researchers are generally required to conduct prior art and patent searches, consider IP protection strategies before publication, and prepare product marketing plans to preserve the commercial value and patentability of research outputs. Legal governance is further strengthened through grant agreements, institutional endorsements, reporting obligations, compliance requirements, and project deliverables that establish accountability between MOHE, universities, and researchers. Ethical approvals are also required where applicable, particularly for projects involving human subjects, environmental implications, or regulated technologies.

In addition, PRGS adopts a joint ownership model over commercialisation outputs generated through the project, whereby the Government and the institution share interests in the resulting intellectual property and innovation outputs. This governance arrangement reflects the public interest character of publicly funded research while simultaneously encouraging institutional participation in commercialisation activities. Overall, the legal governance framework of PRGS demonstrates a transition from conventional academic research governance towards a more commercialisation-oriented governance structure that integrates intellectual property protection, translational research, and accountability mechanisms.

Administrative Governance

Administratively, PRGS is managed through the MyGRANTS system and implemented at institutional level through university Research Management Centres (RMCs). The scheme adopts a multi-layered governance structure involving institutional evaluations, panel assessments, mandatory pitching sessions, mentor appointments, milestone monitoring, progress reporting, and project completion assessments. Universities play a central governance role by providing administrative oversight, verifying compliance with funding conditions, and monitoring project implementation throughout the grant period.

Project assessments under PRGS focus heavily on proof-of-concept viability, prototype functionality, translational capability, Technology Readiness Level (TRL) progression, commercial viability, industry collaboration potential, and market readiness. Unlike conventional academic research grants that primarily evaluate scholarly outputs, PRGS governance places stronger emphasis on prototype development, pre-commercialisation readiness, and the potential economic or societal impact of research outputs. The inclusion of mandatory pitching sessions and mentorship mechanisms further demonstrates the increasing commercialisation orientation of the scheme.

Administrative governance under PRGS also reflects the growing integration of market-driven considerations within publicly funded university research. Monitoring activities are not limited to technical research progress alone, but increasingly include evaluation of prototype functionality, commercialisation potential, and alignment with downstream industry applications. Consequently, PRGS represents an important governance mechanism within Malaysia's lab-to-market ecosystem by linking university-based research activities with translational and commercialisation objectives.

Financial Governance

PRGS adopts a targeted funding approach specifically designed to support prototype development, testing, validation, proof-of-concept activities, and pre-commercialisation preparation. The scheme provides funding of up to RM500,000 for projects with durations ranging from one to two years. Financial governance mechanisms include approved budget allocations, expenditure controls, milestone-based monitoring, periodic financial reporting, and audit requirements intended to ensure proper utilisation of public funds.

Fund utilisation is monitored through institutional oversight mechanisms administered by universities and RMCs to ensure that project expenditures comply with approved objectives and deliverables. Financial governance under PRGS also places emphasis on intellectual property generation, prototype development, and commercialisation preparation as measurable outputs of publicly funded research. Applicants are additionally required to disclose previous and future funding sources in order to prevent duplication of public funding and to ensure continuity of support across different stages of the commercialisation pathway.

Unlike conventional research grants focused primarily on publication outputs, PRGS financial governance aligns funding utilisation with translational and market-oriented objectives. Funding support is therefore directed towards activities that strengthen the progression of technologies from laboratory research towards commercially viable prototypes and eventual market deployment. Overall, the financial governance structure of PRGS reflects a gradual shift in Malaysia's publicly funded R&D ecosystem from research-centric financing towards performance-oriented and commercialisation-driven funding governance.

B. Malaysia Laboratories for Academia-Business Collaboration (MyLAB)

Legal Governance

The Malaysia Laboratories for Academia-Business Collaboration (MyLAB) scheme adopts a significantly more sophisticated legal governance structure compared to conventional university research grants due to its strong emphasis on industry-academia collaboration and commercialisation-oriented research. Governed through the Ministry of Higher Education (MOHE) guidelines, funding agreements, and institutional governance procedures, MyLAB is specifically designed to bridge the gap between academic research and industrial commercialisation by institutionalising collaborative governance between universities and industry partners.

Legal governance under MyLAB extends beyond conventional grant administration to encompass intellectual property (IP) ownership, licensing arrangements, confidentiality obligations, technology transfer governance, commercialisation rights, and benefit-sharing mechanisms between collaborating parties. The scheme formally requires industry participation and imposes minimum Technology Readiness Level (TRL) requirements to ensure that projects possess sufficient technological maturity and commercialisation potential before funding approval is granted. Researchers are also generally required to ensure prior IP filings, particularly for technologies intended for downstream commercial exploitation.

A distinctive feature of MyLAB's legal governance framework is the formalisation of university-industry relationships through legal instruments such as Memorandum of Understanding (MoUs), Memorandum of Agreement (MoAs), licensing term sheets, collaboration agreements, and technology transfer arrangements. These agreements govern ownership and exploitation rights over foreground intellectual property generated during the project, including licensing, royalty-sharing, commercialisation rights, confidentiality obligations, and dispute resolution mechanisms. Conflict of interest declarations are also required to preserve governance integrity and accountability within collaborative arrangements.

Overall, the legal governance framework of MyLAB reflects a transition from traditional academic research governance towards collaborative innovation governance, where legal arrangements are specifically designed to facilitate commercialisation, industry participation, and market-oriented research outcomes.

Administrative Governance

Administratively, MyLAB adopts a rigorous and highly structured multi-stage governance framework intended to ensure strong industry engagement, commercialisation readiness, and accountability throughout the project lifecycle. Governance mechanisms involve university-level screening, Technology Transfer Office (TTO) and Research Management Centre (RMC) assessments, project pitching sessions, internal technical and commercial evaluations, market validation studies, site visits, and approval by institutional Boards of Governors.

Unlike conventional academic grants that focus primarily on scientific merit, project evaluations under MyLAB place strong emphasis on commercialisation viability, industry commitment, market demand, minimum viable product (MVP) development, and collaboration synergy between universities and industry partners. Administrative governance therefore integrates both technical evaluation and market-oriented assessment criteria to ensure that funded projects possess realistic commercialisation pathways and industrial relevance.

Monitoring mechanisms under MyLAB include periodic progress reporting, technical reviews, deliverable verification, industry engagement requirements, milestone monitoring, and commercialisation progress assessments. Governance arrangements are specifically designed to ensure continuous and active participation of industry collaborators throughout the project lifecycle rather than limiting industry involvement to preliminary proposal support. This reflects the scheme's broader objective of institutionalising long-term collaboration between academia and industry within Malaysia's innovation ecosystem.

The governance framework also imposes operational governance controls at institutional level. Universities are generally limited to submitting a maximum of three applications per funding cycle, while administrative charges on industry contributions are prohibited. These governance measures are intended to strengthen project quality, ensure institutional accountability, and preserve the integrity of industry co-investment arrangements.

Overall, the administrative governance structure of MyLAB demonstrates a strong commercialisation-oriented and partnership-driven governance model that seeks to align publicly funded university research with industrial demand, market opportunities, and downstream economic impact.

Financial Governance

MyLAB adopts a relatively substantial and commercially oriented funding structure intended to support collaborative research, product development, technology validation, industrial testing, and commercialisation activities. The scheme provides funding of up to RM3 million for projects with a maximum duration of two years, reflecting recognition that commercialisation-oriented projects require significantly greater financial support than conventional academic research activities.

Financial governance mechanisms include budget approval processes, phased funding disbursement, milestone-based monitoring, expenditure thresholds, seed funding arrangements, and periodic financial reporting requirements. Funding disbursement is generally tied to achievement of technical, commercialisation, and implementation milestones, thereby strengthening accountability and ensuring alignment between public funding and project deliverables.

A defining characteristic of MyLAB's financial governance is its shared-risk financing model. Industry collaborators are required to provide at least 5% cash contributions and, in certain circumstances, contribute up to 50% of permanent asset costs associated with the project. This co-investment mechanism strengthens industrial commitment, introduces commercial discipline, and reduces overdependence on public funding. The requirement for industry financial participation also serves as an indirect market validation mechanism, as projects receiving industry investment are more likely to possess genuine commercialisation potential and market relevance.

Financial governance under MyLAB further recognises that commercialisation activities involve broader expenditure categories than conventional academic research. Accordingly, funding provisions extend beyond

research activities to include technology validation, prototype refinement, market readiness preparation, knowledge transfer activities, industrial testing, and commercialisation support mechanisms.

Overall, the financial governance framework of MyLAB reflects an integrated commercialisation financing model that combines public funding with industry co-investment to support translational research, technology transfer, and market-oriented innovation outcomes.

C. Applied Innovation Fund (AIF)

Legal Governance

The Applied Innovation Fund (AIF), administered by the Ministry of Science, Technology and Innovation (MOSTI), adopts a commercialisation-oriented legal governance framework intended to support innovation development, technology maturation, and experimental development activities among technology-based SMEs, start-ups, cooperatives, associations, and non-governmental organisations (NGOs). Governed primarily through MOSTI administrative guidelines, grant conditions, and contractual funding instruments, the scheme recognises innovation outputs as commercially exploitable assets and therefore incorporates legal governance mechanisms aimed at protecting intellectual property and facilitating downstream commercialisation.

Legal governance under AIF includes a range of eligibility and compliance requirements intended to preserve accountability and governance integrity within publicly funded innovation projects. These include ownership requirements, eligibility restrictions, anti-fraud declarations, insolvency restrictions, declarations concerning overlapping or duplicate funding, and commercialisation obligations imposed on funding recipients. Applicants are required to comply strictly with approved project scopes, implementation conditions, reporting obligations, and commercialisation objectives stipulated in the grant agreement.

A notable feature of AIF's legal governance framework is its incorporation of Environmental, Social, and Governance (ESG) considerations into innovation funding governance. Applicants are required to identify and explain ESG elements within their project proposals, reflecting the increasing integration of sustainability governance within Malaysia's publicly funded innovation ecosystem. This demonstrates that the scheme not only prioritises technological and commercial outcomes but also recognises broader governance responsibilities relating to sustainable and socially responsible innovation practices.

The scheme further adopts a conditional funding governance model whereby continuation of funding support is dependent upon compliance with contractual obligations, implementation requirements, project reporting duties, and milestone achievements. Overall, the legal governance framework of AIF reflects a transition from conventional research grant governance towards innovation and commercialisation governance that integrates accountability, sustainability, intellectual property protection, and market-oriented implementation obligations.

Administrative Governance

Administratively, AIF adopts a commercialisation-oriented governance model that places strong emphasis on innovation impact, technology readiness, scalability, and market relevance. The scheme is centrally administered through MOSTI's Sistem Dana Bersepadu (SDB), which serves as the integrated digital platform for application submission, administrative processing, proposal evaluation, monitoring, and reporting activities.

Administrative governance under AIF involves multiple layers of assessment and oversight, including eligibility vetting, document verification, technical evaluations, commercialisation assessments, regulatory compliance reviews, intellectual property evaluations, and project monitoring throughout the project lifecycle. Unlike conventional academic research grants that focus heavily on scientific merit and publication outputs, AIF governance prioritises projects with strong commercialisation potential, practical applicability, and alignment with national innovation priorities.

The scheme demonstrates relatively flexible administrative governance because it accommodates a diverse range of applicants, including individuals, SMEs, start-ups, cooperatives, NGOs, and industry-based innovation actors.

This broad eligibility structure reflects the Government's policy objective of expanding participation in innovation and commercialisation activities beyond universities and public research institutions.

Administrative assessments under AIF focus on several interconnected governance considerations, including technical feasibility, commercialisation readiness, regulatory compliance, intellectual property potential, market scalability, and financial capability of applicants. Projects are also evaluated based on their potential contribution to strategic sectors, economic growth, and innovation-driven development. The scheme targets innovations across a broad Technology Readiness Level (TRL) spectrum ranging from TRL 2 to TRL 9, thereby supporting projects from early-stage innovation through to commercial deployment.

Monitoring mechanisms include milestone reviews, progress reporting, implementation assessments, and performance evaluations intended to ensure that projects progress according to approved timelines and commercialisation objectives. Overall, the administrative governance structure of AIF reflects a commercially driven and innovation-oriented governance approach that integrates technical assessment, market readiness, and performance accountability within a single funding framework.

Financial Governance

Financial governance under AIF is strongly structured around technology development, innovation commercialisation, and market-oriented implementation objectives. Unlike traditional academic research grants that primarily finance research activities, AIF funding is specifically linked to technology maturation, commercialisation readiness, validation activities, and deployment-oriented innovation outcomes.

The scheme adopts a matching grant model requiring SMEs to contribute at least 30% of project costs, thereby introducing shared financial responsibility between government and funding recipients. This co-investment governance mechanism is intended to strengthen financial discipline, reduce dependence on public funding, and ensure stronger commercial commitment among applicants. The matching contribution requirement also functions as an indirect indicator of commercial confidence and market viability.

AIF supports a broad range of innovation and commercialisation-related expenditure categories, including prototype development, testing and validation activities, intellectual property registration, regulatory compliance, acquisition of technology or intellectual property rights, and specialised technical or commercialisation services. Financial governance mechanisms include approved budget allocations, expenditure monitoring, periodic financial reporting, milestone-based disbursement, and implementation reviews designed to ensure effective and accountable utilisation of public resources.

Funding disbursement under AIF is generally linked to achievement of approved milestones and satisfactory implementation progress. This performance-oriented financial governance approach strengthens accountability while ensuring that public funding contributes directly to commercialisation outcomes rather than merely supporting research activities without market deployment potential.

Overall, the financial governance framework of AIF demonstrates a strong outcome-oriented and commercialisation-focused funding model that aligns public investment with innovation scalability, market readiness, and technology deployment objectives.

D. Technology Development Fund (TeD)

Legal Governance

The Technology Development Fund (TeD), administered by the Ministry of Science, Technology and Innovation (MOSTI) under the PEMACU 2.0 framework, adopts a highly structured legal governance model intended to support technology maturation, experimental development, and commercialisation-oriented innovation activities. Unlike conventional academic research grants, TeD is governed primarily through administrative and contractual governance instruments, including the PEMACU 2.0 Guidelines, funding agreements, implementation procedures, and compliance requirements, rather than through a dedicated statutory framework.

