STRATEGIC ACTIVITIES OF DEEPTECH STARTUP IN COLLABORATION WITH INDUSTRIAL CORPORATIONS

Lappeenranta–Lahti University of Technology LUT

Master's Programme in Industrial Engineering and Management, Master's thesis

2025

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ABSTRACT

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Strategic activities of a deeptech startup in collaboration with industrial corporations

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Deeptech startups focus on solving fundamental scientific and engineering problems, but they often have difficulties with commercializing their technology due to their lack of resources, novelty of their technology and lack of market access. Because of these challenges, deeptech startups often collaborate with large corporations, which can provide them with the resources they lack. However, these asymmetric partnerships have their own problems with cultural differences, intellectual property risks and strategic misalignment which can make it difficult for them to succeed.

This thesis addresses this challenge by developing a practical framework to support deeptech startups in managing collaborations with industrial corporations. It uses an in-depth qualitative case study of a Finnish startup specializing in digital twin technology, aiming to identify strategic activities, critical uncertainties, and methods for defining successful outcomes.

The results validate a five-phase collaboration framework and provide context-specific insight. A phased collaboration model is found to be key activity for lowering risk for the corporate partner. Trusted intermediaries, particularly academic networks, are essential for initial contacts and credibility. The success of an early-stage startup is defined as much by intangible benefits, such as validation and learning, as by tangible metrics. Measurable KPIs related to business value are essential to demonstrate impact. The study offers practical guidance for startups operating similar collaborative environments.

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Syväteknologiastartupit keskittyvät ratkaisemaan perustavanlaatuisia tieteellisiä ja teknisiä ongelmia, mutta niiden kaupallistaminen on haastavaa muun muassa rajallisten resurssien, teknologian uutuuden ja markkinoillepääsyn vaikeuden vuoksi. Näiden haasteiden vuoksi syväteknologiastartupit tekevät usein yhteistyötä suurten yritysten kanssa, jotka voivat tarjota niille puuttuvia resursseja. Näillä epäsymmetrisillä kumppanuuksilla on kuitenkin omat haasteensa esimerkiksi yritysten kulttuurisissa eroissa sekä strategisissa tavoitteissa.

Tämä diplomityö vastaa tähän haasteeseen kehittämällä käytännöllisen viitekehyksen, joka tukee syväteknologiastartupin yhteistyön suunnittelua ja johtamista suurten yritysten kanssa. Tutkimus toteutettiin laadullisena tapaustutkimuksena suomalaisesta digitaalisten kaksosten teknologiaan keskittyvästä startupista. Tavoitteena oli tunnistaa keskeiset strategiset toimenpiteet, kriittisimmät yhteistyöhön liittyvät epävarmuustekijät sekä tavat määritellä ja mitata yhteistyön onnistumista.

Työn tulokset vahvistivat viisivaiheisen teoreettisen viitekehyksen toimivaksi malliksi startup-yritysyhteistyön ohjaamiseen ja toivat lisäksi esiin kontekstisidonnaisia havaintoja yhteistyön toteutuksesta. Vaiheittaisen yhteistyömallin havaittiin olevan keskeinen keino pienentää yrityskumppanin yhteistyön riskejä. Luotettavat yhdyshenkilöt ja etenkin akateemiset verkostot olivat tärkeitä kontaktien luomisessa sekä luottamuksen rakentamisessa. Varhaisvaiheen startup-yrityksen menestynyt yhteistyö määritellään ensisijaisesti aineettomilla hyödyillä, mutta selkeiden ja liiketoiminnan arvoa osoittavien KPI-mittareiden määrittely on olennaista yhteistyön vaikuttavuuden todentamiseksi.

ABBREVIATIONS

AI	Artificial Intelligence
CEO	Chief executive officer
CTO	Chief technology officer
CVC	Corporate venture capital
IoT	Internet of things
IP	Intellectual property
KPI	Key performance indicator
NIH	Not-invented-here
NSH	Not-sold-here
OEM	Original equipment manufacturer
PoC	Proof of concept
R&D	Research and development
RDT	Resource dependency theory
ROI	Return on investment
RUL	Remaining useful life
VC	Venture capital

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DECLARATIONS

Turnitin

The originality of this thesis has been reviewed with the Turnitin similarity checking service.

AI usage

The author of the thesis, Eero Alho, used the following AI-tools during the preparation of the thesis:

1. ChatGPT
    a. Purpose of use: Searching previous research to find relevant sources and improving the language and writing style of the text.
    b. Explanation of the use of the tool: Finding relevant academic and professional sources that may have not been found with the traditional search methods and enhancing clarity, coherence and academic tone of the written text.
2. NotebookLM
    a. Purpose of use: Summarizing the content of selected source material.
    b. Explanation of the use of the tool: The tool was used to extract the most important points from the selected source material, and this helped speed up the literature review.

Responsibility

The author, Eero Alho, takes full responsibility for the content of this thesis and has reviewed and edited the content generated by the possible use of AI tools.

1 Introduction

1.1 Background

Startups play a significant role in society by creating new innovations that enable technological advancement and economic growth. Characterized by agility, startups are often seen as engines of disruptive innovation, and they have already significantly changed many industries and their business practices. Despite their great innovation potential, startups usually operate with very small resources, which makes commercializing their products and scaling their operations very challenging (Christensen et al 2015; Usman & Vanhabeke 2017). Among the diverse landscape of startups, deeptech startups focus on solving fundamental scientific and engineering problems. These businesses are typically based on advanced technologies like artificial intelligence, robotics, quantum computing and biotech. Interest in these technologies has increased dramatically because they are also being used to try to solve some of the largest issues facing society, such as industrial automation, clean energy, and climate change (Siota & Prats 2021).

To overcome these challenges, startups increasingly engage in collaborations with established corporations. These partnerships can offer startups access to critical resources such as funding, knowledge and access to customer networks. These collaborations can improve the innovation performance of both parties involved in. By collaborating with startups, large companies can quickly gain access to new technology, change their culture, acquire talent and speed up their innovation processes. Consequently, large companies have begun to wake up to the fact that innovations created by startups are shaping their industries and startups should be seen as potential partners. Established companies are eager to invest in potential startups, but collaboration can take many different forms beyond traditional venture capital investment. The collaboration can for example be a networking event or a hachathon for early-stage startups and more mature startup companies can act as technology suppliers or strategic partners for larger companies (Corvello et al. 2023; Guttmann & Lang 2022).

Corporate-startup collaboration offers many opportunities, but it also comes with several difficulties. Differences in risk tolerance, strategies, decision-making speed, and culture can

all lead to conflict. Asymmetric partnerships like these can put startups at risk for a number of issues, like losing their intellectual property or becoming dependent on just one investor customer. It is therefore important that these partnerships are managed strategically so that they can enable sustainable growth (Chappert et al. 2024).

The focal company in this study is a deeptech startup from a Finnish university. The company was founded about a year ago and focuses on digital twin technology for heavy manufacturing equipment and machinery. As a young company, it is actively looking for clients and industrial partners, especially from Finnish heavy machinery companies. The company has recognized the need to develop strategic capabilities for managing these collaborations and this need has led to the commissioning of this master's thesis project.

1.2 Objectives and scope

This thesis aims to develop a practical, evidence-based framework that will support the case company of the study and similar startup companies in managing collaborations with large industrial corporations. The focus of the thesis is specifically on the strategic measures startups can take to manage the uncertainties arising from collaboration and how startups should define and measure the success of their collaboration with corporations. To achieve these objectives, this study aims to answer the following three research questions:

RQ1: *"What are the strategic activities for a deeptech startup to collaborate with industrial corporations?"*

This question aims to explore the strategic decision-making of startups and how collaborations should be managed. In this study, *strategic activities* refer to practical measures that a deeptech startup can take to initiate collaboration with industrial corporations while maintaining alignment with its long-term strategic vision.

RQ2: *"What are the most critical uncertainties that startups face when collaborating with corporations, and how they manage them?"*

Research question 2 explores the risks, tensions, and uncertainties that arise in asymmetric partnerships, and the strategies startups use to address them.

RQ3: "*How should startups define and measure the success of corporate collaborations?"*

Finaly, the research question 3 investigates how startups assess outcomes from collaboration and what metrics can be used to evaluate performance and success.

The study draws on a number of related scientific fields, such as innovation management, strategic management, and corporate-startup collaboration. Theories of strategic management offer frameworks and tools for decision-making, allocating resources, and building capabilities under uncertainty. Theories of innovation management provide insight into the study on how startups can leverage external resources, such as corporate partners, to accelerate product development and market access. Finally, the literature on startup-corporate collaboration and asymmetric partnerships gives insight on the dynamics, risks, and success factors that shape collaboration between startups and established corporations. Together, these perspectives form a comprehensive foundation for analyzing and improving the collaboration practices a of the focal company. Figure 1 summarizes the themes of the thesis.

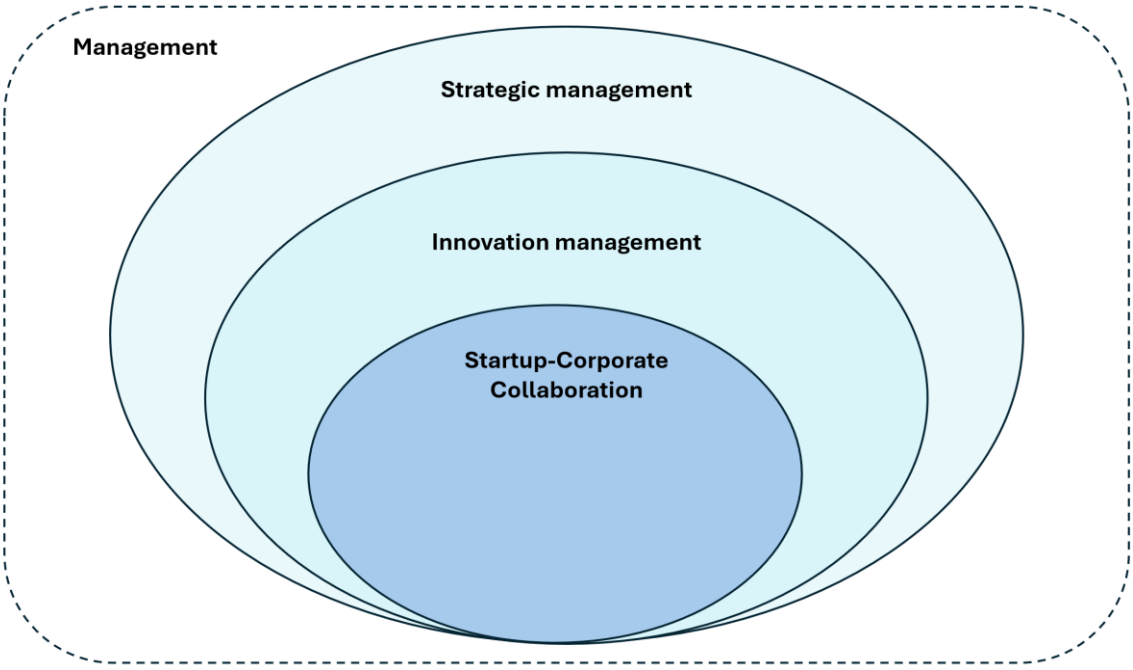

Figure 1. The research positioning.

In this work, startup-corporate collaboration refers to a structured form of relationship that is distinct from both hierarchical control and open market transactions. Unlike a hierarchy, the startup and corporation usually remain legally independent entities, and unlike a market exchange, collaboration involves more than the simple trade of goods or services. It also

includes coordinated interactions that often span knowledge span, joint innovation and complimentary resources (Corvello et al. 2023). This study focuses on collaboration between startups and larger companies from the startup company's perspective. In addition, startup companies focus especially on university-based spin-off startups that utilize advanced technology. The empirical focus of the study is limited to collaborations in the context of heavy machinery and heavy manufacturing industries. In addition, startup collaboration focuses on joint development projects. While the findings are based on the specific focal company, the outcomes are expected to be relevant to other early-stage technology startups operating in similar industrial environment. The empirical part of the study includes the design of the framework, but not the implementation and testing of the framework in practice.

