

Business Planning as an Adaptive Capability for Technology Commercialization in Developing Economies: An Integrative Review

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Abstract

The commercial value of technology emerges not when a prototype works, but when the innovation can be produced, financed, adopted and sustained. This integrative review examines how business planning supports technology commercialization in developing economies. Drawing on entrepreneurship, innovation management, technology-transfer and development literature, and anchored in the Resource-Based View and Dynamic Capabilities Theory, the study synthesizes global, African and Nigerian evidence. The review identifies four recurring mechanisms through which planning contributes to commercialization: market validation, resource orchestration, staged financial discipline, and organizational learning and stakeholder coordination. The evidence also shows that these mechanisms depend on alliances, absorptive and applied-research capabilities, user engagement, finance, infrastructure and institutional quality. The paper concludes that business planning is most valuable as an adaptive capability rather than a static funding document. It recommends evidence-led, milestone-based and partnership-oriented commercialization, especially in institutionally constrained environments. These findings are particularly relevant to research institutions and technology ventures operating under resource and institutional constraints.

Keywords: *business planning; technology commercialization; adaptive capability; innovation management; developing economies; Nigeria*

1. Introduction

A technology may work perfectly and still fail commercially. Across developing economies, laboratories, universities, research institutions and technology ventures continue to produce prototypes that demonstrate technical feasibility but never become products that customers adopt, firms scale or investors finance. A working prototype therefore shows that a technology is possible; it does not necessarily show that it is commercially viable. Between invention and sustained market use lies a more difficult challenge: identifying a sufficiently valuable customer problem, producing at a viable cost, mobilizing complementary capabilities, financing the path to scale and securing adoption. Commercialization therefore requires more than successful invention. It requires the coordinated conversion of technical knowledge into sustained economic or social value (Organisation for Economic Co-operation and Development [OECD], 2013;

Teece, 2010). This persistent gap between technical achievement and market success raises an important managerial question: how can innovators manage the uncertain transition from invention to commercial value? Business planning offers one possible mechanism for managing this transition, but its role remains contested. Entrepreneurship research generally associates planning with venture development and performance, while also showing that its value depends on timing, uncertainty and how the planning process is used (Brinckmann et al., 2010; Delmar & Shane, 2003; Gruber, 2007). Recent evidence further shows that the effort devoted to preparing a business plan may encourage entrepreneurs to seek external equity without necessarily increasing the likelihood of obtaining it (Latifi et al., 2024). This suggests that the existence of a business plan is not, on its own, evidence of commercial readiness. What may matter more is whether planning helps managers identify assumptions, gather relevant evidence and adjust decisions as uncertainty reduces. Technology-commercialization research approaches the same problem from a different angle. It emphasizes complementary assets, market learning, intellectual property, organizational agility, finance and partnerships as conditions for moving technology into productive use (Chen, 2009; Gans & Stern, 2003; Karaveg et al., 2016; Muñoz-Peñas et al., 2024). This literature has contributed significantly to our understanding of what commercialization requires. However, it pays less attention to business planning as the managerial process through which technical, market, financial and organizational evidence can be brought together, tested and revised throughout the commercialization process. This leaves two related conversations only partly connected. Business-planning research explains why planning may matter for venture development, while commercialization research identifies the capabilities and relationships required for market success. Yet, how planning coordinates these requirements under uncertainty remains insufficiently developed.