The scheme therefore establishes legally enforceable obligations through grant agreements, milestone conditions, reporting duties, project deliverables, and compliance provisions governing the utilisation of public funds.

Legal governance under TeD incorporates extensive eligibility and accountability requirements designed to ensure that funding recipients possess the operational and financial capacity to undertake commercialisation-oriented projects. Applicants are generally required to satisfy conditions relating to company registration, Malaysian equity ownership, minimum paid-up capital, declarations concerning overlapping funding, and restrictions against fraudulent, insolvent, or financially distressed entities. The scheme also imposes project eligibility requirements by mandating the presence of experimental development components and demonstrable commercialisation potential. Projects involving security and defence technologies are generally excluded unless clear dual-use commercial applications can be established.

A significant feature of TeD's legal governance framework is its strong emphasis on intellectual property (IP) governance and commercial readiness. Applicants are required to conduct prior art searches, demonstrate novelty, provide evidence of proof-of-concept (POC) or functioning prototypes, and submit business models during the application process. These requirements demonstrate that legal governance under TeD extends beyond conventional compliance administration and actively integrates commercialisation and market-readiness considerations into project eligibility and evaluation.

The scheme also incorporates Environmental, Social, and Governance (ESG) considerations into its governance framework. Applicants are required to identify ESG elements associated with their projects, reflecting the increasing integration of sustainability governance within Malaysia's innovation and commercialisation ecosystem. Overall, the legal governance framework of TeD demonstrates a commercially driven governance structure that combines contractual accountability, intellectual property governance, technology readiness, sustainability considerations, and commercialisation obligations within a single funding framework.

Administrative Governance

Administratively, TeD adopts a highly structured and multi-tiered governance system designed to ensure rigorous technical, commercial, and financial oversight throughout the project lifecycle. Governance processes involve multiple stages of evaluation and approval, including administrative vetting, technical reviews, expert panel assessments, evaluation by the Funding Evaluation Committee (JPD), approval by the Funding Approval Committee (JKD), and continuous post-award monitoring by designated monitoring committees.

Applications are centrally managed through MOSTI's Sistem Dana Bersepadu (SDB), which functions as an integrated digital governance platform for application submission, document verification, evaluation, monitoring, and reporting activities. This centralised governance system strengthens administrative coordination, improves transparency, and standardises monitoring processes across projects funded under the PEMACU 2.0 ecosystem.

A defining characteristic of TeD's administrative governance is its strong alignment with Technology Readiness Level (TRL)-based innovation management. The scheme targets projects at TRL 4 and above and requires applicants to demonstrate proof-of-concept or functioning prototypes before funding eligibility is considered. This reflects a governance emphasis on technology maturity, scalability, and commercial readiness rather than purely academic research outputs.

Administrative governance under TeD further incorporates mandatory project pitching sessions, submission of videos and presentation materials, commercial and technical evaluations, milestone negotiations, and periodic monitoring activities. Project assessments focus heavily on technical feasibility, prototype functionality, field validation capability, market potential, and commercialisation readiness. Monitoring activities include technical verification, prototype assessment, field-testing reviews, implementation evaluations, and milestone reporting designed to facilitate progression from laboratory validation towards commercial deployment.

The governance framework also institutionalises mandatory collaboration between government, academia, and industry. Public universities and government research institutions (GRIs) applying under the scheme are generally required to collaborate with industry partners, thereby operationalising a triple-helix governance model intended to strengthen technology transfer, industry participation, and downstream commercialisation potential.

Overall, the administrative governance structure of TeD reflects a highly commercialisation-oriented and performance-driven governance model that integrates technical assessment, TRL progression, industry participation, and milestone accountability within a coordinated innovation governance ecosystem.

Financial Governance

Financial governance under TeD is characterised by milestone-based and matching grant financing mechanisms intended to strengthen accountability, commercial discipline, and shared financial responsibility between government and funding recipients. Unlike traditional research grants that focus primarily on research expenditure, TeD financial governance is closely aligned with technology development, field validation, commercialisation progression, and market deployment objectives.

The scheme adopts a co-investment governance model requiring SMEs and start-ups to provide matching contributions as part of project financing. Under the PEMACU 2.0 framework, SMEs and start-ups are generally required to contribute at least 15% cash contributions towards total project costs. This shared-risk financing structure is intended to reduce overdependence on public funding, improve financial accountability, and ensure stronger industry commitment towards commercialisation activities.

TeD provides funding ceilings of up to RM4 million for projects with a maximum implementation duration of 36 months. Financial disbursement is closely linked to achievement of approved milestones and satisfactory project monitoring outcomes. Funding recipients are generally required to establish dedicated project bank accounts, comply with approved implementation milestones, and submit detailed expenditure and progress reports before subsequent disbursements are released.

The scheme also incorporates strong financial accountability mechanisms through milestone monitoring, expenditure verification, implementation reviews, and audit requirements. Financial governance further includes repayment and termination provisions in cases involving non-compliance, failed deliverables, project abandonment, or misuse of public funds. This governance approach reflects an increasing shift within Malaysia's publicly funded innovation ecosystem towards performance-based financial governance and value-for-money accountability.

Overall, the financial governance framework of TeD demonstrates a commercially oriented and outcome-driven funding model that integrates milestone-based financing, co-investment principles, TRL progression, and commercialisation accountability to support higher-risk technology development and market-oriented innovation activities.

E. CIP Spark and CIP Sprint

Legal Governance

Cradle Fund's CIP Spark and CIP Sprint programmes adopt an entrepreneur-centred legal governance framework specifically designed to support start-ups, technology entrepreneurs, and innovation-driven ventures as primary vehicles for commercialisation. Governed through grant agreements, funding conditions, intellectual property provisions, and commercialisation obligations, both schemes reflect a governance approach that differs significantly from conventional university-based research grants. Rather than focusing primarily on academic research institutions, the governance structure of CIP Spark and CIP Sprint is designed to facilitate venture creation, product commercialisation, and business scalability within Malaysia's start-up ecosystem.

Legal governance under both schemes is heavily contractual in nature. Funding recipients are subject to legally enforceable obligations through grant agreements that regulate project implementation, utilisation of funds,

milestone achievement, reporting duties, and commercialisation activities. The agreements also incorporate repayment obligations in cases involving termination, breach of funding conditions, non-performance, or misuse of public funds. This conditional grant structure reflects a commercially oriented governance model that balances funding support with accountability and performance expectations.

CIP Spark, which focuses on early-stage innovation development and proof-of-concept activities, imposes several eligibility requirements relating to company age, Malaysian ownership, intellectual property ownership, revenue limitations, and shareholding structures. Importantly, the scheme also permits applications from individuals in addition to companies, thereby reflecting a more flexible and inclusive innovation governance approach intended to encourage participation from early-stage innovators and aspiring entrepreneurs. This governance flexibility distinguishes CIP Spark from many conventional public R&D grants that are limited to registered institutions or established companies.

CIP Sprint adopts a broadly similar legal governance structure but is designed for later-stage commercialisation and market expansion activities. Eligibility governance under CIP Sprint places greater emphasis on corporate ownership structures, business performance, intellectual property governance, commercial scalability, and venture governance capability. As projects funded under CIP Sprint are generally closer to market deployment and scaling activities, legal governance is correspondingly more commercially focused and performance-driven.

Overall, the legal governance framework of CIP Spark and CIP Sprint demonstrates a transition from conventional research governance towards entrepreneurial and venture-oriented innovation governance, where intellectual property protection, commercial rights, founder capability, and business scalability form central governance considerations.

Administrative Governance

Administratively, CIP Spark and CIP Sprint adopt a highly commercialisation-oriented and ecosystem-based governance model centred on entrepreneurial capability, product viability, market validation, and business scalability. Governance under both schemes focuses less on conventional academic research outputs and more on strengthening innovation-driven enterprises, start-up sustainability, and commercial market readiness.

CIP Spark governance focuses primarily on early-stage innovation development, ideation support, proof-of-concept activities, and pre-commercialisation preparation. Compared to larger and more technically intensive MOSTI funding schemes, the administrative governance structure of CIP Spark is relatively simplified and entrepreneur-friendly. Applications are administered through the MYStartup Single Window Portal, which centralises application management, evaluations, monitoring, and ecosystem support services. The scheme integrates funding support with broader ecosystem development mechanisms such as market validation, business model development, mentorship programmes, and networking support. This demonstrates that governance under CIP Spark extends beyond mere compliance administration and incorporates ecosystem facilitation and entrepreneurial development.

Project assessments under CIP Spark generally focus on innovation value, market opportunities, product feasibility, founder capability, scalability potential, and commercialisation readiness. Administrative monitoring mechanisms include milestone reviews, commercialisation progress reporting, and business development assessments intended to ensure that innovations progress towards viable business models and sustainable commercialisation pathways.

CIP Sprint adopts a more commercially mature governance structure aligned with product enhancement, market expansion, scaling activities, and commercialisation acceleration. Administrative governance under CIP Sprint integrates funding support with mentorship, networking opportunities, market access facilitation, investor engagement, and commercialisation ecosystem support. Project assessments place stronger emphasis on scalability, market traction, business sustainability, and commercial growth capability. Monitoring mechanisms focus on commercialisation milestones, market penetration, customer validation, and venture performance.

A defining feature of both schemes is their ecosystem-oriented governance approach. Administrative governance is not confined solely to project administration and compliance monitoring but actively incorporates entrepreneurial support systems intended to strengthen venture growth and innovation commercialisation capability. This reflects a broader policy shift towards integrating funding governance with start-up ecosystem development and innovation entrepreneurship support.

Financial Governance

Financial governance under CIP Spark and CIP Sprint adopts a staged and commercially oriented funding approach intended to support innovation commercialisation while managing the financial risks associated with early-stage ventures and start-ups. Unlike conventional academic research grants that primarily finance research activities, both schemes align funding support directly with business development, market validation, commercialisation readiness, and venture scaling objectives.

CIP Spark provides funding of up to RM150,000 to support proof-of-concept activities, prototype development, validation exercises, and early-stage commercialisation preparation. Financial governance under the scheme is intentionally lighter and more flexible compared to larger MOSTI commercialisation programmes, reflecting the unique needs and financial limitations of ideation-stage innovators and early-stage start-ups. Funding is generally disbursed through a combination of advance payments and reimbursement mechanisms, enabling recipients to manage cash flow challenges commonly faced by start-up ventures.

CIP Sprint provides substantially larger funding support of up to RM600,000 in conditional grants to facilitate product enhancement, market expansion, scaling activities, and commercial acceleration. Financial governance mechanisms include staged disbursement arrangements, advance payments, reimbursement mechanisms, milestone-based funding release, and repayment obligations in cases involving project termination or breach of grant conditions.

Under both schemes, financial governance is closely linked to achievement of business and commercialisation milestones rather than purely technical research deliverables. Funding recipients are generally required to demonstrate satisfactory implementation progress, market validation outcomes, business development achievements, and commercialisation activities before subsequent funding tranches are released. This governance approach strengthens financial accountability while simultaneously encouraging commercial discipline and venture sustainability.

Overall, the financial governance framework of CIP Spark and CIP Sprint reflects a venture-oriented and commercialisation-driven funding model that combines flexible financing with milestone accountability, entrepreneurial support, and ecosystem development to reduce commercialisation risks and strengthen innovation-driven enterprise growth within Malaysia's start-up ecosystem.

F. Commercialisation of R&D Fund (CRDF)

Legal Governance

The Commercialisation of R&D Fund (CRDF), administered by the Malaysian Technology Development Corporation (MTDC), represents one of Malaysia's most commercially-oriented public R&D funding mechanisms specifically designed to bridge the gap between completed research and market deployment. Unlike upstream research grants that focus primarily on scientific discovery or prototype development, CRDF is legally structured to support the commercial exploitation and market translation of locally developed technologies originating from universities, research institutes, and in-house industrial R&D.

The legal governance framework of CRDF is strongly centred on commercialisation rights, intellectual property (IP) ownership, technology exploitation authority, and corporate commercialisation capability. Applicants are generally required to demonstrate clear legal entitlement to commercialise the relevant technology, including ownership, licensing rights, assignment arrangements, or authorised exploitation rights over the underlying

intellectual property. The governance framework therefore prioritises legal certainty over commercialisation ownership and market exploitation capability before public funds are disbursed.

Eligibility requirements further reinforce the commercialisation-oriented legal structure of the fund. Applicants must be companies incorporated in Malaysia with at least 51% Malaysian ownership, operating technology-based projects involving successfully completed R&D with commercially ready prototypes. This reflects a governance approach that deliberately restricts funding to entities capable of actual market deployment rather than early-stage experimental research. The requirement that the R&D must be completed successfully and that a commercial-ready prototype is available demonstrates that CRDF governance is legally positioned at the post-R&D and pre-market commercialisation phase of the innovation lifecycle.

The legal governance framework also accommodates multiple commercialisation pathways including assignment, licensing, joint ventures, spin-offs, and start-ups. This reflects a flexible and commercially adaptive governance model designed to facilitate diverse forms of technology transfer and market exploitation. In particular, the inclusion of university and research institute spin-offs within the CRDF ecosystem highlights the fund's role in strengthening Malaysia's lab-to-market and public research commercialisation agenda.

Additionally, CRDF incorporates contractual and performance-based governance mechanisms through funding agreements, milestone obligations, commercialisation deliverables, repayment obligations for certain financing instruments, and ongoing monitoring by MTDC. Legal governance therefore extends beyond mere grant administration and operates as a hybrid public-commercial governance framework that combines public accountability with private-sector commercialisation principles.

Administrative Governance

Administratively, CRDF adopts a highly commercialisation-driven governance model focused on technology readiness, market validation, business scalability, and commercial deployment capability. The governance framework is designed specifically to accelerate the transition of local R&D outputs into commercially viable products, services, and technology-based enterprises.

Unlike conventional research grants that primarily assess scientific novelty or academic contribution, CRDF governance places strong emphasis on commercial readiness and market-oriented evaluation criteria. Administrative assessments focus on whether the technology is commercially deployable, whether market demand exists, whether the product functions effectively within commercial settings, and whether the applicant possesses sufficient business and operational capability to execute commercialisation activities successfully.

