Developing an Evaluation Framework for Early Stage Technologies

A Case Study in the Aerospace Industry

Master's thesis in Management and Economics of Innovation

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Abstract

In today's rapidly evolving business landscape, innovation and R&D activities are crucial for competitive advantage. Many firms struggle with their innovation performance and especially at the early decisions, which often decide the outcome. This thesis delves into the evaluation of early stage technologies at a tier 1 supplier in the aerospace industry, focusing on the Research & Technology division. Today's evaluation process is generally effective, but fragmented and lacks a structured approach, clear tools, and a decision-making process.

Through a case study approach, the thesis utilized a literature review, internal interviews, and workshops. First, with data obtained from the literature review and interviews, the thesis investigated what criteria are necessary when evaluating early stage aerospace engine technologies. Secondly, drawing from the fields of New Product Development, tools and methods were assessed and tested within Research & Technology through workshops. Lastly, based on the findings a systematic process was developed when evaluating early stage technologies.

The research identified 22 criteria distributed within 4 overarching areas for a comprehensive evaluation. A modified scoring model was deemed the most relevant utilizing rating scales and which stimulates discussion. Evaluators conduct individual evaluations of the technology before being merged with all evaluations. If large deviations between the evaluators occur, discussions are launched. Further, to enhance flexibility the ability to assign weights were introduced as well as visual representations of technologies currently in the portfolio to maintain a balanced and strategically aligned portfolio. By utilizing the framework proposed in this thesis the company can incorporate a systematic way to assess early stage technologies individually and across the portfolio.

Keywords: *Technology Evaluation, Portfolio Management, Scoring Model*

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Alexander Säll & Isak Larsson, Gothenburg, May 2025

List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

AHP	Analytical Hierarchical Process
ECV	Expected Commercial Value
NPD	New Product Development
RRSP	Risk- and Revenue-Sharing Partnership
TRL	Technology Readiness Level

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1

Introduction

This chapter provides an introduction to the thesis and its contextual foundation. It presents the background to the study, its overall purpose, and outlines the research questions guiding the investigation. Finally, the chapter describes the scope and delimitations of the research.

1.1 Background

R&D is a crucial driver of innovation and competitive advantage in today's rapidly evolving business landscape. New product development (NPD) and innovation for long-term success is critical but firms continue to struggle with finding the right strategy, achieving a balanced portfolio of projects, and the process model to deliver innovation performance (Knudsen et al., 2023). 75% of new products ultimately fail in the marketplace (Cooper, 2001) and in a study by Cooper and Kleinschmidt (1995) it was revealed that 55% of companies report not meeting sales or product performance objectives in their efforts.

NPD resources are often limited and too valuable to be spent on the wrong projects (Cooper, 2001). With scarce resources, choosing the right NPD efforts involves concentrating on the truly deserving products (Cooper, 2001). In adjacent fields of study, Savoia (2011) affirms that many are focused on doing it right, when they instead should focus on doing it right. Cooper (2001) argues that companies that succeed in optimizing their new product investments, including achieving an ideal balance of projects and building a portfolio that supports the business strategy, will win in the long run.

Meanwhile, the early stages of the NPD process represent a critical point of vulnerability where initial choices lock in trajectories. Cooper (2001) finds that the greatest differences between winners and losers in NPD lies in these first few plays of the game that seem to decide the outcome. At many firms, these early decisions are the weakest link in their NPD process (Cooper, 2001). Common problems in NPD is the gap between required resources and available resources for the development (Cooper & Edgett, 2003). This gap frequently leads to longer than intended time-to-market (TTM), suboptimal performance, and imbalance in portfolios (Cooper & Edgett, 2003).

There exists different approaches to evaluating new products. Cooper (2001) states three main approaches that aim to enhance the NPD process. The first is benefit measurement techniques emphasizing methods that utilize subjective assessments of strategic factors. The second is traditional economic models such as calculating the expected payback period or the net present value (NPV). The last approach aims to attain a portfolio that maximizes the value, is balanced, and aligned to the firm's strategy.

1.2 Research Setting

The study is conducted in collaboration with a tier 1 supplier specializing in airplane structures and engine structures. The Company supplies products and services to a broad range of customers, including commercial and military aircraft manufacturers, engine contractors, and other Tier 1 suppliers. The Company operates across multiple nations and their components are featured on a majority of all flights that take off and land each day. As of 2025, the Company holds partnerships in numerous Risk and Revenue Sharing Programs (RRSPs), through which it maintains a minority share of ownership in its active programs. A significant portion of the Company's cash flow is derived from aftermarket services, including repairs, part replacements, and maintenance operations.

The Company provides advanced aerospace components and technical solutions to two different markets; Engines and Structure. The study will take place within the R&D-division of the Engine divsion at the Company. The R&D-division is facilitated by a division called Research & Technology (R&T). R&T is divided into three sub-divisions. In this report, these sub-divisions will be referred to as R&T 1, R&T 2, and R&T 3 for confidentiality purposes.

The role of aircraft engine OEMs can be likened with that of system integrators, coordinating complex networks of suppliers responsible for significant portions of engine design and development. Suppliers such as the Company have seen their roles evolve to include more advanced design responsibilities (Almeida, 2001), often taking full ownership of specific components or subsystems. This shift also entails greater involvement in the development of new and innovative technologies. However, as Högman and Berglund (2007) point out, while global trends and industry expectations are typically well defined at a strategic level, the translation of these expectations into actionable technology development at the supplier level remains ambiguous.