This issue is especially important in developing economies. Research institutions and technology ventures often operate within environments characterized by weak university-industry linkages, limited commercialization finance, infrastructure constraints and fragmented innovation systems (Jjagwe et al., 2024; Kirby & El Hadidi, 2019). Across Sub-Saharan Africa, institutional quality and access to finance remain important determinants of innovation-system performance (Alabani et al., 2026). Nigerian evidence similarly highlights the importance of technology-transfer capacity, industrial linkages, research financing and stronger coordination between research institutions and industry (Fadeyi et al., 2019; Okoronkwo et al., 2022; Ozor et al., 2025). Business planning cannot remove these structural constraints, but it can make them visible before substantial resources are committed and help managers decide whether missing capabilities should be developed internally, accessed through partnerships, financed in stages or accommodated through changes in the commercialization pathway. The issue, therefore, is not simply whether planning takes place, but whether it functions as an adaptive mechanism for dealing with resource and institutional constraints. The unresolved question is therefore not whether innovators should write business plans, but how business planning creates value when commercialization is uncertain, capability-intensive and institutionally constrained. Accordingly, this review asks: How does business planning support technology commercialization under conditions of uncertainty and institutional constraint? Drawing principally on the Resource-Based View and Dynamic Capabilities Theory, the study brings together evidence from entrepreneurship, technology commercialization, innovation management and technology-transfer research across global, African and Nigerian contexts. It conceptualizes business planning as an adaptive commercialization capability: a repeatable organizational process through which innovators validate markets, coordinate complementary resources, stage financial

commitments and learn as commercialization unfolds.

The paper makes three related contributions. First, it connects the business-planning and technology-commercialization literatures by shifting attention from the business plan as a static document to business planning as an adaptive managerial capability. Second, it identifies four mechanisms through which planning can support commercialization: market validation, resource orchestration, staged financial discipline and adaptive learning. Third, it brings the institutional conditions of developing economies into the planning-commercialization relationship by showing how finance, infrastructure, partnership capacity and institutional quality can strengthen or constrain the value of planning. In doing so, the study moves the discussion beyond whether business plans improve performance to the more important question of how planning helps innovators convert technical possibility into credible and workable pathways to market.

2. Methodology

The study adopts an integrative literature review. This approach is appropriate when a research problem spans related but fragmented bodies of knowledge and the objective is to synthesize them into a new conceptual perspective rather than estimate a pooled effect (Snyder, 2019; Torraco, 2005). The relevant evidence is dispersed across entrepreneurship, technology commercialization, innovation management, university-industry transfer and development policy research. Accordingly, the review connects findings from these literatures to explain how business planning contributes to commercialization.

The evidence base comprises peer-reviewed studies and a limited number of authoritative policy sources selected for direct relevance to business planning, technology commercialization, market validation and adoption, commercialization capability, or institutional conditions in developing economies. Source identification was organized around combinations of terms including business planning, technology commercialization, commercialization capability, technology transfer, university-industry linkage, market validation, user engagement, innovation finance, developing economies, Africa, and Nigeria. Relevant studies were located through scholarly discovery and publisher searches and were supplemented by backward reference checking from highly relevant studies. Seminal works were retained where they establish the theoretical foundations of planning and capability; no rigid lower publication-year limit was imposed for these foundational sources, while recent evidence through 2026 was emphasized for contemporary empirical and policy developments. A second screening pass prioritized empirical studies with identifiable research designs and outcomes related to commercialization, technology transfer, market engagement, complementary alliances, industry funding, financing, or resource-constrained innovation. Sources concerned primarily with technical invention without a clear market, organizational, or commercialization dimension were excluded. The final synthesis draws on 40 cited sources, combining empirical studies, theoretical and methodological works, and authoritative policy documents. Each retained empirical study was examined for context, sample or method, principal finding, and implication for adaptive commercialization planning.

The synthesis proceeded in four stages. First, the business planning literature was examined to identify what planning contributes and the conditions under which those benefits vary. Second, technology commercialization studies were reviewed to identify the resources, partnerships, and capabilities required to move technologies from development to market. Third, empirical evidence was compared across advanced, transition, African, and Nigerian settings to identify recurring mechanisms and boundary conditions. Fourth, the findings were integrated into an adaptive-capability framework linking market validation, resource orchestration, financial

staging, and organizational learning. Because the review is integrative rather than systematic, it does not claim exhaustive coverage or a PRISMA-style search protocol; its contribution lies in transparent analytical synthesis and conceptual integration.