1.3 Methods and data

The research adopts a qualitative in-depth case study approach to develop a framework that will help the focal company of the work to better implement collaborative initiatives with industrial corporations. In the theoretical part of the thesis, a literature review is conducted on the central topics of the work. Based on the literature review, a theoretical framework for corporate-startup collaboration is formed, and in the empirical part of the work, this framework is validated and further developed to meet the focal company's own needs. The sources used in the literature review are relevant academic literature, industry reports, white papers and case studies. Literature searches were conducted using the LUT-Primo service, as well as the Scopus, Web of Science and Google Scholar databases. The most significant search terms were combinations of keywords such as *corporate-startup collaboration*, *open innovation*, *innovation partnerships*, *startup strategy*, *co-creation*, and *collaboration models*. These search terms were used to find relevant academic articles and empirical studies that examine the dynamics, challenges, and success factors of collaborations between established corporations and startups.

The most relevant empirical data for the thesis was collected through semi-structured interviews with key stakeholders from the focal company. In addition to interviews, empirical data was supplemented by analyzing documents from old collaboration initiatives

and making observations from meetings at the focal company. The methods of the empirical part of the work are described in more detail in Chapter 3.

1.4 Structure of the thesis

The structure of the thesis is presented in the Table 1. The thesis begins with an introductory chapter that presents the background of the work. After this, the literature review chapter establishes a theoretical framework for startup-corporate collaboration. This is followed by the empirical part of the thesis, where the theoretical framework is validated and improved based on observations from the focal company. In the final chapter of the thesis, the results are summarized, and the research questions are answered.

Table 1. Structure of the thesis

Chapter	Description / Main Content
1. Introduction	Presents the research background, objectives, and research questions. Outlines the scope of the thesis.
2. Literature review	Reviews the relevant literature on strategic management of startups and startup–corporate collaboration. Synthesizes prior frameworks and theoretical foundations to the five-phase theoretical framework.
3. Methods	Describes the qualitative research design, including data collection methods and the in-depth case study approach.
4. Results	Presents the empirical findings from the case study, structured according to the five phases of the theoretical framework.
5. Discussion	Interprets the results in light of the theoretical framework and prior research. Discusses emergent themes not captured in the original framework and presents practical implications for startups engaging in corporate collaborations.
6. Conclusions	Summarizes the key findings and provides answers to the research questions.

2 Literature review

2.1 Characteristics of Deeptech startup

Term “Startup” is very common in business and academia, and it is often linked to words like entrepreneurial, innovative, and disruptive but it is difficult to find a single clear definition to it (Cockayne 2019). One common definition is that startup is a temporary organization designed to search for a repeatable and scalable business model under conditions of extreme uncertainty (Blank 2010). Startups typically are characterized by their growth-orientation and ambition but are often constrained by their limited resources. (Giardino et al. 2014). In practice, startups often use the “Lean startup” method to reduce risks through iterative experimentation and customer feedback rather than doing a lot of planning ahead of time (Blank 2013).

Deeptech startups have emerged as their own category within the broader startup community. While traditional start-ups usually build their business on existing technology, Deeptech startups build their ventures more complex and cutting-edge technologies that solve fundamental problems across the industries (Halecker & Dotzel 2023). Common technologies mentioned in connection with deeptech startups are for example artificial intelligence (AI), advanced materials, quantum computing, robotics and biotechnology (Siota & Prats 2021).

The nature of the innovation process is one key difference between normal startups and deeptechs. Deeptech startups typically require longer, or sequential development cycles compared to traditional startups, which often use faster iterative development cycles to quickly adapt to user feedback. (Dealroom 2021). Because the lengthy product development phase requires specialized knowledge, infrastructure, and skills, deeptech startups require more funding in the early stages of their operations. As a result, deeptech startups business operations are often hard to replicate or replace, and if they are successful in developing new products, they have the potential to significantly change existing markets and industries (Schuh et al. 2022).

Deeptech startups have often also originated as spin-offs from projects at universities or other research organizations (Halecker & Dotzel 2023). This means that often the founders of these companies consist of individuals who previously worked in academic organizations, with a high level of education, and a large proportion often have a doctorate degree. As a result, the founders generally possess greater scientific knowledge and research knowledge, and they are more likely to have state of the art technological knowledge. However, they tend to have greater gaps in managerial, commercial, and industry-specific knowledge compared to other small enterprises. Many times, startups with academic roots establish alliances and partnerships to close knowledge gaps, particularly in areas where their existing competencies are limited (Colombo & Piva 2008). University spin-offs also tend to keep close relationships with the research environment they originated from. Most of the time, the university provides labs, equipment, and tech resources, which are often very important for the spin-offs that are resource constrained (Mathisen & Rasmussen 2019). The importance of the relationship with parent organization usually decreases over time as more commercial expertise is needed (Bathelt et al. 2010).

Like all new companies, deeptech startups also involve a lot of risk and uncertainty. Since deeptech startups innovations are often dependent on completely new ideas that have not been validated or tested beforehand, there is a significant risk associated with their technological feasibility. Deeptech startups also typically encounter very high market uncertainty as their technologies often ahead of current market demand or understanding. As a result, entrepreneurs and investors have no certainty that the market is ready to adopt them (Schuh et al. 2022). Due to the scientific complexity and often immature nature of their technologies, deeptech startups are often misunderstood or undervalued by traditional investors, which can make it difficult for them to get funding (Dionisio et al. 2023). In addition, there is a risk that established companies fear the change brought about by new technology and therefore try to slow down or even prevent the development of new technologies from entering the mainstream (Harlé et al. 2017).

2.2 Strategic decision-making in startups

Strategic decision-making in startups differs from that in established corporations due to the inherent characteristics of startups. Startups operate with less resources, in rapidly evolving

environment with high uncertainty that makes long-term planning more difficult. It is often said that only larger companies need a strategy to manage their complex operations, but there is also a lot of research showing that the failure of startups is often due to a lack of a clear business strategy (Cantamessa et al. 2018; Drzewiecki 2023).

Traditional strategic planning models, which typically involve a structured process of setting long- or medium-term goals, analyzing the company's internal and external environments, and then creating specific plans to achieve these goals, are challenged by these startup characteristics (Drzewiecki 2023). Therefore, startups usually use less formal planning what some scholars refer to as strategic thinking. In order to implement strategic thinking in a startup, the founders must have a clear vision of the direction they wish to take the company and the discipline to stay on that path. A typical issue for startups is "strategic drift," which happens when a company pursues new opportunities that take it away from its primary purpose (Mazzarol 2005).

The literature has also presented some frameworks to guide decision-making in startup companies. Eric Ries (2011) developed the Lean Startup method, which is one of the most popular frameworks. It emphasizes quick testing by using validated learning and iterative product development, and it responds quickly to feedback about the product. This approach can work for a lot of digital startups, but it doesn't always work for deeptech startups. This is because their technology and products can be highly complex, so they often need longer development cycles (Schuh et al. 2022). Collis (2016), on the other hand proposed the idea of a “lean strategy” that addresses this need by requiring a strategic framework that is both flexible and consistent. According to Collis, startups should be open to trying new things and learning from their mistakes, but they should do so with a clear understanding of what their competitive advantage is and what their long-term goals are. Lean strategy says that new businesses should clearly define what their business is and what they should not do. Then they can coordinate their actions, set priorities for their resources, and measure their progress without becoming too strict or too specific. The process for making decisions with the lean strategy is shown in Figure 2.

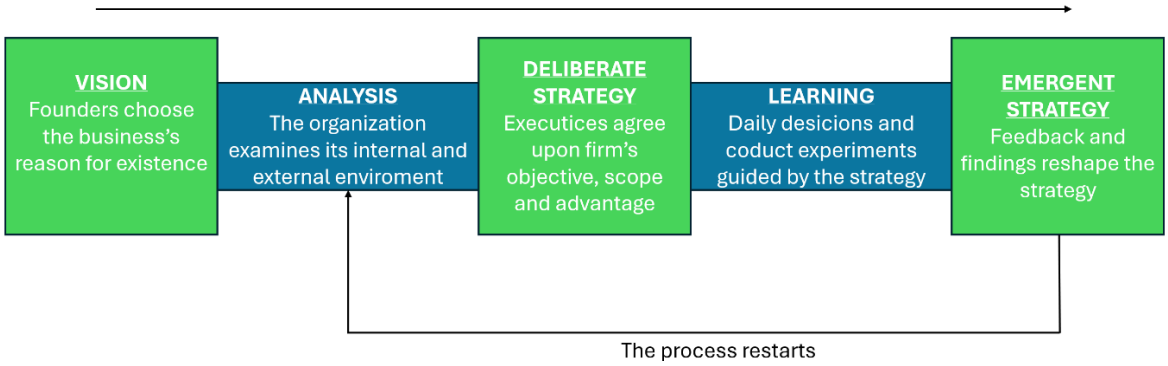

Figure 2. The Lean strategy process (Collis 2016).

Some authors argue that entrepreneurial spirit and innovation are more important in startups than formal planning. For instance, Schramm (2018) is skeptical that formal planning is helpful in the early stages of a new business. He thinks that the main goal of a new business should be to make a new product and sell it. After that, they should learn by doing. Shah et al. (2018) also emphasize that startups should focus on doing things and testing ideas rather than making long-term plans. According to them, the most important thing for startups is to build momentum and try to maintain it. They argue that the true strategic behavior of startups is often only evident through active participation in the market, rather than through pre-defined plans.

A startup's strategic priority may also change as it goes through its lifecycle, from pre-startup and survival to growth and maturity (Mazzarol 2005). At first, startups might focus on finding a product-market fit by trying things out (Drzewiecki 2023). As startups become more mature, their focus often shifts from product development to scaling their operations. This change often needs funding and partnerships from outside the company (Slávik et al. 2022). However, rapid growth can force managers to adopt more formal strategic management methods, as the operations get more complicated and harder to manage with just the founder's vision (Mazzarol 2005). Startups must also be able to pivot and make fundamental changes to their business idea or strategy based on market feedback (Slávik et al. 2022).

A key factor that affects startups strategic management is the lack of resources, such as money, talent, and access to distribution channels (Collis 2016; Spender et al. 2017). Because of this, startups need to utilize and acquire resources efficiently in their business operations and decision-making. This requires being creative when faced with challenges, like using the founder's personal connections and social capital to get resources. This process

is often not straightforward, and it involves using networks of family and friends, as well as more formal sources like angel investors, venture capital (VC), and corporate venture capital (CVC). The sequence in which resources are gathered in can also have an impact on a business's ability to innovate. The initial decision regarding "who to approach first" not only influences access to subsequent resource providers but also impacts the way in which resources are combined and utilized. Because resources are interdependent, decisions made early in resource acquisition can limit a startup's later options. At the same time, these kinds of limitations can make entrepreneurs try out different combinations, which can lead to new business models and creative ways to utilize already existing resources (Zahra 2021).

2.3 Motives for corporate-startup collaboration

Collaboration together between startups and corporations is becoming increasingly recognized as an effective strategy to boost innovation and make businesses more competitive. Although these partnerships are often characterized by resource asymmetry and cultural differences, mutual benefits serve as strong motivators for both parties (Gutmann & Lang 2022).

From the corporate point of view, one of the main reasons to work with startups is to get access to new technologies and ideas that the startups might have. As industries undergo different transformations, corporations seek to get access startups agility and technological capabilities to explore new business models and respond more rapidly to market changes (Weiblen & Chesbrough 2015). Collaborating with startups allows corporations to experiment with new ideas with smaller risk. Corporations can also accelerate their product development cycles and change their organizational culture through exposure to entrepreneurial mindsets. Trough accelerator and venture programs corporations can also scout different innovations and try to integrate them into their existing R&D pipelines (Kohler 2016; Ching & Caetano 2021).