The fund is structured according to different commercialisation stages through CRDF1, CRDF2, and CRDF3, each reflecting varying levels of technology maturity, commercial scale, and corporate capability. CRDF1 focuses primarily on market validation and technology validation for spin-offs, start-ups, and SMEs, while CRDF2 and CRDF3 support full-scale commercialisation activities for SMEs, larger companies, and public listed companies. This tiered governance structure demonstrates a sophisticated administrative approach that aligns funding governance with Technology Readiness Levels (TRLs) and commercial maturity. The framework specifically targets technologies at higher TRL stages involving validation, demonstration, and commercial application phases.

CRDF administrative governance also incorporates structured pitching, evaluation, and monitoring mechanisms. Applications are subjected to MTDC Pitching Committee assessments involving presentations and question-and-answer sessions with MTDC senior management. This governance process reflects venture capital-style evaluation practices where commercial potential, scalability, management capability, and market strategy are scrutinised before funding approval.

In addition to funding support, MTDC provides incubation, advisory services, business linkages, and accelerator support as part of an integrated commercialisation ecosystem. This demonstrates that CRDF governance extends beyond financial administration into active commercialisation facilitation and enterprise development.

Monitoring arrangements further include periodic reporting, implementation reviews, KPI assessments, and commercial performance evaluations throughout the funding duration.

A distinctive feature of CRDF's administrative governance is its strong performance orientation. Success indicators include sales revenue generation, productivity improvements, new IP filings, job creation, and broader commercialisation outcomes. Consequently, the governance framework prioritises measurable economic and commercial impact rather than merely research completion or academic outputs.

Financial Governance

Financial governance under CRDF reflects a hybrid commercial financing model combining grant funding, co-financing principles, and quasi-equity commercialisation instruments. Unlike traditional research grants that operate predominantly through pure grant allocation, CRDF adopts a commercially disciplined financing structure intended to strengthen accountability, market orientation, and financial sustainability within public R&D commercialisation governance.

CRDF1 primarily operates as an early commercial validation instrument providing up to RM500,000 or 70% of eligible costs, whichever is lower, for market validation and technology validation activities over a period of six to twelve months. The funding structure under CRDF1 consists mainly of grant-based financing intended to reduce early-stage commercialisation risk for spin-offs, start-ups, and SMEs.

In contrast, CRDF2 adopts a significantly more commercially oriented financing structure by combining grants with Convertible Promissory Notes (CPN). Funding may reach up to RM4 million or 70% of eligible costs, whichever is lower, involving implementation periods of two years followed by four years repayment obligations. The CPN mechanism represents a sophisticated quasi-equity governance instrument whereby debt financing may later be converted into redeemable preference shares upon mutually agreed terms. This reflects a major evolution from conventional public grant governance towards commercially sustainable innovation financing mechanisms.

The financing structure further differentiates expenditure categories according to commercialisation risk and asset type. For example, certain activities such as production costs may be financed entirely through CPN arrangements, while activities involving technology development, certification, marketing, IP protection, and administration may receive mixed grant-CPN financing ratios ranging from 80:20 to 50:50. This demonstrates a highly strategic financial governance model that allocates public financial risk differently across various commercialisation activities.

CRDF financial governance also incorporates detailed eligible expenditure controls covering production costs, product testing, standards certification, IP registration, marketing and promotional activities, consultation costs, training, outsourcing, packaging, and commercial product design. These expenditure controls ensure that public funds are utilised specifically for commercialisation-enabling activities directly linked to market deployment and revenue generation.

Importantly, financial governance under CRDF is heavily outcome-oriented. Funding disbursement and monitoring are closely linked to commercial KPIs such as sales revenue, productivity growth, IP generation, employment creation, and commercial scalability. This distinguishes CRDF from conventional academic R&D grants where performance indicators are often centred on publications, prototypes, or research outputs. Instead, CRDF governance prioritises downstream economic impact, business growth, and successful market penetration.

Overall, the CRDF financial governance framework reflects a mature commercialisation financing ecosystem that integrates public funding accountability with venture financing principles, market discipline, commercial risk-sharing, and long-term sustainability objectives. The fund therefore represents one of Malaysia's most advanced hybrid governance models for supporting the transition of publicly funded R&D into commercially sustainable technology enterprises.

G. Crest R&D&C&I Grant

Legal Governance

The CREST Research, Development, Commercialisation and Innovation (R&D&C&I) Grant incorporates extensive legal governance due to its collaborative and industry-driven nature. Governance mechanisms address intellectual property ownership, licensing arrangements, confidentiality obligations, industry participation, and commercialisation rights. Industry-university collaboration agreements form a critical component of the legal framework, providing clarity regarding ownership and exploitation of innovation outputs.

The CREST R&D&C&I Grant adopts a highly structured legal governance framework reflecting its collaborative, industry-driven, and commercialisation-oriented nature. The scheme is governed primarily through the CREST R&D&C&I Terms and Conditions, funding agreements, intellectual property arrangements, confidentiality obligations, and collaboration agreements between universities and industry partners.

Unlike conventional academic research grants, the CREST governance framework explicitly integrates research, development, commercialisation, and innovation within a single funding scheme. The scheme legally requires a minimum partnership between a company and a university based in Malaysia, thereby institutionalising industry-academia collaboration as a core governance requirement. This mandatory collaborative structure reflects a demand-driven governance approach intended to ensure commercial relevance and industrial applicability from the outset of the project.

The legal governance framework also places strong emphasis on intellectual property (IP) governance. The scheme requires projects to involve invention, intellectual property generation, and licensing activities. IP registration costs are borne by CREST, and all IP generated under the grant is registered under CREST, subject to supplementary sharing arrangements among collaborating parties. This creates a centralised IP governance structure that differs from university-centric IP ownership models commonly found in MOHE grants. The framework also incorporates invention disclosure obligations, licensing considerations, confidentiality requirements, and commercialisation rights governance.

Confidentiality governance forms another important legal component of the scheme. Project information, technical details, and commercialisation-related matters cannot be disclosed to external parties without CREST's approval. This demonstrates strong protection of commercially sensitive information and industry interests within collaborative R&D activities.

The legal framework further governs research human capital development through the Industry Graduate Research Assistant Scholarship Programme (I-GRASP), which imposes contractual obligations and service bonds on funded postgraduate students. This introduces a talent-retention and industry-linkage governance mechanism rarely observed in conventional public R&D grants.

Administrative Governance

Administratively, the CREST R&D&C&I Grant adopts a highly integrated, demand-driven, and commercialisation-oriented governance model aligned closely with Technology Readiness Level (TRL)-based innovation management. The governance framework differentiates clearly between Research and Development projects targeting TRL 5–7 and Commercialisation and Innovation projects targeting TRL 7–9, thereby creating a lifecycle-based governance structure that supports applied research, prototype development, minimum viable product (MVP) creation, operational validation, and downstream commercial deployment.

Unlike traditional academic grants that focus primarily on research activities and publication outputs, administrative governance under the CREST scheme explicitly prioritises applied industrial research, MVP development, operational environment validation, market-oriented deliverables, and commercialisation readiness. Project selection is strongly influenced by industry demand, market relevance, technical feasibility, and anticipated commercialisation outcomes, particularly within Malaysia's electrical and electronics (E&E)

sector. This demand-driven governance approach ensures that funded projects are aligned with actual industrial needs and commercial opportunities rather than purely academic interests.

The governance framework places substantial emphasis on project monitoring, milestone accountability, and commercialisation reporting. Funding recipients are generally required to submit quarterly progress reports, financial reports, technical presentation reports, business and market plans, impact reports, and project outcome reports throughout the project lifecycle. Monitoring activities include scheduled review meetings, milestone verification exercises, online or physical site visits, and audit reviews prior to approval of subsequent funding disbursements. These governance mechanisms strengthen accountability and ensure continuous oversight of project implementation and commercialisation progression.

Importantly, the CREST administrative governance framework also incorporates formal change management procedures. Any deviation from approved milestones, project scopes, deliverables, or implementation schedules requires submission of a Change Request Form (CRF) and approval from CREST. This reflects a relatively mature and adaptive governance structure capable of balancing project flexibility with governance accountability and commercialisation discipline.

The administrative governance framework further extends beyond conventional grant administration by incorporating publication governance, invention disclosures, market validation obligations, commercialisation reporting, and talent development governance. Consequently, CREST governance represents a broader innovation ecosystem governance model rather than a purely project-based research funding system. Overall, the administrative governance structure of the CREST R&D&C&I Grant demonstrates a sophisticated and commercially mature governance framework integrating industry participation, TRL progression, performance accountability, market validation, and ecosystem coordination within Malaysia's lab-to-market innovation landscape.

Financial Governance

Financial governance under the CREST R&D&C&I Grant is characterised by a strong co-investment and matching grant structure intended to strengthen industry commitment, financial discipline, commercial accountability, and shared-risk financing. Unlike fully government-funded academic research grants, the CREST scheme requires industry and university collaborators to contribute at least 50% of the total project cost through a combination of cash and in-kind contributions. This financing structure demonstrates a highly commercialisation-oriented governance approach designed to ensure strong industry participation and commitment towards downstream market deployment.

The scheme adopts milestone-based financial governance whereby disbursement of subsequent funding tranches is linked directly to achievement of approved milestones, satisfactory monitoring outcomes, implementation progress, and successful completion of project review sessions. This performance-oriented funding model strengthens accountability and ensures that public funds are utilised in alignment with commercialisation progress and agreed deliverables.

CREST also adopts relatively detailed expenditure governance by distinguishing clearly between eligible and non-eligible expenditure categories. Eligible expenditures generally include graduate researchers and technical personnel, equipment and software acquisition, product certification activities, market and clinical trials, and intellectual property management costs. Non-eligible expenditures include consultancy fees, publication fees, conference and travel expenses, office rentals, and administrative supplies. This targeted expenditure governance demonstrates a strong focus on direct commercialisation, technology deployment, and industrial implementation activities rather than general academic or institutional expenditure.

The financial governance framework further incorporates centralised asset governance mechanisms whereby equipment and software acquired under the grant are generally managed and owned by CREST upon project completion. This governance arrangement strengthens accountability over publicly funded assets while enabling continued utilisation of resources within the broader innovation ecosystem.

In addition, financial governance extends to talent financing through the I-GRASP programme, which adopts a tripartite financing structure involving CREST, industry, and universities. Under this arrangement, CREST funds postgraduate stipends, industry partners contribute allowance components, and universities bear tuition and related academic costs. This integrated financing model reflects broader ecosystem governance principles linking government funding, industry participation, and academic support in the development of commercialisation-oriented research talent.

Overall, the financial governance framework of the CREST R&D&C&I Grant represents one of the most commercially mature and industry-integrated funding governance models within Malaysia's publicly funded lab-to-market R&D ecosystem. The scheme integrates milestone-based accountability, co-investment principles, TRL-oriented financing, commercialisation reporting, centralised asset governance, and talent development financing within a unified and performance-driven innovation governance framework.

H. National Technology and Innovation Sandbox (NTIS)

Legal Governance

The National Technology and Innovation Sandbox (NTIS) operates under a unique governance framework that combines innovation support, regulatory facilitation, and technology deployment. The legal governance of NTIS is primarily established through programme guidelines, participation agreements, funding conditions, and regulatory engagement mechanisms administered under the national innovation agenda. The framework provides a structured mechanism through which innovators can test, validate, and deploy technologies within controlled real-world environments while complying with relevant regulatory requirements.

A key feature of NTIS legal governance is the incorporation of regulatory-readiness requirements into the innovation process. Technologies admitted into the sandbox are required to undergo assessments relating to regulatory compliance, standards requirements, certification pathways, safety considerations, and market deployment readiness. The framework facilitates direct engagement between innovators and regulators to address legal and regulatory issues that may arise during technology testing and deployment. This governance approach allows regulatory concerns to be identified and managed at an early stage of the innovation lifecycle, thereby supporting a smoother transition from development to commercial deployment.

The legal governance framework also establishes eligibility requirements for participation and funding. Government funding is generally restricted to Malaysian-owned entities that have successfully been admitted into the NTIS programme. Companies seeking funding support must satisfy ownership requirements, corporate registration requirements, and programme admission criteria. These requirements are intended to ensure accountability, strengthen governance oversight, and align public funding with national innovation objectives.

In addition, NTIS governance incorporates legal obligations relating to project implementation, reporting, compliance monitoring, and achievement of agreed milestones. Participants are required to comply with programme conditions throughout the validation and deployment process. As a result, legal governance within NTIS extends beyond conventional grant administration and encompasses regulatory facilitation, compliance management, and technology deployment governance.

Administrative Governance

The administrative governance of NTIS is centred on facilitating the validation, testing, and deployment of innovative technologies in real-world operating environments. The programme adopts a structured governance process that begins with the assessment of technological readiness, innovation potential, deployment feasibility, and anticipated socio-economic impact. Projects admitted into the sandbox are evaluated not only on technical merit but also on their readiness for operational testing and practical implementation.

NTIS employs a validation-oriented governance model whereby technologies are subjected to pilot implementation, field testing, user evaluation, and operational verification. Administrative oversight focuses on ensuring that technologies perform effectively under actual conditions while meeting applicable regulatory and

market requirements. Monitoring mechanisms are therefore directed towards validation outcomes, testing results, implementation progress, and achievement of deployment objectives.

Another important feature of NTIS administrative governance is its multi-stakeholder engagement approach. The programme functions as a coordination platform that brings together innovators, regulators, industry players, investors, government agencies, universities, and commercialisation partners. Through this ecosystem-based governance model, innovators gain access to technical expertise, regulatory guidance, market validation opportunities, and commercialisation support. The governance structure therefore extends beyond project administration and serves as a mechanism for facilitating collaboration across the broader innovation ecosystem.

The programme also incorporates continuous monitoring and review processes throughout the sandbox period. Project performance is assessed against predefined validation milestones and deployment targets, enabling programme administrators to track progress, identify implementation challenges, and provide intervention where necessary. This structured governance approach strengthens accountability while ensuring that technologies progress towards commercial readiness and market deployment.

