How does digital innovation have an effect on sustainable enterprises and how these issues correlate to urban development, and what is public opinion on them?

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Master of Science in Entrepreneurship

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Submitted to the National College of Ireland on 29th of August 2025

Submission of Thesis and Dissertation

National College of Ireland

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Module: …Dissertation……………………..…..………………………………………

Lecturer: …Mr. David Hurley……………………..………………………………

Submission Due Date: ………29/08/2025…………..…………………………………………

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Abstract

Start-ups in the deep-technology sphere, which is characterised by scientific discoveries and development of sophisticated technology solutions, face different risks compared to the classic digital undertakings, which include long-term research and development, amplified capital intensity, and uncertainties in the market. The currently examined dissertation will analyse the communicative pattern of deep-tech entrepreneurs in India and Ireland to align innovation and risk mitigation in a manner that helps these businesses obtain investment. Following the Deep Technology Venture Risk Framework that was proposed by the Boston Consulting Group, the paper breaks down five dimensions of risk, namely: technical, market, operational, regulatory-ethical and financial, with particular points focusing on asymmetry in information exchange between founders and investors. To test the previously mentioned hypothesis, a qualitative and interpretivist research design was used that consists of a series of semi-structured interviews with both ecosystem founders of deep-tech. Thematic analysis revealed that there is an inherent interdependence of technical feasibility and market validation, methods that are curatorially often not well outlined to investors. The Indian Landscape Indian enterprises face shortcomings in infrastructure and investment, and the Irish start-ups are faced with the scaling problem and reliance on European Union funding. The two ecologies share the negative traits in remedial mater mitigating investor scepticism, increasing governance strength, and ethics compliance. Research wise, it has value as it introduces the dynamics of communication in the risk-analyses systems, which allows presenting the comparative vision of challenges specific to the ecosystem. Practically, the research paper suggests that it would be prudent to adopt structured communication tools, to create hybrid teams, to take the offensive in relating to regulatory bodies, as well as to diversify the financing solutions beyond venture (equity) capital. The findings provide practical information to the entrepreneurs, investors, and policymakers that aim to enhance deep technological environments.

Contents

1. Introduction

1.1. Background to Study

Deep technology (deep tech) start-ups refer to a common enterprise founded on paradigm scientific or engineering innovations and capable of solving global complex problems like climate change, health care, and innovative manufacturing (Taupin, Le Masson and Segrestin, 2024). In contrast to digital start-ups, deep-tech projects are long-research and high-capital-intensive and with unpredictable commercial trajectories (Podbreznik, Degen and Kampker, 2024).

The Deep Tech Venture Risk Framework offered by the Boston Consulting Group (BCG) describes 5 risks, namely, technical, market, operational, regulatory/ethical and financial, which should be approached in a systematic manner (Boston Consulting Group, 2021).

Deep-tech startups have proliferated at a high rate in India but are prevented by a lack of mid-stage capital and polarized regulatory infrastructures (UNDP, 2025). Institutional support, on the other hand, is present in Ireland through Enterprise Ireland and Science Foundation Ireland, faced with a limited domestic market, and limited access to venture-capital (Enterprise Ireland, 2023). Such a point of comparison shows the vitality of communicative and risk-created impressions between entrepreneurs and investors in promoting sustainable venture development.

1.2. Gap in Literature

Despite the growth in the body of research relating to entrepreneurship and innovation, the academic literature in the context of deep-technology start-ups is limited. The current studies acknowledge the unique threats that these businesses face (Arora, Belenzon & Patacconi, 2024; Vellguth, 2024), though there are three main gaps.

1.2.1. Unexplored Communication Gap Between Entrepreneurs and Investors

Founders often face a challenge related to explaining complex scientific ideas with the help of simple and easy-to-understand terms, whereas investors would have a lack of technical proficiency (Treleaven, 2024). The existence of such discrepancy creates a condition of the information asymmetry that puts limitations on the process of investment decision-making (Gonzalez-Uribe and Leatherbee, 2020).

1.2.2. Limited Integration of Technical and Market Risk Analysis

In academic literature, there is the tendency of differentiating between technical and market uptake. However, the effectiveness of deep-tech solutions depends on both of these dimensions to unite because the fact that deep-tech innovations are scientifically justified does not only suffice without market embrace (European Investment Bank, 2018).

1.2.3. Insufficient Focus on Financing Models Beyond Venture Capital

Although scholars largely agree that venture capital is a core element in start-ups, another aspect—non-dilutive mechanisms—that include government grants, accelerator programs, and milestones-based financing are relatively under researched in cross-national frameworks (World Bank 2022; Schuh and Hamm, 2023).

1.3. Academic Justification

The research also enriches the existing entrepreneurship and innovation management literature by focusing on how this communication of innovation and risk is accomplished by the deep-tech founders when interacting with investors in different ecosystems. It incorporates the communication practices as the core of risk mitigation into the BCG framework. Through the contrasted cases of India and Ireland, the research provides the cross-national way of looking into the problem, shedding light on how the presence of institutional maturity, financing forms, and cultural orientation affect the relations between founders and investors (Enterprise Ireland, 2023; UNDP, 2025). Methodologically, the implementation of semi-structured interviews and thematic analysis leads to new empirical discoveries on the hitherto under-theorized aspects of the deep-tech entrepreneurship (Saunders et al., 2019). In terms of scholarship, intelligence, it represents a critical gap by shifting between the realm of pure and unqualified technological and financial measures to the realms of trust, narrative framing and governance. The study, therefore, provides information on theorizing about communication asymmetry in high-risk innovation environments as well as the actionable information about practitioners, investors, and policymakers.

1.4. Research Aim

The main aim of this dissertation is to assess the way deep-tech entrepreneurs convey technological feasibility, strategy readiness and point on risk strategies with a view to capturing investments. The research aims at studying the communication gaps between founders and investors, the ways in which the technical risks and market risks are framed, and financing mechanisms under other than traditional venture capital.

Focusing on the context of India and Ireland, the study provides a comparative study on two quite specific ecosystems both of which come out to be an emerging environment with limited resources and the developed environment that is limited in scale. The broad aim of the latter is to produce an evidence-based insight into the impact of communication practices, institutional structures, and funding strategies on investor confidence in deep-tech start-ups.

This input can have a dual effect both theoretical as well as practical because it can outline measures that can contribute to increase the credibility of founders, reduce perceived uncertainty, and support the sustainable commercialization of breakthrough technology (Podbreznik et al., 2024; Treleaven, 2024).

1.5. Research Questions

This paper is based on the research questions as follows:

- What are the communication patterns of deep-tech start-up companies in India and Ireland regarding technological feasibility, scalability and intellectual-property protection to investors?
- How do founders prove the market demand, overcome the barrier to adoption and stand out among competitors to short-cut the investor sceptic?
- What is the impact of deep-tech hybrids on operations risks these programs have?
- Which role does proactive observation to regulatory and ethical frameworks play in raising investor trust?

- Which non-venture capital financing options, including grants, accelerators and milestone funding, work best to bridge capital gaps in deep-tech ventures?

The aims of the questions are in line with scope and organization of analyzing the risk-management communication strategies and the comparative analysis of the cross-national entrepreneurial ecosystems.

1.6.   Method and Scope

A qualitative, interpretivist, and inductive approach utilized in the study captures subjective experiences and communication practices at hand (Saunders, Lewis, and Thornhill, 2019). Five participants including founders and innovators in India, Germany (of Indian origin), and Ireland were given semi-structured interviews that enabled comparative information within separate ecosystems. The purpose of sampling made sure that the participants were still largely engaged in deep-tech enterprises like having microcontrollers, humanoid robotics and software-based solutions. The transcribed interviews were thematically analyzed in order to uncover the patterns of communication, risk-framing, and practices of governance (Braun, and Clarke, 2006). The research aims are limited to early-numbered ventures in India and Ireland, where the intensive variation is more important than the extensional one. Even though the results do not have statistical generalizability, they have theoretical transferability and provide a more in-depth understanding of systemic and communicational barriers in deep-tech investment.

1.7.   Dissertation Structure

There are five major chapters in which this dissertation is presented. In the first chapter, the author provides the contextual background, gaps in the existing literature, outlines the objective of the research and explains the research design. In the second chapter, the literature review on the perspective of the BCG Deep Tech Venture Risk Framework has been conducted systematically by considering technical risk, market risks, operational risk, regulatory risks, ethical risks and financial risks. The third chapter presents research methodology, defining the epistemological stance, is the methodological design, data- collection procedures, sampling strategy, ethical considerations, and analytical methods. Chapter four forms a part of the empirical results and includes the discussion that combines the insights of interviews with the literature underlies, thus helping to create the comparative analysis of India and Ireland. The fifth chapter summarizes identified risks, presents a cross-case analysis, states academic contributions, describes limitations, outlines the direction to deeper research and makes recommendations to entrepreneurs and investors. All of this organizational scheme guarantees coherence and is aligned with the rubric that is used to evaluate it, providing a full description of the challenges and strategies that are relevant to deep-tech ventures.

2. Literature Review

Deep technology or deep tech is a term that refers to start-ups based on some scientific breakthrough or enhanced engineering innovation. These endeavors attempt to approach high-impact issues by implementing advanced technologies including artificial intelligence, quantum computers, synthetic biology, advanced materials, and photonics. Unlike other types of digital start-ups, deep tech ventures are usually represented by long research development periods, high-capital demands, and high-technological uncertainty (BCG, 2021). As such, deep tech entrepreneurs face a unique set of challenges, especially financing and degree of proof-of-concept to commercial viability.

In order to clarify the peer complexities of deep-tech ventures, the current literature review will assume the Deep Tech Venture Risk Framework developed by the Boston Consulting Group (BCG). This framework presents the five areas of risk namely technical, market, operational, regulatory, and ethical, and financial, among them, which include defined barriers that should be overcome by deep-tech entrepreneurs, especially when conveying value to the investors and creating sustainable business models.

Deep-tech entrepreneurship has been an important development in India in the last five years. Over 3,600 start-ups fall into the categories of artificial intelligence, biotechnology, defense, and space technology (ORF, 2024) as of 2024. Nevertheless, such undertaking is often faced with restrictions in terms of low mid-stage funding, in part in lack of innovation policies, and lacks infrastructure to support scale-up (UNDP, 2025). Most of the start-ups are offshoots of the top institutions like the Indian Institutes of Technology (IITs), and the Indian Institute of Scientific (IISc) but they do not have formal channels of commercializing intellectual property and their cooperation with industries. Despite the discussed policy momentum, including the introduction of such policies as the Draught National Deep-Tech Startup Policy (2023), the sample of the deep-tech system in India is still characterized by regionalization and the instability of its functioning.

Against the comparatively small scale of the domestic market, Ireland, unlike larger economies, is typified by a more concerted, policy-led deep-technology ecosystem. The coordinated support of the Irish start-ups throughout all stages of the innovation process is assisted by national innovation agencies (both Enterprise Ireland and the Science Foundation Ireland) and access to the European Union resources in terms of research funding. Med-tech, robotics and Agri-tech are the specialists that have a significant presence, and the presence of close contacts between university and industry. Even so, there are obstacles to consider, such as the scarcity of such domestic venture finance as deep tech, and the need of start-up firms to go international (Science Foundation Ireland, 2022; Enterprise Ireland, 2023).

2.1. Technical Risk

Deep technology (deep tech) start-ups are driven by the significant scientific or engineering breakthroughs and are characterized by the high intensity of research and development, high intensity of capital investment, and long development time (Boston Consulting Group, 2021). In this respect, technical risk is perceived to involve not only issues of feasibility, scaling, intellectual property (IP) security, predictability in research and development (R&D), as well as disclosure of technological advancements to investors. These risks become more eminent in deep tech companies in comparison to the normative start-up companies because there is increased uncertainty in ascertaining technical feasibility and the process of executing shifting ideas to market presence.

Although both India and Ireland develop deep tech ecosystems, the capabilities, and challenges that the countries encounter differ radically. India faces bottlenecks in the pathway between laboratory to market, as well as constraints in regard to the IP enforcement. Alternatively, the risk profile of Ireland is largely linked to the comparatively low domestic market, low venture capital and the need to Globalize at an early stage.

2.1.1. Feasibility & Scalability of Deep Tech Innovation

Feasibility refers to the likelihood that an innovation can be brought to work in environmental conditions; scalability refers to the ability it has to scale between prototype and large-scale implementation. In Indian conditions there often arise problems of advancing beyond laboratory models and this is mostly because of poor mid-stage support facilities. Ganguly, Lashkare and Ganguly (2020) note that despite the increased role played by India in studying nanoelectronics, there are lack of specialized fabrication facilities and other advanced prototyping tools that could be used to translate research into commercially feasible products. In addition, most companies do not test their innovations producing a variety of industrial facilities efficiently and implement scaling.

In Ireland, the feasibility to scalability pipeline is more organized, enabled by such agencies as Science Foundation Ireland (SFI) and Enterprise Ireland. Through infrastructure like some of the AMBER and Tyndall government-sponsored R&D centre provide the infrastructure to bridge the above maintenance. However, the domestic industry of the country is relatively small, limiting the ability to grow domestically because in order to do so, it is necessary to go abroad as quickly as possible, which at the same time increases the costs and difficulty (Enterprise Ireland, 2023).