Startups, in turn, are driven by a need to access critical resources that enable growth and scalability, and they can obtain these resources through collaboration with corporations. In collaboration, startups are usually interested in access to financial resources, mentoring, networks and market validation offered by corporations (Bańka et al. 2025). Access to technological capabilities is also a key driver for startups seeking collaborative partnerships.

Startups often possess specialized knowledge, but they frequently face challenges in further developing or scaling their technologies independently. This makes potential collaborators particularly appealing if they provide deep technological resources (Simon et al. 2019). Recently established startups often also lack organisational routines and mentoring and organisational support from corporate top management is an important asset offered by corporations in collaboration with startups (Simon et al. 2019). Partnerships with reputable corporations can also enhance a startup's credibility and making it easier to attract customers and build trust in their offerings. Startups often lack reputation and market access and beyond acting as mentors or investors, corporate partners can also serve as early adopters or customers, helping startups create and validate markets for their products (Usman & Vanhaverbeke 2017).

A startup's motives for collaboration also develop depending on what stage the startup is in its life cycle and motives reflect their current strategic priorities and resource needs. Figure 3 shows the different stages and their associated targets. In the first seed phase collaborations are primarily driven by the need to validate technical feasibility and assess the economic viability of the business concept. As the company enters the startup phase, it focuses on making a market strategy and finding the first commercial uses for its technology. To do this, it often looks for partners who can help it reach customers or learn more about the industry. In the emerging growth phase, the motives for collaboration shift toward growth, as startups try to grow their businesses and build credibility by working with established companies. Throughout these stages, the primary objectives of collaboration transition from learning and validation to scaling, market access, and strategic positioning (Schuh & Studerus 2023).

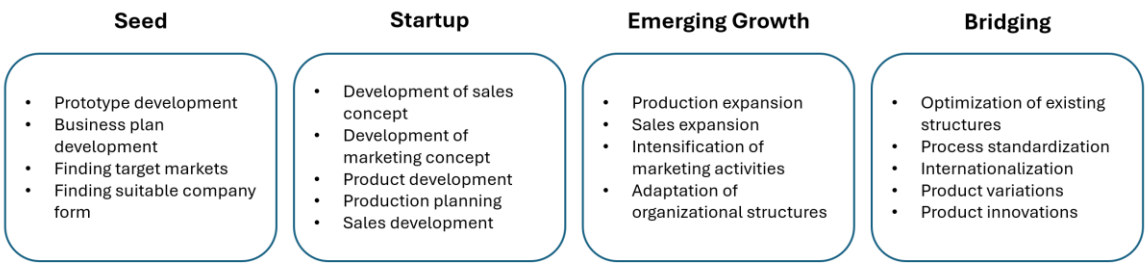

Figure 3. Collaboration targets of startups in different life cycle phases (Schuh & Studerus 2023)

2.4 Forms of collaboration

An increasing number of corporations are now establishing dedicated initiatives to actively foster and manage partnerships with startups. These initiatives that are often labelled as innovation labs, incubators or other similar formats have become very common in recent years. The main goal of any partnership between a startup and a corporation, regardless of what form it takes, is usually to help the business grow and give it a competitive advantage over its competitors. These partnerships, on the other hand, need to take into account the differences between the two groups. Startups are usually more flexible and willing to take risks, while corporations may be conservative and stick to a conventional way of doing things. These differences can be addressed or adapted to, depending on the specific collaboration model chosen. Collaboration generally means a wide range of activities that involve different levels and types of interaction between startups and established companies (Ching & Caetano 2021). The literature presents various forms of collaboration between corporations and startups, emphasizing that these partnerships are essential for the exploration of new knowledge and ideas, as well as for improving innovation performance, particularly in periods of disruption (Riikkinen & Pihlajamaa 2022).

Weiblen and Chesbrough (2015) present a fundamental model that categorizes corporate-startup interactions based on two criteria: the direction of innovation flow (either outside-in or inside-out) and the presence of equity investment. This results in four distinct collaboration models: (1) Corporate Venturing (outside-in with equity), (2) Corporate Incubation (inside-out with equity), (3) Startup Programs (outside-in without equity), and (4) Platforms and Startup Programs (inside-out without equity). This framework emphasizes how innovation and resources are exchanged across organizational boundaries and underscores the strategic intent behind each configuration. Steiber et al. (2021) later validated and expanded this framework by adding four more models to this typology. The four models they added were: Corporate Acquisition (Outside-in with equity), Internal Accelerator (Inside-out with equity) and Co-creation and Co-location (Outside-in without equity). Table 2 presents the mentioned collaboration models and briefly describes them.

Table 2. Different collaboration models (Steiber et al. 2021).

Model	Direction of Innovation Flow	Equity Involment	Description
Corporate venturing	Ouside-in	Yes	Use of corporate VC arm to ivest in starups of potential interest
Acquisition	Ouside-in	Yes	Purchase of a startup, which has desired technology or expertise
Programs	Ouside-in	Yes	The large firm supports the development of stratup companies to promote existing corporate innovations
Co-creation	Ouside-in	No	Direct collaboration with startups and other external partners to develop and market innovations
Co-location	Ouside-in	No	Inviting startup companies to locate on or near the large firm's premises, thereby creating opportunities for serendipity innovation and synergy
Corporate incubation	Inside-out	Yes	Programs which are ment to develop internal (and sometimes external) ideas towards the prototype and test marketing stages
Internal corporate accelerator	Inside-out	Yes	Programs which are similar to Incubators, but are typically shorter-term, cohort-based programs that include an emphasis on building entrepreneurial culture within the large firm
Platforms	Inside-out	No	Platforms that are owned by the large firms but have their value augmented by external contributors. For example, the app store by Apple.

Demir and Lukes (2024) provide a more detailed classification based on a systematic review of collaboration models, focusing on the startup maturity stage (early, middle, mature) and the nature of the investment relationship (equity, non-equity, hybrid). Their model describes nine different types, each of which is designed for a different strategic goal and stage of a

startup. The difference from previous reference frameworks is that it considers the development stage of the startup, as they believe it is a very critical factor for the success of the collaboration. Furthermore, in this framework, Co-creation and Co-location are not their own collaboration models, but rather an underlying mechanism that can be embedded in various forms of engagement. Figure 4 shows categorization of 9 different corporate-startup collaboration models based on the classification made by Demir & Lukes (2024).

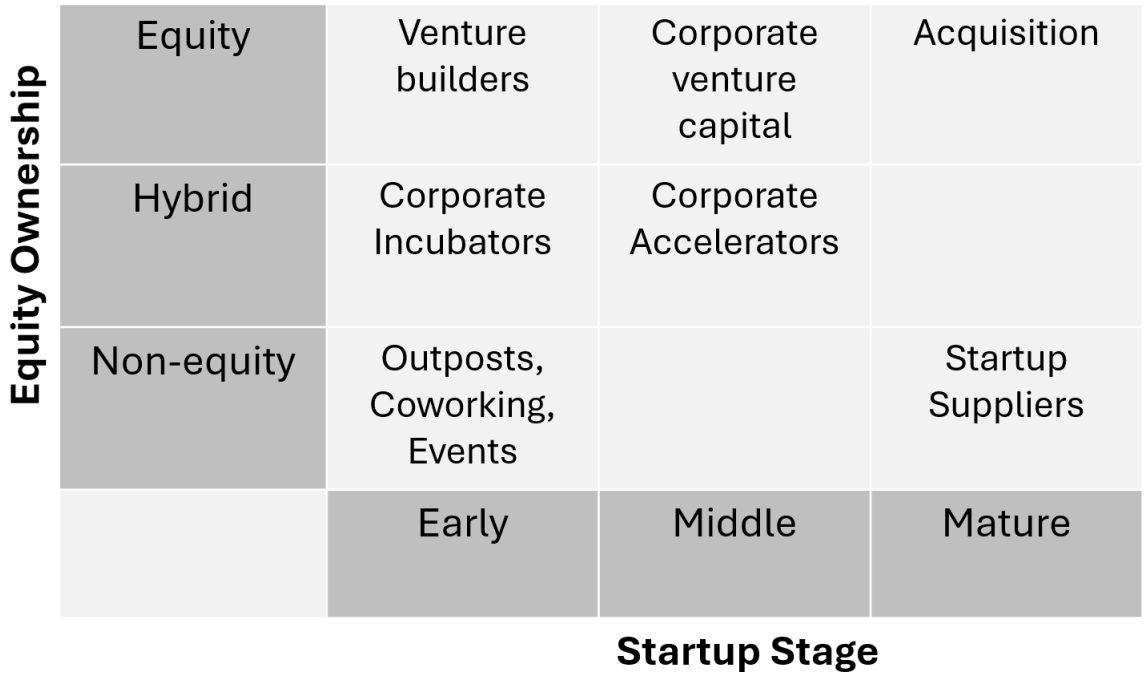

Figure 4. Categorization of corporate-startup collaboration models (Demir & Lukes 2024).

2.5 Co-Creation as a collaborative practice

Co-creation is a strategic approach or managerial practice that unites various stakeholders to collaboratively generate outcomes that are valuable to all parties involved (Steiber & Alänge 2021). As stated in the previous paragraph, within the context of corporate-startup collaboration, co-creation is regarded in literature as both a distinct collaboration model and an underlying mechanism that can appear in various collaboration models. Consequently, co-creation can be regarded as an umbrella term for diverse collaborative approaches, including co-development, co-design, and co-production (Demir & Lukes 2024). In the past, the idea of co-creation was mostly about how consumers and businesses interacted with each

other. However, it has since grown to include a wider range of stakeholders, such as suppliers, makers, and notably startups, which are important because they can help with innovation (Steiber & Alänge 2021).

Co-creation can be seen as a specific type of open innovation, allowing companies to integrate external knowledge and foster innovation. In the case of corporate-startup collaboration that can for example involve collaborative development of products, services, or solutions by corporations and startups (Steiber & Alänge 2021). While traditional collaboration models might involve equity, co-creation often foregoes corporate ownership, making it a more lightweight approach that replaces equity with shared technology to connect both worlds with fewer organizational costs and greater speed (Weiblen & Chesbrough 2015). This is appealing to startups as it allows them to overcome innovation diffusion challenges without giving up equity (Steiber & Alänge 2021).

From a process perspective, co-creation can occur at various stages of the value chain. It can include co-design, co-development, and co-production, and it can also happen virtually (Demir & Lukes 2024). Companies are increasingly using crowdsourcing to come up with a lot of new ideas in the early stages of ideation phase. They do this by defining problem statements or open challenge areas (Hughes 2014; Alänge & Steiber 2018). In later stages, stakeholders may work together to improve ideas and build prototypes. This is often done in short, intense formats like hackathons, which can save a lot of time and money for existing companies compared to the usual way of making prototypes (Steiber & Alänge 2021).

One advantage of co-creation is that it can utilize on the best parts of both parties. Startups bring new technologies, speed, and creativity, while large corporations bring scale, resources, and access to the market (Ching & Caetano 2021). However, the relationship between startups and big companies is many times complicated and involves both working together and competing (Islam et al. 2017). This duality requires careful management to facilitate effective collaboration. Intermediaries and third-party organizations, like accelerators, can help bring people together, set goals, and make it easier for people to work together (Garcia et al. 2024).

Digital co-creation also brings its own challenges to collaboration between corporations and startups (Garcia et al. 2024) One major challenge in digital co-creation is the trust and transparency issues related to data sharing and cybersecurity (Sjödin et al. 2021). The

incumbent's limited prior technological knowledge can also hinder organizational learning, thereby diminishing the effectiveness of the co-creation process (Paiola et al. 2021). There are also problems associated with the commercialization of digital innovations, such as disputes over intellectual property rights or unfair licensing agreements that can reduce the returns from these innovations (Garcia et al. 2024).