3. Conceptual and Theoretical Framework

3.1 Business planning for commercialization

Business planning is the structured process of defining an opportunity, testing assumptions, allocating resources and specifying the actions required to achieve commercial objectives. For technology ventures, this process must go beyond describing a proposed enterprise. It should distinguish proven facts from assumptions and identify the evidence required before further resources are committed (McGrath & MacMillan, 1995). A technically functioning product, for example, is evidence of technical feasibility; it is not evidence of willingness to pay, reliable production cost or a workable distribution model.

Commercialization-oriented planning can therefore be organized around four decision domains. Market validation asks whether an identifiable customer problem exists and whether the innovation offers a credible advantage over alternatives. Resource orchestration asks whether the venture possesses or can access the production, managerial, distribution and service capabilities needed to deliver that value. Financial staging asks whether cash-flow requirements, unit economics and funding milestones are realistic. Adaptive learning asks which assumptions must be tested before the next commitment of resources. These domains convert the business plan from a prediction into a disciplined learning system (Cooper, 2008; Gruber et al., 2008; Teece, 2010).

3.2 Theoretical foundation: Resource-Based View and Dynamic Capabilities

The Resource-Based View (RBV) provides the first theoretical anchor. It explains performance differences through resources and capabilities that enable firms to create and protect value (Barney, 1991). In technology commercialization, the relevant resource base extends beyond the invention itself. It includes engineering competence, production assets, intellectual property, finance, market knowledge, supplier relationships, distribution channels and managerial expertise. A strong technology can therefore fail commercially when complementary capabilities are absent. From an RBV perspective, business planning is partly a capability audit: it clarifies which resources are distinctive, which are missing and which should be developed internally or accessed through partnership. Dynamic Capabilities Theory extends this logic by explaining how organizations sense opportunities, seize them and reconfigure resources as conditions change (Teece, 2007; Teece et al., 1997). This is particularly relevant to commercialization because both the technology and the market may evolve during development. Pilot results can expose design weaknesses; customer feedback can alter the target segment; supplier quotations can change cost assumptions; and regulation can delay market entry. A fixed business plan is poorly suited to these conditions. An adaptive plan, by contrast, creates milestones, feedback loops and decision rules through which the venture can revise its resource configuration. The two theories are complementary. RBV explains why commercialization depends on access to the right resource bundle; Dynamic Capabilities Theory explains why that bundle must be continually adjusted as evidence accumulates. Together they support the central proposition of this paper: the value of business planning lies less in the document produced than in the organizational routines used to validate assumptions, coordinate resources and revise commitments. Diffusion considerations remain relevant at the market level because adoption depends on perceived advantage,

compatibility and trialability (Rogers, 2003), but these are treated here as part of market validation rather than as a separate theoretical framework.

Table 1

Analytical dimensions of adaptive commercialization planning

Planning dimension	Central question	Indicative evidence before scale-up
Market validation	Is there a valuable customer problem and credible demand?	Customer interviews, field trials, willingness-to-pay evidence, trial orders, competing alternatives
Resource orchestration	Can the venture access the capabilities required to produce, deliver and support the innovation?	Capability map, supplier quotations, partner commitments, production and service arrangements
Financial staging	Can the commercialization pathway be financed without creating avoidable liquidity or scale risk?	Unit economics, cash-flow forecast, break-even analysis, working-capital needs, milestone-linked funding
Adaptive learning	Which uncertainties must be reduced before further commitment?	Pilot results, test data, adoption feedback, revised assumptions and explicit decision rules

Source: Authors' synthesis based on McGrath and MacMillan (1995), Gruber et al. (2008), Teece (2010), and Muñoz-Peñas et al. (2024).

