

Iterative Stakeholder-Driven Commercialization Pathways in Academic Entrepreneurship and MVP Learning

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Abstract: Academic entrepreneurs (AEs) commercializing deep technologies operate under high uncertainty conditions, where technological advances precede clearly defined industrial applications. At low TRL, laboratory validation and demonstrations provide technical feasibility signals, yet problem definitions, user contexts, and system-level requirements remain narrow with limited perspective. Market information is fragmented and typically hard to translate into practical use. Under such conditions, commercialization unfolds as an iterative process of entrepreneurial framing, innovation learning, and external alignment. This study examines how AEs structure early commercialization through stakeholder engagement. Empirically grounded in a low TRL technology project, the research draws on expert interviews, internal team reflections, university support actors, workshops and a literature review. The literature provides a conceptual baseline against which emerging empirical themes are compared, refined, and structured. The analysis applies an inductive qualitative coding process, grouping findings into preliminary thematic categories such as entrepreneurial framing, iterative experimentation, business model development, technological advancement, and stakeholder alignment. Early-stage interactions within the team and university ecosystem played a critical role in articulating preliminary benefit hypotheses and shaping initial customer-oriented narratives. As engagement expanded to external stakeholders, effective progress depended on identifying actors with contextual authority and commercialization literacy. Rather than eliciting predefined requirements, exploratory questioning surfaced existing customer technical constraints. These dialogues enabled iterative reframing of problem–solution configurations, aligning technological competitive capabilities with differentiated customer contexts and value creation. Technical development progressed from proof-of-concept experimentation toward validated lab-scale feasibility, allowing more credible hypothesis testing regarding application-specific value propositions. The study conceptualizes early deep-tech commercialization as dialogical validation under time pressure and strategic risk. By integrating narrative stakeholder inquiry, structured analytical intelligence, and iterative technical experimentation, AEs can accelerate learning while managing uncertainty.

Keywords: Academic Entrepreneurship, Technology Commercialization, Opportunity Crafting, Lean Startup, Stakeholder Engagement

1. Introduction

Research commercialization is increasingly important because scientific discoveries often create wider economic and societal value only after they are translated into validated applications, business concepts, and market pathways. However, early-stage academic technologies frequently face a “Valley of Death”, where technical potential exists but commercial relevance, customer need, and follow-up resources remain uncertain. (Grünfeld *et al.*, 2026) This makes stakeholder engagement and MVP learning critical mechanisms for reducing uncertainty, testing opportunity assumptions, and shaping more credible commercialization pathways. Startup failures not always fail due to lack of finance, often many other factors, like skillset related to understanding of the business environments, contribute to lack of transition to commercial stage. (Gbadegeshin *et al.*, 2022) For this stakeholder fuelled review process around novel technology can possibly be one suitable way to anchor down the academic entrepreneurs (AE) towards successful venture.

From general perspective research breakthroughs follow similar innovation process than normal product development, difference is environment where companies conduct small experiments in near vicinity to customer interface and academics research happens much farther from commercial interaction layers. Academic Entrepreneur could understand differently technology readiness level (TRL) and raise funds at wrong time for improperly validated technology without validation systems. Certain process steps can be taken and adapted together for research commercialization as well, like stage gate models, Lean Startup and new product development theories suggest. Many universities have undertaken strategy to establish technology centre to increase stakeholder facilitations to share knowledge in the networks. (Kruachottikul *et al.*, 2023) Experimentations in startup early stages suffer still from improper learning from customer feedback and its impact on business model development. This involves active stakeholder engagement and balancing between various choices with limited resources. (Bocken and Snihur, 2020a) To find answers, following guiding research questions are set:

Main RQ: How does iterative stakeholder engagement shape early commercialization learning in low-TRL academic entrepreneurship? Support questions:

- What types of stakeholder input are most useful for refining early deep-tech commercialization assumptions?
- How do academic entrepreneurs translate fragmented stakeholder feedback into clearer problem-solution, customer, and value proposition hypotheses?
- How does stakeholder input interact with MVP-style experimentation, technical validation, and business model development?
- What criteria can be used to assess whether stakeholder engagement improves the commercialization pathway of an early-stage academic technology?