Unlike the conventional tiered buyer-seller model, the aircraft engine industry operates within a network of six interdependent groups: airlines, airframers, certification agencies and professional bodies, government-funded laboratories and universities, risk and revenue-sharing partners, and suppliers as presented in Figure 1.1 (Prencipe, 2004). Much like in traditional buyer-supplier relationships though, the strategic direction of a supplier in partnership programs is dependent on the decisions made by their customers. This in combination with long development timelines entails difficulties in deciding which strategic initiatives to prioritize. However, in stark contrast to traditional buyer-supplier relationships, the OEM rarely provides explicit specifications for new products, but rather expects the supplier to bring forward new technology which results in a certain performance on the end product. This mix between technology-push and market-pull puts responsibility on the supplier to collect and compile information to align technology projects with market requirements. With new technologies being important means for seizing new business opportunities and responding to the strategies of customers and partners, there is a need to systematically manage the uncertainty in new technology development.

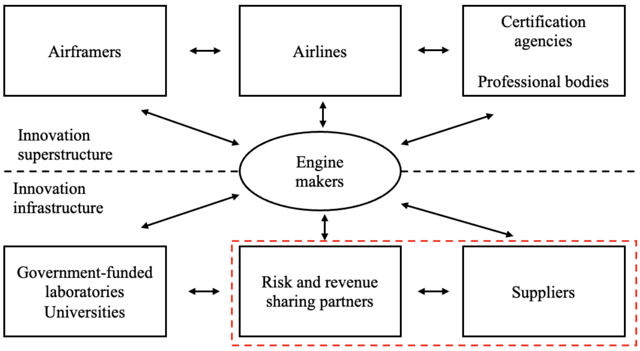


Figure 1.1: Aerospace Engine Industry Network (Prencipe, 2004) - Company in red box

Financial constraints limit both the number of programs and how big of a share the company can pursue. Restricted access to skilled personnel and expertise poses a challenge, making it difficult to manage multiple new programs simultaneously. Meanwhile, all programs are not successful and the Company aims to participate in the programs that are deemed the most strategic, valuable, and with the highest probability of success.

With both development timelines and payback periods being exceptionally long in the aerospace industry, evaluating whether to proceed with a new technology becomes a critical decision in the new product development phase. The current decision-making process at the Company is generally effective, but fragmented and lacks a structured approach. Further, there are no clear tools that are utilized when comparing and evaluating different technologies in the early stages of development.With no clear decision-making process, it is challenging to evaluate and prioritize technologies against each other. Given the industry's long development cycles, systematically exploring tomorrow's technologies is essential for securing future revenue streams and ensuring the long term sustainability for the Company.

1.3 Purpose and Research Questions

The purpose of this thesis is to develop a comprehensive and systematic approach for the early-stage evaluation of aerospace engine R&D technologies. To achieve this, the research integrates three key components into a coherent and structured evaluation framework. First, a set of criteria will be identified to enable a comprehensive assessment of relevant technologies. These criteria will then be embedded within an evaluation tool or method that serves as the operational platform for applying the framework. Finally, the tool and criteria will be supported by a structured process to ensure consistency, robustness, and practical applicability. The resulting framework aims to support decision-makers in analyzing and evaluating new technologies under conditions of uncertainty.

In order to guide us in the fulfillment of this case study's purpose, three research questions have been formulated which are intended to be resolved by the end of this study. These research questions are presented below.

RQ1: *What financial, technical, strategical, and other criteria are essential for evaluating early stage aerospace engine R&D technologies?*

RQ2: *What tools or methods are the most suitable for managing risks and uncertainties in the evaluation of early-stage aerospace engine R&D technologies?*

RQ3: *How can these insights be integrated into a systematic framework to guide the evaluation process in aerospace engine R&D technologies?*

1.4 Delimitations

The research contains a few delimitations which limit the scope and depth of the analysis. First of all, the research is exclusively applied to a specific company within the aerospace industry and the business area relevant to aero-engine systems and engine technologies. The purpose of delimiting the study to one business area is to reach a greater depth in the study. Additionally, the study does not aim for generalizability in the results, but rather an adaptation to the specific case company and its environment.

The study will be conducted over a four month period. This leads to the research having to be adapted to these time-constraints, meaning that we will be forced to consider practical limitations with regards to the amount of data that could be collected and analyzed in the relatively short time-period. This might lead to a narrower than ideal scope in the data collected and could potentially mean that a theory will need to be formulated before the research has reached the point of theoretical saturation.

Lastly, as parts of the Company's operations contain confidential information, some results are excluded from the final study. This could potentially compromise the transferability of the study. However, the intention is that no confidential information will be crucial for being able to fulfill the purpose of the study and answer the research questions.

2

Frame of Reference

This chapter represents the findings from established literature and presents a frame of reference in order to answer the research questions. The selected literature draws primarily from the fields of innovation management and NPD.

These fields have been chosen because they provide a systematic and well-validated foundation for evaluating R&D initiatives, which are typically characterized by high uncertainty, long development timelines, and constrained resources. The literature used in the thesis has broad applicability and a practical orientation. When evaluating a technology thoroughly, one must also consider the feasibility and execution of the associated projects needed to develop the technology. Thus, the evaluation must not only consider the technical and commercial potential of a technology but also the feasibility, resource requirements, and strategic fit of the associated development projects.