2.6 Key challenges in asymmetric partnerships

Corporate-Starup collaboration is an asymmetrical partnership between a big established company and a small startup that works together to come up with new ideas and make the business more competitive. Even though this kind of collaboration is good for both sides, it also causes problems and tensions because of their differences (Chappert et al. 2024).

Various previous studies refer to resource dependency theory (RDT) when they analyze asymmetric partnerships (Kattila et al. 2008; Fierro & Pérez 2018; Chappert et al. 2024). According to RDT, asymmetry arises when the value of a partnership is not equally significant for both parties (Pfeffer & Salancik 2003). RDT explains the dynamics of collaboration within these asymmetric partnerships, especially regarding mutual dependence and power disparity. Corporations often turn to startups for fresh innovations, while startups often turn to corporations for resources. These differences can create a power imbalance in collaboration and sometimes lead to cases of exploitation, such as intellectual property theft or misappropriation of property rights (Chappert et al. 2024).

Power imbalances can make collaboration more difficult to succeed. Corporates often with their size and resource dominance set the rules of engagement and can marginalize the startup’s role in decision-making. This may lead to a loss of autonomy for the startup and create dependency on the corporate partner if they tailor their products too much for the needs of the corporate partner. However, a startup can also be a dominant party of the collaboration if it has a viable radical innovation that attracts many potential companies to partner with it (Chappert et al. 2024).

Differences in culture and management style can also make it hard to work together. Organizations may experience Not-invented-here (NIH) or Not-sold-here (NSH) problems, which refer to negative attitude inside the organization towards absorbing external

knowledge or sharing internal knowledge outside of the organization (Amann et al 2022). Reproducing entrepreneurial culture with its sense of survival and passion for innovation can be difficult for corporations. Startups often operate with a culture of fast experimentation and minimal hierarchy, while corporations are often guided by established routines and complex hierarchies. These differences in operating cultures can cause friction in cooperation and lead to misunderstandings and distrust on both sides (Dizdarevic et al. 2024).

Legal and intellectual property (IP) concerns also pose significant barriers in collaboration. Startups are often cautious about sharing their core technology or business models for fear of IP misappropriation or unfavourable contract terms because these risks can cause significant threat to the existence of a startup. Corporates, on the other hand, require legal assurances and risk mitigation strategies before integrating external innovations, which can delay the potential partnerships (Dizdarevic et al. 2024).

A significant barrier for corporations entering startup collaborations is often their lack of familiarity with the startup ecosystem. Banka et al. (2024) highlight that many large firms struggle to identify which startups are truly aligned with their strategic needs and they end up frequently wasting time on short pilots or partnerships that do not scale. This is because companies have limited understanding of startup innovations and lack established scouting and vetting processes. Poorly implemented startup collaboration can also result in financial losses or reputational damage, and therefore many corporations avoid the risk and collaborate more with more mature companies. This can lead to missed opportunities or ineffective interactions that don't lead to real innovation results (Banka et al. 2024).

In addition to these challenges, research highlights several paradoxical tensions that can also make collaboration more complicated between the startups and corporations (Chappert et al. 2024; Dizdarevic 2024). One example is the performing paradox that refers to the simultaneous pressures of cooperation and competition. This paradox is connected to the pursuit of competing goals or strategies and is often linked with concerns regarding value, transparency, and technological proximity in collaborative projects (Dizdarevic 2024). Value creation versus value capture is also a central issue. Although value is created together during collaboration, capturing it equally is difficult (Chappert et al. 2024). Startups often seek paying corporate resources, while corporations might primarily be interested in accessing new technologies or competencies without a direct commercial agreement initially

(Corvello et al. 2023). The knowledge sharing versus protecting tension add to this issue as both sides face risks of knowledge leakage. This problem is especially common among startups with highly disruptive technologies (Chappert et al. 2024).

The learning paradox is related to the confrontation between stability and change and describes the tensions between short-term exploitation and long-term exploration. Corporations often put more emphasis on exploitation activities, while startups tend to put too much emphasis on exploration. This creates a tension between building future capabilities and making sure current success (Chappert et al. 2024). While corporations may say they want to do radical innovations, they often care more about exploitation-oriented results (Giglio et al. 2025). There are also differences in project schedules and financial urgency, as corporations often have extended deadlines and startups have shortened deadlines (Chappert et al. 2024).

2.7 Factors enabling successful collaborations

At best, collaboration can be very beneficial for both corporations and startups. Success depends on the ability of both parties to recognize their inherent differences while leveraging their complementary strengths. There are many important factors that make it possible for corporations and startups to collaborate successfully, like for example aligning strategies, sharing resources, and managing relationships and processes well (Csik & Torres Junior 2024).

Achieving strategic fit and shared goals are both important factors that make collaboration between corporations and startups successful (De Groote & Backmann 2020; Riikkinen & Pihlajamaa 2022). Collaboration becomes more focused and effective when both parties have the same goals, and the parties are able to benefit each other (Riikkinen & Pihlajamaa 2022). A startup's industry, technical expertise, and innovation potential must align with the corporation’s strategic goals to make it a good partner. This alignment enables joint value creation because collaboration can solve problems that are relevant to both parties. Without this fit, partnerships can waste resources or lead to misaligned expectations (Csik & Torres Junior 2024). A shared purpose and unified vision between both partners help maintain alignment throughout the collaboration. When both sides have clear goals, it becomes easier to track progress and measure outcomes (Bańka et al. 2025).

Another key factor enabling successful collaboration is the complementarity and strategic exchange of resources between the two parties (Giglio et al. 2025). Companies and startups are two very different types of organizations. Large companies possess greater resources but show slower responsiveness, while startups are agile but face resource limitations. This asymmetry creates a mutually beneficial growth opportunity for both parties (Csik & Torres Junior 2024). When these complementary assets are effectively combined and supported by structured knowledge sharing routines, the collaboration enhances innovation and creates competitive advantages for both parties (Giglio et al. 2025).

Successful collaborations between corporations and startups also depends on trust and strong relationships. An environment where the parties trust and support each other reduces opportunistic behavior and improves the effectiveness of the collaboration (Allmendinger & Berger 2019). Openness serves as a key indicator of trustworthiness. When both parties show a willingness to share information and communicate transparently, learning from collaboration becomes easier, information flows more smoothly during collaboration, and actions are better aligned with agreed goals (Bańka et al. 2025; Allmendinger & Berger 2019). The presence of trusted relationships and internal sponsors can also help manage tensions and build trust (Chappert et al. 2024). In addition, previous positive relationships and strong social connections between individuals can act as indicators for success and help minimize opportunistic behaviour (De Groote & Backmann 2020).

Clear collaboration process and an effective organizational structure are also important for the success of the collaboration (Giglio et al. 2025). Collaboration projects usually follow a sequential process that includes initial setup, startup scouting, alignment of product offerings with corporate needs, testing, integration, and eventual scaling. To help these phases, companies can benefit from creating specific roles, like startup advocates or relationship managers, who oversee the collaboration and act as liaisons (Giglio et al. 2025). Involving multiple organizational functions such as purchasing, R&D or legal, early in the process, can also help the collaboration (Riikkinen & Pihlajamaa 2022). For startups it can be hard to find the right person to talk to about initiating the collaboration because corporations can be very big and complex. Startups should try to get in touch with the right people, ideally C-level executives or people who work in the core of the company. This will make them more likely to collaborate (Simon et al. 2019).

A dynamic approach to collaboration is also necessary, as the optimal mode of interaction may evolve in response to market shifts or organizational changes. Tailored processes that consider the specific development stages of startups and the goals of individual projects are more effective than rigid, stable models (Corvello et al. 2023). Smooth deal setup and clear agreements on guiding principles is also important for long-term success of the collaboration. These clear agreements should also be followed with ongoing review and adaptation, so that the success of the collaboration can be monitored and any corrective measures can be taken during the partnership. Furthermore, implementing a stage-gate process can optimize resource allocation to most promising collaborations and ensure acceptance and commitment (Dizdarevic et al. 2024).

External accelerators and other intermediary organizations can also help set up the collaboration (Demir & Lukes 2024). These organizations usually connect and help corporations and startups to work together. They can help startups grow and meet corporate needs by creating custom programs, putting on networking events, and giving them advice and resources (Giglio et al. 2025). Intermediaries can also help to balance power and reduce differences in knowledge, resources, and influence, which can help to reduce tensions in collaboration (Corvello et al. 2023). Intermediaries can also have a crucial role in widening the market visibility of startup products (Garcia Martin et al. 2024).

There are also many risks involved in corporate-startup collaboration that need to be managed effectively. A common concern for startups when collaborating with large companies is protecting their intellectual property rights (Bańka et al. 2025). The risk of misappropriation is particularly significant if the corporation has the ability to create value from the technology provided by the startup. Therefore, it is essential to choose the right IP strategy and collaboration model (Simon et al. 2019). Another major risk is dependency, which means that startups may become too dependent on their corporate partner. This dependency can make it harder for them to make their own decisions about products and strategies (Simon et al. 2019). Using project-based collaboration models can lower this risk better than deeper arrangements, like for example CVC that involve equity stakes (Weiblen & Chesbrough 2015). Long-term partnerships with businesses can be risky for startups because they can make them dependent on the business. However, if the partnership fits well with the startup's strategic goals, it can also be very beneficial. Ensuring strategic fit helps reduce risks and get the most out of the partnership (Chappert et al. 2024). Strategic

negotiation is also important tool for startups to lower risks in the collaboration projects. Startups must effectively tailor contract terms to their limited resources and tight schedules, while constantly evaluating the strategic value of the partnership. Knowing what parts of the partnership are open to negotiation and what parts are governed by non-negotiable corporate policies can help avoid misunderstandings (Freytag 2019).

Measuring the success of corporate-startup collaboration is also important so that its effectiveness can be assessed and ongoing and future collaboration projects can be justified. Results of the collaboration are often measured using specific performance indicators like product launches, revenue growth, customer base expansion, or market share growth. (Bańka et al. 2025). However, many of the benefits startups seek from corporate collaborations such as learning and building reputation through association with a well-known partner can be difficult to measure. Unlike increased revenue or new product launches, these intangible outcomes do not always show immediate results but can still have significant long-term value even if they are not easily captured by standard performance metrics (Corvello et al. 2023).

2.8 Summary and theoretical framework

Previous chapters have discussed the strategic management of startup companies and different aspects of startup-corporate collaboration. This theoretical framework presented in Figure 5 conceptualizes effective corporate-startup collaboration from the startup perspective as a five-phase process encompassing strategic alignment, partner selection, collaboration management, risk governance, and outcome and learning aspects of collaboration. The framework draws some influence from earlier frameworks of startup-corporate collaboration presented by Csik and Torres Junior (2024) as well as Bańka et al. (2025), but it has been adapted to emphasize the startup perspective. Other elements are the author’s own compilation and synthesis of the presented theory.