Financial Governance

The financial governance of NTIS is designed to support technology validation, pilot deployment, and commercialisation readiness activities. Funding is provided primarily to facilitate the testing and demonstration of innovative technologies under real-world conditions, enabling innovators to generate evidence of technical performance, operational feasibility, and market applicability prior to large-scale commercial deployment.

NTIS adopts a milestone-based financing approach in which funding is linked to the successful completion of validation activities and achievement of agreed project objectives. Under the Validation Sandbox programme, eligible participants may receive convertible grants of up to RM500,000 for a period of one year. The funding mechanism incorporates a convertible feature whereby up to 20 per cent of the grant may be converted into a Convertible Promissory Note (CPN) upon the occurrence of specified success triggers. This financing arrangement introduces an element of commercial discipline while maintaining the developmental objectives of public funding.

Financial governance also emphasises accountability, transparency, and effective utilisation of public resources. Recipients are required to utilise funding in accordance with approved project scopes, implementation plans, and validation activities. Expenditure monitoring, financial reporting, milestone verification, and compliance reviews are incorporated into the governance framework to ensure that public funds are used efficiently and contribute directly to technology validation and deployment outcomes.

In addition to direct funding support, NTIS serves as a gateway to a broader innovation financing ecosystem. The programme provides innovators with access to various public and private funding mechanisms covering different stages of the Technology Readiness Level (TRL) pathway, including innovation grants, commercialisation funds, venture capital financing, and industrial investment programmes. This integrated financing approach strengthens funding continuity and supports the progression of technologies from validation and testing towards commercialisation and market expansion.

Overall, the governance structure of NTIS reflects a comprehensive approach to technology validation and deployment by integrating regulatory facilitation, ecosystem coordination, performance monitoring, and milestone-based financing within a single governance framework. The programme therefore plays an important role in supporting the transition of innovative technologies from development to real-world application and commercial implementation.

I. Domestic Investment Accelerator Fund (DIAF)

Legal Governance

The Domestic Investment Accelerator Fund (DIAF), administered by the Malaysian Investment Development Authority (MIDA) under the Ministry of Investment, Trade and Industry (MITI), adopts a distinctly industry-

oriented legal governance framework designed to support industrial transformation, technology adoption, automation, digitalisation, and productivity enhancement within Malaysia's manufacturing and industrial sectors. Unlike university-centred R&D grants that focus primarily on prototype development and intellectual property generation, DIAF is structured around industrial deployment, operational implementation, and business competitiveness enhancement.

Legal governance under DIAF is primarily administrative-contractual in nature and is implemented through funding guidelines, approval conditions, industrial compliance requirements, and grant agreements between MIDA and recipient firms. Eligibility is generally restricted to companies registered and operating in Malaysia, particularly firms operating within targeted industrial sectors aligned with national industrial development policies and the New Industrial Master Plan (NIMP) 2030.

The governance framework incorporates extensive regulatory and operational compliance obligations relating to manufacturing licences, investment approvals, taxation requirements, ESG compliance, industrial standards, and sector-specific regulatory requirements. Unlike research-focused funding schemes where governance centres heavily on intellectual property and research outputs, DIAF governance prioritises operational implementation and industrial transformation outcomes. Legal governance therefore focuses on ensuring compliance with investment obligations, technology adoption requirements, operational implementation targets, industrial standards, sustainability commitments, and accountability for industrial upgrading outcomes.

A notable feature of DIAF's legal governance framework is its performance-oriented structure. Funding recipients are contractually obligated to utilise the grant specifically for approved industrial upgrading purposes and to achieve measurable outcomes relating to productivity enhancement, automation, competitiveness improvement, and technology deployment. Companies receiving funding are also subject to audit requirements, reporting obligations, and compliance monitoring imposed by MIDA and MITI.

The scheme further incorporates Environmental, Social, and Governance (ESG) considerations as part of industrial governance and investment compliance. This reflects Malaysia's broader policy transition towards sustainable industrial development and responsible business governance. Overall, the legal governance framework of DIAF demonstrates a mature industrial governance model where public funding is used not only to support innovation activities but also to facilitate industrial modernisation, operational transformation, and national economic competitiveness.

Administrative Governance

Administratively, DIAF adopts a highly industry-driven governance model focused on industrial competitiveness, operational readiness, technology deployment, automation, digital transformation, productivity enhancement, and ESG implementation. Unlike research-oriented grants that primarily evaluate scientific novelty and prototype development, DIAF governance focuses on the practical deployment and operational effectiveness of technologies within real industrial and manufacturing environments.

Administrative governance under DIAF involves multiple layers of project evaluation and implementation oversight, including technical assessments, commercial evaluations, productivity impact analysis, ESG readiness assessments, investment feasibility reviews, and implementation monitoring. Project assessments place strong emphasis on operational readiness, industrial scalability, competitiveness enhancement, technology integration capability, deployment feasibility, and anticipated economic impact.

The governance framework is strongly aligned with Malaysia's national industrial transformation agenda, particularly policy priorities relating to automation and smart manufacturing, digital transformation, sustainability and ESG adoption, high-value manufacturing, and industrial productivity enhancement. Administrative governance therefore integrates innovation governance with broader industrial policy governance and economic transformation objectives under MITI's national development agenda.

Monitoring activities under DIAF focus primarily on implementation progress, operational deployment outcomes, productivity improvements, business transformation indicators, and achievement of approved

industrial upgrading targets. Unlike academic grants that emphasise publications, patents, or prototype generation, DIAF governance evaluates actual industrial deployment and operational performance outcomes. This reflects a governance model that prioritises measurable industrial and economic impact rather than upstream research outputs alone.

Another distinctive feature of DIAF's administrative governance is the close integration between funding governance and industrial competitiveness governance. The scheme effectively links technology adoption and commercialisation activities with broader national economic development priorities, thereby positioning innovation governance as part of a larger industrial transformation ecosystem. Overall, the administrative governance framework of DIAF reflects a highly operational, deployment-oriented, and industry-centric governance structure designed to accelerate industrial modernisation and enhance Malaysia's manufacturing competitiveness.

Financial Governance

Financial governance under DIAF is based primarily on a matching grant and co-investment financing model intended to strengthen industrial commitment, reduce overdependence on public funding, and enhance value-for-money governance. Unlike conventional research grants that focus on funding research activities or prototype development, DIAF financial governance is strongly aligned with industrial implementation, operational deployment, and productivity enhancement objectives.

Funding support under DIAF is generally directed towards automation projects, machinery acquisition, digitalisation initiatives, technology upgrading, ESG implementation activities, and industrial modernisation programmes. The matching grant structure introduces shared financial responsibility between Government and recipient firms, thereby encouraging stronger financial discipline, commercial accountability, and private-sector commitment towards project implementation.

Financial governance mechanisms include approved expenditure categories, staged disbursement procedures, financial reporting obligations, expenditure monitoring, procurement compliance requirements, and audit controls. Funding disbursement is typically linked to implementation milestones and verification of project progress. Recipient companies are generally required to demonstrate actual deployment of approved technologies, achievement of productivity targets, operational implementation progress, and compliance with approved project objectives before subsequent disbursement tranches are released.

A defining characteristic of DIAF's financial governance framework is its strong emphasis on measurable industrial and economic outcomes. Governance indicators are therefore more closely linked to productivity gains, industrial competitiveness, operational efficiency, technology adoption rates, ESG outcomes, and broader economic impact rather than prototype development or intellectual property generation. This distinguishes DIAF from upstream lab-to-market grants such as PRGS or CIP Spark, which focus more heavily on research translation and early-stage commercialisation activities.

Overall, the financial governance framework of DIAF demonstrates a mature and deployment-oriented commercialisation governance model that integrates co-investment principles, milestone accountability, operational performance monitoring, and industrial transformation objectives within a unified funding governance structure. The scheme therefore reflects the downstream and industry-facing end of Malaysia's publicly funded lab-to-market R&D ecosystem, where public funding is strategically utilised to accelerate industrial upgrading, strengthen technological competitiveness, and generate long-term economic impact.

VI. Comparative Analysis

The nine selected schemes—Prototype Development Research Grant Scheme (PRGS), Malaysia Laboratories for Academia-Business Collaboration (MyLAB), Applied Innovation Fund (AIF), Technology Development Fund (TeD), Cradle Investment Programme (CIP Spark and CIP Sprint), Commercialisation of R&D Fund (CRDF), CREST R&D&C&I Grant, National Technology and Innovation Sandbox (NTIS), and Domestic

Investment Accelerator Fund (DIAF)—collectively represent Malaysia’s publicly funded lab-to-market R&D governance ecosystem. Although all schemes share the overarching policy objective of facilitating the translation of research, innovation, and technology into commercial, industrial, and socio-economic outcomes, the analysis demonstrates substantial variation in the legal, administrative, and financial governance structures adopted across the innovation lifecycle.

The comparative analysis further reveals that Malaysia’s lab-to-market funding ecosystem has evolved beyond conventional academic research governance into a multi-dimensional innovation governance architecture involving translational research governance, intellectual property governance, commercialisation governance, entrepreneurial governance, regulatory governance, industrial deployment governance, and ecosystem-based innovation governance. Each scheme therefore contributes a distinct governance capability within the broader national innovation and commercialisation landscape.

A. Legal Governance

Similarities

Across all nine schemes, legal governance is fundamentally built upon contractual accountability, public funding compliance, intellectual property protection, and commercialisation-oriented obligations. All schemes utilise formal funding agreements, grant conditions, implementation guidelines, and reporting obligations as the primary legal instruments governing the relationship between funding agencies and recipients. These agreements establish legally enforceable obligations relating to project implementation, milestone achievement, utilisation of public funds, reporting duties, compliance monitoring, and project deliverables.

Another major similarity is the increasing recognition of intellectual property (IP) as a commercially exploitable strategic asset requiring structured governance throughout the innovation lifecycle. Nearly all schemes incorporate some form of IP governance relating to ownership, licensing, commercial exploitation rights, invention disclosures, technology transfer, confidentiality obligations, or downstream commercialisation arrangements. This reflects Malaysia’s broader policy transition from conventional research governance centred on academic publication outputs towards commercialisation-oriented innovation governance.

Additionally, most schemes impose eligibility restrictions, anti-fraud declarations, overlapping funding prohibitions, and compliance obligations designed to strengthen governance integrity, accountability, and value-for-money governance in the utilisation of public funds. Several schemes—including AIF, TeD, NTIS, and DIAF—also incorporate Environmental, Social, and Governance (ESG) considerations, reflecting the increasing integration of sustainability governance within Malaysia’s publicly funded innovation ecosystem.

Differences

Despite these shared foundations, the schemes differ significantly in the nature and intensity of their legal governance structures according to their position within the lab-to-market continuum.

PRGS and MyLAB remain comparatively university-centric and research-governance oriented. Legal governance under these schemes focuses heavily on intellectual property protection prior to publication, translational research governance, university-industry collaboration arrangements, and institutional oversight through university Research Management Centres (RMCs) and Technology Transfer Offices (TTOs). MyLAB further introduces more sophisticated collaboration governance through formal MoUs, MoAs, licensing arrangements, royalty-sharing provisions, confidentiality clauses, and benefit-sharing mechanisms between universities and industry partners.

In contrast, AIF, TeD, CIP Spark, CIP Sprint, and CRDF adopt more commercially oriented legal governance frameworks focused on venture scalability, technology maturation, market deployment, commercialisation rights, and operational implementation capability. These schemes place stronger emphasis on corporate governance, ownership structures, business viability, commercialisation obligations, and downstream market exploitation capability rather than purely research governance considerations.

CRDF represents a particularly important transition point within Malaysia's innovation governance architecture because it legally positions commercialisation through corporate entities as a core governance requirement. The scheme requires commercially ready technologies, completed R&D outputs, and clear legal entitlement over technology exploitation before funding eligibility is granted. Consequently, CRDF governance is significantly more commercially mature than upstream prototype-oriented schemes such as PRGS.

CREST adopts one of the most sophisticated collaborative legal governance structures within the ecosystem. Unlike conventional university-centric funding schemes, CREST institutionalises mandatory industry-academia partnerships, centralised intellectual property governance, invention disclosures, licensing arrangements, confidentiality governance, and commercialisation rights management within a single integrated governance architecture.

DIAF differs substantially from the other schemes because its legal governance is primarily industry-operational rather than research-oriented. Governance focuses on industrial implementation, manufacturing compliance, operational deployment, ESG obligations, investment compliance, productivity enhancement, and industrial upgrading rather than intellectual property creation or prototype development.

NTIS occupies a unique position because its legal governance extends beyond conventional grant administration into regulatory governance. Unlike the other schemes, NTIS integrates sandbox governance, testing approvals, regulatory exemptions, certification pathways, sector-specific regulatory compliance, and real-world validation mechanisms into its governance structure. This demonstrates the emergence of regulatory-readiness governance as a distinct governance capability within Malaysia's lab-to-market ecosystem.

Unique Features

The comparative analysis reveals that each funding scheme contributes a distinct legal governance capability that supports a specific stage of Malaysia's lab-to-market innovation pathway. At the upstream stage of the innovation lifecycle, PRGS contributes a translational research governance model that emphasises prototype development, invention disclosure, intellectual property protection, and the conversion of academic research outputs into commercially relevant technologies. MyLAB extends this governance approach by introducing collaborative governance mechanisms through formalised academia-industry partnerships, incorporating legal arrangements relating to intellectual property ownership, licensing, benefit-sharing, confidentiality, and shared commercialisation responsibilities.

At the technology development stage, AIF and TeD contribute innovation-readiness governance frameworks that integrate technology maturation, Technology Readiness Level (TRL) progression, commercialisation obligations, and Environmental, Social and Governance (ESG) considerations. These schemes strengthen governance over the transition from prototype development to commercially viable technologies by emphasising commercial readiness, technology ownership, and market-oriented innovation outcomes.