Technology evaluation means one has to make a decision on what technology to invest in given limited resources. Three approaches to make sure to invest in the right initiatives will be introduced in this chapter; benefit measurement techniques, economic models, and portfolio selection and management.

Lastly, several key technology evaluation criteria commonly cited in the literature are presented. These criteria, identified by multiple scholars, are regarded as essential considerations in the evaluation process.

2.1 Picking the Winners

Cooper (2001), one of the most cited authors within the field of product portfolio management, mentions two fundamental ways to win at product innovation; doing projects right and doing the right projects. Within the context of this study, doing the right projects and choosing the right technologies to invest in is of utmost importance.

New product development resources are often limited and too valuable to be spent on the wrong projects according to Cooper (2001). He also highlights that most businesses face more opportunities for new product development than they have resources available to bring them to market. Choosing projects is about concentrating scarce resources on the truly deserving products. Cooper (2001) argues that those companies which effectively optimize their new product investments — including achieving an ideal balance of projects and building a portfolio that supports the business strategy — will win in the long run.

Cooper (2001) states that the three main approaches to project evaluation and selection include benefit measurement techniques, economic models, and portfolio selection and management methods.

2.1.1 Benefit Measurement Techniques

As stated by Cooper (2001), benefit measurement techniques depend on a knowledgeable and well-informed management team to evaluate projects across a range of characteristics. Rather than relying on traditional economic metrics, these methods emphasize subjective assessments of strategic factors, such as alignment with corporate objectives, potential for competitive advantage, and the attractiveness of the target market (Cooper, 2001).

Benefit measurement techniques acknowledge the limited availability of concrete financial data during the early stages of project evaluation. According to Cooper (2001), these methods are widely used and are specifically designed to incorporate the subjective input of management, often through tools such as comparative approaches, simple checklists, and scoring models.

Comparative approaches, such as the Analytical Hierarchy Process (AHP) developed by Saaty in 1980, provide structured support for multi-criteria decision-making. AHP integrates both qualitative and quantitative factors by breaking down complex problems into a hierarchy of criteria, enabling pairwise comparisons and priority weighting. As per Palcic (2009), AHP as a tool is especially applicable when a certain degree of expert judgement is required. In many situations, particularly in project selection, there is a need to evaluate attributes that cannot simply be quantified or put into monetary terms. These might include risk, technological feasibility, commercial value, and other factors that are subject to a high degree of uncertainty. In Figure 2.1, a simple AHP hierarchy is presented with an objective, underlying criteria at level 2 and the alternatives to choose from at level 3.

Saaty (1987) outlines three key principles in the AHP method. The decomposition principle involves breaking down a complex decision problem into a hierarchical structure, starting from broad criteria and dividing them into more specific subcriteria, meaning that in Figure 2.1, an extra level can be added between level 2 and 3. The comparative judgment principle allows decision-makers to evaluate elements through pairwise comparisons to determine their relative importance. Finally, the synthesis of priorities combines these judgments by calculating weighted scores across the hierarchy to derive overall priorities for each alternative. This structured approach helps decision-makers evaluate trade-offs and make more objective, transparent choices. Additionally the process enables the evaluation and analysis of multiple criteria simultaneously.

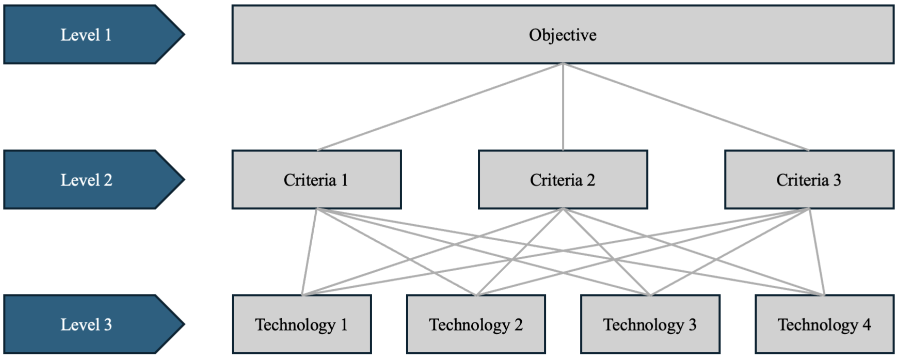
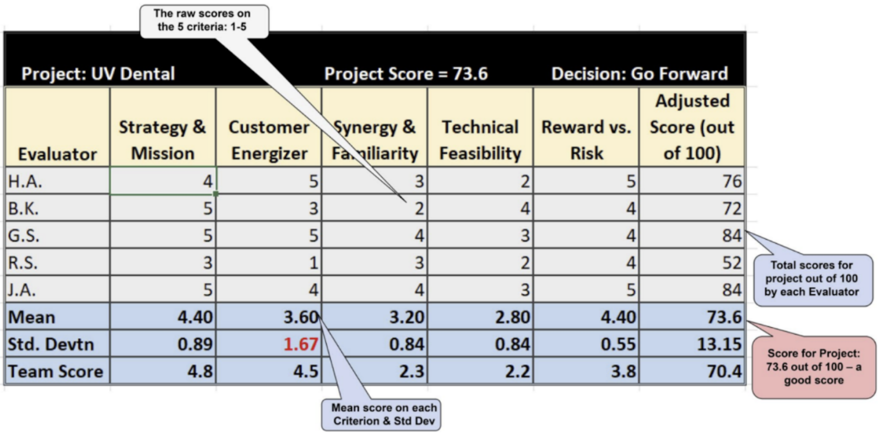