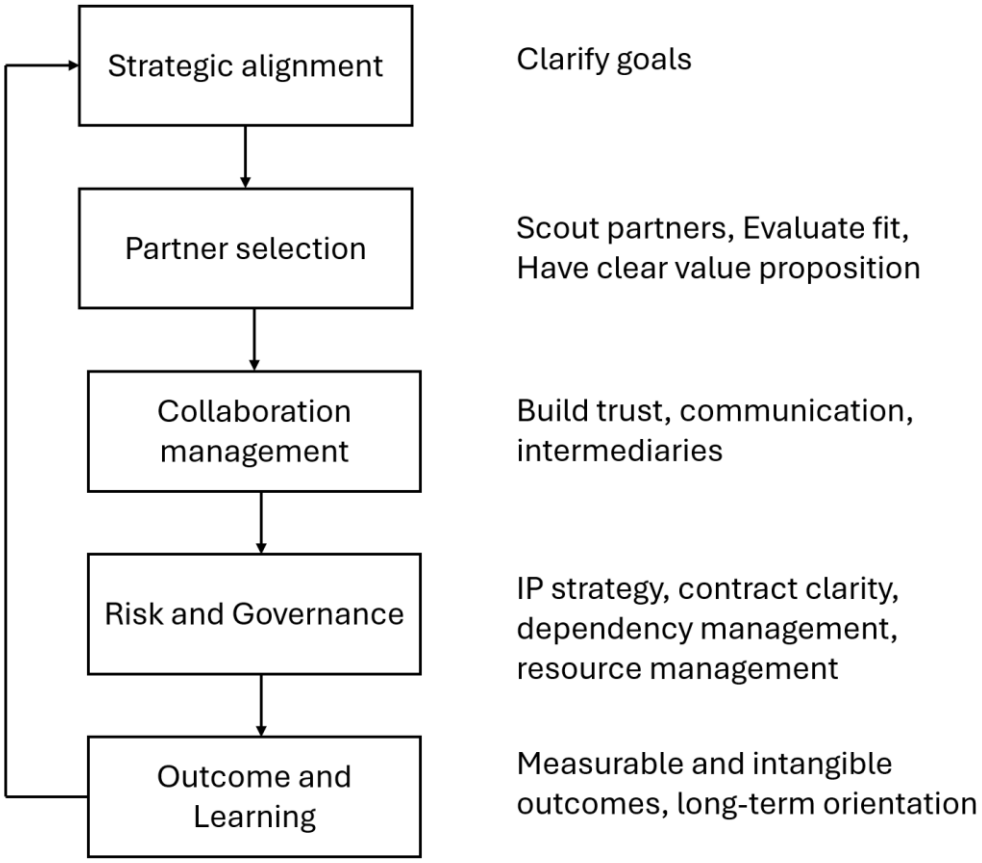

Figure 5. Theoretical framework.

Strategic alignment is an important first step in successful startup-corporate collaboration. To avoid strategic drift, startups need to keep a clear strategic vision (Mazzarol 2005). Startups need to be open to exploring new things and learning from their mistakes, but they should do this with a clear idea of what makes them better than their competitors and what their long-term goals are (Collis 2016). This is especially important for deeptech startups, whose product development times are often longer (Dealroom 2021 A clear set of operational goals for the collaboration, like learning, getting a paying customer, getting more exposure, or expanding their network, is also important for the success of the collaboration (Corvello et al. 2023; Banka et al. 2024; Csik & Torres Junior 2024). It is also important for startups to understand the corporate goals for the collaboration. Corporations engage in collaboration for example to drive innovation, access new technologies and talent, explore new markets. It is therefore important to acknowledge that differences in expectations

between a large firm and a startup and ensure that both parties agree on the end goals (Banka et al. 2024; Chappert et al. 2024; Ching & Caetano 2021).

Partner selection is a critical strategic activity that can significantly influence the outcome of a startup–corporate collaboration. Startups should actively seek out corporate partners whose strategic interests and technological focus align with their own long-term goals (Corvello et al. 2023). Evaluating the potential partners strategic fit is also essential for successful collaboration. This includes areas such as, technological alignment and overlap of knowledge areas, aligned motivations for collaboration to for both parties, and relational alignment (Riikkinen & Pihlajamaa 2022; Csik & Torres Junior 2024; De Groote & Backmann 2020) Strategic fit is also a dynamic process, and partners need to regularly revisit the common goals (Dizdarevic et al. 2024). Startup should also have a clear value proposition application, and proof of concept ready for collaboration. This preparation is critical to avoid being an "inadequate startup" (Harlé et al. 2017).

Collaboration management is an ongoing phase that requires startups to foster strong relationships and actively manage the complexities of working with large industrial corporations. Collaboration often begins with human ties and a discussion that evolves into a project (Chappert et al. 2024). Trustworthiness is assessed during the formation stage, and startup must invest in the process to improve mutual understanding of organizational cultures and goals (Allmedinger & Berger 2019). Informal relationships can help overcome collaboration barriers (Giglio et al. 2025). Startups should insist on transparent communication, with regular follow-up meetings, and continuous exchange of information and feedback (Banka et al. 2025; Dizdarevic et al. 2024).

The Risk and Governance phase is critical for ensuring that collaboration between startups and industrial corporations proceeds with fairness, transparency, and protection for both parties. Many authors emphasize that startups often fear that corporations will steal their ideas or misappropriate their IP during collaboration (Banka et al. 2024; Chappert et al. 2024; Csik & Torres Junior 2024; Simon et al. 2019). Therefore, establishing a clear IP strategy is an important early step for collaboration. This should be formalized through contractual agreements that includes safeguards and clauses related to IP rights (Dizdarevic et al. 2024; Banka et al. 2025; Chappert et al. 2024). Clear and structured contractual agreements are also essential for resource allocation, commercialization rights, governance mechanisms, and financial incentives (Banka et al. 2025). Equally important is the need to

limit dependency on the corporate partner. Startups run the risk of becoming dependent on the larger partner, which can affect their product development, sales, and even their ability to make their own business decisions (Simon et al. 2019). Project-based approaches can help to limit this risk (Weiblen & Chesbrough 2015).

In the Outcome and Learning phase, the startup should review the results of the collaboration and consider what worked and what didn't. These lessons should then be utilized in planning future collaborations. Startups should be prepared to show the impact of collaboration by using specific performance indicators, such as product or service launches, revenue and sales growth, customer acquisition, or market share expansion (Banka et al. 2025).

3 Methods

3.1 Qualitative research methods

This study adopts a qualitative in-depth case study design to investigate the strategic activities that support collaboration between deep-tech startups and industrial corporations. Qualitative research seeks to explore and explain a phenomenon in depth by answering questions of *why* and *how* (Pyo et al. 2023). A case study approach allows to identify essential concepts and contextual conditions while deepening the understanding of how things work (Basias & Pollalis 2018). Conducting a single case study is suitable when the aim is to research the existence or importance of a phenomenon in depth, as it allows the researcher to test existing theories, build new theoretical relationships, and to get deeper understanding of the underlying dynamics within a specific context (Dyer & Wilkins 1991). While the study remains primarily interpretive, it incorporates elements of design science research principles outlined by Hevner et al. (2004). These elements are in this study particularly through the creation of a theoretical framework for startup collaboration and then testing and validating the framework in the empirical part of the study.

The study was conducted using semi-structured interviews and complementary observations from collaboration-related meetings. Semi-structured interviews were chosen for this study, as they provide consistency across respondents and flexibility to explore emerging themes in depth (Tuomi & Sarajärvi 2018). Observations offered additional insights and helped to capture aspects of collaboration not always articulated in interviews. The company also has quite a few employees, so without observations, the data could have remained limited. The purpose of the data collection was to validate and further develop the proposed theoretical framework for startup-corporate collaboration. Data analysis followed a qualitative coding process where interview transcripts and observation notes were systematically coded to identify recurring themes and patterns. Both inductive and deductive approaches were applied in the analysis process. Deductive approach was included in linking the material to the five-phase framework, and inductive in allowing new categories to emerge from the data. This iterative process enabled an updated understanding of the framework and ensured that findings were supported with empirical evidence.

3.2 Case description

The focal company in this study is an early stage deeptech startup developing digital twin technology for heavy industrial machinery. It originates as a spin-off from a Finnish university, based on research in physics-based simulation and data-driven systems. Before founding the company in 2024, the founders conducted research with support of Business Finland into the feasibility of the technology and the potential market for the product, and during the research, the company's business model was found to be viable. The company's main innovation deals with what it calls the "Digital Twin Problem". This problem refers to the tendency of traditional, design-based simulation models to diverge from the actual behaviour of machines during real-world operation. To solve this problem the company develops digital replicas of industrial equipment by combining real-time sensor data with physics-based simulation and machine learning techniques.

As a new deeptech startup, the focal company faces challenges common to young technology firms that includes for example limited market access, constrained resources, and the need to validate its technology in operational contexts. Strategic collaboration is therefore a central component of the company’s growth model. The company is still in its early stages, so it is not actively looking for venture investors yet but rather is looking for suitable partners for joint development projects. Company’s initial market focus includes sectors with heavy mobile machinery such as construction, mining and forestry where complex and interconnected systems present a strong use case for optimizing performance and enhancing production efficiency.

Partners suitable for the focal company are presented in Figure 6, which provides a simplified description of focal company’s operating environment. Partnerships with original equipment manufacturers (OEM) who manufactures heavy machinery are particularly promising. With focal company’s technology OEMs could improve their after-sales service offerings, for instance by introducing predictive maintenance packages or optimizing spare part supply chains. In addition, OEMs may also leverage the technology in their own R&D processes, as the insights from digital twins could accelerate their product development. For the focal company, a successful customer or collaboration project with an established company would build trust and make it easier to acquire new customers, as its technology would have been proven to work in the real world. The company has had only a few

collaborative projects with larger heavy equipment manufacturers during its operations, and its technology is not yet ready for larger commercial operations.

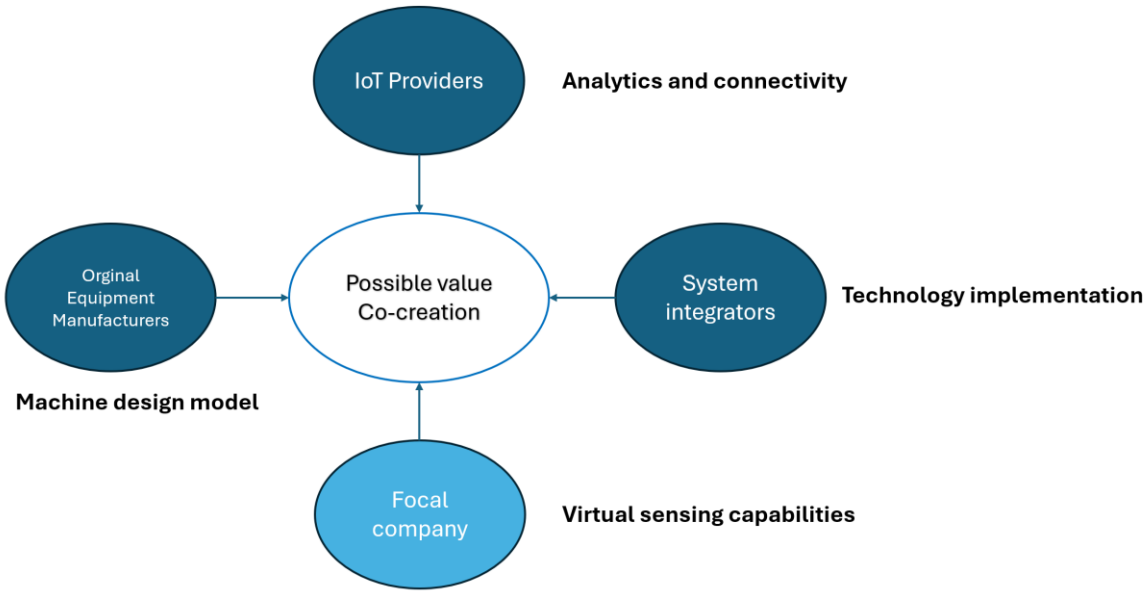

Figure 6. Potential partners for focal company.

Collaborations with Internet of things (IoT) providers are another key opportunity, as these partners could bring advanced expertise in connectivity, data acquisition, and analytics. This expertise could complement the focal company's expertise in physics-based modeling and enable the creation of various services for heavy machinery manufacturers. For example, these parties can create a seamless data pipeline where real-time sensor inputs are transformed into actionable information through the case company's simulation layer. In the same way, system integrators might be important to the technology's broader adoption. System integrators help enabling deployment of the technology, as the solution often requires integration across multiple technologies and legacy systems.