4. Results

4.1 Business planning: positive but contingent effects

The business planning literature does not support a simple conclusion that more planning always produces better outcomes. Delmar and Shane (2003) found that planning helped new ventures organize activities and reduced the likelihood of disbandment. Gruber (2007) showed that the value of planning depends on the novelty of the venture and the uncertainty surrounding it. Brinckmann et al. (2010), in a meta-analysis, reported an overall positive planning-performance relationship but emphasized important contextual differences. These studies converge on a process interpretation: planning is useful when it structures action under uncertainty rather than when it merely increases documentation. Recent research reinforces this conclusion. Latifi et al. (2024) found that greater business-plan effort increased the likelihood of searching for external equity but did not, by itself, secure financing. Nakajima and Sekiguchi (2025), reviewing the broader literature, similarly argue that planning is most useful when it supports learning, communication and adaptation. The result is a clear distinction between plan possession and planning capability. Investors, customers and partners respond to credible evidence; they do not respond to the existence of a document alone.

4.2 Commercialization requires complementary capabilities

Commercialization research identifies the capabilities that business planning must coordinate. Gans and Stern (2003) show that innovators must choose between competing in product markets and cooperating through markets for technology, depending partly on access to complementary assets. Chen (2009) links commercialization capability and external support to new-venture performance, while Karaveg et al. (2016) identify marketing, technology, finance, intellectual property and human resources as important commercialization criteria. More recent evidence from research-network organizations similarly emphasizes the competence base required to execute technology commercialization effectively (Walasik et al., 2026). Dutta and Hora (2017), using alliance data for 603 biotechnology ventures, provide particularly useful evidence on complementarity: upstream alliances with research universities improved invention success but did not significantly improve commercialization success on their own; when combined with downstream alliances with established industry partners, the joint effect was positive for both invention and commercialization. The implication is that technical knowledge must be connected to market-facing and scaling capabilities rather than treated as sufficient for commercial readiness. Evidence from public technology transfer reinforces the importance of complementary capabilities, knowledge characteristics and relationships. Ardito and Svensson (2024), using patent data with commercialization information, found that inventions grounded more strongly in applied knowledge reached innovation more quickly, whereas inventions drawing more heavily on basic knowledge tended to yield more profitable innovations but were harder and riskier to commercialize. Min et al. (2020) analyzed 514 technologies transferred by 43 major universities and public research institutes in Korea. Effective partnership between firms and research institutions was a key factor in successful commercialization across market conditions, while absorptive capacity became particularly important under stronger market competition. Lee and Jung (2021), using longitudinal South Korean university data from 2009 to 2015, found that technology transfer office capability did not independently improve commercialization performance; it became effective where universities possessed sufficiently strong applied-research capability. These findings caution against equating formal commercialization structures with commercialization capability: commercialization outcomes depend on the knowledge base, complementary capabilities and relationships through which formal structures are enacted.

Market-facing learning also has direct empirical support. Asgari et al. (2022), studying technology-based SMEs in an Iranian science-and-technology park with partial least squares structural equation modeling, found that cooperative innovation, external R&D and resource search all contributed to commercialization performance, with cooperative innovation the strongest component. Cai et al. (2022), using survey data from 216 high-tech enterprises, found that external user engagement strengthened technology commercialization capability and that big-data analytics capability helped firms sustain this relationship under environmental uncertainty. Together with the longitudinal evidence of Muñoz-Peñas et al. (2024) on market context learning, agility, alignment and credibility building, these studies show that commercialization capability is created through repeated interaction with users, partners and evidence rather than through internal technical development alone.

4.3 Developing-economy evidence: institutions and resource constraints

Evidence from transition and African economies makes the institutional qualification especially clear. In Azerbaijan, Belarus and Kazakhstan, Belitski et al. (2019) developed a multi-level dataset that began with 2,602 scientists, used a generalized Heckman approach on 272 scientists