2. Literature Review

2.1 Academic Entrepreneurship, Deep-Tech Uncertainty and Experimentation

Commercialization of academic research is often characterized as high uncertainty, information asymmetry, unclear product applications and limited entrepreneurial capabilities. Academic entrepreneurship is broadly defined as activity conducted by researchers in research institutions. Activities contain collaborative research, consulting, startup creation and universality-industry partnerships development and networking. (Grimaldi *et al.*, 2011) Another common characteristic is closeness to small and young entrepreneurial ventures that work around deep-tech (DT) research concepts with so new concepts, grounding to market is challenging in early stages, possibly due to disruptive nature and novelty. Technologies in this field (eg. robotics, electronics) are commonly often highly regulated and require expertise to introduce or incorporate within existing value networks. Such high barriers can lead to high risk and research often remains in academic environments. (Micol, Leendertse and van Rijnsoever, 2026)

Experimentation can help academic entrepreneurs reduce uncertainty by testing assumptions before committing to a specific commercialization path. In deep-tech commercialization, several value creation and value capture options may appear possible, but limited resources prevent all alternatives from being pursued simultaneously. Experimentation therefore supports learning by comparing strategic options, reducing weaker choices, and informing decision-making. However, it also creates costs, since testing one path may consume scarce resources and partially close other alternatives. The aim is therefore not to identify a perfect numerical optimum, but to narrow uncertainty and select the most feasible strategic path based on available evidence and learning. (Gans, Stern and Wu, 2019) Indications show that those entrepreneurs who considers and experiment various options to pursue commercialization have higher chance of success, even more improved when involving mentorship guidance in decision process to absorb best possible alternative outcome. (Agrawal, Gans and Stern, 2020)

2.2 Stakeholder Engagement and Commercialization Networks

Commercialization is not only an internal firm activity, but a networked process in which external actors contribute to adoption, diffusion and market creation. Customers, users, suppliers, distributors, investors, public organizations, regulators and expert communities can perform practical commercialization tasks, provide credibility, support access to resources, shape adoption conditions and help create favorable market structures. (Aarikka-Stenroos, Sandberg and Lehtimäki, 2014) When dealing with academic based low TRL inventions it important to verify and validate through interaction means. Going to deep tech, markets are full of various impacting drivers like regulation which acts sometimes as market creation mechanism, followed by non-organized value chains and disorder formulating towards established business. As such stakeholders can enable academic entrepreneurs working mechanisms to refined assumptions and experiments from various market signals and approach problems with better aligned hypotheses of their idea value and solution. (Engez and Aarikka-Stenroos, 2023)

Commonly new ventures emerge through social interaction with actors such as financiers, customers, suppliers, employees and communities. For low-TRL AEs, stakeholder engagement is not only about listing relevant actors, but about refining and iterating the opportunity, identifying who has relevant power, legitimacy and urgency, and gradually enrolling actors whose contributions can turn an imagined opportunity into a credible venture pathway. (Mitchell *et al.*, 2021) In universities such early groups are often guided through advisory groups of the projects, comparable to board of directors, just with different angles, business vs research aspirations.

To draft successful opportunities from assumptions, AEs must consider wider stakeholder environment in their venture journeys. Typically, strongest voice is carried by customers whose needs AE should focus to satisfy via

opportunity-actualization perspective to filter out non-market stakeholders that might constrain success in some cases. Early engagement with most relevant stakeholders has its crucial role in low-TRL stages of AEs experimentation journey utilizing Lean methods or similar. (Ramoglou, Zyglidopoulos and Papadopoulos, 2021)