3.3 Data description

To validate and further develop the theoretical framework presented in the previous chapter, the empirical research was conducted with semi-structured interviews. Interviews were

conducted in August 2025 via Microsoft teams. The interviewees were sent preliminary interview questions (Appendix 1) in advance so that they could think about their answers. In addition, supplementary questions were asked during the interviews if further information was needed on a particular topic. The interview questions were designed to respond to themes that emerged from the research questions and the theoretical section, such as:

- Strategic goals and alignment
- Partner selection and strategic fit
- Collaboration process and trust building
- Risks and uncertainties in collaboration
- Defining and measuring collaborations success
- Long-term strategic implications

The first interviewee was the Chief Executive Officer (CEO) of the focal company, while the second interviewee was the Chief Technology Officer (CTO). Both hold doctoral degrees from the same Finnish university from which the focal company originated as a research spin-off, and they are currently the most important people in the company's operations. Table 3 details the dates and durations of the interviews.

Table 3. Interview dates and durations

Interviewee	Date	Duration of the interview
CEO	8.8.2025	1 h 2 min
CTO	27.8.2025	55 min

The number of interviewees (2) was small due to the schedule and circumstances. So, to complete the data, study also draws upon documentary evidence that includes internal materials and documents from previous collaboration projects with industrial partners. Some of these documents also include client-related materials, which illustrate the practical outcomes and challenges of earlier co-creation projects. These documents complement the interview data by offering concrete examples of collaboration practices and providing additional contextual depth.

Further data was gathered through the researcher's notes from five internal meetings held with the focal company between August and September 2025. These meetings included the CEO, CTO, the researcher, and two other team members, and they addressed topics such as business development, business model refinement, and preparation for ongoing and upcoming collaboration discussions with industrial partners. These observation notes provided access to focal company's strategic decision-making and complemented the interview data by providing insight into how collaborative aspects are implemented in practice. A combination of interviews, documents, and observational data was collected to develop a more multidimensional picture of the case under investigation.

4 Results

This section presents the results of the empirical part of the work. The results are structured according to the five phases of the proposed theoretical framework. In each phase results highlight how the focal company's experience validates, challenges or extends the insights from the literature. In addition, the chapter discusses new themes that emerged during empirical research.

4.1 Strategic alignment

Both interviewees from the focal company saw the strategic alignment as an important part of their collaborative projects. The long-term vision of the focal company is to make heavy machines more autonomous and both interviewees acknowledged that achieving this vision requires corporate partners, because they don't have the resources to do it alone. The CEO also stated in the interview that partnerships are also needed to bring their startup closer to the industry from the research world:

"That's why it's it was our main strategic goal and our vision for the future is to create this digital twin technology to automate heavy machinery, to make heavy machinery more intelligent as well. But in order to do that, we need corporate partners. We cannot do it by ourselves. We need to also obtain some expertise from the industry because it's not the same when you switch from academia to industry."

The focal company's motives for collaboration were also very similar to the motives mentioned in the literature. Both respondents highlighted that partnerships with corporates are needed to validate their technology in real-world contexts and to access markets that would otherwise remain unreachable. Collaboration with corporate partners was also seen as an opportunity to get more information about industry-specific problems and give access to resources which are otherwise inaccessible, such as data and industry expertise. In addition, the paying customers and revenue sources from collaborative projects were seen as a significant motivation for collaboration. Customer cases were also seen important tool for building track record and reputation as a reliable partner, as the CTO stated in the interview that: "*Collaboration gives a lot of boost and it also gives boost to pitching and*

saying we had a paid customer and so on”. These answers show that the focal company’s strategic intent for collaboration is fundamentally exploratory as they are trying to learn, validate, and build credibility.

Meeting documentation with potential partners also showed that corporates want partnerships to have a clear goal and produce quantifiable results as the document stated the one of the main goals for this technology to be: *"Reduce downtime and warranty costs by estimating critical internal states with physics and data."* This can cause challenges in aligning the startup's exploratory goals with the more exploitative goals of a corporate partner. The CEO stated in the interviews that they are trying to understand the partner's acute pain points instead of going with their own grand vision.

“We need to provide something of value for them. So it's not, it's not that we offer the solution just because we think we have everything that they need, but we need to 1st discover and figure out what are their main problems, for example what kind of machines they have the their problems or in which kind of components they have the problems regarding for example maintenances or failures. We need to understand how their business processes work or operational processes work.”

This process ensures that the collaboration is primarily built around the goals of the corporate partner and that a common goal is created. The startup’s broader goals, such as validation and learning are then achieved as a byproduct of solving the partner's specific problem.

4.2 Partner selection

The focal company’s partner selection process emerged as a deliberate and informed activity, guided by both opportunities and clear evaluation criteria. The most effective channel for initiating collaborations was through academic networks. Connections were created to industry during their research project and through industry-academia networking events. Both founders also explicitly identified the university and their professor that is well-known in the industry as the primary gateway to the corporations.

“So we had our, let's say supporter (the professor) in the university and many members of the industry knows him and he recommended us and also he was contacting us with the

manufacturers, so the manufacturers can actually trust us. So there's this big factor when there's a link in the university that actually supports you." -CEO

"So trust is mainly established just on one factor that we have a very strong reference Professor, because he's very active and everyone knows him." -CTO

The focal company's partner selection criteria focused on the digital maturity of potential partners. Firms already experienced with simulation models, IoT sensor deployment, and remote monitoring were considered more promising collaboration candidates. The middle size manufacturers were also seen as more promising partners than large manufacturers, because they often lack in house capabilities and large manufacturers do not necessarily trust new startups as suppliers of important systems.

Before approaching a new potential partner, the team conducted a "tentative study" to evaluate the company's level of digital maturity. The CTO stated the process in the interview as: *"We do make a base kind of a tentative study on what is their maturity in terms of this digital twin aspect... whether they use simulation models or not... At what stage they are using it?"* This pre-assessment helped avoid unproductive engagements and to ensure a stronger strategic fit. The tentative study was also used to determine the offers presented to potential partners.

The process from initial contact to an agreement is described as long and uncertain. The CTO stated in the interview that they usually approach potential partners with cold e-mails and the response rate is often very low: "*So initial step is sending them cold emails and describing our technology like an elevator pitch in there and also mention about a reference name of the people from where we got their contact and so on. 99 % of the time it's no response of course.*" If they get response to their initial contact the process usually involves multiple meetings over months. First meeting was to pitch the business idea, subsequent meetings involved more technical details, and further meetings to define value proposition. However, a common outcome even with interested parties is delayed engagement due to corporate budgeting and prioritization. This highlights the power asymmetry in the selection process where the startup frequently must wait for the corporate partner to make decisions about whether and when to move forward, depending on internal priorities that are out of the startup's control.

4.3 Collaboration management

The empirical findings show that the focal company approaches collaboration with industrial partners as a phased process designed to manage uncertainty and build trust. Both interviewees emphasized the importance of structuring engagements into distinct stages. They stated that collaboration usually starts with feasibility study that involves an initial assessment of customers technological capabilities. If the partner wants to continue the development after the feasibility study the second phase if the collaboration is the Proof of Concept (PoC) that is a small project that demonstrates the core technology's validity on a specific use case, like for example in one component of the machine. PoC is followed by technical pilot in which the validation is expanded to the integration in a real-world environment. Final phase of the collaboration would be the commercial pilot where the technology is implemented to the partners operations and jointly developed into a new service offering. This model lowers the entry barrier for the corporate partner, allowing them to commit minimal resources until value is proven at each subsequent gate. The meeting documents with potential partners presented the same model of a formal commercial plan, divided into three tiers: "Discovery Sprint", "a Pilot", and a "Production Subscription". This structured offering is a key managerial tool to make the collaboration process predictable and manageable for both parties and it is presented in the Figure 7.

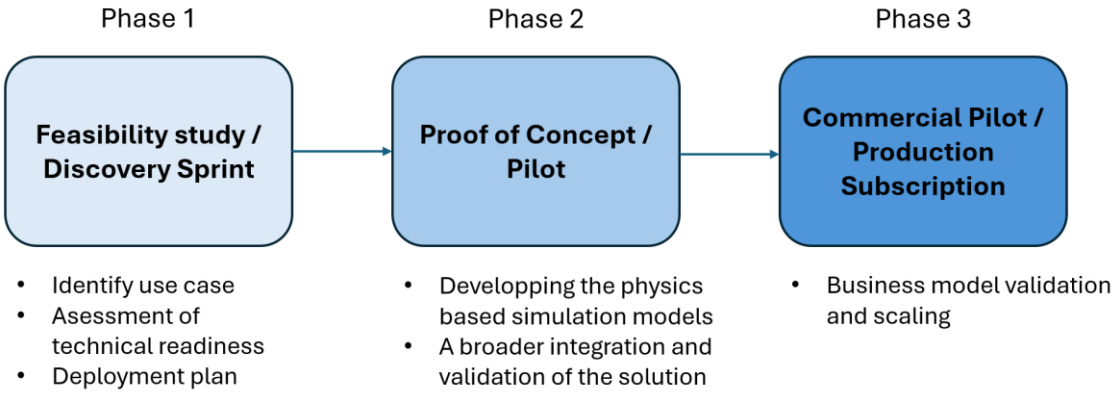

Figure 7. Different phases of the collaboration.

Another key theme in managing collaborations was trust building. Multiple factors contributed to the development of trust: their university background's endorsement, their doctorate-level expertise's technical credibility, and their interactions' personal integrity. The

CEO stated that sometimes the trust was built with the corporation during their research project when they didn't have their own startup established yet and the feasibility studies can also be very useful tool to build trust:

"This is the first step or let's say the first milestone of building trust, the university supports you and so you can go there to the market saying that you become to the university and you're analyzing this technology… And then the one of the most important part is to provide some feasibility studies to reduce the maximum amount of risk for the lowest price. So provide feasibility studies for them so you can analyze what is the technology maturity, what are the simulation and virtual models, what is the current status of the status of those models."

Transparent planning and communication was also another important theme for managing collaboration. The CTO detailed their use of Gantt charts and clear timelines as a way to manage their own work and to a way to build trust when they deliver the results in timely manner. One challenge mentioned by both interviewees was the differences in operational tempo and culture. The CEO stated in the interview that the corporate decision-making and resource allocation cycles are often slow and bureaucratic:

"And once you create the project proposal, then several steps follow, but that's from the company side, the approval from the CEO, the approval of the CTO, all this, let's say organizational approval that you need to, and it can take some time. And you need to provide several testimonials and several use cases on how this technology can be done because it's something new."

Empirical evidence also highlighted an internal management challenge related to founder overload. Collaboration is often challenging for small teams and can affect their work efficiency if administrative work and meetings take too much time away from technological development. The CTO stated in the interview that in an ideal situation people could focus on their own core competencies:

"I was the one doing both of it. Managerial people should just manage the people, the resources and the accounts and the budget and the funds and then like and setting up these meetings, discussions and so on. Technically guys should focus only on the technology."

4.4 Risk and governance

The interviews showed that the focal company operates with many risks common to early stage deeptech startups, which shape its approach to collaborations. The founders mentioned several categories of risk, which they addressed through informal practices and more formalized strategies.

A primary concern for potential partners is financial risk, as corporates are often hesitant to commit resources to unproven technology. This challenge was also a common theme in the literature of startup-corporate collaboration. In addition, the current economic situation has caused large companies to reduce their R&D budgets and focus more on their own core functions. Meeting notes with potential partners also stated that potential customers might see the value of the focal company's technology, but they are still exploring how to integrate it into their current data processes and services and therefore are not yet ready to invest in this technology. To mitigate these partner's financial risks and lower the barrier to entry for collaborations, the focal company has shaped its offering in the way that lowers the upfront investments and provides an opportunity to explore the possibilities of technology in low-risk setting. The CEO of the focal company said in the interview that this is one of the biggest challenges now for focal company's collaborative efforts:

"So that's why the challenge it's not often a lack of interest, it's just a lack of resources and they want to reduce the risks, and also the economic situation. So at the moment it's not the most favorable. So that's why it has been challenging. I think I will say that's the most relevant challenge so far."