Figure 2.1: Example of an Analytical Hierarchical Process

The second benefit measurement technique is checklists and is described by Cooper (2001) as one of the simplest methods for evaluating new product proposals. Checklists can be used to assess projects through a series of qualitative yes/no questions. A project may be required to meet all or a subset of these criteria to pass the evaluation. Checklists are usually used as a tool to be able to make a go/no-go-decision for single projects but not for rating different projects against each other. In a study by Cooper et al. (2002) the most popular selection criteria to use in the checklist were strategic fit, financial reward, risk, probability of success, and the business's technological and commercial capabilities to undertake the project. Cooper (2001) finds that checklists are effective for evaluating new products, especially in the early stages, and provide a practical approach to assessment. He further states that their implementation is simple, as they incorporate multiple criteria, ensuring that key factors are not overlooked. This method promotes a consistent and systematic evaluation process while requiring minimal financial input and avoiding dependence on a single criterion. However, checklists have certain limitations. The selection of questions is subjective, relying on the developers' best judgment of the most important factors to consider. Additionally, the method does not account for the varying significance of different elements within the list. Cooper (2001) also points out that the responses provided may be subjective and may not always reflect careful consideration.

This leads to the third benefit measurement technique, the scoring model. A scoring model serves as an extension of the checklist by allowing projects to be evaluated on a range of criteria using rating scales rather than simple yes/no answers. The scales often range from 0-10 or 1-5. These ratings are then combined to produce an overall project score. This approach addresses several limitations of checklists, such as expanding the range of possible responses, acknowledging that some criteria carry greater importance than others, and generating a single project score, often referred to as the project attractiveness score which can be used to rank projects or products against each other or against a minimal acceptable score (Cooper, 2001). In the scoring model, stakeholders independently evaluate the project, and their ratings are consolidated into a single score (Cooper, 2001).

In a recent article, Cooper and Sommer (2023) present a model that has proven to be both useful and predictive for evaluation of NPD. The model resembles the scoring model to a high degree but it's also a decision-making system designed to stimulate critical thinking. Through empirical research, Cooper and Sommer (2023) found five factors that proved to be successful in evaluation; mission and strategy, customer energizer, synergy, technical feasibility, and reward versus risk. According to Cooper and Sommer (2023) users of the model highlighted that, while the overall project value score is helpful for prioritization, its true strength lies in the behavioral aspect. The process brings together senior stakeholders to collaboratively assess the project and through projecting each stakeholders rating on a large screen, are forced to discuss key questions (Cooper & Sommer, 2023). Figure 2.2 depicts how the projection can look. Each evaluator has scored the project on criteria within each factor and yields an overall score. If there exists a large enough deviation between the scores, the highest and lowest individual evaluator must engage in debate and align their perspectives. Ultimately the goal is to reach a well-informed decision (Cooper & Sommer, 2023).



Project: UV Dental — Project Score = 73.6 — Decision: Go Forward

Evaluator	Strategy & Mission	Customer Energizer	Synergy & Familiarity	Technical Feasibility	Reward vs. Risk	Adjusted Score (out of 100)
H.A.	4	5	3	2	5	76
B.K.	5	3	2	4	4	72
G.S.	5	5	4	3	4	84
R.S.	3	1	3	2	4	52
J.A.	5	4	4	3	5	84
Mean	**4.40**	**3.60**	**3.20**	**2.80**	**4.40**	**73.6**
Std. Devtn	**0.89**	**1.67**	**0.84**	**0.84**	**0.55**	**13.15**
Team Score	**4.8**	**4.5**	**2.3**	**2.2**	**3.8**	**70.4**

The raw scores on the 5 criteria: 1-5

Total scores for project out of 100 by each Evaluator

Score for Project: 73.6 out of 100 – a good score

Mean score on each Criterion & Std Dev

Figure 2.2: The scores from each evaluator is displayed on a large screen at the decision meeting (Cooper & Sommer, 2023).

2.1.2 Economic Models

Economic models treat project evaluation much like a conventional investment decision. They are familiar to managers, and they are accepted for other types of investment analysis in businesses, such as capital expenditure (Cooper, 2001). Cooper (2001) also states that the two most popular financial methods for new products are payback period and discounted cash flow (DCF), which includes NPV. According to Cooper et al. (2001), financial methods were found to be among the most popular methods when evaluating new products.

The payback period of an investment is a simple financial metric that evaluates the time required to recoup the cost of investment ("Corporate Finance Institute", n.d.). Cooper (2001) presents three different measures of time; cycle time as the time from project initiation to market launch, payback period as the time from launch date to the full recovery of initial expenditures, and break-even time as the time from project initiation to when all expenditures are recovered. Cooper (2001) acknowledges that these metrics — just as financial tools, have advantages such as capturing both risk and return, having a faster payback time which means a higher return on investment and a lower risk, and use a cash flow approach and hence avoid accounting method disputes.