2.3 Lean Startup, MVP Learning and Entrepreneurial Experimentation

To further understand methods of venture creation Lean Startup (LS) and associated MVP learning needs to be understood. Starting from basis of LS, which entails Build-Measure-Learn feedback loop and its fast paced Minimum Viable Product thinking. (Ries, 2011) Especially interesting is to know how early TRL level experiments should be crafted when available information is scarce in nature and might be false, which is partial critique towards LS which was created for manufacturing incremental setups not radical deep tech environments often faced by AEs where communication towards customer is not yet developed enough. One main trait of LS is also to push external validation strongly and leave less for hypothesis drafting to push faster outputs and pivoting. (Felin *et al.*, 2020) Further criticism can lead to constructive suggestion in which specific areas AEs should implement LS methods, for which stakeholder input is often fragmented due to early nature of commercialization process. (Leatherbee and Katila, 2020)

Challenges remain with communication and experimentation culture, though practice can be seen to positively affect business model regeneration and creation activities in the startups via faster dialogue simultaneously contributing hypothesis drafting, but for deep tech orientation, research need to continue further in this domain. (Bocken and Snihur, 2020b) To gain better results AEs should increase use of front-end learning process in validation of MVP pivots, finding right market domain, opportunities and stakeholder groups to support better hypothesis formation and stronger business and commercialization impact. (Shepherd and Gruber, 2021)

3. Conceptual Framing

In this study academic entrepreneurship and deep tech commercialization validation via stakeholders is viewed as iterative learning process and not linear technology transfer process. Key characteristics is non fully clear market opportunity, and not yet fully understood applications for technology, early pivoting stage experimentations both in technology and business models. Study aims to better understand how stakeholder interaction impacts the process, based on studies effect is not always positive and failures happen. Improving background relevancy of stakeholder with right information should in theory lead to stronger validation paths. The conceptual framing connects three literature streams: academic entrepreneurship and deep-tech uncertainty, stakeholder engagement and commercialization networks, and Lean Startup / MVP experimentation.

The main theoretical argument is that stakeholder engagement functions as a front-end hypothesis refinement mechanism before meaningful MVP validation can occur. The case analysis should therefore classify stakeholders by their contribution to commercialization learning, not only list them as contacted actors. Each stakeholder category can be assessed by the type of input provided: technical feasibility, market need, adoption barrier, business model option, value-chain access, credibility, regulation/IP, or investment logic. This framing prepares the case description by showing why the empirical case is analysed as a sequence of stakeholder-driven learning cycles.

3.1 Methodology Structure

This study applies an exploratory qualitative single-case design. A case study design is appropriate when the aim is to examine a phenomenon in its real-life context and when multiple forms of evidence are needed to understand how the process unfolds. (Yin, 2009) The case was selected because it represents an early-stage academic deep-tech commercialization process where technical development, stakeholder engagement and opportunity framing occurred in parallel. Rather than examining commercialization as a completed outcome, the study focuses on how commercialization assumptions were formed, challenged and refined during the early stages of pre-venture development. This makes the case suitable for theory-building purposes, as case studies can be used to identify emerging constructs and relationships in underexplored phenomena (Eisenhardt and Graebner, 2007). The aim is analytical insight into how stakeholder-driven learning supports early commercialization pathway development.

The empirical material was collected from several complementary sources, including internal team reflections, expert interviews and statements, workshops, ecosystem interactions, and desk research. Internal reflections

captured the initial technical logic, perceived benefits and early value assumptions of the academic team. Expert interviews and statements provided technical, commercial, IP-related and market-oriented assessments. Workshops supported collective sensemaking and reframing of the opportunity. Ecosystem interactions included input from commercialization support actors, incubator representatives, investors, events and advisory actors. Desk research and literature review materials provided external comparison and theoretical grounding.

The analysis followed an abductive thematic logic. Empirical observations were first grouped around recurring commercialization issues such as technical constraints, customer problems, adoption barriers, stakeholder credibility, value proposition assumptions and business model options. These observations were then interpreted through broader themes including entrepreneurial framing, stakeholder alignment, MVP learning and technical-commercial translation. The stakeholder classification in the case description was used to show how different actor groups contributed to commercialization learning across project phases. The emerging interpretation was finally compared with prior literature on academic entrepreneurship, stakeholder networks and Lean Startup experimentation.