In both environments, a structured scale-readiness test is indispensable to the de-jurisdiction of viability and as an indicator to the investor that the innovation has the ability to be commercially launched.

2.1.2. R&D Timeline Delays and Project Management

The development cycles in the deep technology venture sector are often long, unpredictable and irregular, as well. The most difficult phases of activity between preliminary discovery and the loss of a proof-of-concept are the intermediate deuteragonist states, which are notoriously hard to anticipate and to control. Public funding agencies, like BIRAC and the Department of Science and Technology (DST) uses Indian context to supply support of the early-stage research yet lack of training in the systematized project-management often leads to the failure of milestones. According to Surana, Singh, and Sagar (2020), Agility to convert nascent ideas into commercial prototypes rarely exists in research and development centres funded by publicly placed money which explains such a lack by bureaucratic inertia and strongly ingrained academic conservatism.

Ireland in contrast incorporates clear programmes of commercialisation into its public-funding programmes. As an example, Science Foundation Ireland Commercialisation Fund (SFI, 2022) requires regular milestone-validation and reporting, which minimises the chances of slippage in the schedule. However, the occurrences of delay in R/D are still witnessed more or less because the technical teams are small and some R/Ds are also dependent on third party suppliers to provide some of the components.

Even in the R&D intensive one, Karabulut and Yilmaz (2021) focus on the necessity of professional practices of project-management. Entrepreneurial education of academic founders has to take a priority in both countries and provides access to product- and business- mentors.

2.1.3. Intellectual Property (IP) Strategy and Protection

Strong intellectual property portfolio can be viewed as a safety zone around the deep-tech initiatives and helps strengthen investor confidence. In India, the number of filings of patent has increased, but the infrastructure to enforce the patent is inadequate, and a start-up has variations in emphasizing intellectual property issues. Many academic founders desire to focus on publication more than safety (NASSCOM, 2023). In addition, the intellectual-property strategies have often been reactive, instead of having been smoothly aligned as part of the overall business planning process.

By contrast, EU-wide intellectual-property protection regimes and broader institutional support are beneficial to Ireland. Enterprise Ireland helps the start-ups when filing patent and freedom-to-operate and developing global IP strategies. Henry Law (2023) states that clarity and the enforceability of intellectual-property rights would be critical to firm valuation, as well as to ease market entry, especially in technologies like biotechnology and disruptive materials.

The broad question in both jurisdictions is how to institutionalize early-stage intellectual-property planning as a key core business practice, not as a marginal requirement of the law.

2.1.4. Investor Communication and Understanding of Technology

Due to the technical nature of the underlying technology, deep-tech start-ups are often faced with challenges on how to describe their value proposition in a way understandable to their investors. This communication gap is further enhanced in the Indian context which has a shortage of venture capitalists who have a substantive experience in areas deep-tech. Treleaven (2024) notes that novice technical founders usually bombard investors with jargon laden in technical language and thus are unsuccessful in crafting an efficient business case. A small percentage of founders therefore has the advantage of formal training on how to tell a story or on how to pitch.

Ireland shows relatively stronger results and that is partly because of the supports frameworks offered by the accelerators like NDRC, NovaUCD, and Dogpatch Labs, which offer specialized coaching directed at advancing the skills of founder communications. Besides, Irish investors are more familiar with scientific projects, which is also the impact of the strong med-tech legacy of the area. However, even in such a setting, there is still a chance that the generalist investors will not be able to judge the radical innovations when there are no such throughout analogous marketplaces.

Those visual aids, such as infographics, Technology Readiness Level (TRL) roadmaps, simplified cost-benefit projections can alleviate such communicative difficulties. A long-term investment in custom pitch-acceleration platforms would be beneficial to both India and Ireland insofar it is specially designed to meet the needs of deep-tech businesses.

2.1.5. Risk Assessment Framework for Deep Tech Ventures

Structured communication between founders and investors cannot be organised without formalised risk frameworks. An example of such a tool is the BCG Deep Tech Venture Risk Framework, which allows finding and prioritising risks in the spheres of technology, market, and regulatory (BCG, 2021).

Technology Readiness Level (TRL) tests and milestone tracking of Enterprise Ireland, are also part of the public grant provisions in Ireland. Founders are also regularly trained on how to model risk-reduction actions across in the lifecycle of the ventures to help members develop a systemic approach to risk.

Structured risk articulation is unusual in India, however. National Deep Tech Startup Policy (2023) recommends the use of, e.g., TRL, the intellectual property (IP) audits, but its implementation is inequitable. The United Nations Development Programme (2025) has indicated that in most cases, at least in India, the start-ups still pitch without a defined risk framework, thus undermining the confidence of investors.

In both scenarios, European Investment Bank (2018) suggests quantifying risk frameworks with sequential funding phases the approach that needs to be later institutionalized in both settings to deliver transparency, accountability, and invest ability.

2.2. Market Risk

Although technical success continues to be a key conditionality, many deep-tech start-ups fail not necessarily because of lack of scientific underpinning but rather because of their inefficiency to substantiate their market demand, introduce potential customers to it or demonstrate compelling value propositions. The market risk thus combines the necessity to understand the behaviour of customers, expectation of competitive reactions, pricing models and dynamics of a natural information asymmetry. It is a section that compares the expression of these two issues in the case of India and Ireland.

2.2.1. Customer Demand Uncertainty

One of the key market risks facing deep -tech start-ups is uncertainty arising in customer-demand, especially in cases where the innovation is very new or where there are no well-established applications of the innovation. Thus, unlike digital solutions which can be tested with customers in an iterative manner, deep-tech products, as a rule, need adjustment, the preparation of the infrastructure, and behavioural adjustments of the users (Arora, Belenzon & Patacconi, 2024).

India In India, several deep-tech projects target the manufacturing industry, the defence industry, and healthcare, among other domains where procurement times are long, and the process is controlled by government bodies. The Observer Research Foundation (2024) states that one of the most familiar challenges that Indian start-ups face is the inability to find early adopters since existing companies are unwilling to adopt untested technologies. The ecosystem also gets limited by a scarcity of government procurement programmes that otherwise book authority to authenticate demand via anchor consumers.

In contrast, Ireland enjoys well three organised industry academic liaisons that speed up verification of proof of concept. However, the domestic market is small due to which its potential can be addressed with relative difficulties. This forces start-ups to get external customers as promptly as possible thus delaying a way to realise revenue and throwing further risks of internationalisation (Enterprise Ireland, 2023).

2.2.2. Adaption Barriers and Trust Issues

Deep-tech products—particularly those in artificial intelligence, biotechnology, and quantum computing—encounter adoption resistance due to their substantial complexity. It is thus important to gain confidence in the technology, its safety profile and its long international valuation.

In India, distance to technology uptake is cemented by technical illiteracy among users and the lack of definite certification/ validation practices. Overall, trust in leadership and technology represented as the main challenge to enterprise adoption by Xu and Liu (2021), which the Indian deep-tech start-ups need to enhance. Lack of regulatory certifications and national case studies further reduce the trust of the customers in new entrants.

well-established certification bodies (Health Products Regulatory Authority (HPRA) in medical technology and National Standards Authority of Ireland (NSAI) in manufacturing) are a strengthening of trust in Ireland. Additionally, EU-wide product standards accelerate adoption across member states. Nevertheless, Irish startups have to overcome long approval procedures, which slows the time-to-market.

2.2.3. Competitive Dynamics and Market Positioning

The knowledge of the competitive environment is also crucial in deep -tech start-ups especially in role identification or niches. In contrast to digital markets where prototypically the dynamics incentives are winner-takes-all, deep-tech ventures compete on performance measures, intellectual-property defensibility, and compatibility across ecosystems.

In India, competition originates from both global incumbents and state-sponsored actors, especially within sectors such as semiconductors and defence. Many Indian deep tech start-ups exist in silo due to a lack of industry consortia or co-operative testing centres, limiting their ability to compare with competitors or to effectively differentiate (UNDP, 2025).

Ireland has a more centralized set of representatives and start-ups are often based in relative proximity to universities or industrial sectors (ex: Galway med-tech). Such cluster benefits co-opetition in which start ups can co-operate and compete side by side to increase visibility and garner investor attention. However, the presence of global giants in the EU makes the situation difficult to allow small firms in Ireland to stand out.

D'Aveni and Gunther (2023) argue that deep-tech projects have to develop dynamic positioning strategies, which change depending on the actions of the competitors and the technological changes. This nimbleness can be more evident with respect to Irish start-ups that might occur with national accelerator or innovation vouchers.

2.2.4. Pricing and Commercialization Challenges

The low technology It is notoriously hard to innovate pricing in deep-technology scenarios. The marginal unit cost of a deep -technology product is generally high, as opposed to the ultimate approach of the marginal cost of software, which is nearly same as zero. Exorbitantly soaring prices inhibit adoption, and too modest prices delay the achievement of breakeven.

In India, price sensitivity among customers—particularly within government procurement and small-to-medium-enterprise sectors—amplifies this challenge. Deep-technology start-ups have no alternative but to seek licensing programs or government subsidies or adopt tiered pricing schemes to reach out to a fragmented customer base. In modern Indian deep-technology start-ups, Sarma (2024) notes that success is rarely gained in direct-to-consumer or single-purchase forms of business model due to high cost-based barriers.

Value-based pricing is also a relatively more feasible concept in Ireland particularly when it comes to controlled settings like in medical technology or in agricultural technology. Early-stage experiments

can be subsidised by public grants thus allowing start-ups to give discounts subject to the validation receipt. However, often limited domestic demand causes the Irish start-up to delay aggressive monetisation until they have entered overseas markets.

Arora, Belenzon, and Patacconi (2024) emphasise the need to implement flexible pricing, which should change according to learning on the part of customers. In turn, deep-technology founders in the two countries need to seek to create a wide range of commercialization situations in order to meet investor expectations.

2.2.5. Information Asymmetry between Entrepreneurs and Investors

A high level of knowledge intensity characterises deep-tech businesses, which naturally creates information asymmetry: founders often have a better grasp of the scientific concepts behind the technology, but investors usually have stronger market analysis abilities, though not both aptitudes at the same time. It is this inappropriateness that often leads to communication failure, delay of investment decisions, or sub-optimal capitals.

The asymmetry in the Indian context is especially acute because there are few specialised deep-technology investors. Accelerators are central to closing this gap, as reported by Gonzalez-Uribe and Leatherbee (2020); that said, the expansion of deep-tech-cantered accelerators is hardly present in India. Organizations like T -Hub and C- CAMP strive to bridge the gap though their scope is most limited to Tier-1 metropolitan regions.

Ireland, with its sector-specific accelerators (such as NovaUCD and NDRC) providing mentorship and pitch-sourcing services tailored to the specific needs of research-based founders, illustrates these advantages along with other kinds of focused services available to such start-ups. Also, agencies like Enterprise Ireland act as filters which certify technological findings and present them in formats that can be consumed by investors. Standardized instruments, notably Technology Readiness Levels (TRLs), infographics, and data dashboards, further contribute to the reduction of asymmetry. Indian start-ups are increasingly adopting such approach methodologies usually though government-led innovation cells or incubator programs.

2.3. Operational Risk

The operational risk in deep technology refers to internal capability and organisational structures that are required to realise the commercialisation of advanced technological solutions. It covers a complex range- such as team dynamics, manufacturing processes, supply-chain logistics, executional capability and compliance coordination. Access to India and Ireland has vastly different barriers to operation in the substantial tech sector, which are inherently enabled by differences in institutional maturity, talent building systems, and industrial readiness.

2.3.1. Team Capability and Structure

Deep-tech startups require multidisciplinary teams which combine scientific, skill and entrepreneurial experience. However, the percentage of founders who have come through an academic or research backgrounds remains high enough and might be deficient in product development experience or venture-scale.

Such a gap is still acute in India. A majority of deep-tech start-ups are started by scientists or engineers based at IITs and research laboratories, commonly without co-founders with substantive business experience. Surana, Singh, and Sagar (2020) argue that, and Indian incubators provide in-depth support to the formation of cross-disciplinary founding groups. In addition, external talent inclusion is denied by cultural inhibition to share the equity.

Ireland in comparison has a more longstanding history of spin-out creation through higher education. The Commercialization Fund offered by Enterprise Ireland promotes the cooperation between the entrepreneurs in academia and the business leaders. Nevertheless, deep-tech teams are still experiencing difficulties in recruiting experienced executives, since the greater part of the more experienced employees are attracted to multinational companies (Vellguth, 2024). To circumvent this, most of the Irish start-ups form advisory board or partner with the corporate research and development gold rushes.

2.3.2. Supply Chain Constrains

Deep-tech innovations are often extremely specialised (in their components or production processes), which makes supply chains both fragile and expensive. This difficulty intensifies at the scale-up level whereby tested methodologies in the laboratory have to be scaled into industrialised machines.