The governance orientation becomes increasingly entrepreneurial in CIP Spark and CIP Sprint, which contribute entrepreneur-centred governance models focused on start-up creation, venture development, founder capability, intellectual property exploitation, and business scalability. These schemes recognise entrepreneurs and start-ups as key vehicles for commercialising innovative technologies and therefore incorporate governance mechanisms that support venture growth and market expansion.

At the commercialisation stage, CRDF contributes a hybrid public-commercial governance model that links publicly funded R&D directly to corporate commercialisation structures. The scheme emphasises technology licensing, market deployment, business capability, and commercial exploitation through corporate entities, while incorporating quasi-commercial financing arrangements to strengthen accountability and commercial discipline.

CREST contributes an ecosystem-based collaborative governance model characterised by mandatory industry participation, centralised intellectual property management, co-investment requirements, and demand-driven innovation. Its governance framework integrates universities, industry partners, researchers, and

commercialisation actors within a coordinated innovation ecosystem designed to strengthen industrial relevance and market responsiveness.

A distinctive governance capability emerges under NTIS, which introduces regulatory-readiness governance into Malaysia's innovation ecosystem. Through regulatory sandbox arrangements, testing approvals, certification pathways, compliance facilitation, and real-world validation mechanisms, NTIS integrates innovation governance with regulatory governance and enables technologies to address regulatory barriers prior to commercial deployment.

At the downstream end of the innovation lifecycle, DIAF contributes an industrial transformation governance model that links public funding directly to industrial upgrading, technology adoption, automation, ESG implementation, productivity enhancement, and operational competitiveness. The scheme therefore extends innovation governance beyond commercialisation and into large-scale industrial deployment and economic transformation.

Collectively, these findings demonstrate that Malaysia's publicly funded lab-to-market ecosystem no longer operates through a single research governance paradigm. Instead, it comprises a diverse and interconnected set of governance models encompassing translational research governance, collaborative governance, innovation-readiness governance, entrepreneurial governance, commercialisation governance, ecosystem governance, regulatory-readiness governance, and industrial transformation governance. The governance requirements imposed on funding recipients therefore vary according to technology maturity, commercialisation readiness, regulatory complexity, industrial deployment needs, and ecosystem positioning, highlighting the need for a more integrated governance framework capable of ensuring continuity across the entire innovation lifecycle..

B. Administrative Governance

Similarities

All schemes adopt structured administrative governance mechanisms involving proposal evaluations, technical assessments, milestone monitoring, implementation reviews, reporting obligations, and post-award performance oversight. Across the ecosystem, governance has evolved substantially from traditional research-administration models towards performance-oriented and commercialisation-driven governance frameworks.

A major similarity across the schemes is the growing incorporation of market-oriented and commercialisation considerations into project assessments. Unlike conventional academic research grants that primarily evaluate scientific novelty or publication potential, most schemes now assess projects based on commercial viability, industry relevance, scalability, market readiness, operational deployment capability, and downstream economic impact.

Another important similarity is the increasing use of Technology Readiness Level (TRL)-based governance. TeD, CREST, CRDF, NTIS, and several other schemes explicitly incorporate TRL progression into project selection, milestone monitoring, and commercialisation governance. This reflects the gradual institutionalisation of lifecycle-based innovation governance within Malaysia's public R&D funding ecosystem.

Differences

The schemes differ significantly in administrative governance orientation depending on their strategic objectives and target beneficiaries.

PRGS adopts a translational research governance model focused primarily on prototype development, proof-of-concept activities, and pre-commercialisation preparation within universities. Administrative governance remains relatively research-centred despite increasing commercialisation orientation.

MyLAB adopts a collaborative governance model institutionalising active industry participation throughout the project lifecycle. Administrative governance therefore integrates market validation, industry engagement, MVP development, and long-term partnership governance.

AIF and TeD adopt highly structured innovation-governance models emphasising technology maturation, TRL progression, commercial scalability, and commercialisation readiness. TeD, in particular, demonstrates a highly formalised governance structure involving multiple evaluation committees, pitching mechanisms, implementation monitoring, and milestone accountability frameworks.

CIP Spark and CIP Sprint differ from most other schemes because they adopt entrepreneur-centred and ecosystem-based governance approaches. Administrative governance extends beyond funding administration into entrepreneurial mentorship, networking, market facilitation, investor engagement, and ecosystem support services.

CRDF adopts a venture-commercialisation governance model strongly influenced by private-sector and venture capital governance practices. Administrative assessments focus heavily on business capability, market deployment, scalability, technology validation, and commercialisation performance indicators rather than academic outputs.

CREST employs one of the most commercially mature governance models within the ecosystem through its demand-driven and industry-led governance structure. Administrative governance is strongly aligned with industrial requirements, operational validation, MVP development, and downstream market deployment. The incorporation of formal change-management procedures, quarterly commercialisation reporting, and integrated ecosystem governance further distinguishes CREST from conventional public R&D grants.

DIAF adopts an entirely deployment-oriented governance model centred on industrial implementation, productivity enhancement, operational transformation, automation, and competitiveness improvement rather than upstream innovation activities. Administrative governance therefore focuses on operational effectiveness and industrial deployment outcomes rather than prototype generation or invention activities.

NTIS features distinctive governance practice because its administrative framework incorporates regulatory sandbox management, real-world testing governance, regulatory coordination, and technology validation within live operational environments.

Unique Features

The comparative analysis reveals that each funding scheme contributes a distinctive administrative governance capability that supports a particular stage of Malaysia's lab-to-market innovation pathway. At the upstream stage of the innovation lifecycle, PRGS institutionalises prototype development governance within universities by establishing structured mechanisms for prototype creation, translational research, milestone monitoring, and progression towards commercialisation. This governance model is designed to bridge the gap between academic research outputs and practical applications through systematic project oversight and institutional governance support.

MyLAB strengthens this governance pathway by formalising long-term academia-industry collaborative governance. Its administrative framework places significant emphasis on industry participation, market validation, commercialisation planning, and joint project management, thereby ensuring that research activities remain aligned with industrial needs and market opportunities throughout the project lifecycle.

At the technology development stage, AIF and TeD contribute technology-readiness governance frameworks that integrate Technology Readiness Level (TRL)-based project management with innovation and sustainability objectives. Administrative governance under these schemes is characterised by structured technical evaluations, commercialisation assessments, milestone monitoring, and technology maturation processes designed to facilitate the progression of innovations towards market readiness.

The governance orientation becomes increasingly entrepreneurial under CIP Spark and CIP Sprint, which integrate entrepreneurial ecosystem governance with funding administration. Beyond conventional project monitoring, these schemes incorporate mentorship, networking opportunities, business model development, market access facilitation, and venture growth support. Their administrative governance therefore extends beyond grant management to encompass broader ecosystem development aimed at strengthening start-up formation and commercial scalability.

CRDF contributes a distinct commercialisation-oriented governance model by incorporating venture capital-style assessments into public funding administration. Its governance framework places strong emphasis on commercial readiness, market validation, business capability, scalability, and corporate commercialisation potential. Administrative evaluations are therefore directed towards ensuring that technologies possess both technical viability and commercial deployment capability before receiving support.

CREST contributes an integrated ecosystem governance model centred on demand-driven industrial innovation. Administrative governance under the scheme is characterised by strong industry participation, market-oriented project selection, coordinated stakeholder engagement, and continuous monitoring of commercialisation outcomes. The framework operationalises collaboration between industry, universities, researchers, and commercialisation actors within a single governance ecosystem, thereby strengthening alignment between research activities and industrial needs.

A distinctive governance innovation emerges under NTIS, which institutionalises regulatory sandbox governance within Malaysia's public innovation funding ecosystem. Its administrative governance framework focuses on technology validation, regulatory readiness, real-world testing, compliance facilitation, and deployment feasibility. By incorporating regulators directly into the innovation process, NTIS enables technologies to be tested under actual operating conditions while simultaneously addressing regulatory requirements and market-entry challenges.

At the downstream end of the innovation lifecycle, DIAF contributes an industrial transformation governance model that links innovation governance directly with industrial competitiveness objectives. Its administrative framework focuses on technology adoption, automation, productivity enhancement, operational deployment, ESG implementation, and industrial upgrading. Governance is therefore directed towards ensuring that innovation activities generate measurable improvements in business performance, operational efficiency, and industrial competitiveness.

Collectively, these administrative governance innovations demonstrate that Malaysia's publicly funded lab-to-market ecosystem encompasses a broad range of governance models tailored to different stages of innovation development. These include prototype development governance, collaborative governance, technology-readiness governance, entrepreneurial ecosystem governance, commercialisation governance, ecosystem governance, regulatory-readiness governance, and industrial transformation governance. Together, these governance capabilities form the foundation of Malaysia's innovation and commercialisation ecosystem while highlighting the need for greater integration and coordination across the entire lab-to-market pathway.

C. Financial Governance

Similarities

Financial governance across all schemes is fundamentally grounded in public accountability, expenditure control, milestone monitoring, auditability, financial reporting, and value-for-money governance. All schemes require recipients to utilise public funds strictly according to approved project scopes, implementation schedules, and expenditure categories.

Another common feature is the widespread adoption of milestone-based disbursement mechanisms linking funding release to achievement of deliverables, implementation progress, or commercialisation milestones. This reflects a broader policy shift from input-based public funding governance towards performance-oriented financial governance.

Additionally, most schemes increasingly align financial governance with commercialisation and market-oriented outcomes rather than purely academic research activities. Consequently, expenditure categories across the ecosystem increasingly include prototype validation, market readiness preparation, certification activities, IP protection, commercialisation support, operational deployment, and industrial implementation costs.

Differences

The schemes differ substantially in funding philosophy, risk allocation, co-investment structures, and financing mechanisms.

PRGS and MyLAB remain primarily grant-funded schemes designed to support prototype development, translational research, collaborative validation, and pre-commercialisation preparation. However, MyLAB introduces significantly stronger co-investment governance through mandatory industry cash contributions and shared-risk financing arrangements.

AIF and TeD adopt more commercially disciplined co-investment models involving mandatory matching contributions, milestone-based financing, and performance-oriented implementation governance. These schemes increasingly treat public funding as catalytic innovation financing rather than purely research funding.

CIP Spark and CIP Sprint adopt flexible venture-oriented financing structures designed specifically for start-up ecosystems. Financial governance incorporates advance payments, reimbursement mechanisms, staged financing, milestone accountability, and commercialisation-linked disbursement structures suitable for entrepreneurial ventures facing cash flow and scalability challenges.

CRDF adopts one of the most sophisticated financial governance structures within the ecosystem through its hybrid financing model combining grants, co-financing principles, and Convertible Promissory Notes (CPNs). This represents a major evolution from conventional public grant governance towards quasi-equity and venture-style commercialisation financing governance.

CREST adopts a highly mature shared-risk governance structure requiring at least 50% industry co-investment while integrating milestone accountability, centralised asset governance, TRL-oriented financing, and ecosystem-based talent financing through the I-GRASP programme.

DIAF differs substantially from upstream innovation schemes because financial governance focuses almost entirely on industrial deployment, machinery acquisition, automation, operational transformation, ESG implementation, and productivity enhancement rather than R&D or prototype development.

NTIS develops a distinctive financial governance practice since it is integrated closely with regulatory validation activities, live operational testing, certification pathways, and sandbox implementation support.

Unique Features

The comparative analysis reveals that each funding scheme contributes a distinctive financial governance capability that supports a specific stage of the lab-to-market innovation pathway. At the upstream stage of the innovation lifecycle, PRGS adopts a financing model that focuses on university-based prototype development and proof-of-concept activities. Its financial governance is designed to support the transition of research outputs into functional prototypes through targeted funding for validation, testing, and pre-commercialisation activities.

MyLAB extends this financing approach by institutionalising shared-risk collaborative financing between universities and industry partners. Through mandatory industry contributions and joint funding arrangements, the scheme promotes financial accountability, strengthens industry commitment, and ensures that publicly funded projects are aligned with market needs and commercialisation objectives. This shared-risk governance model reflects a more collaborative approach to financing innovation and commercialisation activities.

At the technology development stage, AIF and TeD introduce technology-readiness financing governance by aligning funding with Technology Readiness Level (TRL) progression and commercialisation milestones. Their financial governance frameworks incorporate co-investment requirements, milestone-based disbursement mechanisms, and performance-oriented funding arrangements designed to accelerate technology maturation while strengthening accountability for commercialisation outcomes.

The financing governance becomes increasingly entrepreneurial under CIP Spark and CIP Sprint, which operationalise venture-style funding mechanisms tailored to the needs of start-ups and innovation-driven enterprises. Their governance frameworks combine staged financing, milestone-based disbursement, reimbursement mechanisms, and commercialisation-linked funding structures to support venture creation, product development, market validation, and business scaling activities. These schemes therefore introduce financing governance principles commonly associated with entrepreneurial ecosystems and start-up development.

A distinctive financing innovation is evident in CRDF, which incorporates hybrid commercialisation financing mechanisms through the use of grants and Convertible Promissory Notes (CPNs). This quasi-equity financing structure introduces elements of commercial discipline and risk-sharing while maintaining the developmental objectives of public funding. The governance framework therefore bridges conventional public grant financing and private-sector commercialisation financing models.

CREST contributes a highly integrated financial governance model that combines industry co-investment requirements, centralised asset governance, milestone-based disbursement, and talent financing mechanisms. The scheme not only finances research and commercialisation activities but also supports talent development through dedicated industry-linked postgraduate programmes. This integrated financing approach strengthens industry commitment, improves accountability, and aligns financial governance with long-term innovation ecosystem development.

A unique financial governance capability emerges under NTIS, where funding support is integrated with regulatory-readiness and technology validation activities. Financial governance is directed towards supporting pilot implementation, real-world testing, standards compliance, certification processes, and deployment readiness. The programme also incorporates innovative financing mechanisms, including convertible grants and commercialisation-linked funding support, to reduce regulatory and market-entry risks faced by emerging technologies.

At the downstream end of the innovation lifecycle, DIAF adopts a financial governance model that aligns public funding directly with industrial upgrading, automation, technology adoption, ESG implementation, and operational transformation objectives. Through matching grant arrangements and performance-oriented funding mechanisms, the scheme ensures that public investment contributes directly to measurable improvements in industrial productivity, competitiveness, and economic performance.