3.2 Project Case Description

The empirical setting is a university-based low-TRL technology commercialization case, based on decades of special material research translated into motion technology for robotics domain. (Kulagin *et al.*, 2022, 2024) The main concept idea was initially developed in a research environment, where technical potential had been demonstrated with small scale demos, but commercial use contexts, customer needs, adoption barriers and business model options were highly uncertain and required a project to advance commercial angle. The case therefore represents an early-stage academic entrepreneurship setting in which technical advancement precedes market clarity. In this case researchers are interpreted to be similar to academic entrepreneurs but not yet working in startup company. Early market validation showed promise of feasible business opportunities which led to project funding. Project length was two years (before, early, mid, late, post phases).

Table 1: Identified stakeholder groups, role, contribution type and project phase estimation during project.

Stakeholder Group	Role in MVP Development	Role in Commercialization	Contribution Type	Project Phases
Core Internal Project Stakeholder Landscape				
Academic entrepreneurs = core project team	Define PoC architecture, run experiments, modelling, integration	Frame value propositions, coordinate stakeholder engagement, business modelling	Technical + orchestration + framing	All phases
Technical researchers / engineers (PhD, MSc, specialists)	Technology design, simulation, control systems, validation	Translate technical features into application-level capabilities	Deep technical knowledge	Before, all phases
University ecosystem actors	Provide infrastructure, labs, procurement, support services	Support IP strategy, commercialization planning, funding alignment	Institutional + support	Early - mid phase
External research partners	Provide domain expertise (MSM materials, coils, modelling)	Increase credibility and validation for external stakeholders	co-development	Early TRL validation
Market-Facing and Validation Stakeholders				
Industrial companies (potential customers / OEMs)	Provide constraints for design such as performance and integration limits	Validate use cases and define application-specific requirements	Contextual validation	Mid phase / post-
Component suppliers (materials, coils, machining)	Enable physical PoC through materials and manufacturing	Define scalability constraints and cost structure	Supply chain + feasibility	Early - mid
System integrators / engineering partners	Help integrate actuator into larger systems	Enable pathway to industrial adoption	Integration capability	Mid late
End-user domain experts (aerospace, medical, robotics)	Provide indirect input through requirements and constraints	Identify high-value niche applications	Application knowledge	Mid phase

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Commercialization and Funding Ecosystem				
Investors	Indirect influence through expectations on proof level	Validate business potential and define funding thresholds	Business validation + capital	Mid - late
External experts / consultants	Provide targeted insights on market, IP, and industry structure	Support positioning and competitive benchmarking	Analytical intelligence	Mid phase
IP service providers	Define invention technical boundaries	Enable protection strategy and white-space positioning	Legal / strategic IP	Early - mid
Funding bodies	Define reporting structure and KPIs	Shape commercialization pathways and expectations	Institutional validation	All phases
Ecosystem and Learning Stakeholders				
Events	Provide exposure to benchmarks and competing solutions	Support market sensing, networking, and positioning refinement	Ecosystem intelligence	Continuous
Internal cross-functional team (business + tech)	Translate PoC into communicable concept	Align technical capability with market narratives	Iterative framing	All phases

The case process involved multiple input channels: internal team discussions, expert statements, university support services, workshops, investor discussions, possible customer and supplier contacts, public events, website-based interest collection, visual concept materials, patent and desk research, and MVP-oriented validation tools such as Lean Startup. These inputs were used to iteratively refine the value proposition and validate commercialization pathways for the novel technology.

4. Findings

Based on literature review and case context following comparison table have been drafted and findings per each identified core observation. These comparisons and findings are preliminary and should be investigated more further and deeply with further studies to increase credibility, currently providing limited perspective on one case study which has limited amount of special skills and team compositions as well as ecosystem and good example of highly novel material deep tech concept and attempt to commercialize it.