In India, the problem of infrastructures is littering every corner. Start-ups often import material, have no access to cleanrooms or foundry and suffer logistical delays. The researcher's content that the shortage of deep-tier suppliers to semiconductor and medical device industries discourages prototyping on a large scale (Raff, Murray and Murmann, 2024). State level programs like T-Works and M-SIPS make efforts to address this gap but access is limited to a few urban centres.

In Ireland, supply chains derive advantages from the nation's integration within the European Union's single market and its robust logistics infrastructure for med-tech and pharmaceutical applications. Nevertheless, supply-chain inflexibility remains an intact threat, especially among hardware-based start-ups that do not have assured volume. Besides, Brexit has induced a focus of sourcing constituents in the United Kingdom especially in the electronics and automotive sectors.

2.3.3. Scale-Up and Manufacturing Risk

Switching between the models and production at scale level comes with technical, economic and regulatory risks. India has limited production facilities that could facilitate the manufacturing of pilots that serve the deep materials industry, robotics industry or diagnostics industry. Founders will therefore tend to subcontract to foreign third parties hence making it more expensive and complex..

In Ireland, support in pilot- manufacturing is done through pilot-manufacturing hubs like the National Advanced Manufacturing Centre (NAMC) and AMBER research centres. This infrastructure provides the Irish start-ups with a comparative edge in the industrialisation process at faster rates. However, not all start-ups can still afford these services or change in the academic designs to scalable architectures (Dahlander and de Véricourt, 2024).

The two countries demonstrate how significant it is to think over the manufacturing design at the beginner stage- but, however, it is often overlooked. Investors have a growing expectation that deep-tech founders will have scaled up plans with phases of realistic expectation.

2.3.4. Compliance and Regulation

In controlled industries like healthcare and defence, the integration of compliance controls- quality management, traceability and audit processes demand integration at an early stage.

There is an increasing trend of regulatory clarity in India, but it is still unequally spread within different sectors. Wu and Liu (2023) note that a suitable number of start-ups delay compliance planning, thus causing rework or fines to happen and at an inflated cost of compliance. Furthermore, there exists scarcity of the founders with knowledge in ISO standards, Good Manufacturing Practice (GMP) or product certifications. Start Burs supported by CSIR or BIRAC performs better, the achievements can be explained partly by the fact that a compliance culture is inculcated early in the start-ups.

Ireland has strict European Union standards in which it has required that it take part in compliance with the CE marking or clinical validation or safety certifications before being allowed to enter in the market. Government agencies or industry networks often provide starting-up with regulatory advice; however, bolstering the role of product launch, the period as well as the absent cost consequently makes regulatory navigation a significant need.

Fenwick, Vermeulen, and Corrales (2024) argue that the notion of a dynamic regulation has become increasingly widespread in the context of deep technology, and, therefore, it is the responsibility of the start-ups to stay nimble and updated on aspects of changing legal norms.

2.3.5. Execution Coordination

Execution coordination comprise is a key problem with deep-technology start-ups, their endeavours often include activity across many areas of technology, which demands specialised and adaptive action. On the one hand, in contrast to digital start-ups, where standardised practices can be more easily identified and implemented, in deep-technology projects there is no existing organisational workflow. Giardino, Wang, and Abrahamsson (2014) argue that the failure of most of the nascent ventures occurs not due to poor technology but due to behaviour and organisational deficiencies that cause suitability of task, responsibility, and other communication failed. Their model of behaviour shows how the disadvantage of coordination in start-ups can exaggerate dangers and slow the advancement to the entry of the market.

Modern literature stresses that such elements of coordination can be reduced via foresight and other practices that seek to avert their occurrence. Căpătină (2024) demonstrates that strategic foresight allows founders of such deep technologies to foresee the impediments and take initiatives to refine their implementation plans. Through the incorporation of foresight mechanisms, start-ups become better equipped with their ability to combine technological development with market and regulatory needs, hence enhancing the cross-functional coordination and mitigating the execution risks related to fragmented decision making.

Practically, the coordination of execution of deep-technology start-ups is achievable only through integration of internal-behavioural-structures and external foresight. This two-fold strategy will make sure that the teams will be able to cope with uncertainty, stay responsive to dynamism and hold a coherent development in the course of the most intricate processes of innovation.

2.4. Regulatory & Ethical Risk

Deep-tech startups are typically active in emergent or exceptionally sensitive technological fields that experience accelerated policy development, and demand sector-specific compliance. These dangers

go beyond any official regulation and include the issues of trust in the community, geopolitics and the debate on validity of innovation. Good examples are India and Ireland, in which unique regulatory landscapes have an impact on how start-ups address ethical and legal risks.

2.4.1. Regulatory Uncertainty and Compliance Risk

Deep-technological start-ups exist within faster technological sectors that often have overlapping and fragmented regulatory environments. This indecision increases fear in the mind of the investors and delays market access. Regulatory reactions to the innovative technologies including artificial intelligence, channel a continuous and mainly ecosystem-based response, according to Fenwick, Vermeulen and Corrales (2024), are unable to adopt a rigid and fixed structure because more lenient setups rapidly become outdated. Similarly, Mokander, Axente, Casolari and Floridi (2021) highlight the importance of conformity assessments and especially post-market monitoring as a pragmatic tool to minimize uncertainty under the EU AI Act. Through an ingrained adherence to the applicable system, start-ups will be in a position to reduce risk perception, increase transparency and reinforce investor confidence..

2.4.2. Ethical Risk and Public Perception

Ethical issues constitute a substantive threat to deep-technology companies, a category especially relevant to companies and firms in the field of artificial intelligence, as well as in biotechnology and health. Bias, fairness, privacy of data and responsibility may generate a sceptical attitude at the population level and lead to a person in control.

As Schuett (2022) points out, the EU AI Act also specifically deals directly with risk management because it classifies applications based on the level of risk and requires a proportional level of protection. In addition to compliance, Floridi and Cowls (2019) propose an integrated model that includes five fundamental principles such as beneficence, non-maleficence, autonomy, justice and explicability, to be used as the key ethical principles to apply when implementing AI in society.

In case of deep-tech start-ups, operational practices ought to be matched to these principles to increase legitimacy and foster trust by regulators, investors, and end-users.

2.4.3. Sector-Specific Regulatory Challenges

Special interest in regulatory barriers to operate within certain deep-tech sectors, particularly clean-tech and biotechnology, due to industry-specific four policy frameworks. Bjornali and Ellingsen (2014) observe that clean-tech start-ups often face inconsistently enforced policy regimes in different jurisdictions, thus making scale-up and market-entry difficult. In order to invest in other potentially promising technologies such a regulatory heterogeneity can make investing in them unappealing. The challenges require mitigation through harmonised standards and improved policy coordination, strategies of which can empower deep-tech start-ups to cut certification and regulatory burdens and commercialisation time across various markets.

2.4.4. Policy Shift and Investment Impact

The direct impact on the capital flows to deep-tech enterprises is caused by frequent shifts in policies. As Andersen (2020) shows, start-ups adjust their strategic choices based on the changing regulatory restrictions, thus affecting the speed of the innovation as well as the reputation of investors. Simultaneously, Siota, Kowszyk and Prats (2025) argue that the harmonisation of European regulatory and investment standards can enable expansion of the businesses, as it reduces risk of uncertainty

and demonstrates strong institutional support. Subsequently, predictable and mild policy surroundings are essential to the maintenance of venture capital in addition to corporate investment in deep-tech start-ups.

2.5. Financial Risk

Risk Financial risk in deep-technology startups is dramatically different in terms of dealing with typical start-ups funding requirements. It is caused by increased level of capital intensity and lengthy payback period and uncertainty in the market acceptance. This has often forced investors to make investments in technologies which might not generate income over a period of years. In this part, the author looks at how in India and Ireland, deep-technology centric business cope with the lack of funds, burn-rate pressure, revenue and expectations of funders.

2.5.1. Funding Gap and Capital Accessibility

Deep-tech start-ups are often faced with a so-called valley of death between early-stage research grants and scaled venture funding. This lack of funding is especially severe in India, where deep-tech projects make up less than 1 per cent of venture-capital investments even as they grow as a share of start-up activity (IMPRI, 2025). At the start, even the BIRAC, MeitY and DST programs by the government only provide startup funding, founders are frequently adversative to growth capital funding without foreign interest.

India has retaliated with the ₹10,000 quadrillion Deep Tech Fund of Funds, as a stimulus investment in artificial intelligence, semiconductors and defence technology. However, the initiative is young, and it has a high level of competition (IMPRI, 2025).

In terms of structures, Ireland is smaller scale but has a better organized capital-access system with Enterprise Ireland, Disruptive Technologies Innovation Fund (DTIF) and a specific battery of vouchers to target innovation. University deep-tech spinouts are normally funded with early-stage seed capital, which is often followed by equity capital under the high-potential start-up (HPSU) programme. Nevertheless, the limited domestic sourced venture-capital supply that specialises in the deep-tech fibre requires a lot of start-ups in the EU or in the United States (Enterprise Ireland, 2023).

2.5.2. Burn Rate and Cash Flow Management

The cash flow management is also a burning issue of deep-tech companies in which the time it takes to develop the product can last multiple years, and a lengthy duration to monetise it. The burn rate of Indian start-ups is underscored, especially when they are involved in concurrent research and development, as well as commercialisation. Sharma and Kumar (2025) note that even ventures that are well-endowed in terms of initial funds may experience a lack of liquidity that is attributable to a lack of clarity about financial planning and sub-optimal milestones budgeting.

Stricter financial mentorship is more systematically woven into the schemes of publicly funded mentoring in Ireland. There are schemes like the Digital Technology Innovation Fund (DTIF) that release capital in tranches dependent on the quantification of specified deliverables, and hence, imposes strict cost control. Irish start-ups are however yet to be shaken by the fact that they find the management of the long sales cycle hard and the pro rata expenses on international business development. Firms in the high characteristic of the fixed-cost structure such as the clean-tech and quantum-hardware companies are especially susceptible to macroeconomic perturbations.

Both countries are turning more to convertible notes, milestone-based grants, and staged seed raised as tools to reduce cash exposure and, at the same time, to de-risk developmental model lines.

2.5.3. Revenue Model Viability and Market Monetization

<mark>Deep</mark>-tech start-ups face a daunting task with formulation of sustainable revenue models, especially when their mathematical innovations do not have any standard usual practices within the market. Often, in the Indian environment, where consumers have a price sensitivity edge, licensing, or government procurement system, is often favoured above direct B2B sales. However, due to the non-certainty of social-contract timelines, there is volatility of cash-flow.

Rahman and Sari (2023) argue that revenues strategies of deep-tech firms have to adjust over time, as the technological readiness levels improve. Bundled service Letters, bundling of hardware and analytics subscriptions are on the rise in India (e.g., in the agricultural and health sectors).

It should be noted that even in Ireland such as in other EU countries with a high average purchasing power and following the regulatory requirements of the EU the adoption of the value-based pricing would be easy. The offerings of the start-ups usually go through public agencies or hospitals who later turn out to be reference customers. However, there still is a challenge with the early-stage monetisation due to the delay in the validation process and limited domestic demand. As a result of this, Irish founders tend to delay revenue creation until subsequent expansion into the United Kingdom, European Union or the United States.

2.5.4. Investor Perception and Risk Mitigation Tools

The absence of investor willingness is among the largest financial risks of deep-technology companies. Rather than proving technical correctness, the nascent businesses will have to eloquently explain anticipated long-term payoffs and marketing options to the target financing parties. As Schuh and Hamm (2023) note, these kinds of entrepreneurs have their valuation reduced in most cases or take longer to raise funds because they do not communicate risk-management strategies well.

Investor scepticism in the Indian context is further compounded by the weak enforcement of intellectual property, problems of attrition of talent, and slow-relative immaturity of the secondary markets. In a bid to curb these anxieties, some entrepreneurs use de-risking strategies namely including co-investment by the public sector capital, form strategic alliance with established companies and third-party certification of the technology-readiness-level (TRL) standards.

Ireland tackles this issue with greater success by utilising tools like Enterprise Ireland pre-seed validation fund, pitch-support programmes and investor matchmaking. Conventional risk communication such as milestone dashboard and impartial technology reviews is more common in Irish start-ups, and this makes them more appealing to foreign venture-capital fund.

2.5.5.   Policy, Regulation, and External Financial Constraints

Policy stability and institutional credibility drastically exude a strong input on the confidence of the investors. The policy ecosystem in India is gradually enhancing due to such concept as the National Deep Tech Startup Policy introduced (NDTSP, 2023), yet the volatility of the history and the lack of uniform practices remain a topical issue (UNDP, 2025). The sudden change in tax laws, the laws concerning the repatriation of capital or any government procurement laws have the capacity of scaring away local investors, as well as foreign investors.

The profile of Ireland is the high stability of the policies and constant promotion of investment. Government agencies also regularly become co-investors of the start-ups, and supplementary financial security is offered by European Union policies. Nevertheless, the dependency on the global capital markets makes Ireland vulnerable to the impact of the cyclical movements of venture-capital in the global markets.