and supplemented the analysis with 27 interviews. Research commercialization was associated with direct industrial funding rather than the mere existence or awareness of technology-transfer offices or contracts routed through them. In Africa, Kirby and El Hadidi (2019) found that weak university-industry collaboration constrained technology transfer in Egypt, while Jjagwe et al. (2024) identified system fragmentation, infrastructure shortages and financing gaps as major commercialization barriers in Uganda. Hailu (2024) similarly emphasizes trust, coordination, finance and intermediary capacity in university-industry-government relationships. The consistent message is that formal structures have limited effect when they are not backed by resources, market relationships and implementation capability. At the regional level, Alabani et al. (2026) report substantial differences in national innovation-system performance across 43 Sub-Saharan African economies and identify institutional conditions as important influences on innovation outcomes. The planning implication is that infrastructure, finance, regulation and partnership assumptions should be treated as explicit boundary conditions rather than background information. A commercialization plan in a constrained setting must therefore specify how missing capabilities will be accessed, which external actors are critical to implementation, and how delays, financing shortages or cost shocks will alter the commercialization pathway. Nigerian evidence supports this resource-orchestration argument. Fadeyi et al. (2019) show that university technology-transfer performance is associated with the resources available for transfer activities, while Okoronkwo et al. (2022) emphasize technology transfer and industrial linkages at the Federal Institute of Industrial Research Oshodi. More recent firm-level evidence adds an important qualification. Using the World Bank's 2014 Nigerian Enterprise Survey and a linked Innovation Follow-up Survey of 905 firms, Dohse and Fehrenbacher (2026) find that cooperation with other domestic firms increased the probability of product innovation by about 22.6 percentage points and was especially valuable to young and financially constrained firms. Their outcome is innovation rather than commercialization per se, so the result should not be overextended; nevertheless, it provides directly relevant evidence that cooperation can compensate for missing knowledge and financial resources in the environment in which Nigerian commercialization occurs. Ozor et al. (2025) further identify fragmentation, weak coordination and limited private-sector participation in the national research and innovation funding ecosystem.

Table 2
Representative empirical evidence and implications

Study/context	Main empirical finding	Implication for adaptive commercialization planning
Brinckmann et al. (2010), meta-analysis of small firms	Planning has an overall positive but context-dependent association with performance.	Planning should be contingent on uncertainty and venture conditions, not treated as a universal prescription.

Study/context	Main empirical finding	Implication for adaptive commercialization planning
Dutta & Hora (2017), 603 biotechnology ventures	Upstream university alliances improved invention but not commercialization alone; combined upstream and downstream alliances improved both.	Technical knowledge must be paired with market-facing and scaling partners.
Belitski et al. (2019), Azerbaijan, Belarus & Kazakhstan; multilevel analysis plus 27 interviews	Commercialization was associated with direct industrial funding rather than the mere presence or use of TTO arrangements.	Formal transfer structures need substantive industry engagement and financing.
Min et al. (2020), Korea; 514 transfers from 43 universities/public research institutes	Effective partnership consistently supported commercialization; absorptive capacity mattered more under strong competition.	Plans should assess partner quality, absorptive capability and competitive conditions.
Lee & Jung (2021), South Korea; longitudinal university data, 2009-2015	TTO operation capability alone was not significant; it became effective where applied-research capability was high.	Commercialization offices create value only when supported by complementary research and implementation capabilities.
Asgari et al. (2022), Iranian technology-based SMEs; PLS-SEM	Cooperative innovation, external R&D and resource search improved commercialization performance; cooperation was strongest.	External resource search and cooperation should be designed into the commercialization pathway.
Cai et al. (2022), 216 high-tech enterprises	User engagement strengthened technology-commercialization capability; analytics capability helped under environmental uncertainty.	Customer learning and evidence-processing capability should inform iterative planning.
Muñoz-Peñas et al. (2024), longitudinal commercialization case	Commercialization capability developed through market-context learning, agility, alignment and credibility building.	Plans should function as learning systems with revision points and milestones.
Jjagwe et al. (2024), Uganda; mixed methods	System fragmentation, infrastructure and finance constrained commercialization.	Ecosystem dependencies and mitigation measures should be explicit in plans.

Study/context	Main empirical finding	Implication for adaptive commercialization planning
Dohse & Fehrenbacher (2026), Nigeria; 905-firm innovation follow-up survey	Domestic inter-firm cooperation strongly supported innovation, especially for young and financially constrained firms.	In resource-constrained settings, partnership can partly offset missing knowledge and resources; the evidence is indirect for commercialization.
Yedgenov et al. (2025), 140 publicly funded scientific projects	Financing, co-financing and capital expenditure influenced commercialization outcomes.	Funding structure and sequencing are part of commercial readiness.