Table 2: Literature vs. case comparison & findings interpretation

Literature Expectation	Case Observation	Finding
Academic entrepreneurship involves uncertainty, unclear applications and limited commercialization capability (Grimaldi <i>et al.</i> , 2011; Micol, Leendertse and van Rijnsoever, 2026)	The case started from advanced material-based motion technology with technical promise but unclear commercial use context.	The case supports the literature: technical potential existed before market clarity.
Experimentation helps reduce uncertainty, but resources limit how many paths can be tested (Gans, Stern and Wu, 2019)	The project had to compare possible application domains, customer groups, MVP directions and business model options.	Stakeholder input helped narrow strategic options rather than produce one final answer.
Mentorship and external guidance can improve commercialization decision-making (Agrawal, Gans and Stern, 2020)	University support actors, experts, consultants, investors and ecosystem actors helped interpret commercial direction.	External input supported decision-making when it was connected to specific commercialization choices.
Commercialization is networked and depends on external actors such as customers, suppliers, investors and support organizations (Aarikka-Stenroos, Sandberg and Lehtimäki, 2014)	The case involved technical researchers, university actors, customers/OEMs, suppliers, investors, IP experts, events and support organizations.	The case confirms that early commercialization is distributed across a stakeholder network, not handled only by the academic team.
Stakeholders shape markets, adoption conditions and value-chain formation in	Various stakeholders contributed information about integration limits,	Stakeholder engagement helped translate the technology into

Literature Expectation	Case Observation	Finding
deep-tech settings (Engez and Aarikka-Stenroos, 2023)	supply-chain feasibility, application constraints, credibility and funding best practises.	possible market and value-chain positions.
Stakeholder identification is entrepreneurial action, not only stakeholder listing (Mitchell <i>et al.</i> , 2021)	Different stakeholders had different usefulness depending on timing and ability to provide actionable input for the moment.	The case shows that stakeholder quality matters more than stakeholder quantity.
Lean Startup emphasizes fast validation, but weak hypothesis formation limits learning (Ries, 2011; Felin <i>et al.</i> , 2020)	Low-TRL technology was difficult to present as a simple MVP because customers could not always evaluate the technical potential directly.	MVP learning required prior stakeholder-supported hypothesis formation.
Front-end learning strengthens business model and opportunity development (Bocken and Snihur, 2020b; Shepherd and Gruber, 2021)	Internal framing, workshops, expert input and stakeholder discussions helped convert technical capability into more specific value propositions.	The case supports the idea that stakeholder engagement functions as a front-end learning mechanism before MVP validation.

Based on the findings, clear trait for AEs is not having early defined market opportunity for which stakeholder exposure can be efficient tool or mechanism to bring technical concepts closer to the markets. Secondly, not all stakeholders are relevant to answer all questions and there should be systematic plan to divided certain themes like customer need to specific stakeholders like industrial partners and then technical validation questions to engineering stakeholders to maximize efficient process. Case project received a lot of input and feedback during all stages, from beginning concept was very limited, but by the end picture was formulating strongly and supporting evidence to make further decisions was possible to the level of business plan and possible spinout to specific market areas with specific value propositions. This was possible because of the input that shaped idea along the way, especially angles that emphasized commercial business logic and solving customer pains (from industrial advisory board stakeholders).

Fourth finding was technical oriented and required experimentation to figure out proper communication strategy to explain the benefits and viability of the concepts without having actual product. This included the most intensive knowledge transfer and synthesis from various stakeholders and multiple perspectives to find suitable angles, like power density or low voltage claims benefits. Even here it was hard to find business related logic at first, but eventually via interactions ideas started to formulate. As final findings, stakeholders and MVP building provided enough information to formulate efficient statements like product market fit, and which information needs to be gained / validated for next stages.

4.1 Answers to Research Question and Subquestions

RQ: Iterative & nonlinear stakeholder engagement shapes commercialization learning by turning an uncertain academic technology idea into a more structured commercialization pathway. In the case, stakeholder interaction helped the team refine application domains, identify market entry barriers, clarify value proposition assumptions, interpret technical constraints and adjust MVP/business model logic. Learning occurred through repeated cycles of internal framing, stakeholder exposure, feedback interpretation, technical-commercial translation and reframing.