Collectively, these financial governance innovations demonstrate that Malaysia's publicly funded lab-to-market ecosystem encompasses a broad spectrum of financing models ranging from prototype funding and collaborative financing to co-investment governance, venture-style financing, quasi-equity financing, regulatory-validation financing, and industrial transformation financing. The diversity of these financing mechanisms reflects the differing funding requirements of innovations at various stages of maturity and highlights the importance of developing an integrated governance framework capable of ensuring funding continuity and coordination across the entire innovation lifecycle.

D. Overall Comparative Findings

The comparative analysis demonstrates that Malaysia has developed a highly diversified and increasingly sophisticated governance ecosystem for publicly funded lab-to-market R&D activities.

Collectively, the schemes reveal a clear policy transition away from conventional research-centric governance towards integrated innovation-commercialisation governance. Across the ecosystem, governance structures

increasingly incorporate intellectual property management, TRL progression, commercialisation readiness, industry participation, ecosystem support, venture scalability, regulatory compliance, ESG governance, operational deployment, and downstream economic impact considerations.

Importantly, the schemes collectively represent different governance stages along the lab-to-market continuum:

- PRGS represents prototype and translational research governance;
- MyLAB represents collaborative commercialisation governance;
- AIF and TeD represent technology maturation and innovation-readiness governance;
- CIP Spark and CIP Sprint represent entrepreneurial and venture-governance ecosystems;
- CRDF represents corporate commercialisation financing governance;
- CREST represents demand-driven ecosystem governance;
- NTIS represents regulatory-readiness and sandbox governance; and
- DIAF represents industrial deployment and operational transformation governance.

This demonstrates that Malaysia already possesses many of the essential governance components necessary for a comprehensive lab-to-market innovation ecosystem. However, these governance capabilities currently operate largely as fragmented and scheme-specific governance silos rather than as part of an integrated national governance architecture.

The analysis therefore suggests that the next stage of governance reform should focus not merely on introducing new funding schemes, but on developing an integrated governance framework capable of harmonising legal governance, administrative governance, financial governance, TRL progression governance, regulatory-readiness governance, ESG governance, and commercialisation governance across the entire lab-to-market continuum. Such integration would strengthen coordination, reduce governance fragmentation, improve funding continuity across innovation stages, and enhance the overall efficiency and commercialisation performance of Malaysia's publicly funded R&D ecosystem.

Table 1 below summarises the similarities, differences and unique features of the funding schemes under comparison.

Table 1: Comparative analysis of governance across major publicly funded lab-to-market R&D grant schemes in Malaysia.

COMPARATIVE ANALYSIS OF GOVERNANCE ACROSS MAJOR PUBLICLY FUNDED LAB-TO-MARKET R&D GRANT SCHEMES IN MALAYSIA										
	PRGS	MyLAB	AIF	TeD	CIP Spark	CIP Sprint	CREST	NTIS	DIAF	
SIMILARITIES	Contractual Accountability All schemes are governed by formal grant agreements with compliance requirements, reporting obligations and accountability mechanisms.		Intellectual Property Governance All schemes recognise innovation outputs as assets and include provisions for IP protection, ownership or exploitation.		Monitoring & Reporting All schemes implement structured monitoring, milestone verification, progress reporting and performance evaluation mechanisms.		Financial Accountability All schemes enforce expenditure controls, financial reporting, auditability and ensure value for money in the use of public funds.		Common Objective All schemes aim to bridge the gap between research outputs and market/industrial application, creating economic and societal value.	
DIFFERENCES	Legal Governance Emphasis • Varies in IP ownership models, licensing rights, commercialisation obligations and regulatory requirements. • University schemes focus on institutional IP, commercial schemes focus on market exploitation and business ownership.		Administrative Focus & Assessment Criteria • Differ in target beneficiaries, TRL stages and assessment priorities. • University schemes emphasise prototype & research quality; commercial/industrial schemes emphasise market viability, scalability and deployment readiness.		Financial Structures & Risk Sharing • Range from research grants to matching grants, venture financing, quasi-equity (e.g. Convertible Promissory Notes) and industrial deployment funding. • Co-investment requirements and funding intensity vary across schemes.		Commercialisation Stage in the Continuum • Schemes support different stages: from prototype development, technology maturation, start-up creation, market validation to industrial scale-up and deployment.		Primary Beneficiaries • Beneficiaries vary from universities & researchers, start-ups, SMEs, industry consortia to established manufacturing firms.	
UNIQUE FEATURES	PRGS • IP protection before publication • Prototype & proof-of-concept focus • University RMC oversight	MyLAB • Mandatory academic-industry collaboration • MoU/MoA, licensing & benefit sharing • Industry cash co-investment	AIF • TRL 3-9 focus • ESG requirements • Broader applicant categories (SMEs, NGOs, cooperatives, etc.)	TeD • TRL 4+ with POC/prototype requirement • Multi-tier evaluation (UPD/AD) • Mandatory industry collaboration for IPT/GH	CIP Spark • Early-stage start-up support • Up to RM150k • Mentorship, networking & ecosystem support	CIP Sprint • Growth-stage scaling support • Up to RM600k • Market access facilitation & commercialisation acceleration	CRDF • Commercialisation of completed R&D • Up to RM6M • Hybrid financing (Grants + Convertible Promissory Notes) • Corporate vehicle requirement	CREST • Demand-driven industry-led funding • ≥50% industry co-investment • Shared IP & central IP registration • I-CRASP talent financing	NTIS • Regulatory sandbox & real-world testing • Regulatory exemptions & approvals • Certification & validation support	DIAF • Industrial deployment & productivity enhancement • Matching grants up to RM5M • ESG & Investment compliance focus
KEY TAKEAWAY: The nine schemes form a complementary governance ecosystem covering the full lab-to-market continuum—from research translation to industrial transformation. Strengthening integration and coordination across schemes will enhance funding continuity, reduce fragmentation and improve commercialisation outcomes.										

Proposed Integrated Governance Framework

The comparative analysis of the nine major publicly funded lab-to-market R&D grant schemes demonstrates that Malaysia has developed a relatively comprehensive but highly fragmented innovation funding ecosystem. Collectively, schemes such as PRGS, MyLAB, AIF, TeD, CIP Spark, CIP Sprint, CRDF, CREST R&D&C&I Grant, NTIS, and DIAF support different stages of the innovation lifecycle ranging from prototype development and technology validation to commercialisation, regulatory testing, industrial deployment, and post-market scaling. However, the analysis also reveals that these schemes operate largely within separate governance under different Ministries and agencies, resulting in inconsistencies in legal governance, administrative governance, financial governance, monitoring systems, commercialisation pathways, and performance measurement mechanisms.

The fragmentation is particularly evident in intellectual property ownership structures, licensing arrangements, reporting obligations, milestone monitoring systems, commercialisation criteria, co-investment requirements, and funding continuity across Technology Readiness Levels (TRLs). While upstream schemes such as PRGS and MyLAB focus heavily on translational research and prototype governance, downstream schemes such as CRDF, CREST, NTIS, and DIAF adopt more commercially oriented, industrial, or regulatory governance approaches. Consequently, publicly funded innovations often experience governance discontinuity as projects transition from research translation to market deployment, thereby contributing to duplication, inefficiencies, weak coordination, and the persistence of the “valley of death” within Malaysia’s innovation ecosystem.

In response to these challenges, this study proposes an Integrated Governance Framework for Publicly Funded Lab-to-Market R&D Grants based on a whole-of-government and whole-of-ecosystem governance approach. The proposed framework is guided by the principle of “One Innovation, One Governance Journey,” whereby publicly funded innovations are governed through a coordinated and seamless pathway from research translation to commercialisation and post-market performance regardless of the funding agency involved. The framework therefore seeks to integrate the currently fragmented governance structures into a coherent national innovation governance ecosystem capable of strengthening commercialisation outcomes, improving accountability, and enhancing public return on investment (ROI).

At the national level, the framework proposes the establishment of a National Lab-to-Market Governance Coordination Committee comprising representatives from MOHE, MOSTI, MITI, the Ministry of Economy, public R&D funding agencies, universities, Technology Transfer Offices (TTOs), Research Management Centres (RMCs), industry partners, investors, and commercialisation agencies. The committee would function as the central governance coordination mechanism responsible for policy harmonisation, governance standardisation, inter-agency coordination, resource optimisation, strategic oversight, and performance evaluation across all publicly funded lab-to-market R&D programmes. This centralised coordination mechanism is necessary because the comparative analysis demonstrates that while individual schemes possess strong governance features, there is currently no integrated governance platform capable of aligning legal, administrative, and financial governance across the national innovation ecosystem.

The framework further organises publicly funded lab-to-market grants into a unified innovation lifecycle consisting of five interconnected governance stages aligned with TRL progression. The first stage, Research Translation (TRL 3–4), focuses on proof-of-concept development, prototype planning, invention disclosure, and preliminary intellectual property protection. Governance at this stage is largely represented by PRGS and MyLAB. The second stage, Prototype Development (TRL 4–5), focuses on working prototype construction, prototype refinement, IP filing, and preliminary market validation activities supported by schemes such as PRGS, MyLAB, AIF, and TeD. The third stage, Validation and Testing (TRL 5–7), involves field testing, regulatory readiness, user validation, pilot implementation, and technology verification activities represented by schemes such as TeD, NTIS, and CRDF. The fourth stage, Scale-Up and Commercialisation (TRL 7–9), focuses on licensing, technology transfer, spin-off creation, pilot production, industrial scaling, and market entry through schemes such as CREST, CIP Sprint, CRDF, and NTIS. The final stage, Post-Market Performance (Post-TRL 9), focuses on revenue generation, market adoption, socio-economic impact, industrial productivity enhancement, and long-term ROI evaluation supported by industrial deployment mechanisms such as DIAF.

The proposed framework is built upon three integrated governance pillars. The first pillar is Legal Governance, which introduces harmonised governance arrangements relating to intellectual property ownership, licensing, benefit-sharing, confidentiality obligations, dispute resolution, regulatory compliance, and commercialisation rights management. This directly addresses the inconsistencies identified across the schemes, where governance structures currently vary significantly between university-centric, entrepreneur-centric, commercialisation-oriented, regulatory, and industrial deployment funding models. Standardised legal governance would therefore improve governance continuity and reduce uncertainty as projects transition across commercialisation stages.

The second pillar is Administrative Governance, which establishes a unified governance pathway covering proposal assessment, technical evaluation, commercialisation readiness assessment, milestone monitoring, reporting systems, project verification, performance measurement, and enforcement procedures. Under the proposed framework, common assessment criteria, integrated digital governance systems, standard operating procedures (SOPs), and coordinated monitoring mechanisms would be implemented across participating Ministries and agencies. This directly addresses the inconsistencies identified in the comparative analysis, where current schemes apply differing assessment standards, monitoring structures, and performance indicators despite pursuing similar commercialisation objectives.

The third pillar is Financial Governance, which introduces a stage-gated and TRL-based funding model aligned with technology maturity and commercialisation readiness. Funding disbursement would be linked to achievement of predefined technical, commercial, regulatory, and market-oriented milestones. Standardised financial governance mechanisms covering procurement, budget variation, milestone-based disbursement, expenditure reporting, audit requirements, co-investment governance, and accountability controls would be harmonised across all participating schemes. This governance approach addresses the current fragmentation in financing structures, where some schemes adopt conventional grants while others utilise matching grants, venture-style financing, quasi-equity instruments, or industrial deployment funding mechanisms.

To operationalise the framework, several enabling governance systems are proposed. These include an Integrated Digital Governance Platform capable of supporting centralised applications, monitoring, analytics, and reporting across all schemes; a National Innovation Data Repository consolidating information on project deliverables, IP generation, licensing, start-ups, revenues, and commercialisation performance; strengthened Industry and Investor Engagement Mechanisms to improve market participation and commercial scalability; a Capacity Building Ecosystem for researchers, TTOs, entrepreneurs, regulators, and industry players; and a Policy and Regulatory Support Mechanism to facilitate certification, standards compliance, regulatory approvals, and market access.

Importantly, the proposed framework introduces a comprehensive national performance management system integrating both innovation-commercialisation indicators and governance-delivery indicators. Innovation and commercialisation indicators include TRL progression, IP generation, licensing activities, technology transfer, spin-off and start-up formation, market-ready products, commercialisation revenue, industrial productivity gains, market adoption, and socio-economic impact. Governance and delivery indicators include utilisation rates of research funds, fulfilment of project deliverables, completion of projects within stipulated timelines, audit findings, compliance rates, governance integrity, milestone achievement rates, and accountability performance. The integration of these indicators addresses one of the key weaknesses identified in the comparative analysis, namely the absence of a unified and coordinated national performance evaluation system across publicly funded commercialisation programmes.

The proposed Integrated Governance Framework seeks to transform Malaysia's fragmented lab-to-market funding ecosystem into a coordinated, coherent, and performance-oriented national innovation-commercialisation governance system. By harmonising legal, administrative, and financial governance across funding schemes, agencies, and the entire innovation lifecycle, the framework aims to strengthen governance continuity, improve project deliverables, enhance innovation and commercialisation performance, optimise the utilisation of public funds, and reduce duplication and fragmentation within the R&D ecosystem.

The framework further promotes stronger accountability, compliance, and delivery performance through standardised governance mechanisms and integrated monitoring systems. Ultimately, it is intended to increase the number of market-ready innovations generated from publicly funded research while maximising the economic and societal value of public R&D investments. As such, the framework provides a strategic governance blueprint for advancing Malaysia's RDICE agenda, strengthening national innovation competitiveness, and enhancing the overall effectiveness of the country's lab-to-market R&D ecosystem.

Figure 1 below illustrates the integrated governance framework for publicly funded lab-to-market R&D grants in Malaysia.