An NPV analysis involves projecting annual cash flows and discounting them using the required rate of return, ultimately yielding the investment's present value (Gallo, 2014). If the yielding NPV is positive, the project has cleared the discount rate. According to Cooper (2001), a DCF approach has certain advantages such as recognizing that money has time value and that it tends to place less emphasis on cash flow projects that are many years into the future.

A third financial option mentioned by Cooper (2001) is the expected commercial value (ECV) of a project. The ECV utilizes an options pricing theory, meaning it realizes that new product projects are investments made in increments (Cooper, 2001). This stands in contrast to the NPV and payback period methods assuming an all-or-nothing decision situation (Cooper, 2001). A project can have different outcomes and each scenario is assigned a possibility with a subsequent project value. The ECV is calculated by multiplying each possibility with the situation's value and adding the results (Cooper & Edgett, 2003).

The most difficult project selection decisions occur early in the process when limited information is available, making traditional financial methods less effective due to their reliance on precise data Cooper (2001). Conducting financial analysis too soon tends to favor only low-risk projects, as probability-adjusted methods often undervalue high-risk opportunities (Cooper, 2001). According to Cooper et al. (2001), firms that rely heavily on financial tools tend to perform worse, as the complexity of these methods often surpasses the quality of the available data. In contrast, top-performing companies place greater emphasis on non-financial approaches like strategic alignment and scoring models. However, Cooper (2001) states that economic models are still a powerful and useful tool in project evaluation, provided it is used at the right time and for the appropriate project type.

2.1.3 Portfolio Selection and Management Methods

Patterson (2004) outlines portfolio management as a process involving portfolio assessment, resource management, and portfolio review, all aimed at enhancing a company's long-term performance. Souder (1994) emphasize five factors that need to be taken into consideration for effective project and portfolio management. Firstly, the organizational overarching strategic objectives and organizational mission must be reflected in the decision model. Cooper et al (2002) found in a study that businesses that prioritize strategic alignment in their evaluation methods perform better than those that don't. Secondly, Souder (1994) states that the model must allow a comparison between different types of projects. Thirdly, the model must be modifiable and accommodate future potential adjustments. Fourthly, the model should be easy to use by people in all areas of the organization. And lastly, the model should not be overly time consuming and expensive (Souder, 1994). Cooper (2001) defines portfolio management as *"A dynamic process, in which a business's list of active new product (and development) projects is constantly updated and reviewed. In this process, new projects are evaluated, selected, and prioritized; existing projects may be accelerated, killed, or deprioritized; and resources are allocated and reallocated to active projects."*

Chien (2002) notes that most studies on portfolio selection evaluate projects in isolation before aggregating them into an R&D portfolio. However, he argues that assembling a set of individually strong projects does not automatically lead to an optimal portfolio. Supporting this view, Schilling and Hill (1998) emphasizes that new product development should be managed as a balanced portfolio, comprising projects at various stages of development.

Cooper et al. (2001) describe that portfolio management offers several key benefits, such as establishing a common foundation for decision-making, prioritizing major and breakthrough initiatives, enhancing the strategic alignment of the portfolio, balancing short- and long-term projects, fostering unified support and stakeholder buy-in, and strengthening overall strategic planning (Cooper et al., 2001). Further, Cooper et al. (2001) states that top performers in portfolio management distinguish themselves from weaker counterparts by employing a clearly defined and consistently implemented approach. Their methodology is explicitly structured, governed by clear rules and procedures that facilitate systematic decision-making. The method is supported by the management and it treats all projects as a portfolio — considering them not in isolation but rather in aggregation (Cooper et al., 2001).

In a study by Cooper et al. (2002), the authors analyze the usefulness and applicability of different portfolio management methods employed by businesses in a diverse set of industries. Furthermore, it was discovered that management support for an explicit portfolio method with clear and simple procedures leads to better overall portfolio performance. Chien (2002) second this notion by underscoring manager perception of the project selection method as a crucial factor for the practical adoption and application of the chosen methods.

Cooper (2001) finds three goals of portfolio management; value maximization, balance, and strategic alignment. Different tools tend to be best suited for achieving each goal.

2.1.3.1 Goal 1: Value Maximization

The first goal of portfolio management is value maximization. Cooper et al. (2002) explain that the objective is to select new product projects in a way that maximizes the total value or commercial worth of all active projects in the firm's pipeline, based on a specific business goal, such as profitability. Cooper (2001) explains that this is typically achieved using tools and methods described in benefit measurements and economic models such as scoring models, NPV, or ECV.

2.1.3.2 Goal 2: Balance

Balance is mentioned by multiple authors as important in portfolio management. Cooper et al. (2001) finds a balance between factors such as time and risk as critical. Archer and Ghasemzadeh (1999) believe that a balance between different risk levels and project sizes are of importance when selecting projects. Also Schilling and Hill (1998) points that new product development must consist of a balanced portfolio that contains projects at different stages in development. Cooper and Edgett (2003) conducted a study that showcased that all companies have must-do projects such as responding to major customer requests, keeping the product line up-to-date, or to just fix a problem, but they often tend to take up the majority of the development budget. A majority of the studied firms indicated a poorly balanced portfolio, heavily skewed to the short-term rather than long-term (Cooper & Edgett, 2003).