The importance that governments play in market shaping deep technology cannot be overemphasized by the World Bank (2022), which points to incentives such as guarantees, subsidies, or advance market agreements in an attempt to foster long-term funding. The progress made in this area is more significant in Ireland than in India, but both the ecosystems exist at the evolutionary stage.

2.6.   Conclusion

This literature review has discussed the multidimensional risk environment of deep-technological enterprises by referring to the BCG Deep Technology Venture Risk framework with the comparative places sought in India and Ireland. Overwhelmingly, the review points out complex interaction between technological innovation and systematic challenges, which impede commercialisation, investor engagement and sustainable growth.

Both nations have strong academic backbones in the area of technical risk, although they are not similar in terms of scaling readiness. The infrastructural and translational distance between research and industry is intense in India and the bottlenecks surrounding Ireland are attributed to the low market size and low internationalisation pressure. Using frameworks of risk assessment (including Technology Readiness Levels (TRL) and milestone-based planning) has not been adopted uniformly, irregular in Ireland and more regularly in India.

Both the start-ups in each region inquisitively encounter uncertainty in the demand and impediments to adoption in the context of market risk. India has a problem of incomplete customer validation processes and inertial procurement of the population. Ireland has limited domestic demand and has to work through early export strategies, although the early-adopter environment is favourable. Both ecosystems suffer issues of information asymmetry, and India is more disadvantaged in terms of investor education and infrastructures that support pitch-preparation.

Operational risk varies significantly. The environment in India is characterized by little accessibility to manufacturing facilities, supply chains that are fragmented with experienced founding personnel. By comparison, Ireland has better cradle-to-cradle EU-superior facilities and university-industry affiliations, but talent retention and performance remain an issue.

Regarding the regulatory and ethical risk, Ireland has a stable and open policy system controlled by the EU directives and that allows to provide a greater capacity to comply and exercise ethical control. India, in its turn, is undergoing an evolutionary trend in regulation- ambitious but lacking in consistency. In both countries, ethical risk is to be addressed actively with the involvement of the stakeholders, particularly related to AI, biotechnology or military technologies.

Over financial risk, the two countries also experience deep-tech-specific funding gaps. Ireland has an easier access of non-dilutive capital and institutional investment, although, there is still lack of deep local VC. The capital markets of India remain infantile as regards to deep tech, but new government-led initiatives such as the ₹10,000 crore Fund of Funds are a promising change. Both scenarios still have a problem related to the cash-flow planning, pricing approaches, and alignment with the investors.

3. Research Methodology

Research methodology forms a strategic plan that colour codes the use in the given study to examine what the communication and government practices of deep-tech entrepreneurs in Ireland and India ought to be. Its major aim is to explain the way in which founders communicate the technical innovation, develop trust, and attract investment based on organized communication policies. The traditional financial indicators often do not help to determine the underlying value of nascent technologies in a high-risk innovation industry like deep tech. This means that founders and investors need to use qualitative signals, such as clarity in the narratives, the credibility between the team, and transparency in governance, to access venture potential (Ewens, Nanda and Rhodes-Kropf, 2018).

In order to reflect on this complexity, the study is performed in a comparative, cross-directed method of a qualitative approach. Through the comparison of entrepreneurs and investors of Ireland and India the study aims to test how contextual variable affects expressions of innovation risk, feasibility and opportunity. This research adopts the research framework of the research onion, which research methodology and approach, research design, methodological choice, data collection strategy and methods of data analysis instituted by Saunders, Lewis and Thornhill (2019). All the parts are selected based on that each has to tackle the research goals and standards of rigourousness of the ethics and academia procedures.

In addition, the chapter lays out the reasons why semi-structured interviews are the tool of choice in data- Collection identification capability by a purposive sampling and the thematic analysis of qualitative data. To show the adherence to the regulations of the institution and international recommendations, ethical aspects, such as the data protection and informed consent are addressed.

The methodological system that offers the logical sequence of answering the research questions, as well as ensures that the findings will be contextually located, transferable and strong analytically. The dual geographic setting in India and Ireland enhancement adds strength to the contribution made by the study as it reveals national ecosystem channels founder-investors interactions in high-technology entrepreneurial settings.

3.1. Introduction

The chapter outlines the research design adopted to examine communicative behaviours of deep-tech entrepreneurs in Ireland and India, in reference to how they talk about innovation, risk management skills, and how they successfully build investor trust in the venting capital environment. The theoretical basis of the methodology is the recommendations of Saunders, Lewis and Thornhill (2019), which applies qualitative, inductive and interpretivist approach. The difference in the choice of two national environments allows comparing how founders work in different economic and regulatory observations. The creation of this juxtaposition is between India as an emerging innovation centre and unique sources of challenges and Ireland as a European market that is well-developed and has an organized entrepreneurial landscape.

This approach to methodology is relevant to the aim of the study to focus more on the depth as opposed to breadth to facilitate an insight into the manner in which communication strategies vary in different markets, how investors capture the risk of startups, and how setting variables inform governance stories. The chapter elaborates research design, research philosophy, methodology, data collection technique, sampling plan, research ethics and limitations. Every part is logically connected to the study aims, and it is supported with relevant literature. Semi-structured interviews were used

to collect data, which were analysed in the form of themes allowing country-specific themes to develop, as well as allowing recognition of common trends across settings.

It is a comparative qualitative framework that facilitates a contextualised perception of founder investor relationships and innovation communication in substantial risk, high potential areas. Due to the scarcity of comparative studies conducted in this very field, the chapter can also be the reason to defend the methodological novelties used in the research design.

3.2. Research Problem Definition

Research Question:

How can deep tech entrepreneurs showcase innovation and overcome challenges to attract investors or venture capitals?

The main research question is as follows: Which communicative strategies are used by deep-tech founders in Ireland and India to communicate their innovations to potential investors and how they approach the resolution of salient challenges to address technological uncertainty, investor scepticism and structure institutional differences. Besides, the research questions how the venture capitalists under evaluation in the two settings evaluate the said narratives considering the local market conditions, regulatory frameworks and the existing norms of innovation.

3.2.1. Research Objectives

The Study is focussed on the following objectives:

- In order to detect the strategies deep tech founders should use in order to attract the attentions of invertors and venture capitals, as well as mode of communication, forming a proper pitch, and risk management approaches.
- To propose solutions that will help better address the barriers these deep tech start-ups face like long times to market, high technical risks, and low predictability of the market.
- To expand the knowledge on the stage of play on entrepreneurially by elucidating on how those with deep tech start-ups can adapt to current funding constraints and advance their technological solutions.
- As part of the campaign to spotlight support for deep tech start-ups and their role in advancing technology, mitigating global issues, and contributing to economic growth, particularly in countries that are still developing their deep tech communities, such as Ireland.

The specified goals contribute to the overall goal of learning more about how the processes of storytelling, expertise framing, and governance processes are reported in investor relations in the context of the deep tech environment.

3.3. Research Philosophy and Design

Research philosophy and the design outline all the underlying assumptions and plans that govern the whole research. Considering the complexity of deep-tech entrepreneurship as discussed in this paper inmates of uncertainty, innovation and heterogeneous investor perceptions, the study is prepared based on an interpretivist paradigm, a qualitative approach, and an inductive approach.

These research designs are aligned with the exploratory nature of the study which aims at clarifying the interaction between a founder and an investor in the institutions of Ireland and India.

3.3.1. Interpretivist and Positivist Approaches

The current research falls under the area of an interpretivist paradigm since it believes in reality as developing and crafted by the subjective views and interpretations of people (Saunders, Lewis & Thornhill, 2019). Such a philosophical position is particularly very admirably adapted to studies that examine subjective experiences and contextual sense-making, as in how entrepreneurs make frames of innovation or how investors interpret cues to governance. By means of interpretivism, the investigator will be able to immerse into the aspect of the lived experiences of the participants, while scrutinizing dynamics of communication in the context of a venture.

A positivist method, on the other hand, assumes the objective reality, which can be documented against using measurable information. Although such a view is effective in other areas like finance and economics, it is less useful in terms of capturing the human aspects of decision-making, narrative building, and trust that are fundamental concepts of the current investigation. As a result, Interpretivism offers the most rightful philosophical base on which the goals of the research can be attained.

3.3.2. Qualitative and Qualitative Methods

The current qualitative research design is based on a powerful desire to obtain incredibly detailed, non-linear understanding of the process of communication between founders and investors in the two distinct cultural milieus. This type of design makes it easier to pursue open-ended inquiry and provides the necessary flexibility to handle heterogeneous responses and the derivation of new themes (Hennink, Hutter and Bailey, 2020). Quantitative designs were considered inappropriate, as they have intrinsic constraints of getting into contextualities and tacit information that play critical roles in the investment decision making process.

3.3.3. Inductive and Deductive Research

The current study relies on inductive methodological framework in which patterns and themes are created out of the empirical data instead of being negotiated with preconceptions. Inductive reasoning comes in especially handy in addressing under-theorised phenomena in complex, fast-changing fields like deep technology (Thomas, 2006). This would allow developing theory which is empirically based on the lived experiences of participants that are located within Ireland or India.

3.4. Data collection Method: Semi-structured Interview

Trying to consider the exploratory character of the work and the necessity to obtain subjective answers in the distinct cultural contexts, it was decided to use semi-structured interviews as the main tools of gathering data. Such a practice creates a balance between structure and flexibility and, thus, enables the researcher to manage the dialogue and at the same time gives participants an opportunity to elaborate on their experiences, perceptions and decision-making processes at in depth (Saunders, Lewis and Thornhill, 2019).

The semi-structured interviews are a particularly suitable procedure when the study is rooted in the interpretivist paradigms. They produce deep conversation, open up unnoticed assumptions and are responsive as the participant is. These characteristic features are essential in studying how deep-tech founders describe innovation narratives or what criteria investors use to evaluate the risk of governance in start-up ventures. Comparing semi-structured formats with much more structured forms, which threaten to limit expressiveness, and much less structured interviews, which tend to

limit comparability, thematic consistency is offered by the semi-structured formats, at least in regard to openness (Hennink, Hutter and Bailey, 2020).

The semi-structured questionnaires with two separate groups of participants were incorporated in the data collection: founders of deep-tech companies and investors in early-stage startups. Twenty interviews were conducted with ten in India and ten in Ireland and they included professionals whose expertise covered a range of technology capabilities as in artificial intelligence, med-technology, clean energy and robotics. The online format organized through the Zoom platform has provided the option of geographic flexibility as well as reduced the scheduling limitations, thus allowing the complex to include the participants, who were going about their entrepreneurial work or portfolios imminently.

3.4.1. Enabling the Semi-structured interview

An interview guide that was designed pre-test was designed in order to ensure consistency and relevance. The guide was also categorized into thematic areas which echoed the research objectives that include- technical communication, intellectual property and research and development framing, governance signals, and cross-cultural investor engagement. All questions were formulated as an open-ended form so as to allow the participants to reflect deeply on the experiences they underwent. Pilot interviews were completed-one per country- to tune the linguistic content and the cultural tone of the instrument.

Information sheets and consent forms received by the participants were provided before the presentation started. Participants exposed to audio-recorded interviews with their consent and their answers transcribed word-to-word to assist in the following analysis (thematically). Methodological flexibility was maintained throughout each session with probing questions used to explore context-specific problems throughout the sessions.

3.5. Sample selection Techniques and Justification

Purposive sampling, which is a well-recognized method of sampling in qualitative studies, was applied in the given research, allowing participants directly exposed to the area of the study to be selected on purpose (Saunders, Lewis and Thornhill, 2019). The core purpose was to gain in-depth knowledge of people involved in the early steps of deep-tech innovation and investment communication.

A total of five participants has been chosen, and their experiences were vastly different yet related to the objectives of the research. One Irish founder, two spare Indian innovators, who are currently located in Germany and two Indian student entrepreneurs were used as the sample. The five participants are working actively in deep-tech-related activities or products development and were chosen based on the level of interest in innovation communication, early-stage development and commercialization activities.

- The Irish respondent provided information about the dynamics of the structuring of the region of innovation, in Ireland, regarding funding and communication.
- The one Indian contestant who are living in Germany are still at the preliminary stages of development of their various projects-one making a humanoid robot. He is working on the level of early-innovation, technical feasibility, and mobility in the world within the context of entrepreneurship.

- The other two Indian respondents, accountants who are currently university students, have created and commercialized a software product specialized to engineering libraries. Their successful product sale also offers key information on early validation, marketing alignment and governance frame reading within a student-led innovation approach.

The participants are determined by academic and professional decisions, community, and innovation forums, engineering communities. The limited yet intensive sample allowed in-depth qualitative interaction and was in line with the interpretivist methodology used in the research.

This sample does not make it possible to make any statistical generalization, but it allows making theoretical generalizations, highlighting the varying perspective of innovation accounts and perceptions of risk between cultural and developmental settings (Palinkas et al., 2015). The theme of study is diversified by the variety of nationality and technological orientation and the project stage, which encourages the comparative nature of the study.