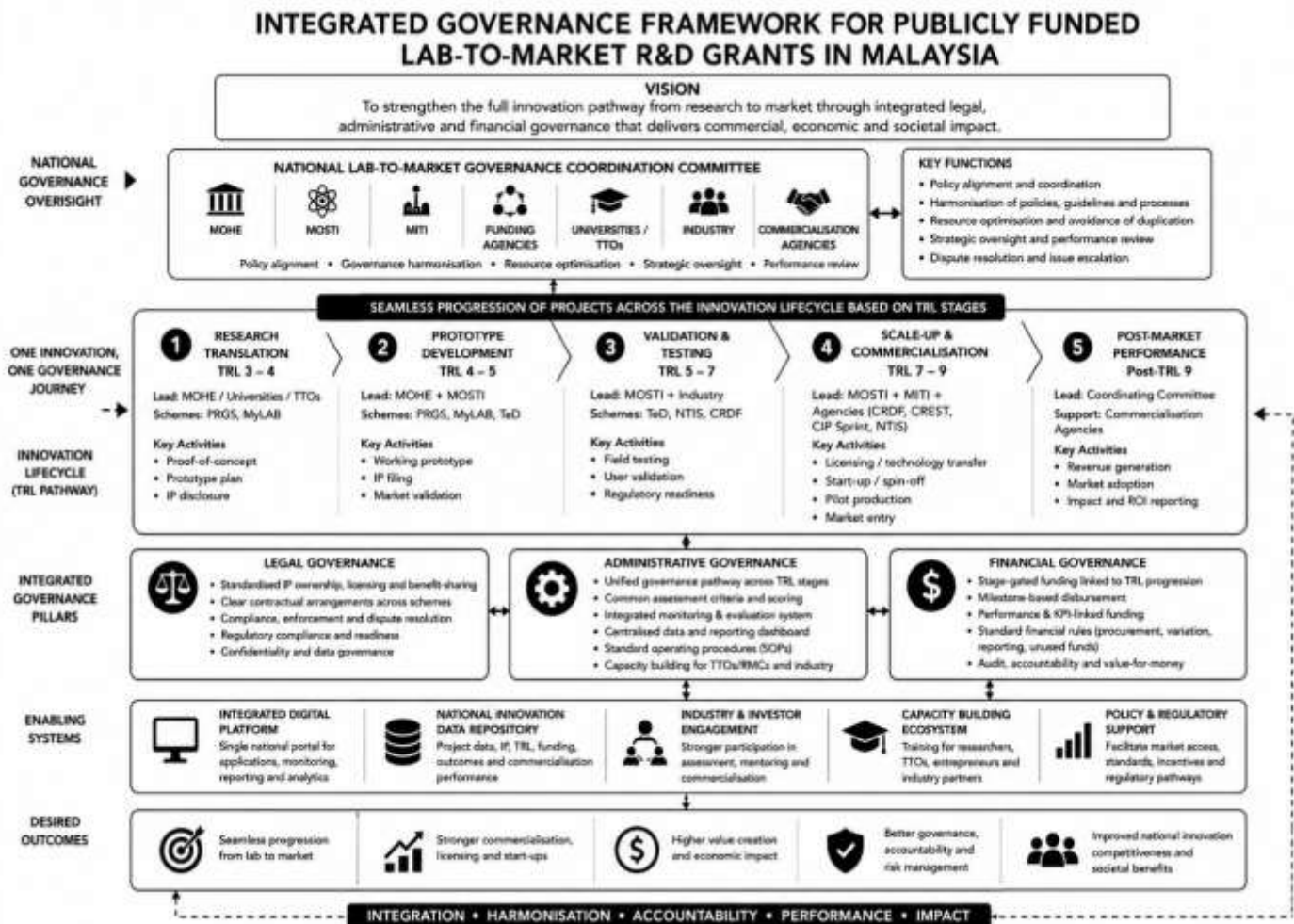


Figure 1. Integrated Governance Framework for Publicly Funded Lab-to-Market R&D Grants.

Practical Implications

The proposed Integrated Governance Framework for Publicly Funded Lab-to-Market R&D Grants has significant practical implications for strengthening Malaysia's national innovation and commercialisation ecosystem by transforming the current fragmented governance environment into a coordinated, lifecycle-based, and performance-oriented governance system. The framework operationalises a "One Innovation, One Governance Journey" approach that integrates legal, administrative, and financial governance across the full Technology Readiness Level (TRL) pathway, from research translation and prototype development to commercialisation, industrial deployment, and post-market performance.

At the national level, the framework introduces a whole-of-government governance mechanism through the proposed National Lab-to-Market Governance Coordination Committee involving MOHE, MOSTI, MITI, the Ministry of Economy, public R&D funding agencies, universities, Technology Transfer Offices (TTOs), Research Management Centres (RMCs), industry players, investors, and commercialisation agencies. This

integrated coordination structure would improve policy alignment, governance harmonisation, strategic oversight, and resource optimisation across publicly funded lab-to-market programmes. As demonstrated in the comparative analysis, the current ecosystem operates through multiple governance silos with differing governance structures, performance indicators, funding arrangements, and commercialisation pathways. The proposed framework therefore addresses these structural gaps by establishing common governance standards and coordinated oversight throughout the innovation lifecycle.

From a legal governance perspective, the framework strengthens governance certainty and commercialisation readiness through harmonised arrangements relating to intellectual property ownership, licensing, benefit-sharing, confidentiality obligations, dispute resolution, regulatory compliance, and contractual governance. This is particularly important because the comparative analysis revealed substantial inconsistencies across existing schemes in areas such as IP ownership structures, licensing rights, commercialisation obligations, and industry participation arrangements. Standardised governance arrangements would reduce legal uncertainty among researchers, universities, start-ups, SMEs, industry partners, and investors, thereby facilitating technology transfer, licensing, spin-off formation, industry collaboration, and downstream market deployment.

Administratively, the framework introduces a unified governance pathway involving integrated project assessments, standardised evaluation criteria, milestone monitoring systems, harmonised reporting requirements, and coordinated performance management mechanisms across Ministries and agencies. This would allow Malaysia's public R&D funding ecosystem to move beyond fragmented and compliance-oriented grant administration towards integrated and performance-based innovation governance. The framework also incorporates integrated digital governance systems, national innovation databases, and coordinated monitoring mechanisms capable of supporting evidence-based decision-making, centralised analytics, and national-level commercialisation performance tracking.

For universities, researchers, TTOs, and RMCs, the framework provides a clearer and more seamless commercialisation pathway across different TRL stages. Currently, many projects experience governance discontinuity when transitioning between prototype development, technology validation, commercialisation, and industrial deployment phases because funding schemes operate independently under separate governance regimes. By integrating the governance continuum, the framework is expected to improve fulfilment of project deliverables, strengthen TRL progression, reduce project abandonment, and increase the number of technologies successfully translated into market-ready products and commercially sustainable ventures.

The framework also carries important implications for industry players, SMEs, start-ups, and investors. Stronger governance consistency, clearer commercialisation arrangements, integrated regulatory-readiness support, and coordinated market validation mechanisms would improve confidence in publicly funded innovations and strengthen industry participation throughout the innovation lifecycle. The framework's emphasis on industry engagement, demand-driven innovation, regulatory-readiness governance, and commercial scalability would help ensure that publicly funded technologies are better aligned with market needs, operational requirements, and industrial adoption capability.

From a financial governance perspective, the framework introduces a stage-gated and TRL-aligned funding model linked to milestone-based disbursement and commercialisation-oriented performance indicators. This would strengthen value-for-money governance by ensuring that funding progression is tied directly to technical readiness, commercialisation milestones, regulatory validation, and market deployment outcomes. The harmonisation of financial governance procedures relating to procurement, budget variation, reporting, auditability, and co-investment arrangements would further improve accountability, transparency, and consistency in the utilisation of public funds across Ministries and agencies.

Importantly, the framework establishes a comprehensive national performance management system integrating both innovation-commercialisation indicators and governance-delivery indicators. Innovation and commercialisation indicators include TRL progression, IP generation, licensing activities, technology transfer, spin-off and start-up creation, market-ready products, commercialisation revenue, industrial productivity gains, market adoption, and socio-economic impact. Governance and delivery indicators include fund utilisation rates,

project completion within stipulated timelines, fulfilment of project deliverables, compliance levels, governance integrity, audit findings, and return on public investment (ROI). This integrated performance framework enables more systematic evaluation of both innovation outcomes and governance effectiveness across Malaysia's publicly funded R&D ecosystem.

The proposed framework also supports Malaysia's broader Research, Development, Innovation, Commercialisation and Economy (RDICE) agenda by strengthening the Innovation–Commercialisation (I–C) interface and improving the translation of publicly funded research into tangible economic and societal value. In addition, the framework aligns closely with the objectives of the 13th Malaysia Plan (RMK13), particularly the Public Service Reform Agenda, by promoting integrated governance, institutional coordination, digital governance, evidence-based policymaking, accountability, and performance-oriented public sector management.

Ultimately, the practical implication of the proposed framework lies in its potential to reposition Malaysia's publicly funded lab-to-market ecosystem from a fragmented grant-management system into an integrated national innovation-commercialisation governance system. Through harmonised legal, administrative, and financial governance, the framework is expected to strengthen governance continuity across the innovation lifecycle, improve commercialisation success rates, optimise utilisation of public funds, reduce duplication and inefficiencies, increase the number of market-ready innovations, and enhance Malaysia's global innovation competitiveness and socio-economic impact generated from public R&D investments.

Suggestion For Future Research

While this study proposes an Integrated Governance Framework for Publicly Funded Lab-to-Market R&D Grants in Malaysia, future research should focus on validating, operationalising, and refining the framework through empirical, longitudinal, and implementation-based studies. Future studies should evaluate the effectiveness of the proposed framework after implementation across Ministries, public R&D funding agencies, universities, Technology Transfer Offices (TTOs), Research Management Centres (RMCs), commercialisation agencies, and industry partners. Such studies may examine whether integrated governance improves key innovation, commercialisation, governance, and delivery indicators, including Technology Readiness Level (TRL) progression, utilisation of research funds, fulfilment of project deliverables, project completion within stipulated timelines, licensing activities, technology transfer, start-up and spin-off formation, market-ready products, commercialisation revenue, industrial productivity gains, and return on investment (ROI).

Future research should also investigate institutional readiness and governance capability across different actors within Malaysia's innovation ecosystem. Comparative implementation studies involving Ministries, universities, public research institutions, industry partners, and commercialisation agencies would provide valuable insights into organisational capacity, governance maturity, inter-agency coordination, digital governance capability, and change management requirements necessary for successful implementation of integrated governance systems. Such research is important because the comparative analysis in this study demonstrates that Malaysia's current lab-to-market ecosystem remains fragmented across multiple governance silos despite the existence of relatively sophisticated individual funding schemes.

Given the central role of intellectual property within publicly funded commercialisation activities, further research is required on harmonised intellectual property governance, licensing frameworks, revenue-sharing models, spin-off governance, and benefit-sharing arrangements across Ministries and agencies. Future studies may also explore the feasibility of establishing national standards for intellectual property ownership, commercialisation rights, technology transfer governance, and cross-agency licensing arrangements within publicly funded innovation ecosystems.

Another important area for future research concerns regulatory-readiness governance. Future studies should examine how the proposed framework can better integrate regulatory compliance, standards certification, market authorisation, ESG governance, and risk management into the broader innovation-commercialisation pathway, particularly for highly regulated sectors such as biotechnology, pharmaceuticals, medical devices, semiconductors, aerospace, hydrogen technology, advanced manufacturing, and artificial intelligence. This

would strengthen the integration between innovation governance and regulatory governance within Malaysia's lab-to-market ecosystem.

Future studies should also explore the development of integrated digital governance systems to support national-level innovation governance coordination. Research may investigate the feasibility of establishing a national integrated digital platform incorporating grant applications, project monitoring, TRL tracking, milestone verification, intellectual property management, commercialisation analytics, funding dashboards, and performance reporting systems. Further research on the application of artificial intelligence (AI), predictive analytics, big data technologies, and digital governance tools for portfolio management, grant evaluation, risk assessment, and evidence-based policymaking would also contribute significantly towards strengthening Malaysia's innovation governance ecosystem.

In addition, future comparative research should benchmark Malaysia's governance framework against leading international innovation ecosystems and public R&D commercialisation models such as those in the United States, United Kingdom, Germany, Finland, South Korea, Singapore, and Israel. Comparative studies involving these jurisdictions would provide valuable insights into international best practices relating to integrated governance, regulatory-readiness governance, venture-commercialisation financing, industrial deployment governance, and innovation ecosystem coordination. Such studies would assist policymakers in continuously refining Malaysia's national lab-to-market governance framework to ensure that it remains adaptive, globally competitive, commercially effective, and capable of maximising the economic and societal impact of publicly funded R&D investments.

Finally, future research should examine the broader socio-economic impact of integrated lab-to-market governance on Malaysia's RDICE agenda, industrial competitiveness, national productivity, and sustainable development objectives. This includes evaluating how integrated governance contributes towards strengthening Malaysia's innovation-driven economy, enhancing public sector governance reforms under RMK13, increasing commercialisation success rates, improving public value creation, and positioning Malaysia as a globally competitive innovation and commercialisation hub.

CONCLUSION

This paper examined the governance of Malaysia's major publicly funded lab-to-market R&D grant schemes, namely the Prototype Development Research Grant Scheme (PRGS) and Malaysia Laboratories for Academia-Business Collaboration (MyLAB) under the Ministry of Higher Education (MOHE); the Applied Innovation Fund (AIF) and Technology Development Fund (TeD) under the Ministry of Science, Technology and Innovation (MOSTI); CIP Spark and CIP Sprint under Cradle Fund; the Commercialisation of R&D Fund (CRDF) under the Malaysian Technology Development Corporation (MTDC); the CREST R&D&C&I Grant; the National Technology and Innovation Sandbox (NTIS); and the Domestic Investment Accelerator Fund (DIAF) under the Ministry of Investment, Trade and Industry (MITI)/MIDA. Collectively, these schemes form Malaysia's publicly funded lab-to-market innovation ecosystem, supporting the progression of innovations across the Technology Readiness Level (TRL) continuum from research translation, prototype development, and technology validation to commercialisation, industrial deployment, and post-market impact.