Source: Authors' synthesis from the reviewed empirical studies.

4.4 Integrated findings

Across the reviewed evidence, four mechanisms recur. First, market validation reduces demand uncertainty by forcing innovators to define users, competing alternatives and value propositions; the user engagement evidence of Cai et al. (2022) directly supports this mechanism. Second, resource orchestration connects technical knowledge with complementary market, production and relational assets, as shown by the alliance evidence of Dutta and Hora (2017), the partnership findings of Min et al. (2020), and the cooperation evidence of Asgari et al. (2022) and Dohse and Fehrenbacher (2026). Third, staged financial discipline links investment to evidence on cost, demand and readiness; Latifi et al. (2024), Belitski et al. (2019) and Yedgenov et al. (2025) show that financing effort, industrial funding and funding structure materially shape commercialization pathways. Fourth, adaptive learning turns pilots, customer feedback and organizational experience into revised decisions, consistent with Lee and Jung (2021) and Muñoz-Peñas et al. (2024). These mechanisms are not equally effective in all environments. Min et al. (2020) show that market competition changes the value of absorptive and innovation capabilities; Lee and Jung (2021) show that technology transfer office capability depends on applied-research capability; and Belitski et al. (2019) demonstrate that formal transfer structures may be less consequential than direct industry engagement in transition economies. African and Nigerian studies further identify finance, infrastructure, institutional coordination and resource scarcity as important boundary conditions. The same planning routine can therefore produce different commercialization outcomes across contexts, which helps reconcile the contingent findings in the business planning literature with the systemic constraints emphasized in developing-economy research.

5. Discussion

The central contribution of this review is to reconcile two literatures that are often discussed separately. Business-planning research asks whether planning improves venture outcomes; technology commercialization research asks which capabilities, relationships and ecosystem conditions are required to move technology into productive use. The expanded empirical evidence suggests that the appropriate bridge between them is not the business plan as an artifact but business planning as an adaptive commercialization capability. In this interpretation, planning creates value when it repeatedly converts market, resource, financial and partnership evidence into decisions about whether and how to proceed. This distinction helps explain the mixed evidence on business plans. A static plan can become obsolete quickly when customer

preferences, production costs, financing conditions or partner commitments change. By contrast, the evidence from user engagement, alliance portfolios, public technology transfer and commercialization-capability development shows that successful commercialization is iterative and relational (Cai et al., 2022; Dutta & Hora, 2017; Min et al., 2020; Muñoz-Peñas et al., 2024). An adaptive planning capability structures this learning process: managers state assumptions, expose capability gaps, collect evidence, compare outcomes with expectations and revise the route to market. Planning is therefore most valuable where uncertainty is material but reducible through engagement, experimentation and staged commitment. The RBV and Dynamic Capabilities perspectives also become more useful when combined with this evidence. RBV explains why commercialization requires a resource bundle larger than the technology itself. Dutta and Hora (2017) show that research alliances create invention value that may not reach the market without downstream industry relationships; Min et al. (2020) show the importance of partnership and absorptive capacity; and Asgari et al. (2022) show the commercialization value of cooperative innovation and external resource search. Dynamic Capabilities Theory explains how this resource bundle is updated as conditions change. The user engagement findings of Cai et al. (2022) and the longitudinal process evidence of Muñoz-Peñas et al. (2024) illustrate the sensing and learning processes through which commercialization capability is renewed. Business planning connects these logics by converting resource requirements and new evidence into staged decisions. The review also extends the planning debate by identifying institutional boundary conditions. The results of Lee and Jung (2021) are especially instructive: a formal technology-transfer capability generated value only when supported by sufficiently strong applied-research capability. Belitski et al. (2019) similarly show that, in transition economies, direct industrial funding was more closely associated with commercialization than formal technology transfer office arrangements. In African settings, institutional fragmentation, finance and infrastructure constraints further shape what organizations can implement (Jagwe et al., 2024). A strong plan cannot substitute for a missing ecosystem, but it can identify dependencies, reveal which capabilities must be obtained externally and prevent premature scale-up based on technical readiness alone. This argument has particular relevance for Nigeria. Existing policy emphasizes stronger research-industry linkages and commercialization, while the Nigeria Startup Act provides support structures for technology-enabled ventures (Federal Ministry of Science, Technology and Innovation, 2022; Federal Republic of Nigeria, 2022). More recent federal initiatives also emphasize market-driven research and the conversion of research outputs into commercially viable products (Federal Ministry of Innovation, Science and Technology, 2026). The evidence of Dohse and Fehrenbacher (2026) adds a useful firm-level perspective: domestic cooperation is particularly valuable to young and financially constrained Nigerian firms. Commercialization policy should therefore encourage not only institutional transfer offices but also practical inter-firm relationships, industry co-development and financing arrangements through which missing capabilities can be accessed. For managers of public research and technology institutions, the implication is practical. Commercial planning should begin before technical design is frozen and should explicitly map both upstream knowledge relationships and downstream market relationships. Customer and user engagement should influence specifications and adoption assumptions; supplier and industry engagement should expose production, distribution and service constraints; and the plan should identify which capabilities must be acquired through licensing, co-development, contract production or strategic partnerships. The evidence also cautions against treating a commercialization office as sufficient in itself: its effectiveness depends on applied-research quality, partner access and the ability to learn from