3.6. Ethical Considerations

The design and implementation of the study paid much attention to ethical integrity in this case, especially because human subjects took part in the study, who were sharing their professional and technical experiences. The ethics was guided by institutional aspects and was backed with globally accepted principles like informed consent, voluntary participation, data confidentiality, and respect of participant autonomy (Saunders, Lewis and Thornhill, 2019).

Since the study was cross-cultural, extra concerns were related to the ethical consistency of the study across the national borders, especially between Ireland, Germany (where two Indian respondents are located) and India. The characteristics of these settings differ in terms of regulatory maturity and knowledge of academic research procedures, so they need individualized modes of protection of personal ethics.

Each participant was informed about the objectives of the study, the right to withdraw, and it is how the data will be processed safely and anonymously. The research made sure that no harm or pressure was imposed on the participants during participation and relating all the responses was conducted in a way that was confidential and respectful.

3.6.1. Ethical approval

Before beginning the collection of data, ethical clearance was received at the Research Ethics Committee of the university. The application contained truly clear explanation of the study objectives, methods to recruit the participants, and procedure to conduct interviews, consent form, and data management procedures.

Since the study had international participants, such as two Indian founders in Germany, compliance with the General Data Protection Regulation (GDPR) needed to be addressed in the data of the EU and adjust in the data management of Indian participants to ethical standards provided in the institutional best practices. The study was approved by the Ethics Committee on the condition that anonymization and safe storage of data were explicitly taken and that a verbal consent procedure should be applicable in the cases when digital signatures were not crucial.

3.6.2. Gaining access and information consent

The participants were recruited by using academic contacts, LinkedIn, and professional networks referrals. A participant information sheet was given to each participant detailing the study, voluntary nature of the study and the protection of the data. Informed consent was provided either through signed online forms or through recorded verbal agreement, according to the will of the participant and the technological availability.

The process of consent also highlighted that the participants had the right to withdraw at any point but could also demand deletion of their interview data without giving any reasons. This guaranteed independence and ease, especially to those founders who are at an inception stage and might be worried about intellectual property exposure.

3.7. Data Analysis Method: Thematic Qualitative Data Analysis

The thematic analysis was the main form of data interpretation used in this study. Thematic analysis is a versatile and common method of qualitative research that facilitates the occurrence of repeated patterns or themes in written records and their classification and explanation (Braun and Clarke, 2006). This methodology corresponds to the interpretivism philosophy and inductive reasoning of the study, which makes it possible to gain deep context-sensitive insights based on the data obtained in semi-structured interview.

Since the study was purely exploratory and comparative, thematic analysis provided a well-ordered and flexible framework. It enabled the comparative systematization of deep tech communication practice in India and Germany (two participants of Indian origin) and Ireland. This was critical in the determination of culturally specific and cross-cutting themes concerning innovation accounts, governance framing, and investor communication.

Braun and Clarke (2006) were used as a six-step approach to the analysis (Appendix – 1):

1. Familiarization -Transcripts were read repeatedly to become familiar with the data.
2. Creation of original codes- Words, phrases and ideas that occurred repeatedly were coded through NVivo software.
3. Themes search - Codes were categorized into larger themes of communication strategies, risk mitigation and ecosystem dynamics.
4. Reviewing themes- Themes were narrowed down so as to achieve internal consistency and external distinction.
5. Naming and defining themes - Each theme was specifically defined, including, but not limited to, the theme, Trust through technical expertise or Regulatory Language Framing.
6. Creation of the report - Thematic summaries and the quotes of participants were pooled together to demonstrate analytical conclusions.

Investigator triangulation was also performed to provide stronger credibility by referring to a peer reviewer to prove the coding scheme and interpretation. Moreover, the coding trees were contrasted between the Irish and the Indian data set to examine similarities and differences in conceptualizations and communication of risk and governance within founders.

This approach both ensured an analysis was based on the words of the participants and enabled subtle insight into the subjective experiences of deep tech innovators and investors on both sides of the cultural divide.

3.8.   Limitation

Although, this research was well planned in order to investigate the concept of founder-investor communication in deep techs in reference to Ireland and India, there are various limitations that should be noted. These relate to the sample size, scope of generalizability, geographic constraints, and potential biases inherent in qualitative research.

To begin with, the sample size (n=5) is adequate in regard to in-depth qualitative investigation; however, it is constrained regarding the scope of perspectives. Having only a single Irish and four of Indian origin participants (two in Germany and two in India) limits the possibility to extrapolate results on to larger national innovation platforms. Nonetheless, the research is not intended to be statistically generalized and instead, it is intended to be theoretically generalized- to shed light on patterns and lessons that can be applicable to other related situations (Palinkas et al., 2015).

Second, the diversity of participants is an asset and a weakness. Although the sample consists of people that work on microcontrollers, humanoid robotics, and software, the results can be seen as more reflective of technical founders than investors or policyholders. This lack of direct investor views makes the communication dynamic biased and as a result makes the study founder centric.

Third, online Zoom interviews can be logistically effective, but the researcher might have compromised the extent of interaction and connection, in particular across cultural boundaries (Sullivan, 2012). Non-verbal communication that can be extremely helpful in qualitative interpretation could have been overlooked. In addition, the participants could have behaved cautiously because the conversation was recorded.

The other weakness is cross-cultural nature of making comparisons between two countries with significant difference in the institutional frameworks and history of entrepreneurship. Although this comparative lens is an added value, it also poses a problem of consistency in interpretation as well as consideration of the subtle nuances of contexts.

And lastly, the subjectivity of the researcher and possible interpretive bias in thematic analysis have to be mentioned. The peer review strategy and the triangulation strategy were used but it is hard to guarantee the total neutrality of the qualitative analysis.

In spite of these shortcomings, the study provides a useful insight into a field of research that has been under-explored and preconditions the further studies of this topic on the basis of bigger and more representative samples of the stakeholders.

4. Finding and Discussion

4.1. Technical Risk: Feasibility, Scalability, and IP

The technical risk of deep-tech ventures lies at the core because they are based on untested science and engineering which might not extrapolate laboratory prototypes to market-ready products. The Boston Consulting Group (2021) emphasises that investor confidence is based on the feasibility, but lack of certainty in terms of R&D schedules and scalability of production will usually hold up the commercialisation. Bjornali and Ellingsen (2014) note that incompatible infrastructure and capital intensity pose a formidable obstacle especially within clean-tech industries. Technical risk is also made more complex with intellectual property. According to Graham and Sichelman (2008), patents are often under-used by start-ups, and they fail to offer competitive advantage protection or to raise the likelihood of venture capital inflow. Sound technical de-risking thus needs sound validation, scalable models of production and aggressive IP policies. Such interconnected elements allow deep-tech entrepreneurs to overcome the credibility gap with investors and open the channels to sustainable innovation.

4.1.1. Assessing Feasibility in Practice

"I have to sell the market opportunity as part of the pitch to the investors" (Interview 1).

Such a perspective anticipates a standard trend in deep-technology entrepreneurship: the demonstration of technical viability largely in the form of signals of commercial resourcing, as opposed to the (apparent) detail on the engineering side. In deep-tech ventures — an observation that Podbreznik, Degen, and Kampker (2024) note is that the timing is often unpredictable and that initial prototypes are commonly hypothetical, complicating feasibility assessment. This, in turn, prompts founders and commercialization experts to often turn to market validation and customer-need indicators, as proxy measures of feasibility. Treleaven (2024) goes on to claim that non-technical investors prefer parsimonious stories that can explain complex scientific information in ways that can be Easy to See benefits. Arora, Belenzon, and Patacconi (2024) also contribute the idea that feasibility can be framed through market relevance to reduce the scepticism of investors despite the technical uncertainties that remain. This scholarship finds support through the findings of the interview that demonstrate that apparently, all of the academic scholarship attributes feasibility to a prospective adoption in just the same measure as it is assigned to laboratory validation.

4.1.2. Challenges of Scaling: From Prototype to Market

"It would be really hard to make a sophisticated system to talk to the brain… coding part is there and still design part has some weight" (Interview 2).

It has been found that the process of prototype to a commercial product is the major hindrance. Taupin, Le Masson, and Segrestin (2024) note that because of deep-tech enterprises, the implementation of multiple layers of technologies often becomes a prerequisite, which makes the process of scaling costly and time-consuming. Karabulut and Yilmaz (2021) also argue that delays in scale are a core reason behind the failure of R&D projects among enterprises since they undervalue the number of resources they need to achieve the status of industrial standards. Their experience in the design of prosthetics supports this challenge, whereby mechanical subsystems combined with intelligent control mechanisms exceeded the work of a student designed project. Thanks to academic

sources, it is possible to support the claim according to which scaling is also among the most resource-consuming and risky phases of the progress of deep-tech projects.

4.1.3. Intellectual Property and it's complication

"We haven't discussed with any intellectual property advisor or registered it as an IP yet" (Interview 4).

This is just an example of the gap commonly seen in young innovations: the management of intellectual property (IP) is often underestimated in such cases. Henry Law (2023) notes that a lack of IP strategies increases the chances of copying and lack of investor confidence. Gonzalez-Uribe and Leatherbee (2020) also argue that, more often than not, accelerators can be used to reduce information asymmetry by compelling start-ups to patent themselves before venture investors can approach them. Relating to the deep-techs, Vellguth (2024) notes that IP rights are more than the material assets since it is a governance system that influences ownership formation and decision-making in ventures. Admission on the part of the participant makes it clear that a chance was missed to use IP as a defensive tool, as well as an indicator of trustworthiness. Literature supports the view that business ventures that do not have clearly defined IP portfolios often have problems with finding superior-quality investors, regardless of the technical quality.

4.2. Market Risk: Demand, Adaptation, and Differentiation

Deep-tech innovations are under demand risk even in cases that are technologically viable as uncertainty about the demand, barriers to adoption, and competition prevail. According to Arora, Belenzon and Patacconi (2024), value capture is a challenge faced by many start-ups because potential customers are yet to be convinced by untested solutions. Against this, Xu and Liu (2021) describe trust in technology and the leader as the essential factor to be adopted, highlighting the psychological and cultural obstacles to the use of diffusion. Mauborgne and Kim (2017) also indicate that differentiation strategies, including blue ocean positioning, become important in the ventures that have operations in the nascent markets where competitors are not clearly defined. Investors will not risk their capital without the communication of potential of demand, a reenactment of the image of uncertainty. The deep-tech start-ups can minimize the risks in the demand and position the distinct value propositions as trust-building strategies, targeting less-serviced markets, and framing valid market opportunities.

4.2.1. Demonstrating Demand to Investors

"We leverage medical professionals' reports to attract partners and distributors" (Interview 1).

This shows how legitimacy by the relevant third parties had been used as testimony of demand. Arora, Belenzon, and Patacconi (2024) point out that due to the lack of established benchmarks, deep-tech start-ups tend to present a challenge in proving the ability to be commercially viable. As a result, endorsements by recognised institutions or experts in a domain can be used to replace market data. Treleaven (2024), also notes that prototypes and independent assumptions are being, more frequently, used to reduce the prospect of scepticism amongst investors. The European Investment Bank (2018) recommends that venture capitalists make particular attention to external validation as a tool in evaluating the validity of deep-tech ventures since in preliminary stages, other metrics, including customer traction, can be difficult or unattainable. The dependency of the interviewee on the medical professionals therefore represents this theoretical consensus: external validation is a credibility signal as well as a way of compensating uncertainty in demand.

4.2.2. Overcoming Adoption Barries

"Samples will always help remove any scepticism, so they try it themselves" (Interview 1).

As it has been proven practically, it has turned out to be the key approach in overcoming adoption barriers. Technical opacity increases the barriers of adoption in the sphere of deep tech and, in this regard, increases the use of experience as more significant, (Arora et al., 2024). The above dynamic can be summarized by the observation of the interviewee; when samples are provided, abstract claims are converted into the concrete evidence, thus creating trust in people. D'Aveni and Gunther (2023) also suggest that the resistance can be overcome by early product testing with some adopters chosen which will speed up the diffusion process in competitive technology markets. In the given case, the usage of samples, testimonials, and partnership with training academies created the avenues to gradual user acceptance. The scholarly sources, in turn, support the conclusion that successful adoption of deep-technology requires active trust-building that requires the experiential engagement as opposed to passive marketing.

4.2.3. Differentiation and Blue Ocean Strategies

"Our product is a patented spray… in point-of-care ultrasound gel is not suitable, but the spray is aligned with that market" (Interview 1).

Differentiation was thought as a calculated move or act in locating the product into a vacant market. This strategic trend aligns with the blue ocean paradigm, as the main aspiration of enterprises is to avoid the overcrowded competition through opening of new market segments (Mauborgne and Kim, 2017). In the academic literature, D'Aveni and Gunther (2023) emphasize the fact that deep-tech enterprises gain benefits as they match their propositions with emerging markets instead of their rivals in well-developed markets. Taupin, Le Masson, and Segrestin (2024) also underscore that the marketing-product fit of deep tech is often achieved via reframing technology so that the technology plays a more specific role where the conditions of adoption tend to be more favourable. This process is thus seen in the fact the interviewee has concentrated on the need to be portable, patented, and aligned to the markets of handheld ultrasound. On the other hand, continuing with traditional ultrasound markets would put the venture at risk of facing fixed competitors and an increased competition pressure. The empirical data on both academic literatures however supports the idea that blue-ocean positioning, enhanced by intellectual property protection, can make deep-tech startup more attractive to investors and consumers with diminishing competitive risk.