Data privacy was also highlighted as a major risk in both interviews and meeting documents. Focal company's technology needs access for several types of sensitive data such as CAD models, sensor data, and operational information that corporates are often hesitant to share with new partners. The CEO stated in the interview that the needed operational information of the machines is often from the customers of the manufacturer and it can cause more problems with data sharing. The focal company has addressed this issue through specific technical safeguards that they planned with their potential partners. The company's default deployment model, which can be used on-premises, on the edge, or in the customer's own virtual private cloud, ensures that private information never leaves the partner's infrastructure. They also try to use "no CAD egress" where they only need extracted

parameters from the CAD models and core intellectual property remain securely behind the client's firewall. In addition, other security measures are used, such as customer-managed encryption keys, auditable usage logs, and, as an optional advanced feature, federated learning techniques that allow models to be trained across locations without merging or sharing raw data.

Technical integration was also seen as a significant challenge to the focal company. Many corporates operate with legacy software systems that are difficult to integrate with the company's simulation and data-driven models. This creates uncertainty around implementation timelines and costs, further complicating collaboration efforts. In addition to being a technological challenge, this is also a management problem, as companies often experience resistance to change for new systems and working against established practices. The CTO stated following about change management:

"In industry there is a thing that people don't want to adapt to new changes very soon. It's like a religion. They want to stick with just one, not change it, right? So that is like making them choose something new and saying this is the way forward. That is more one of the most challenging part"

The company's approach to IP has been relied on informal, trust-based mechanisms. The CTO described a previous project where they *"ended up giving up the codes to them,"* relying on the informal belief that *"our algorithm is complex enough for them to understand things by themselves."*. This strategy highlights how vulnerable a startup with little negotiating power is in its initial agreements, where the desire to secure a first customer can outweigh strict IP protection. They now have realized the limitations of this strategy and started implementing more official IP protections.

Another concern for the focal company is a model risk, or the potential liability associated with inaccurate predictions of their physics-based simulation models. The document from meeting with potential partner stated following:

"The accuracy of the virtual sensor is paramount. If the model does not accurately reflect reality, it can lead to worse outcomes than having no data at all. Liability questions: Who is responsible if a failure occurs that the virtual sensor did not predict?"

A failure of the technology in the field could lead to significant financial losses or safety issues for the partner, potentially resulting in reputational and legal consequences for the

startup. The focal company should therefore manage this risk in the future through clear contractual agreements with partners or their own insurance.

Finally, the company reflected on dependency risks**.** While they do not currently feel reliant on any single partner, the small number of paying customers creates vulnerability. The CTO stated in the interview that he is not concerned that collaboration would result in the company's technology being overly tailored to the partner's requirements, creating dependency and making collaboration with other companies more difficult in the future, because "*our technology is quite broad and we can, it's more about applied research for their case example".* The CEO was more concerned that the company's business is dependent on only a single collaboration project and that potential partners currently do not have the budget for new development projects.

4.5 Outcome and learning

The most significant outcome of the focal company's early collaboration projects has been more intangible than financial benefits. The most important achievements of the collaboration projects so far can be considered the access to real-world data, industry-specific expertise, technical validation of the solution in industrial contexts, and the reputational benefit of being able to demonstrate experience with paying customers. The CTO stated in the interview that just being able to say in pitches that "*we had a paying customer*" has increased their credibility with potential partners and investors.

In the interviews, the founders gave different definitions of successful collaboration projects and talked about success more in general terms than in precise measurable metrics for success. The company highlights timely delivery, achievement of agreed milestones, and positive feedback from corporate partners as immediate success criteria for collaborative project. After the first project completion the most significant indicator of success is progressing to the next phase in collaboration and obtaining follow up contract. The CEO stated in the interview that the end goal of these collaborations is to develop solution that can be sold continuously to the customers:

"I will say that you are successful when you achieve this commercial pilot, once you achieve the commercial pilot, I think you are ready to offer the solution continuously."

The documents from the meetings with potential partners add further details to defining success by giving more quantifiable key performance indicators that are tailored for the company's technological context, and which could be used in collaborative projects with customers or partners. One of the central indicators is the accuracy of remaining useful life (RUL) predictions. Accuracy of this prediction could demonstrate reliability in forecasting machine failures or maintenance needs that is central part of the focal company's value proposition. Closely related is the "early-warning horizon," which sets a minimum number of hours by which the system should detect anomalies or malfunctions before they cause downtime and at the same time ensuring that operators have enough time to take preventive action. They also planned one metric about avoided downtime that focuses on the outcome of these predictive capabilities. In addition, for these technical KPIs, the company has also planned to develop an ROI calculator that presents these results in financial terms. Together these metrics could create a structured way of linking technical performance to measurable business value.

Learning was also considered an important part of collaboration, and the company had indeed learned important lessons from previous collaboration projects that had helped make changes to the company's operations and value proposition. From the technological perspective the company learned that technology that is developed in laboratory faces significant challenges in real-world environments, dealing with data noise, legacy systems, and the financial infeasibility of ideal data collection setups. The CTO also stated in the interview that that at some point they should try to standardize their technology:

"We need to make it in a way that it companies can use it because everyone has different system on their end. Some people just have a laptop, some people have an actual machine, some people have a desktop. The data is also coming in a different way. So we need to standardize the technology"

Managerially, the founders acknowledged that it is difficult to balance technical development with business responsibilities, and they identified the need to separate these roles and expand the team with both technical and business-focused hires when the financial situation of the company allows it. In terms of strategy, the company learned that it is more important to show how its solution generates business value than to highlight its technical expertise. In their case this means that they need to develop their offering in a way that reduces their partners' costs, gives them efficiency gains, and new service opportunities.

One example of strategic learning was observed in a business modelling meeting at the focal company. The focal company learned through feedback received from the partners and its own internal discussions that it should focus its offering more on predictive maintenance and after-sales services as technology applications, as these areas have been identified as the most promising. They learned that while its technology had broad potential, its initial market entry would be more successful by targeting a specific problem that was easier for partners to budget for and integrate.

4.6 New themes

The five-phase theoretical framework covered many dynamics of startup-corporate collaboration, but the empirical findings revealed multiple additional themes which were not mentioned in the theoretical framework. The most significant new theme is that the university is still an active strategic player in the collaboration ecosystem. The university is not just where the spin-off started as it also acts as a reliable intermediary that helps the startup work with industry and lowers the risks involved. The CEO stated in the interview that university research project also served as a starting point for business collaboration for them:

"*So we started from the university collaboration and then it switched into the professional or industrial collaboration. In this case it was easy because it was the same partner. It just changed, let's say the role of us and the role of them. Before it was like, let's say like a low risk academic or university collaboration and then switched into a professional collaboration"*

The "research-to-business" project model made it easy for the first collaboration to happen without too much risk. Corporations could use the technology in a less risky way as part of an academic project, which is not something that is usually available in commercial settings. This helped the focal company make its first proof-of-concept and build a track record before officially becoming a business, which changed the usual path that a startup takes when it launches.

Another new theme was the challenge of the liability of foreignness, even when working in just one country. The fact that the founders were not Finnish entrepreneurs created a unique

social and cultural barrier that affected the partner selection and trust-building phases. The CTO said this was a trust issue: *"The one part which is not trustworthy is we we both are foreigners in Finland and trusting 2 foreigners running a Finnish company. It's not everyone's cup of tea."* This finding shows that for collaboration to work, it needs to be more than just a good fit in terms of strategy or technology. It also needs to fit in with the culture and society. This barrier called for additional strategies, such as the expressed desire to hire Finnish team members to improve relatability and ease business interactions.

5 Discussion

5.1 Evaluation of the theoretical framework

The theoretical framework of this study defined corporate-startup collaboration as a five-phase process including strategic alignment, partner selection, collaboration management, risk and governance, and outcome and learning. The framework was developed to show how startups think about working with big corporations. The results demonstrate the dynamic, iterative, and ecosystem-dependent characteristics of collaboration processes for early-stage deeptech startups that have originated from universities.

The results strongly back up the framework's focus on keeping strategic alignment as the foundation for collaborating. The focal company had a clear long-term goal: to become a system integrator that combines physics-based simulation with real-world data for intelligent machines. They also demonstrated flexibility and iterative development as they focused their offerings more on after-sales services and predictive maintenance rather than product development based on feedback from the collaboration. They also did understand the corporate partners motivations and pain points which was noted as important part for achieving the strategic alignment in the literature (Banka et al. 2024; Chappert et al. 2024).

The empirical findings mostly confirm the theoretical assumptions concerning partner selection while also enhancing them by uncovering context-specific dynamics relevant to early-stage deep-tech startups in industrial markets. The theoretical framework emphasizes that startups must proactively seek partners whose strategic interests are aligned, technological compatibility is ensured, and relational fit is established (Corvello et al. 2023; Riikkinen & Pihlajamaa 2022; De Groote & Backmann 2020). The focal company clearly demonstrates such selectivity in practice and provided insight to the theory about how to seek the collaborations. Data reveals a stark contrast in effectiveness as the cold emails had a very high failure rate, the introductions via the university network were the primary successful channel. The theoretical framework points out relational alignment and cultural fit. However, empirical findings reveal that the focal company's partner selection decisions were predominantly influenced by technical and operational readiness rather than relational considerations.

The empirical data from the focal company supports the theoretical framework of collaboration management and adds some context into it. Consistent with the literature, the results show that effective collaborations between startups and corporations involve continuous relationship building, transparent communication, and the establishment of trust (Chappert et al. 2024; Banka et al. 2025). The literature also talked about, that collaboration is often sequential process that can involve different stage-gates, and this is also in line with the different phases of collaboration that the focal company presented (Dizdarevic et al. 2024). Although in the literature these stages were mentioned as ways for corporations to optimize their resources for the best collaborations, in the results of this thesis the phases were introduced for the development of the startup's business model and de-risking the corporation's decision to collaborate. The interviews also showed that there were struggles with internal management, since the dual technical and managerial workload made it challenging to coordinate effectively. These findings indicate that collaboration management in startups is dependent upon internal readiness and resource allocation, aspects that are not often considered in current frameworks.

The empirical findings provide validation for the theoretical framework's main risks while revealing nuances in how risks appear and are governed in practice, particularly for a deeptech startup. The theory's emphasis on startup's fear of IP theft (Banka et al. 2024; Simon et al. 2019) was evident, but it wasn't the biggest concern in the collaborations. The focal company has relied to the complexity of their technology, but they have acknowledged the IP risk and are working on more formal ways of dealing with this issue. The theory's warning about dependency risk (Simon et al. 2019) is reflected in the empirical data, though it appears more as a business dependency than a technological one. The CEO's concern about relying on a *"single collaboration project"* due to corporate budget freezes captures this risk, confirming that dependency is not just about product roadmap but about basic financial survival.

Financial risk emerged as one of the most dominant themes in the empirical data. In line with prior research (Schuh et al. 2022), corporate partners were hesitant to allocate resources to unproven technologies and the current uncertain economic situation added to this issue. The company addressed this problem by creating a phased offering with low commitment that lowers the initial investment and lets partners test the technology step by step. This

method fits well with what the literature says about project-based collaboration models (Weiblen & Chesbrough, 2015).