market evidence (Lee & Jung, 2021). Financial projections should remain milestone-based and should show cash requirements and downside conditions, not only expected profit.

6. Practical Relevance for Policymakers

For policy makers, commercialization support should combine project funding with capability and relationship development. Research grants that stop at prototype development can leave promising technologies stranded before certification, pilot production or market validation. The findings of Belitski et al. (2019) suggest that direct industry engagement and funding can be more consequential than formal transfer structures in institutionally constrained settings, while Min et al. (2020) show the persistent value of effective research-industry partnership. Staged financing, accessible testing infrastructure, industry co-development, user validation and transparent procurement pathways should therefore be treated as complementary instruments. Performance measures should extend beyond patents and prototypes to field validation, licensing, customer adoption, repeat use, private co-investment and production continuity.

7. Conclusion

Commercialization is not the final administrative stage of research; it is a distinct process of converting technical possibility into sustained user and economic value. The evidence reviewed across entrepreneurial ventures, public technology transfers, universities, high-technology firms and developing-economy innovation systems supports a qualified conclusion: business planning can strengthen commercialization when it coordinates market validation, complementary resources, staged finance and organizational learning. The expanded empirical base also shows why planning is not sufficient on its own. The nature of the underlying knowledge, partnerships, applied-research capability, absorptive capacity, user engagement, industry funding and institutional conditions determine whether planned actions can actually be implemented.

This interpretation is more precise than the conventional claim that business plans improve performance. It explains why planning can be useful without being sufficient and why the same planning practices produce different results across institutional environments. In developing economies, the effectiveness of planning is especially dependent on finance, infrastructure, industry linkages and institutional coordination. The appropriate managerial response is therefore evidence-led and partnership-oriented commercialization rather than technical enthusiasm followed by large-scale commitment. The review is limited by its integrative narrative design and does not claim exhaustive coverage or causal estimation. Future research should test the proposed adaptive commercialization capability directly in public research institutions. Useful measures would include the quality of market validation, frequency of plan revision, milestone discipline, partner commitment and the speed with which projects progress from prototype to sustained market use. Comparative studies across African innovation systems could also examine whether institutional quality and commercialization finance strengthen or weaken the effect of planning capability on commercial outcomes. The policy and managerial principle emerging from the review is concise: evidence should precede expansion. Before committing to scale, an innovation project should be able to show not only that the technology works, but also that customers value it, the required capabilities are available, the financial path is credible and the route to market can be implemented.

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