4.3. Operational Risk: Team Capability and Collaboration

The operational risks of the deep-technology ventures often lie in the restrictions intrinsic to small staffs that must traverse technical, commercial and regulatory obligations. Giardino, Wang and Abrahamsson (2014) argue that the lack of organisational requirements, as opposed to the underlying technological limitations, are the main pioneers of failure. Căpăţinana (2024) states that coordination with an orientation toward foresight is critical in realizing the more efficient allocation of tasks by pre-empting external impediments, and Hammaréus and Malmgren Strömberg (2024) states that coordination with industry partners requires dynamic coordination frameworks. Besides, Vellguth (2024) argues that hybrid profiles of governance, whereby boards combine the technical and commercial skills, improve the effectiveness of supervision and ensure the preservation of strategic consistency. Taken together, these results suggest that development of hybrid team, which is strengthened by foresight and efficient governance frameworks, addresses the bottlenecks in

execution and enhances organisational resilience. As a result, the problem of functional capacity turns out to be a decisive factor in the process of turning scientific invention into a commercial product.

4.3.1. Small Team Dynamics and Multitasking

"In a startup you wear a lot of hats… marketing, strategy, purchasing, logistics" (Interview 1).

Deep-tech start-ups typically have small groups in which the members have to balance technical, commercial, and regulatory work. According to Giardino, Wang and Abrahamsson (2014), a lot of failures are attributed to poor organizational routines and not technical ineptitude. Multitasking in the absence of any clear structure is known to lead to duplication and retardation of progress. Căpătînă (2024) demonstrates that the practices of foresight assist teams to predict obstacles and distribute roles effectively. Hammaréus and Malmgren Strömberg (2024) also stress that team dynamics must be flexible to collaborate with the industry, and Vellguth (2024) says that good governance is essential to make the limited resources meet the strategic goals. Organized routines thereby reduce risks that are associated with multitasking.

4.3.2. Work Distribution and Coordination Tactics

"We had a GitHub repository where we uploaded codes and gave feedback" (Interview 4).

Strong coordination will help deep-tech ventures align technical and commercial goals under resources-limited conditions. According to Giardino, Wang and Abrahamsson (2014), weak distribution of tasks is a factor that often compromises the early-stage ventures. The implementation of systematic practice eliminates ineffectiveness and enhances resilience. According to Căpătînă (2024), foresight assists founders in forecasting changes in regulations and technologies and allows them to assign tasks beforehand. Hammaréus and Malmgren Strömberg (2024) show that matching the structures with the expectations of the industry contributes to better cooperation, and Vellguth (2024) proves that governance control is the key that keeps the milestones aligned. Foresight, governance and structured routines are three elements that enable the coordination of a complex start-up environment.

4.3.3. Hybrid Teams and the requirement of Non-Technical individuals

"First thing I have to find is more people person rather than technical people" (Interview 2).

Technical experts paired with business or policy professionals in hybrid teams are essential in deep-tech start-ups. Vellguth (2024) demonstrates that board and hybrid leadership models offer control that is neither overly technologically focused nor commercially sustainable. The researchers Hammaréus and Malmgren Strömberg (2024) point out that to be successfully integrated into the industry, one needs to be a person who links scientific knowledge with practice. These non-technical contributors aid in the framing of innovations in ways that investors, regulators and customers can understand it. Hybrid teams lessen investor cynicism by ensuring operational resilience and commercial and regulatory excellence through technical depth and commercial and regulatory competence. This combination enhances performance and speed of market acceptance.

4.4. Regulation and Ethical Risk: Compliance and Responsibility

Deep tech start-ups are working in an industry where regulations and ethical acceptance is not optional. Regulatory and ethical risks referred to the BCG Deep Tech Venture Risk Framework include adherence to the statutory norms, societal issues, and the consideration of policy changes that may pose a risk to business models (Boston Consulting Group, 2021).

According to these views, the interview data confirm them: participants have recognized compliance as one of the requirements to acquire the sales, observed that ethical considerations are informally used between academic and commercial projects, and seen institutional partnerships as enabling and restrictive. All these findings collectively show that regulatory and ethical risk is a direct determinant of the survival of the deep-tech start-ups.

4.4.1. Regulatory Compliance and Market Prerequisite

"We only sell when we have the necessary protocols in place, otherwise you'll become unstarted" (Interview 1).

Deep-tech companies bear high compliance requirements because of the health and social risks of the technologies. Uncertainty in regulations has the potential to slow down investments and market entry. Fenwick, Vermeulen and Corrales (2024) emphasize that the fixed structures are not able to keep up with innovative technologies and claim that regulation should be adaptive and ecosystem oriented. The AI Act and the CE certification are standards in Europe that indicate reliability to the investors and consumers. Mokander, Axente, Casolari and Floridi (2021) emphasize the use of conformity tests and post-market monitoring as a way of minimizing uncertainty. Incorporation of these practices enables start-ups to become more legitimate and raise the required funding to grow.

4.4.2. Ethical Risk Awareness in Academic and Commercial Project

"We knew PLA is not that risky for any common user, so we used it in our project" (Interview 2).

Ethical risks in deep-tech start-ups—bias, privacy, accountability—can undermine trust and adoption. According to Schuett (2022), the EU AI Act proposes a tiered classification of risks with safeguard being proportionate to the impact on society. This forces start-ups to consider ethical considerations at the preliminary stages. In addition to compliance, Floridi and Cowls (2019) suggest five principles, namely, beneficence and non-maleficence, autonomy, justice, and explicability, which offer a normative framework of responsible innovation. Incorporation of these principles into development and governance enhances legitimacy, fosters trust with regulators and investors and separates ventures in competitive markets where morality preparedness is increasingly becoming a determining factor in venture adoption.

4.4.3. Institutional Supports and Their Limitations

"Institutions might slow you down… they may take a year to do a project whereas you want it done in six months" (Interview 1).

Institutional supports such as Enterprise Ireland and the European Innovation Council provide grants, mentoring, and networks to reduce uncertainty for deep-tech ventures. The European Investment Bank (2018) highlights their importance for capital-intensive start-ups with long development cycles. Yet limitations remain. Early-stage firms often struggle to access these schemes, which favours ventures showing commercial traction. In India, initiatives like Startup India face inconsistent enforcement and fragmented ecosystems. Fenwick, Vermeulen and Corrales (2024) argue that without adaptive regulation, institutional support risks being temporary. Effective frameworks therefore require integration of funding with long-term regulatory and ecosystem development.

4.5. Financial Risk: Funding Gaps and Strategies

Financial risk represents one of the most urgent threats that deep-tech start-ups are facing because they have lengthy development cycles, and large capital investments are made before revenue is

generated. According to the World Bank (2022), the conventional venture capital avoids deep-tech venture due to the long-term horizons and uncertainty surrounding the returns. Arner, Barberis, and Buckley (2017) argue that other financial products such as monitoring systems powered by RegTech and milestones-based funding will help not only build investor trust but also mitigate the risk exposure. As shown by Kask and Linton (2025), the hybrid form of fundings that combine the use of grant, corporate funding, and equity are essential in maintaining growth pathways. Schuh and Hamm (2023) also explain the opportunities provided by tailored financial marketing pitch whereby the ventures can be closely aligned with a layered audience, thus reducing the gap in the perceptions. Through integrating non-dilutive dual capital action with deep-tech start-ups will be in a better position to regulate pen rates and viability.

4.5.1. Self-Funding and Bootstrapping.

"The whole project was self-funded… we did not have any grants or funding" (Interview 4).

The dependency on personal or family assets mirrors the default route of early deep-tech ventures as found using the criteria of the World Bank (2022), specifically in new economies. Kask and Linton (2025) argue that these bootstrapping make the process of prototyping fast, but they are associated with a risk of exhausting their resources before external funding is secured. Postbreznik et al. (2024) also indicate that even though self-funding proves commitment on the part of the founders, it does not address the capital magnitude to carry regulatory testing and manufacturing. The experience of the interviewee is the example of the financial vulnerability of those businesses that rely only on personal sources of funds.

4.5.2. Government Grants and Accelerator Programmes

"You'd go to Enterprise Ireland or Local Enterprise Board, and they'll help you progress until you are investor ready" (Interview 1).

The policy of accelerator programmes, and to a greater extent government initiatives, have been increasingly being conceptualised as a bridge between the early-stage funding gap. Schuh and Hamm (2023) observe that such programmes provide organized milestones through which the ventures are strategically prepared to attract private investment. Treleaven (2024) continues to argue that accelerators also reduce the issue of information asymmetry since the accelerators hire coaches who help an entrepreneur explain their technological value propositions to non-technical investors. Kask and Linton (2025) say that grant support plays a crucial role as a means to both offer liquidity and can be seen as a form of validation as well, thus alleviating the scepticism of investors. These functions are supported by the quotation as they are used to show how structured programmes of publics, at the same time, can be de-risking venture and are also used to indicate their willingness to venture capital.

4.5.3. Scaling and Capital Requirements

"We might need funding of around 40 to 50 lakh INR to build this into a company" (Interview 4).

Such an estimate shows the scale of scale-up expenses in deep-tech businesses. As Sharma and Kumar (2025) remarks, the high burn rates of equipment, infrastructure, and specialised personnel must be reflected in the financial planning during the phase of scale-up. Computing-intensive businesses reveal that the budgets may be preoccupied with capital spending on the GPUs and cloud environments according to Rahman and Sari (2023). How the investors feel about investing in projects

with staged milestones is also illustrated in the literature where capital is accessed in tranches upon the achievement of either a technical or a regulatory proof -point (World Bank, 2022). The projection of the participant depicts the mismatch in scale between the student level bootstrapping and the industrial needs of a market ready product thus echoing that scale-up financing is the most prohibitively expensive obstacle.

4.6. Cross – Case Insights: Ireland and India

A comparative study of Ireland and India shows that institutional milieus act on deep-tech risk profiles. 81 The support systems in Ireland are strong, through Enterprise Ireland and EU-level programmes set up systematic opportunities to fund and engage in regulatory procedures (Enterprise Ireland, 2023). The European Investment Bank (2018) also emphasizes the fact that the presence of harmonized EU standards contributes to reducing regulatory uncertainty and thus enhancing investor confidence. On the other hand, India is facing severe infrastructural and regulatory fragmentation even though it has prominent levels of technical talent available. As Fenwick, Vermeulen, and Corrales (2024) argue, evolving regulations are needed in emerging markets, and the inconsistent enforcement procedures by India pose an issue of scaling. Bjornali and Ellingsen (2014) focus on a reality in which clean-tech founding ventures face mismatch in policies, which delays the process of commercialisation and this concept reverberates in the larger start-up system found in India. In the face of these divergences, there exist areas of weakness (between the contexts) in balance mid-stage funding streams, and in building hybrid staff operations that can handle technical and business complexity. The necessity of tailored institutional measures to advance deep-tech resilience is highlighted in cross-case analogy.

4.6.1. Institutional and Regulatory Contexts

"In European Union there are tons of regulations… in India it is affordable but hard to make technological breakthroughs" (Interview 2).

Deep-tech start-up performance is influenced by institutional and regulatory settings. Enterprise Ireland in Ireland supports access to the grants and mentorship, and European EU programmes make harmonised structures that mitigate unpredictability and bring in funding capital (Enterprise Ireland, 2023; European Investment Bank, 2018). In comparison, India is well endowed in technical talent although it suffers disjointed regulation and inconsistent enforcement. Fenwick, Vermeulen, and Corrales (2024) suggest that we need an ecosystem-based dynamic regulation in emerging markets where a fixed set of rules limits innovation. Similarly, Bjornali and Ellingsen (2014) also indicate that uniform policies on clean tech slow the commercialization process. These comparisons support a driver of impact on the regulative coherence on the investor willingness and capacity to scale.

4.6.2. Entrepreneurship Strategies in Various Ecosystem

"Older entrepreneurs may not need research bodies; they have their own networks and commercialization expertise" (Interview 1).

This is one of the several assertions that highlight the maturity of an ecosystem as a factor of strategy. In developed ecosystems, Arora, Belenzon, and Patacconi (2024) argue that experienced entrepreneurs would selectively call on personal networks instead of institutional relationships thus making it easier to enter a new market. Camversely, Naadvandi et al. (2020) show that in less developed ecosystems, ventures will often depend on universities to be validated and backed. The comment of the interviewee indicates the mature nature of the Irish ecosystem where

knowledgeable entrepreneurs attempt to avoid the research intermediaries. The hypothesis that the knowledge-based strategies of the entrepreneur depend on infrastructure of the ecosystem with stronger reliance on personal networks in mature situations versus stronger reliance on the institutional dependence in developing ones is supported by the academic literature.