Achieving a desired level of portfolio balance requires considering several key dimensions, such as long-term versus short-term investments, high-risk versus low-risk initiatives, and the distribution across markets, technologies, and project types (Cooper, 2001). Visual tools like portfolio maps, bubble diagrams, and pie charts can effectively illustrate this balance (Cooper, 2001).

Pie charts visually represent spending by dividing the whole into slices, illustrating the allocation of resources or the number of projects across categories, product lines, or market segments (Cooper et al., 2001).

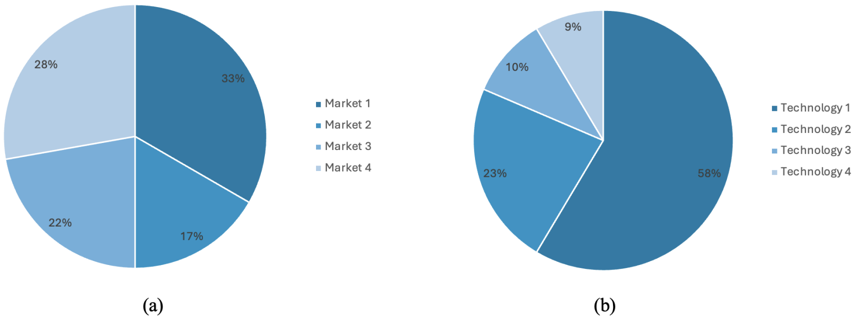


Figure 2.3: Two pie charts illustrated. The first pie chart (a) showcases allocation per market. The second pie chart (b) demonstrates allocation per technology.

Bubble diagrams present projects as bubbles on a two-dimensional grid, as shown in Figure 2.4. While the axes can vary, the most common version is the risk-reward diagram, where each project's probability of success is plotted against the project's NPV. The bubble's sizes can depict their weighting, a common weight is each project's budget. With the aid of this visualization, decision-makers can seek to identify an appropriate balance of spending and projects across different risk-reward levels (Cooper et al., 2001).

Cooper et al. (2001) explain that unlike the maximization tools described earlier,

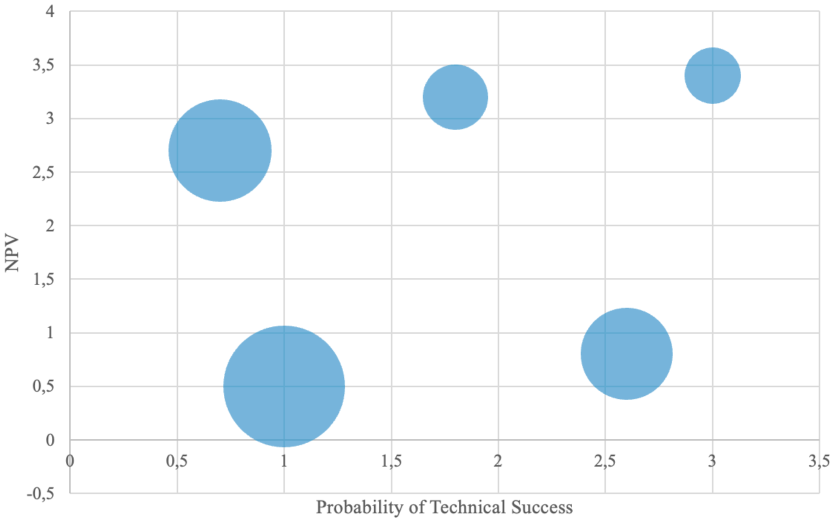


Figure 2.4: Illustration of a three-dimensional bubble diagram with X-values, Y-values, and size of the bubble.

bubble diagrams and pie charts are not decision-making models but visual tools for displaying information. They illustrate the current state of the portfolio and how resources are currently allocated, the “what is”. These charts serve as a valuable starting point for discussions around the “what should be”, or how resources should be distributed moving forward.

2.1.3.3 Goal 3: Strategic Alignment

Nickols (2012) describes strategy as what bridges the gap between means and ends. Strategy is built up into a four-part structure. The ends to be obtained, the ways in which resources will be deployed, the ways in which resources that have been deployed are employed, and the resources or means at our disposal (Nickols, 2012). According to Cooper (2001), the third goal of portfolio management is that the portfolio of projects reflects the business’s strategy and that the spending within this portfolio mirrors the strategy.

Cooper et al. (2002) mention forging a link between project selection and business strategy as critical in portfolio management — the portfolio is the expression of strategy and must therefore support the strategy. Cooper (2001) states that the objective of strategic alignment is to ensure that the final portfolio reflects the organization’s overarching strategy. This involves aligning the distribution of investments across projects, domains, and markets with strategic priorities, ensuring that each project supports the intended direction. Si et al. (2022) lists insufficient alignment with strategy as one of the greatest portfolio challenges. In an industry study, Cooper et al. (2002) found that the top performing firms at new product development utilize the business strategy to allocate resources and decide the portfolio to a much higher degree than the worst performing firms.

Both Si et al. (2022) and Cooper (2001) identify the strategic buckets approach as an effective method for ensuring strategic alignment within an R&D portfolio. In this approach, the firm begins with its overarching business strategy and determines the product innovation strategy by identifying where investments should be made in order to support the strategy (Cooper et al., 2002). Based on this innovation strategy, distinct buckets are defined — such as project types, markets, technologies, or product lines (Cooper et al., 2002). Management then pre-allocates resources to each bucket, assigning a specific budget. Projects are subsequently evaluated and funded within these buckets according to their alignment and characteristics (Cooper et al., 2002).