The empirical data also highlighted the risk associated with technical integration challenges and this was not specifically addressed in the theoretical framework. The theory (Banka et al. 2025) talks about governance in legal and contractual terms, but the focal company's problems with legacy systems and change management also shows that technical integration is a management problem. Transparency issues related to data sharing and cybersecurity were also noticed to be challenge in digital co-creation in the literature (Sjödin et al. 2021). This problem was also recognized as one of the key problems for the company's collaborations and they have planned to address this with technological architecture that ensures that sensitive data never leaves the partner's infrastructure. The findings show that technical design decisions can function as governance mechanisms where trust and compliance are achieved through system design.

The case also showed a new type of risk called model risk that is unique to data-driven and simulation-based technologies. Model risk is different from regular IP or financial risks because it means that an incorrect algorithm could lead to operational failures or even safety incidents. This brings up new questions about governance, such as who is responsible and who is liable, that most startup-corporate collaboration theories don't cover.

The empirical findings generally support the theoretical perspective (Banka et al. 2025) that collaboration outcomes include both tangible and intangible that should be measured with quantifiable performance metrics and the (Corvello et al. 2023) perspective that says that many of the benefits startups seek from corporate collaborations can be difficult to quantify but can still have significant long-term value. The theoretical framework highlights measurable performance metrics, but the company's current evaluation mostly uses process-based indicators like meeting milestones, delivering on time, and making partners satisfied. The internal documents, on the other hand, show that there is a shift toward more advanced and measurable KPIs, like how accurate RUL predictions are. In short, empirical evidence shows that for deep-tech startups, the Outcome and Learning phase is less about generating revenue right away and more about building credibility, collecting data, and learning as an organization so that business models can be scaled up in future collaborations.

Table 4. Comparison of theoretical framework and empirical findings

Phase	Main points from literature	Main points from empirical data
Strategic alignment	• Maintain strategic focus • Clarify goals	• Exploratory strategic intent • Startup goals achieved as a byproduct of solving the partner's specific problem
Partner selection	• Actively seek corporate partners • Evaluate stragic fit	• Relational access through networks • Tentative study to asses partners digital maturity • Power asymmetry in the selection process
Collaboration management	• Build trust • Transparent communication • Regular follow-up meetings • Continuous exchange of information and feedback	• Phased engagement model • Trust building with academic endorsement and technical credibility
Risk and Governance	• Clear contratctual agreements • IP strategy • Limit dependency	• Corporate partner's financial risk • Technical safeguards for dataprivacy cybersecurity • Technical integration risk • Model liability • Liability of foreignness
Outcome and Learning	• Demonstrate impact with concrete performance indicators • Capture the results to inform future strategy	• Technical validation • Industry specific expertise • Reputational benefit

The empirical findings mostly validated the five-phase theoretical framework developed in the literature review. The empirical data also revealed various context-specific issues that add to theoretical understanding. These include the importance of academic networks, the introduction of phased collaboration frameworks to mitigate risks, and the emphasis on data protection and integration challenges in deeptech environments. Table 4 shows how the theoretical framework and the empirical findings fit together.

5.2 Practical implications

The results of this study have several practical uses for the focal company as it keeps growing and expanding its collaboration with industrial partners. The company has already shown that it has strong technical skills and a clear plan for the future. However, the results show that there are still some areas where management practices, partnership strategy, and internal organization can be improved to help the company grow over the long term.

The study shows that the focal company's strategy has changed from one that was based on research towards a commercially oriented business. To keep this change going, the company needs to continue making its value proposition clear and communicating it in business terms that make sense to corporate decision-makers. The planned ROI calculator is a good start, because with that technical performance metrics can be turned into financial and operational benefits. Regularly reviewing and improving the value proposition based on partner feedback will help keep everyone on the same page strategically and stop them from getting too focused on technology goals.

The focal company should also formalize their collaboration management practices. The phased collaboration model is a good way to reduce the risks of partnerships, but to make it even stronger, the company should also make clear internal guidelines for each phase of the collaboration. These should include details about objectives, deliverables, timelines, and success metrics for each stage. As the business grows, making these ways of working together official will keep them consistent and allow more people to use them. This will help better manage partner expectations from the start, shorten sales cycles, and ensure that communications remain consistent.

The focal company’s collaborations so far have generated significant learning outcomes. The focal company should try to capture these lessons learnt in a more systematic way with a formal "Post-Collaboration Review" process after each collaborative project. This review should capture technical learnings, client feedback on the value proposition, and strategic insights about the partner's industry. Systematizing this learning ensures that empirical knowledge is captured and directly feeds back into refining the company's strategy, offerings, and internal processes. Keeping organized records of project metrics, success stories, and testimonials would also bring more credibility in future negotiations with potential partners.

A key practical implication for the focal company is that it needs to find additional funding to help with strategic hiring and get past its current "chicken-and-egg" problem. The empirical findings indicated that the company is in a position where it requires corporate partners to validate its technology, but the potential collaborators often require proof of validation prior to agreeing to collaborate. This cycle makes it hard for the company to grow and show off its technological and business potential. By obtaining funding through instruments, like Business Finland grants, EU programs or private investors the company

could allocate resources for dedicated personnel in business development and project management, as well as for independent pilot projects to demonstrate its technology in real industrial settings. Such funding would not only relieve the founders from excessive managerial workload but also enable the company to generate proof points that strengthen credibility with future partners and investors.

6 Conclusions

The objective of this study was to create a practical and evidence-based framework that helps deeptech startups manage collaborations with established corporations. The study examined how startups can strategically leverage collaboration, what challenges exist in collaboration, and how success of collaboration should be defined and measured. The study was conducted by combining insights from academic literature and empirical data collected from a case company. The results of the work improve the theoretical understanding of the topic by providing context-specific insights and it also provides practical guidance for early-stage deeptech startups operating in similar industrial environments.

6.1 Answering the research questions

RQ1: *"What are the strategic activities for a deeptech startup to collaborate with industrial corporations?"*

The study found that a startup needs to transform its long-term technological vision into a commercially viable product. The key activity for this is designing a phased commercial model that lowers the risk for engagement to the corporate partner and aligns the immediate project goals whit the strategic vision. Another observation was that startups should actively select partners based on strategic fit and digital maturity, but the critical activity is leveraging trusted intermediaries to initiate contact and build the needed credibility required to enter serious discussions. The central activity for managing the partnership itself is the disciplined execution of the phased model by transparent communication, careful planning, and milestone-driven projects to build trust and demonstrate value incrementally. Proactive risk management and governance is also an important strategic activity which, according to the study, should be done through a combination of formal safeguards and strategic adaptations to mitigate IP, data, financial, and model liability risks. The final strategic activity is to make learning adaptation from the collaboration to systematic process that captures both tangible and intangible outcomes and use these learnings to refine the business model, value proposition, and internal operations.

RQ2: *"What are the most critical uncertainties that startups face when collaborating with corporations, and how they manage them?"*

The study identified many significant uncertainties that startups face when collaborating with large corporations. The results show that startups can manage these uncertainties with mix of technical, strategic, and relational mechanisms.

Technological and market uncertainty was one major issue. It comes from corporations not wanting to work with new technologies that aren't proven yet and whose usefulness and business value are still unclear. The focal company used a phased collaboration model to solve this problem, as they started with small, low-risk projects that showed proof of concept before moving on to bigger ones. Financial uncertainty was another major barrier, as corporate partners didn't want to spend their limited R&D budgets on new innovations, especially in uncertain economic times. The focal company responded to this problem in the same way by offering low commitment projects, and by communicating the benefits of their technology as clear business benefits. Technical integrations also bring their own uncertainties to collaboration. When startups try to connect their advanced, data-driven solutions with the software and operational systems of a corporate partner, they often run into problems. These problems with integration lead to both technical and management issues. For instance, problems with integration can make projects take longer and cost more. Also, established engineering teams in corporations may not want to change how things are done or use new technologies.

Uncertainty about data protection and IP was also identified as major barrier to trust in collaboration, with corporations worried about data breaches and startups worried about IP theft and other liabilities. To address this the company planned to use a proactive governance approach that included technical protection like "no CAD egress", as well as formal IP strategy to protect trade secrets. Model liability was also identified as its own unique uncertainty, which can be protected against, for example, with clear contractual agreements.

Finally, relational and cultural uncertainty, such as the "liability of foreignness" and the fact that decisions are made at different speeds, caused challenges to mutual understanding and trust. To address these issues, the focal company used recommendations from university networks, open communication and planning, and the ability to be patient to keep up with the slower pace of corporate decision-making.

RQ3: "*How should startups define and measure the success of corporate collaborations?"*

The study found that, for early-stage deeptech startups, the most significant outcomes of collaboration are often intangible rather than financial. These are things like getting access to industrial data, getting technical validation, boosting your credibility, and learning about what customers want and how things work in your field. However, the study also showed that it is useful to measure the success of collaborations with measurable indicators. The focal company has planned KPIs that are specific to its field, such as prediction accuracy for remaining useful life (RUL), early-warning horizons, and avoided downtime. These metrics help measure the value of the solution and make it easier to communicate the value to potential future partners. So, success should be defined as both moving toward commercial maturity and being able to show real, verified business value through working together.

6.2 Limitations and future research

While this study provides an in-depth analysis of corporate-startup collaboration from the startup's perspective, it has its own limitations that are important to recognize. First limitation is the fact that main part of the empirical data was two semi-structured interviews with the company founders, which is a very limited number. These interviews offered insights into the startup's strategic thinking and collaborative practices, but they reflect the viewpoints of a limited number of individuals from a single organization. This narrows the perspectives covered in the study and makes it difficult to generalize the results to other situations. Including more detailed opinions from corporate partners could have provided a more comprehensive picture of how the collaboration worked and the problems that arise between the companies.

This study also focuses only one early-stage deeptech startup operating in the Finnish industrial context. This means that the results reflect the features of the company's industry's environment and maturity level. The processes and challenges identified can be very different across industries, countries, and stages of business development. Future studies could expand the analysis by including various cases across different sectors to evaluate the differences in strategic alignment, partner selection, and risk governance based on firm size, industry, or type of innovation.

Further research could also examine the development of collaboration over a longer period of time. Research like this could help explain how initial strategic plans can lead to long-term outcomes and how early partnership experiences can influence future collaborations. Quantitative or mixed-methods studies could also be a good way to investigate the effectiveness of specific collaborative practices.

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Appendix 1. Interview questions

1. Background and context

- Can you briefly describe your startup and its current stage of development?
- What kind of collaboration(s) have you engaged in with industrial corporations?
- What were your main motivations for entering into these collaborations?

2. Strategic goals and alignment

- What were your startup's strategic goals entering the collaboration? And are those same today?
- How did you ensure that your goals aligned with those of the corporate partner?
- Were there any early discussions to define a shared vision or expected outcomes?

3. Partner selection and fit

- How did you choose or get connected with your corporate partner(s)?
- What factors were most important in determining whether they were a good fit?
- Did you assess strategic or technological alignment before proceeding?

4. Collaboration process

- Can you describe the steps from initial contact to active collaboration?
- Can you describe how trust was established and maintained during your collaboration with the corporate partner?
- Were any specific models or structures (accelerator, joint project, programs) used?
- What roles or people (internal sponsors, intermediaries) helped manage the collaboration?

5. Value and learning

- What kinds of resources (e.g., funding, infrastructure, expertise) did the corporation provide? Are the desired resources still the same?
- What did your team learn from the collaboration technologically, managerially, or otherwise?
- Were there any specific moments or milestones where value creation was most apparent?

6. Risks and challenges

- What were the biggest challenges or tensions you encountered?
- How did you manage issues around intellectual property, speed, or cultural differences?
- Did you experience any risk of dependency on the corporate partner?

7. Measuring success and outcomes

- How do you define or measure the success of these collaborations?
- What tangible results came from earlier collaborations?

8. Long-term vision and strategy

- Did the collaboration support your long-term strategic vision?
- Are you pursuing further partnerships, and what will you do differently next time?
- What advice would you give to another startup entering a similar collaboration?