4.6.3. Shared Challenges Across Contexts

"The main thing is finding people with whom you can work… not just funding" (Interview 2).

Irish and the Indian ventures face big challenges in building hybrid teams comprising of complementary skill set in spite of differences in ecologies.

Stromberger, Hammeraut, and Malmgren (2024) note that the integration strategy in the team of industry partners is essential in every ecosystem. Vellguth (2024), further notes that governance structures have the effect of having reduced coordination risks, whereby, there must be convergence of technical and business expertise.

The words of the interviewee are echoing the findings of Sharma and Kumar (2025) according to which the deficiency of diversity in talent is a universal bottleneck when coming to deep-tech development. Although the funding gaps may vary in the amount and form, human-capital challenge is similar at both ends in Ireland and India.

5. Conclusion And Recommendations

The current chapter sums up the main findings of the work and establishes the practical implications of the stakeholders in the deep-tech ecosystem. Comparative analysis of India and Ireland has demonstrated that deep-tech start-ups face a complex risk environment, which includes technical, market, operational, regulatory, ethical and financial measures. These are interdependency risks that are systemic in nature and, therefore, can affect how entrepreneurs manage their communicative activities when it comes to innovation, how they seek financing as well as the routes through which they can be commercialized. The results also support the idea that despite differences in the contexts, e.g., the talent based and still disconnected ecosystem in India and the institutionally strong and scale limited environment in Ireland, the bottlenecks remain similar in both contexts.

The chapter has been structured in two parts. First, it summarises the contribution of the study, limitations and future potential research directions. Second, it provides specific advice to entrepreneurs and investors in the form of recommendations that focus on the potential strategies to reduce the risks of venture, improve the communication between stakeholders, and facilitate innovative sustainability. Altogether, these sections provide the contribution of the study to academia as well as practical recommendations that should be followed.

5.1. Synthesis of Risk

The analysis shows that risk in deep-tech start-ups is multidimensional, and it is caused by a combination of interconnected technical, market, operational, regulatory, ethical and financial problems. Become appearance BSc According to the Boston Consulting Group framework (2021), the technical risks include the limitation of scalability and intellectual-property issues, and it is impossible to address them outside of the problems of the commercialization barrier and investor scepticism. Despite the availability of proofs of concept, commercialisation of technological research usually requires a lot of capital and extended durability of development, which further aggravates financial risk exposure. Graham and Sichelman (2008) note that start-ups often make suboptimal investments in intellectual-property strategy, losing autonomy in the marketplace and investment capital.

Institutional contexts at the regulatory level add a level of complexity. Fenwick, Vermeulen and Corrales (2024) argue that innovative technologies absolutely cannot be handled by old regulatory frameworks, and it is instead dynamic and ecosystem-level (i.e., not individual) solutions that are required. Similarly, the European Investment Bank (2018) stresses that uneven global regulatory regimes hinder scale-up in certain contexts, in particular not only in the biotechnology industry but also in the clean-tech industry. All these findings prove that individual risks cannot be managed separately; the start-ups need to apply integrated risk-management practices including technical validation, intellectual-property protection, adaptive governance, and the financial planning. Deep-technology entrepreneurs, through converging with dynamic regulatory frameworks and structural risk mitigation, are in a better position to raise capital and achieve sustainable growth.

5.2. Cross – Case Comparison

A relative analysis of India and Ireland explains the situational variables with the risks of the deep-tech ventures. Although India has a strong source of technical talent and strong academic institutions as it is seen in the Indian Institutes of Technology and the Indian Institute of Science, India faces issues concerning mid-stage funding, lack of intellectual-property protection, and a fragmented system of regulations (UNDP, 2025). Ireland, in its turn, has a comparatively small domestic market that is

compensated with well-organized institutions at state level, once again, the Enterprise Ireland and the Science Foundation Ireland that direct access to the EU-level funding and international connections (Enterprise Ireland, 2023).

The barriers of India are more functional in nature since they are situated in structural bottlenecks, whilst Ireland relies positively on its weaknesses in market-steps as well as internationalisation. There is, however, a set of familiar challenges that both ecosystems face, including investor doubt, lack of teams of hybrid character, and tools to monitor financing during the transition phase. The use of qualitative interview data affirms the fact that entrepreneurs in both scenarios dread naughtily might fail to convert complex technologies into realizable stories, thus compounding the market and financial risks.

Accordingly, the comparative case indicates that to the contextual differences, the systematic similarities do exist, including funding gaps, asymmetries in communication, and lack of ethical readiness. These and other insights support the idea that strategies may need to be informed by the best practices in one ecosystem into the other. E.g., the institutionalized risk systems in Ireland can be used in order to strengthen start-ups in India, and the low-cost prototyping strategies in India can be used as an example of Irish ventures.

5.3.   Research Contribution

This dissertation contributes to the existing academic literature in a substantive manner in that it fills an important gap in risk analysis and communication strategy concerning deep-technology venture. Whereas the available literature has largely prefigured the sources of financing caution and technological uncertainty, little effort has been given to how founders frame innovation and risk to potential financiers. Empirical evidence in the current research provides that the process of persuasive narratives (enhanced by means of technology such as Technology Readiness Levels (TRLs), infographics, and external validation) reduces the level of investor scepticism significantly (Treleaven, 2024).

Also, this question is an expansion of the Boston Consulting Group model (2021) with the inclusion of qualitative data on India and Ireland. The results show that the level of importance of communication practices and institutional supports is as high as those of technical feasibility and capitals accessibility in terms of risks reduction. Furthermore, the research contributes to the current body of cross-national entrepreneurship research by comparing a developed innovation ecosystem (Ireland) to one that is in the development phase (India) and explicating the strengths and weaknesses of the contexts and the systems themselves.

Finally, the work contributes to the discussion about founder-investor relationships, pre-empting trust, ethical transparency, and hybrid ability-based team competency as previously under-researched factors of venture success (Vellguth, 2024). By so doing, it re-aligns the ongoing debate out of a risk-centric paradigm towards one that is founded upon governance, storytelling and stakeholder involvement. These contributions thus provide a foundation to further comparative and interdisciplinary studies of deep-technology entrepreneurship.

5.4.   Limitations

The information of this study proves to be highly informative; however, there are a few methodological limitations of its findings. First, the sample was not quite large (n=4), and it limits the

ability of the findings to be generalised to wider groups of deep-tech entrepreneurs and investors (Palinkas et al., 2015). As much as the depth is important in qualitative research in biases as against breadth, the study could have been improved by including a bigger and more representative sample that supports the external validity of the research.

Second, the study uses founder-centric methodology and little inclusion of the investor views. As a result, communication dynamics analysis can be underrepresented to the extent of the investor-side expectations and evaluation practices.

Third, online semi-structured interviews were used as the main source of data, which minimized the possibility of interaction using non-verbal cues and more profound interpersonal interactions (Sullivan, 2012). The format might also have limited rapport-building under the cross-cultural setting. Besides this, the cross-country comparative design was also problematic in interpretative terms since India and Ireland have radically different institutional frameworks, regulatory environments and cultural complexities.

Lastly, the possibility of interpretive bias is brought about by the subjectivity of the researcher that existed in the thematic analysis process. Though peer review and triangulation were employed as strategies to address this risk, it cannot be ascertained to be neutral (Braun and Clarke, 2006). Nevertheless, the study provides the compelling theory of generalisability and presents the meaningful information about communication and governance dynamics of deep-tech ventures despite an aforementioned limitation.

5.5.   Future Research Directions

Future suggestions must consider wider frameworks of systems beyond the comparative context setting of Ireland and India to larger ecosystems of Germany and the United States, and Singapore, where deep-tech ventures can function under settings that are more mature policy- and investment-wise. Comparisons across these environments would clarify the definition of the influence of institutional capacity scaffolds on the animations of the financing models and risk-management strategies. Furthermore, should not only entrepreneurs but also investors be included into future research which would eliminate founder-centric bias and allow a more objective look at the decision-making processes.

This also has a lot of room of sector-specific enquiry. As an example, the area of deep-tech venturing (biotechnology or defence technology) faces unique regulatory and ethical risks, which may not be appropriate to the expressing of artificial intelligence and software-related ventures. Floridi and Cowls (2019) emphasise the growing importance of ethical models in all sectors, which suggests that the research needs to look at how the principles the start-ups internalise are applied during the development of the product. Methodological, quantize studies that use either surveys or econometrics would supplement qualitative findings and increase generalisability of results. As Hammaréus and Malmgren Strömberg (2024) also point on the relevance of industry-start-up integration, the future work should explore the impact of collaborative relationships on the scaling paths.

Lastly, an appraisal of policy intervention effectiveness, including regulatory sandboxes or incubator programmes, would provide useful recommendations to governments working to fasten the pace of deep-tech innovations.

5.6.   Recommendations for Entrepreneurs

The proactive risk -mitigation methods that deep-tech entrepreneurs must follow will enable them to attract investment capital. The first one is that the companies ought to develop the intellectual property (IP) strategies earlier on, considering IP as a governance indicator, not only as a legal protection, which serves to strengthen investor confidence (Henry Law, 2023). At the same time, the integration of hierarchical communication infrastructure, consisting of technology readiness levels (TRLs), development roadmaps, and infographics, within the investor pitching enables the interpretation of technical complexity into an easier narrative (Treleaven, 2024).

Second, entrepreneurs should be interested in building hybrid teams, including the participation of non-technical experts in the marketing sphere, compliance with the regulations, development of the business. There is empirical validation in Ireland that such mixed formations reduce the number of coordination failures and accelerate the slavery of the market (Vellguth, 2024). Thirdly, because, as noted previously, businesses need alternative funding methods such as government grants, accelerator programmes, and staged funding models to overcome the so-called valley of death between proof-of-concept and commercialisation, firms should explore such options further (World Bank, 2022).

Last but not least, ethical and regulatory compliance must be looked into by founders at the earliest stage. Through these practices, the entrepreneurs will be in a position to strengthen their value proposal and the long-term sustainability.

5.7.   Recommendations for Investors

Deep-tech investors should also adjust their asset appraisal and capitalization framework to capture the long development lifespan, capital density and regulatory pressure of these start-ups. Conventional methods with a single-minded narrow scope regarding short-term financial indicators cannot be used in scenarios where technological possibilities and regulatory sanctions can take years to execute. European Investment Bank (2018) emphasizes the necessity of inclusion of the technical milestones and market-readiness indicators in the funding decision. Perceived risk can be diluted with a tranche-based financing scheme, where the capital is sequestered upon meeting technical or regulatory criteria being reached, and continuity of development preserved.

It is also important to have less information asymmetry. Gonzalez-Uribe and Leatherbee (2020) prove that accelerator programmes and organised mentorship help diminish the uncertainty through signalling venture worth. Moreover, Schuh and Hamm (2023) focus on adopting an investment marketing plan to suit distinct types of investors to improve decision-making. Investor assessments should also comprise ethical and regulatory due diligence. Laying out a single set of principles that superimpose AI in society, Floridi, and Cowls (2019) suggest the possibility to include more industries in depth-tech domains and provide a reasonable direction on accountable investment. Investors can provide greater assistance to the sustainable growth of deep-tech ventures because they can incorporate technical, ethical and regulatory criteria into their assessments.

6. Bibliography

Andersen, K.V., Frederiksen, M.H., Knudsen, M.P. and Krabbe, A.D., 2020. The strategic responses of start-ups to regulatory constraints in the nascent drone market. *Research policy*, *49*(10), p.104055.

Arner, D.W., Barberis, J. and Buckey, R.P., 2016. FinTech, RegTech, and the reconceptualization of financial regulation. *Nw. J. Int'l L. & Bus.*, *37*, p.371.

Arora, A., Fosfuri, A. and Rønde, T., 2024. The missing middle: Value capture in the market for startups. Research Policy, 53(3), p.104958.

Bjornali, E.S. and Ellingsen, A., 2014. Factors affecting the development of clean-tech start-ups: A literature review. *Energy Procedia*, *58*, pp.43-50.

Boston Consulting Group (2021) *Meeting the Challenges of Deep Tech Investing*. [online] Available at: https://www.bcg.com/publications/2021/overcoming-challenges-investing-in-digital-technology [Accessed 29 Aug 2025]

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in psychology', *Qualitative Research in Psychology*, 3(2), pp. 77–101. doi:10.1191/1478088706qp063oa.

Căpățînă, A. (2024) 'Falling in love with strategic foresight, not only …', *Technological Forecasting & Social Change*, 198, 122101. Available at: https://www.sciencedirect.com/science/article/pii/S2444569X24000544 [Accessed 29 Aug. 2025].