Cooper (2001) introduces a simplified version of the strategic bucket approach, as illustrated in Figure 2.5. The buckets are divided according to strategic priorities — namely, platform projects (major initiatives aimed at developing a new product platform that can serve as a base for a family of derivative products), new product projects (development of new products, often building on existing platforms or technologies), and others (non-innovation-focused projects necessary for business continuity such as cost reduction projects). Projects are first assigned to the appropriate bucket and then ranked within each one, resulting in three distinct project portfolios.

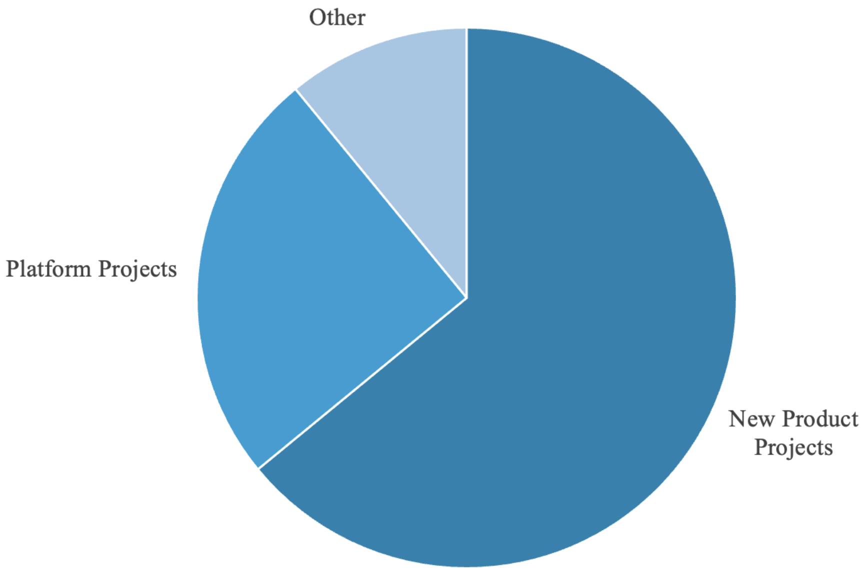


Figure 2.5: Illustration of strategic buckets.

2.2 Evaluation Criteria

This section is organized around several central evaluation criteria frequently cited in the literature. Drawing on established literature in innovation management, new product development, and project selection, ten different overarching categories that have emerged from the study will be presented and synthesised to give an insight into the theoretical dataset that will be applied in the pursuit of an answer to research question 1. The criteria include traditional financial metrics such as NPV and ROI, but also extend to technical feasibility, strategic alignment, intellectual property considerations, stakeholder support, and sustainability. Furthermore, criteria such as risk, market attractiveness, team dynamics, and resource availability are examined for their impact on project potential and portfolio outcomes. Finally, other non-monetary considerations that can significantly influence long-term success such as synergies, corporate image, and the ability to leverage core competencies are presented. The findings from this part of the study are compiled in Table 2.1 for a more comprehensible overview.

2.2.1 Financial

A recurring theme in the studied literature when it comes to both project selection and portfolio management is the central role of financial metrics in evaluating potential projects particularly within high-technology industries where investments are typically capital-intensive. Pinto (2019) groups financial criteria under the category of commercial factors, identifying ROI, payback period, and the project's ability to generate future business as key indicators for decision-making.

Cooper et al. (2001) introduces "project value" and the tools available to quantify it. Notably, they advocate for the use of NPV to prioritize projects based on the constraints of limited resources, aiming to maximize the overall value of the portfolio. Additionally, the ECV method is introduced as a means to account for uncertainty by weighing various future outcomes against their probabilities. This approach allows decision-makers to rank projects in terms of expected payoff relative to investment. The ultimate purpose of these financial criteria is to maximize the value of the portfolio. At the same time, it is important to consider the fact that inaccurate input will lead to skewed results and a model to determine things like NPV is only as good as the data put into the model. As Cooper (2001) states, "the sophistication of financial tools often far exceeds the quality of the data inputs," which can render even the most theoretically sound methods ineffective in practice.

Cooper and Sommer (2023) instead advocate for simpler criteria such as payback time over more complex but data-sensitive models like NPV, particularly in contexts where input assumptions are uncertain or difficult to verify. Cooper and Edgett (2003) argue that an exclusive focus on short-term financial returns can undermine long-term strategic goals. They emphasize the importance of incorporating growth-oriented metrics alongside financial indicators to ensure a more balanced and forward-looking evaluation.

2.2.2 Technical Feasibility

Technical feasibility is a recurring theme in the literature on project evaluation. Unlike financial metrics, which emphasize value realization, technical feasibility assesses whether a project or new product development can be successfully executed from a technological standpoint. According to Cooper and Sommer (2023), technical feasibility plays a central role in determining the likelihood of technical success in new projects. This probability can be evaluated through several dimensions, including the size of the technical gap, the level of technical complexity, and the degree of technical uncertainty (Cooper & Sommer, 2023). These factors help assess how far the proposed solution is from the organization's current capabilities and how difficult it may be to close that gap within existing constraints. A larger gap or greater complexity increases the risk of failure, while high uncertainty reflects the ambiguity surrounding whether the required technologies can be developed or integrated as intended.