SQ1: The most useful input was not general interest or opinion-based feedback, but contextual and actionable input. Useful stakeholder input included:

- Technical feasibility constraints
- Application-specific requirements
- Integration and system-level limitations
- Customer problem clarification (why would they buy the product?)
- Adoption barriers
- IP and freedom-to-operate signals
- Supplier and manufacturing feasibility (sourcing issues)
- Investor proof-level expectations
- Business model, earning and value-chain logic

SQ2: The case materials suggests that translation occurred through interpretation rather than direct adoption of feedback. Fragmented stakeholder input was processed through workshops, internal team discussions, expert comparison, desk research and business model tools. The team had to decide whether feedback should be accepted, rejected, parked or converted into a testable assumption.

SQ3: Stakeholder input influenced what should be tested technically and commercially. Technical validation made stakeholder discussions more credible, while stakeholder feedback helped define which technical demonstrations mattered commercially, or what pivot should be prioritized. Business model development was shaped by customer needs, integration requirements, supply-chain feasibility, investor expectations and IP positioning.

SQ4: Stakeholder engagement improves the commercialization pathway when it reduces ambiguity, creates testable assumptions, strengthens evidence for decision-making and helps the team choose the next feasible commercialization step.

Overall, the findings show that stakeholder engagement in low-TRL academic entrepreneurship should not be understood only as market validation. In the case, stakeholders acted as sources of contextual authority, technical-commercial translation, credibility and strategic filtering.

5. Conclusion and Results

Stakeholder validation in the academic entrepreneurship and low TRL MVP settings was examined in this study and how it shapes commercialization process. Starting from technical points and not market opportunity fits well academic setups with research findings and their early steps towards market readiness. To achieve successful ventures, AEs and other stakeholders within universities should pay attention to getting right feedback at a right time to ensure processes efficiency and spinout processes with relevant market product fit approaches and strategies to monetize on the inventions. For this, study has contributed to further identify stakeholders in one research to business process and how each actor contributes in the system towards successful commercialization which makes this attractive study addition to existing literature.

Remarks on the nature of stakeholder interaction is one main factor and how should be used strategically at a right time, to ensure right hypothesis are built with right stakeholders and the next step is targeted, and validation happens with again right stakeholder groups minimizing risks along the way. Quite often ventures fail to deliver proper product market fit with right value propositions either being positioned wrong or developed with non-sustainable fashion and this balancing mix with finding right steps is valuable strategic assets in decision making process for future AEs considering to spinout with their research ideas but lack proper knowledge and require this stakeholder interaction to verify statements.

5.1 Limitations and Future Research Directions

This study has several limitations. First, the analysis is based on a single deep-tech commercialization case, which limits statistical generalizability. The findings should therefore be interpreted as conceptual and processual insights into early commercialization learning rather than as general evidence of commercialization success. Second, the case was analysed during an early commercialization stage, meaning that final market outcomes, such as pilots, licensing, investment or spinout formation, could not yet be assessed. Third, stakeholder input was uneven, as some actors provided more detailed and actionable feedback than others. Researcher proximity to the case may also create interpretive bias, although the use of multiple data sources and comparison with prior literature partly reduces this limitation.

Future research should compare several academic deep-tech commercialization cases across different technology domains, institutional settings and TRL stages. Longitudinal studies would be especially useful for examining whether early stakeholder-driven assumptions later develop into validated pilots, investment decisions, licensing pathways or spinout creation. Further research should also develop clearer criteria for evaluating stakeholder input quality. Relevant criteria may include contextual authority, market relevance, technical relevance, decision impact and the ability to generate testable assumptions. Future work could also turn the proposed process model into a practical tool for supporting MVP, NABC and business model validation in academic commercialization projects.

Ethics Declaration

This study is based on professional discussion stored as project documentation, project reflections, workshops and stakeholder interactions related to an academic deep-tech commercialization case. The empirical material was analyzed at the project and stakeholder-group level, and no personal or sensitive data are reported in the paper.

AI Declaration

Artificial intelligence tools were used for language refinement, including sentence condensation, grammar correction and improvement of readability. AI was not used to interpret interview data, conduct the analysis, or generate the conclusions. All analytical decisions and final interpretations remain the responsibility of the authors.

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