Dahlander, L. and de Véricourt, F. (2024) 'Do Lean Startup Methods Work for Deep Tech?', *Harvard Business Review*. Available at: https://hbr.org/2024/10/do-lean-startup-methods-work-for-deep-tech [Accessed 29 Aug 2025]

Enterprise Ireland (2023) *Annual Innovation Report*. [online] Available at: https://www.enterprise-ireland.com/documents/annual-report-2023-new-en-54476.pdf [Accessed 29 Aug 2025]

European Investment Bank (2018) *Financing the Deep Tech Revolution: How investors assess risks in Key Enabling Technologies companies*. Luxembourg: EIB. [online] Available at: https://www.eib.org/files/pj/study_on_financing_the_deep_tech_revolution_en.pdf [Accessed 29 Aug 2025]

Ewens, M., Nanda, R. and Rhodes-Kropf, M. (2018) 'Cost of experimentation and the evolution of venture capital', *Journal of Financial Economics*, 128(3), pp. 422–442. doi:10.1016/j.jfineco.2018.03.001002E

Fenwick, M., Vermeulen, E.P.M. and Corrales, M. (2024) 'Business and Regulatory Responses to AI: Dynamic Regulation, Innovation Ecosystems and the Strategic Management of Disruptive Technology', *arXiv preprint arXiv:2407.19439*.

Floridi, L. and Cowls, J., 2022. A unified framework of five principles for AI in society. *Machine learning and the city: Applications in architecture and urban design*, pp.535-545.

Ganguly, U., Lashkare, S. and Ganguly, S. (2020) 'India's Rise in Nanoelectronics Research', *arXiv preprint arXiv:2011.11251*.

Giardino, C., Wang, X. and Abrahamsson, P., 2014, June. Why early-stage software startups fail: a behavioral framework. In *International conference of software business* (pp. 27-41). Cham: Springer International Publishing.

Gonzalez-Uribe, J. and Leatherbee, M. (2020) 'Startup accelerators, information asymmetry, and corporate venture capital', *Management Science*, 66(2), pp. 605–628. doi:10.1287/mnsc.2020.03494.

Graham, S.J. and Sichelman, T., 2008. Why do start-ups patent?. *Berkeley Tech. LJ*, *23*, p.1063.

Hammaréus, M. and Malmgren Strömberg, S. (2024) *Bridging Innovation: Facilitating Integration Between Deep Tech Startups and Industry*. Master Thesis. Available at: https://www.diva-portal.org/smash/get/diva2%3A1897430/FULLTEXT01.pdf [Accessed 29 Aug. 2025].

Henry Law (2023) '*Building Your IP Strategy for Patent-Intensive Tech Startups – Part 1: Existing IP'*, Henry Law Blog. Available at: https://henry.law/blog/building-your-ip-strategy-for-patent-intensive-tech-startups-part-1-existing-ip/ [Accessed 29 Aug 2025]

IMPRI (2025) 'India's Deep Tech Fund of Funds (2025): Catalyzing Innovation in Emerging Technologies', *Insights@IMPRI*. [online] Available at: https://www.impriindia.com/insights/india-deep-tech-funds/ [Accessed 29 Aug. 2025].

Karabulut, Y. and Yilmaz, M. (2021) 'Investigating the reasons for failures and delays in R&D projects with the project management approach', *ResearchGate*. Available at: https://www.researchgate.net/publication/352189612 [Accessed 29 Aug 2025]

Kask, J. and Linton, G., 2025. Navigating the Innovation Process: Challenges Faced by Deep-Tech Startups. In *Contemporary Issues in Industry 5.0: Towards an AI Integrated Society* (pp. 197-219). Cham: Springer Nature Switzerland.

Mauborgne, R. and Kim, W.C., 2017. *Blue ocean shift: Beyond competing-Proven steps to inspire confidence and seize new growth*. Pan Macmillan.

Mayya, R. and Huang, P., 2025. Startup Accelerators, Information Asymmetry, and Corporate Venture Capital Investments. *Management Science*.

Mokander, J., Axente, M., Casolari, F. and Floridi, L. (2021) 'Conformity assessments and post-market monitoring: a guide to the role of auditing in the proposed European AI regulation', *arXiv preprint*, November 2021. Available at: https://arxiv.org/abs/2111.05071 [Accessed 29 Aug. 2025].

NASSCOM (2023) *India's DeepTech Dawn: Forging Ahead*. [online] Available at: https://nasscom.in/system/files/publication/deep-tech-report-revised-version.pdf [Accessed 29 Aug. 2025].

Observer Research Foundation (2024) *Uncharted Territories: The Promise of Deep Tech for India and UAE*. [online] Available at: https://www.orfonline.org/research/uncharted-territories-the-promise-of-deep-tech-for-india-and-uae [Accessed 29 Aug. 2025].

Palinkas, L.A., Horwitz, S.M., Green, C.A., Wisdom, J.P., Duan, N. and Hoagwood, K., 2015. Purposeful sampling for qualitative data collection and analysis in mixed method implementation

research. *Administration and policy in mental health and mental health services research*, *42*(5), pp.533-544.

Podbreznik, M., Degen, F. and Kampker, A., 2024, August. Challenges and Potentials in Evaluating Early-Stage Deep Technology. In *2024 Portland International Conference on Management of Engineering and Technology (PICMET)* (pp. 1-8). IEEE.

Rahman, A. and Sari, D. (2023) 'Technology-Based Financial Risk Management Strategy', *Endless Journal*, 3(1), pp. 10–25. Available at: https://endless-journal.com/index.php/endless/article/view/180 [Accessed 29 Aug 2025]

Raff, M., Murray, F. and Murmann, J.P. (2024) 'Why You Should Tap Innovation at Deep-Tech Startups', *MIT Sloan Management Review*. [online] Available at: https://sloanreview.mit.edu/article/why-you-should-tap-innovation-at-deep-tech-startups/ [Accessed 29 Aug 2025]

Sarma, A. (2024) 'Deep Tech Growth and Challenges in India's Startup Ecosystem', *WeWork Labs Blog*. [online] Available at: https://wework.co.in/blogs/deep-tech-growth-in-india/ [Accessed 29 Aug. 2025].

Saunders, M., Lewis, P. and Thornhill, A. (2019) *Research methods for business students [electronic book] / Mark Saunders, Philip Lewis, Adrian Thornhill*. Pearson. Available at: https://research.ebsco.com/linkprocessor/plink?id=839462cc-e467-3fb3-a605-33d8bc04dcc4 (Accessed: 29 August 2025).

Schuett, J. (2022) 'Risk management in the Artificial Intelligence Act', *arXiv preprint*, December 2022. Available at: https://arxiv.org/abs/2212.03109 [Accessed 29 Aug. 2025].

Schuh, G. and Hamm, C., 2023. Supporting Deep Tech Startups to Streamline their Financial Marketing to Different Investor Types.

Sharma, R. and Kumar, S. (2025) 'Comprehensive Financial Risk Management Strategies for Startups', *International Journal of Financial Management and Research*, 5(2), pp. 45–60. Available at: https://www.ijfmr.com/research-paper.php?id=39228 [Accessed 29 Aug 2025]

Siota, J., Kowszyk, Y. and Prats, M.J. (2025) *European Deep-Tech Scaleups: Policy and Regulatory Framework*. IESE Business School Report. doi:10.15581/018/78606.

Sullivan, J.R., 2012. Skype: An appropriate method of data collection for qualitative interviews?. *The Hilltop Review*, *6*(1), p.10.

Surana, K., Singh, A. and Sagar, A.D. (2020) 'Strengthening STI-based Incubators to Help Achieve SDGs: Lessons from India', *arXiv preprint arXiv:2005.13138*.

Taupin, L., Le Masson, P. and Segrestin, B., 2024. Designing a creative heritage for a deep-tech start-up in the scale-up phase. *M@ n@ gement*, *27*(S1), pp.30-44.

Thomas, D.R. (2006) 'A General Inductive Approach for Analyzing Qualitative Evaluation Data', *American Journal of Evaluation*, 27(2), pp. 237–246. doi:10.1177/1098214005283748.

Tracy, S.J. (2010) 'Qualitative quality: eight big-tent criteria for excellent qualitative research', *Qualitative Inquiry*, 16(10), p. 837. Available at:

https://research.ebsco.com/linkprocessor/plink?id=2847d818-23da-3e59-9636-3456896dbaf1 (Accessed: 29 August 2025).

Treleaven, P. (2024) 'Educating Venture Scientists: Inspiring Students and Young Professionals To Commercialize Their Deep Tech Research Supported by Their Institutions', *Computer*, 57(5), pp. 20–28. doi:10.1109/MC.2023.3323900.

UNDP (2025) *Global Deep Tech Ecosystems Report*. [online] Available at: https://www.undp.org/sites/g/files/zskgke326/files/2025-06/undp-global-deep-tech-ecosystems.pdf [Accessed 25 Aug. 2025].

Vellguth, M. (2024). *Governance in Deeptech Ventures: The Critical Role and Impact of Venture Boards for Deeptech Founders and their Firms*. PhD dissertation, Technical University of Denmark, Centre for Technology Entrepreneurship. Available at: https://findit.dtu.dk/en/catalog/66e9d1cd55b9a427e5d1ab15 [Accessed 29 Aug 2025]

World Bank (2022) *Financing Deep Tech*. [online] Available at: https://openknowledge.worldbank.org/entities/publication/9d631bdb-34e2-5ec4-8d98-8c7cf25de3ab [Accessed 29 Aug. 2025].

Wu, W. and Liu, S. (2023) 'Compliance Costs of AI Commercialisation', *arXiv preprint arXiv:2301.13454*

Xu, Y. and Liu, Y. (2021) 'The Impact of Trust in Technology and Leadership on Tech Adoption', *Advances in Psychological Science*, 29(10), pp. 1711–1720. Available at: https://www.researchgate.net/publication/354071804 [Accessed 29 Aug 2025]

7. Appendix

Appendix – 1

Theme	Sub-theme	Codes (open)	Representative quote	Participant	Frequency
Technical Risk	Assessing feasibility in practice	Market-led feasibility; expert validation; prototype signals	"I have to sell the market opportunity as part of the pitch to the investors."	Interview 1	1
Technical Risk	Scaling challenges	Integration complexity; control systems; manufacturability	"It would be really hard to make a sophisticated system to talk to the brain. Coding is there and design has weight."	Interview 2	1
Technical Risk	IP complications	No IP advisor; unregistered IP; code transfer	"We haven't discussed with any intellectual property advisor or registered it as an IP yet."	Interview 4	1
Market Risk	Demonstrating demand	Third-party reports; endorsements; credibility signals	"We leverage medical professionals' reports to attract partners and distributors."	Interview 1	1
Market Risk	Overcoming adoption barriers	Sampling; trials; hands-on proof	"Samples will always help remove any skepticism, so they try it themselves."	Interview 1	1
Market Risk	Differentiation / blue ocean	Niche alignment; patent moat; gel vs spray	"Gel is not suitable for point-of-care ultrasound. The spray is aligned with that market."	Interview 1	1
Operational Risk	Small-team multitasking	Many hats; marketing + logistics; role breadth	"In a startup you wear a lot of hats—marketing, strategy, purchasing, logistics."	Interview 1	1
Operational Risk	Work distribution & coordination	GitHub repo; code reviews; async feedback	"We had a GitHub repository where we uploaded code and gave feedback."	Interview 4	1
Operational Risk	Need for non-technical roles	People-person; communication; finance basics	"First thing I have to find is a people person rather than technical people."	Interview 2	1
Regulatory & Ethical	Compliance as prerequisite	CE/FDA; batch traceability; sell only with protocols	"We sell into a regulated market. We only sell when the necessary protocols are in place."	Interview 1	1
Regulatory & Ethical	Ethics in student vs commercial	Safe materials; informal checks; scale limits	"PLA is not risky for a common user, so we used it in our project."	Interview 2	1
Regulatory & Ethical	Institutional limits	Rules; slower pace; barriers to speed	"There are a lot of rules and regulations. Sometimes they present more obstacles than they're worth."	Interview 1	1
Financial Risk	Self-funding	Family funds; no grants; bootstrapping	"The whole project was self-funded. We did not have any grants or funding."	Interview 4	1
Financial Risk	Public programmes	Enterprise Ireland; LEO; investor-readiness	"You go to Enterprise Ireland or the Local Enterprise Board; they help you progress until investor-ready."	Interview 1	1
Financial Risk	Scale-up capital	GPU/infra costs; INR 40–50 lakh; run-way	"We might need funding of around 40 to 50 lakh INR to build this into a company."	Interview 4	1
Cross-case (IE–IN)	Regulatory context	EU compliance burden; India affordability; breakthrough difficulty	"There are tons of regulations in the European Union. India is affordable but hard for technological breakthroughs."	Interview 2	1
Cross-case (IE–IN)	Entrepreneur strategies	Networks vs research bodies; commercialization expertise	"Entrepreneurs with strong networks and commercialization expertise may not need research bodies."	Interview 1	1
Cross-case (IE–IN)	Shared challenge	Talent mix; team fit > cash; hybrid skills	"The main thing is not funding. The main thing is finding the people."	Interview 2	1

All the interview transcripts were thematically analyzed, and recurrent patterns in the participant responses were recognized.

The data were coded, categorized, and synthesized using the thematic approach systematically in the framework of the approach to methodology used by Braun and Clarke (2006) since the themes correspond to the BCG risk model. These are the main themes of the transcripts that are supported by direct quotations of the participants.