The doctrinal, policy, and comparative analyses revealed that Malaysia has developed a relatively sophisticated and diversified public innovation funding ecosystem encompassing translational research governance, collaborative governance, entrepreneurial governance, commercialisation financing governance, regulatory-readiness governance, ecosystem governance, and industrial transformation governance. However, despite the existence of these multiple governance capabilities, the ecosystem remains highly fragmented across Ministries and funding agencies. Significant variations were identified in legal governance structures, intellectual property ownership arrangements, commercialisation rights, assessment criteria, monitoring systems, funding models, performance indicators, reporting requirements, and accountability mechanisms. As a result, publicly funded innovations frequently experience governance discontinuity as projects transition across different commercialisation stages and funding schemes.

The findings further demonstrate that governance plays a central role in determining both the deliverables and overall performance of publicly funded lab-to-market R&D grants. Effective governance influences not only commercialisation outputs, but also utilisation of research funds, fulfilment of project deliverables, project completion within stipulated timelines, compliance and accountability performance, technology transfer activities, licensing outcomes, start-up and spin-off formation, market-ready products, industrial adoption, and overall return on investment (ROI). Consequently, improving Malaysia's commercialisation performance requires more than increasing public R&D expenditure alone; it requires an integrated governance ecosystem capable of managing the entire innovation journey from laboratory research to market deployment and post-market impact.

To address these structural challenges, this paper proposed an Integrated Governance Framework for Publicly Funded Lab-to-Market R&D Grants based on a whole-of-government and whole-of-ecosystem governance approach. The framework integrates legal governance, administrative governance, and financial governance within a coordinated innovation lifecycle aligned with TRL progression. It further incorporates harmonised governance standards, integrated monitoring systems, stage-gated funding mechanisms, commercialisation-oriented performance indicators, regulatory-readiness governance, and enabling digital governance systems to support coordination, accountability, and continuity across Ministries and funding agencies.

The proposed framework contributes to both theory and practice. Theoretically, the study extends the emerging literature on innovation and commercialisation governance by demonstrating how legal, administrative, and financial governance collectively shape innovation performance, commercialisation outcomes, and public value creation across the innovation lifecycle. The study also contributes to the growing discourse on integrated governance and regulatory-readiness governance within publicly funded innovation ecosystems. Practically, the framework provides policymakers, funding agencies, universities, Technology Transfer Offices (TTOs), Research Management Centres (RMCs), commercialisation agencies, investors, and industry stakeholders with a comprehensive governance blueprint for improving the coordination, effectiveness, accountability, and impact of publicly funded lab-to-market R&D grants in Malaysia.

Ultimately, this study argues that the future success of Malaysia's Research, Development, Innovation, Commercialisation and Economy (RDICE) agenda depends not only on the availability of funding, but more importantly on the existence of a coordinated and integrated governance ecosystem capable of ensuring seamless progression of innovations from research to market. By strengthening governance continuity, institutional coordination, commercialisation readiness, accountability, regulatory integration, and performance management across the innovation lifecycle, the proposed framework has the potential to transform Malaysia's fragmented public R&D funding landscape into a more integrated, commercially driven, efficient, and globally competitive national innovation system capable of generating sustained economic, industrial, and societal impact from publicly funded research investments.

REFERENCES

1. Abidin, N. (2022). The Roles of National and Local Policy and Practices in Support Knowledge Transfer and Commercialisation of Biotechnology in Malaysia (Doctoral dissertation, University of Sheffield).
2. Academy of Sciences Malaysia (ASM). (2022). Development of the research, development, commercialisation, innovation and economic roadmap (R, D, C, I & E). Academy of Sciences Malaysia Annual Report 2022. <https://www.akademisains.gov.my/ar22/development-of-the-research-development-commercialisation-innovation-and-economic-roadmap-r-d-c-i-e/>
3. Ajagbe, M. A., Isiaewe, D. T., Ogbari, E. M., Sholanke, A. B., & Land, C. (2015). Financing early staged technology based firms in Malaysia. *Technology*, 6(4).
4. Ali, A., Hamzah, F., Hashim, H. N. M., Khair, M. H. M., Zulkifli, N., & Jamil, Z. (2025). A Theory-driven Framework for Malaysia's Research, Development, Innovation, Commercialisation and Economy (RDICE) Ecosystem. *International Journal of Research and Innovation in Social Science (IJRISS)*, 9(10).
5. Armstrong, C., Shieh, J., & Zielinski, P. (2019). Increasing the return on investment from federally-funded research and development. *Theoretical Issues in Ergonomics Science*, 20(1), 4-7.

6. Bernama. (2024, May 14). Mosti: National research, development, innovation, commercialisation and economy roadmap to boost GDP by RM9.21t by 2030. Malay Mail. <https://www.malaymail.com/news/malaysia/2024/05/14/mosti-national-research-development-innovation-commercialisation-and-economy-roadmap-to-boost-gdp-by-rm921t-by-2030/134337>
7. Collaborative Research in Engineering, Science and Technology (CREST). (n.d.). CREST R&D application. <https://crest.my/crest-rd-application/>
8. Cunningham, J. A., & Link, A. N. (2022). The returns to publicly funded R&D: A study of US federally funded research and development centers. *Annals of Science and Technology Policy*, 6(3), 228-314.
9. Cunningham, J. A., & Link, A. N. (2022). The returns to publicly funded R&D: A study of US federally funded research and development centers. *Annals of Science and Technology Policy*, 6(3), 228-314.
10. Department of Higher Education, Ministry of Higher Education Malaysia. (2023). MyGRANTS. <https://mygrants.gov.my/main.php>
11. Dikweni, S., Makgabutane, B., & Mhlanga, S. D. (2023). Lab-to-market guide for commercialisation of nanomaterials: A South African university perspective. *South African Journal of Science*, 119(1-2), 1-3.
12. Economic Planning Unit (EPU). (2015). Strategy paper 21: Translating innovation to wealth. Putrajaya: Prime Minister's Department, Malaysia. <https://ekonomi.gov.my/sites/default/files/2021-05/Strategy%20Paper%2021.pdf>
13. Hemmatian, I., Ponzio, T. A., & Joshi, A. M. (2022). Exploring the role of R&D collaborations and non-patent IP policies in government technology transfer performance: Evidence from US federal agencies (1999–2016). *Plos one*, 17(5), e0268828.
14. Ishak, M. K., Ahmad, N. A., Noor, N. M., Husain, M. K. A., & Abidin, A. R. Z. (2025). ICCubeX Ignite: Empowering Future Innovators and Leaders. In *Integrating Artificial Intelligence, Security for Environmental and Business Sustainability: Volume 2* (pp. 363-371). Cham: Springer Nature Switzerland.
15. Islam, N. (2017). Crossing the valley of death—An integrated framework and a value chain for emerging technologies. *IEEE Transactions on Engineering Management*, 64(3), 389-399.
16. Kusmintarti, A. (2022). Management of Research Results and Intellectual Property Commercialization. *Academic Journal of Interdisciplinary Studies*.
17. Malaysian Investment Development Authority (MIDA). (2024, March 25). Guidelines and procedures for the application of the Domestic Investment Accelerator Fund (DIAF) – ESG adoption. <https://www.mida.gov.my>
18. Malaysian Investment Development Authority (MIDA). (n.d.). Grants. <https://www.mida.gov.my/forms-and-guidelines/grants/>
19. Malaysian Science, Technology and Innovation Information Centre (MASTIC). (2023, August 28). Malaysia Laboratories for Academia-Business Collaboration (MyLAB). https://mastic.mosti.gov.my/services/sti/sti_grants1_view.php?editid1=10
20. Malaysian Science, Technology and Innovation Information Centre (MASTIC). (2024, June 21). Dana Applied Innovation (AIF). https://mastic.mosti.gov.my/services/sti/sti_grants1_view.php?editid1=14
21. Malaysian Science, Technology and Innovation Information Centre (MASTIC). (2024, June 21). Technology Development Fund 2 (TeD 2). https://mastic.mosti.gov.my/services/sti/sti_grants1_view.php?editid1=16
22. Malaysian Science, Technology and Innovation Information Centre (MASTIC). (2023, October 12). CIP Spark. https://mastic.mosti.gov.my/services/sti/sti_grants1_view.php?editid1=34
23. Malaysian Science, Technology and Innovation Information Centre (MASTIC). (2023, June 20). CREST R&D&C&I Grant. https://mastic.mosti.gov.my/services/sti/sti_grants1_view.php?editid1=12
24. Malaysian Technology Development Corporation (MTDC). (2015). Funding for commercialisation [PowerPoint slides]. Malaysian Science, Technology and Innovation Information Centre (MASTIC). https://mastic.mosti.gov.my/storage/2024/07/data_collection_on_sti_survey_workshop_2015_-_slide_mtdc.pdf
25. Malaysian Technology Development Corporation Sdn. Bhd. (n.d.). Commercial fund. <https://www.mtdc.com.my/commercial-fund/>

26. Ministry of Finance Malaysia. (2016). Laws and regulations. <https://www.mof.gov.my/portal/pdf/bisnes/maklumat-pendaftaran-syarikat/undang-undang-peraturan-en.pdf>
27. Ministry of Science, Technology and Innovation (MOSTI). (2024). National Technology & Innovation Sandbox (NTIS). <https://sandbox.gov.my>
28. Miškinis, J. (2024). Exploring the challenges faced by life science start-ups in commercializing their technologies (Doctoral dissertation, Vilnius universitetas.).
29. Moktar, Z. (2018). From Lab to Market: Early-Stage Business Models for the Commercialisation of University Technology in the Cleantech Industry (Doctoral dissertation).
30. Nielsen, J., Nicol, D., & Stewart, C. (2023). The Australian 'Valley of Death'? Australian research and patenting practices in bioprinting and genome editing. In *Research Handbook on Empirical Studies in Intellectual Property Law* (pp. 47-73). Edward Elgar Publishing.
31. Nitu, R. M. N. M. (2025). From lab to market: how governments and enterprises compose the future of innovation. *Theoretical & Applied Economics*, 32(1).
32. Noor, N. B. M. (2024). Incubator Program in Accelerating Research. *University Incubators and Their Role in the Entrepreneurial Ecosystem*, 147.
33. Olawore, A. S., Wong, K. Y., Ma'aram, A., & Sutopo, W. (2022, September). Factors That Influence Successful Technology Commercialization. In *3rd Asia Pacific International Conference on Industrial Engineering and Operations Management*, Johor Bahru, Malaysia, September (pp. 13-15).
34. Organisation for Economic Co-operation and Development (OECD). (2025). Prototype Research Grant Scheme. OECD Science, Technology and Innovation Policy (STIP) Compass. <https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2025%2Fdata%2FpolicyInitiatives%2F99992582>
35. Rahim, N. A., Mohamed, Z. B., & Amrin, A. (2021). From Lab To Market: Challenges Faced By Academic Entrepreneur In Technology Transfer Pursuit. *International Journal of Business & Society*, 22(3).
36. Ravikumar, R. N., & Aarthi, S. (2026). From Lab to Market: Industrial Pathways for Translating Academic AI Research Into Scalable Innovation. In *Applied Triple Helix (University-Government-Industry) Models for AI Innovation* (pp. 245-278). IGI Global Scientific Publishing.
37. Ravikumar, R. N., & Aarthi, S. (2026). From Lab to Market: Industrial Pathways for Translating Academic AI Research Into Scalable Innovation. In *Applied Triple Helix (University-Government-Industry) Models for AI Innovation* (pp. 245-278). IGI Global Scientific Publishing.
38. Ribeiro, C. (2025). Bridging Research and Market: Innovative Approaches to Biotechnology Commercialization. *Journal of Commercial Biotechnology*, 30(3), 58-68.
39. Rosdi, S. A. M., Ramdan, M. R., Habidin, N. F., & Suwarno, A. I. M. (2021). Strengthening Support Services in Innovation and Commercialisation: The Malaysia's Higher Education Perspectives. *Rigeo*, 11(12).
40. Salem, I. E., Abdulqader, A. W., Ismaeel, M. M., & Mijwil, M. M. (2021). A Survey: The Role of Research and Development in Securing the Effective Transfer of Technology. *Asian Journal of Applied Sciences* (ISSN: 2321-0893), 9(5).
41. Shahidan, N. H., Abdul Latiff, A. S., & Abdul Wahab, S. (2025). Examining issues and challenges in the commercialization of university generated intellectual property rights in Malaysia. *ASEAN Entrepreneurship Journal* (AEJ), 11(1), 25-39.
42. Shaikh, A., Berrouane, M. T., Bottaro, C., & Bazan, C. (2024, March). Lab-to-Market Product Innovation: Implications of Using a Translational Research & Development Model and Methodology. In *International Conference on Smart Technology* (pp. 99-113). Cham: Springer Nature Switzerland.
43. Silvestri, M., Gucciardi, G., Tenca, F., Landolfo, T. L., Zampella, A., & Capizzi, V. (2026). Addressing the Multiple Valleys of Death in ATMPs: Translational Uncertainty Load and Ecosystem-Based Financing. Available at SSRN 6801579.
44. Subramonian, H., & Rasiah, R. (2016). University-industry collaboration and technological innovation: sequential mediation of knowledge transfer and barriers in automotive and biotechnology firms in Malaysia. *Asian Journal of Technology Innovation*, 24(1), 77-99.



45. Ting, S. H., Yahya, S., & Tan, C. L. (2019). The influence of researcher competence on university-industry collaboration: The mediating role of domain knowledge transfers and spillovers. *Journal of Entrepreneurship in Emerging Economies*, 11(2), 277-303.
46. Wan, P., He, F., Zhang, H., & Wu, R. (2026). From lab to market: the financial impact of industry-university-research cooperation on Chinese pharma firms. *Kybernetes*, 55(5), 1683-1704.
47. Zaki, N. A. M., & Hashim, F. M. (2023). Effective Process of Commercialization at the Research Institutions in Malaysia. *Journal of Advanced Research in Business and Management Studies*, 30(1), 45-57.
48. Zolkepli, F. (2025, October 10). Malaysian R&D innovations to be given a boost. *The Star*. https://www.thestar.com.my/news/nation/2025/10/10/malaysian-rd-innovations-to-be-given-a-boost_