Similarly, Cooper et al. (2001) emphasize the importance of technical gap and complexity as key elements in assessing technical risk, which is frequently used in portfolio models to balance high-risk, high-reward initiatives against more incremental and technically secure investments. Cooper (2001) further argues that increased pre-development efforts in new product development should include early technical assessments. Such assessments not only evaluate technical feasibility but also address implications for manufacturing and operations, and help identify critical technical risks and issues early in the process. Expanding on this, Silva et al. (2010) introduce the concept of technological maturity as a criterion for evaluating R&D projects, particularly within the aerospace industry. Projects working with technologies at low maturity levels tend to be more feasible and predictable. Meanwhile, projects working with emerging and novel technologies often encounter obstacles in development. Silva et al. (2010) also recognize that a technology with strong fit to existing capabilities can reduce development time and enhance success.

In addition, Silva et al. (2010) propose opportune attendance as a criterion, which evaluates whether the expected development timeline aligns with customer expectations — further refining the assessment of a project's realization potential.

2.2.3 Strategy

Strategic alignment is widely recognized in the literature as a foundational principle for effective project selection and portfolio management. It refers to the extent to which a project or portfolio supports the broader mission, long-term goals, and competitive strategy of the business. Projects that align with strategic priorities are more likely to succeed, attract internal commitment, and result in more efficient resource allocation (Cooper, 2001). To enhance the effectiveness and efficiency of new product development processes, Schilling and Hill (1998) states that a selection and screening process must include strategic implications.

Cooper and Edgett (2003) operationalize this principle through their concept of strategic buckets, which ensure resources are distributed according to predefined strategic priorities such as innovation type, market segment, or product class. This prevents the portfolio from becoming skewed toward either opportunistic or misaligned projects. Building on this, Cooper and Sommer (2023) emphasize that strategy should not only guide project selection but also be shaped by it — suggesting that innovation initiatives should help realize future strategic intent.

Strategic fit, a related concept, is cited by Cooper (2001) as one of the most critical project evaluation criteria. It includes alignment with the firm's long-term vision, product roadmap compatibility, and the ability to leverage existing competencies in areas such as R&D, marketing, or operations. Their research indicates that companies which consistently apply strategic criteria outperform those that rely solely on financial metrics. Similarly, Si et al. (2022) identify lack of strategic alignment as a major barrier in innovation portfolio management, while Cooper et al. (2001) associate such misalignment with ineffective portfolio performance.

Within the aerospace sector, Silva et al. (2010) identify strategic alignment as one of the two most important overarching criteria for R&D project prioritization. They introduce several sub-criteria: potential to generate innovation (e.g., whether the project advances technological maturity), duality (whether the technology applies to both military and civilian contexts), and operational alignment (how well the project addresses actual operational needs).

Lastly, both Cooper (2001) and Cooper and Sommer (2023) stress the importance of incorporating the voice of the customer into strategic alignment. A strong market orientation that is based on customer needs and preferences, improves the likelihood that R&D initiatives will generate successful outcomes and reduce the risk of misaligned efforts.

2.2.4 Market Attractiveness

Market attractiveness appears as a central criterion in project selection, especially when commercial success is a prioritized outcome. Assessing the potential of a market allows organizations to prioritize projects that align not only with internal capabilities but also with external opportunities.

Cooper (2001) emphasizes the importance of market need and product advantage by highlighting that successful projects often target markets where there is clear customer demand and where the offering delivers superior value. This includes the ability to provide unique customer benefits and a compelling value-for-money proposition.

Projects targeting large or rapidly growing markets are more likely to deliver returns that justify the investment and higher risk. Relating to this, Silva et al. (2010) point to indicators such as market size, growth potential, and profit margins as essential dimensions in evaluating projects. According to them, a thorough assessment of market attractiveness ensures that selected projects are not only technically feasible and strategically aligned but also have a strong foundation for commercial success.

Also, Cooper et al. (2001) highlight market size, market growth rate, and the level of competitive intensity as central factors in evaluating the attractiveness of a market. Similarly, Cooper and Kleinschmidt (1987) emphasize that larger market size, higher growth rates, and clearly identified market needs are positively associated with project success. Cooper (2001) reinforces this view by stating that products targeting attractive markets are more likely to succeed, making market attractiveness a critical consideration in the selection and prioritization of innovation projects.

2.2.5 Resources

The availability and quality of resources are critical factors influencing a project's likelihood of success. In the context of project selection, assessing resource readiness goes beyond identifying what is available — it involves determining whether the organization can realistically support the execution and commercialization of selected initiatives. Cooper and Edgett (2003) identify inadequate resourcing as one of the most persistent weaknesses in new product development. When resources are stretched too thin, firms often default to smaller, lower-impact projects that are easier to fund but unlikely to yield substantial returns. This leads to suboptimal portfolio performance and missed opportunities for innovation.

Cooper et al. (2001) further highlight that the availability of skilled personnel, infrastructure, and technological capabilities directly contribute to the probability of technical success. Similarly, Silva et al. (2010) emphasize the importance of evaluating financial, human, and infrastructure resources in R&D project assessment — especially in industries where successful execution depends on substantial upfront investment and cross-functional collaboration.

Reinforcing this, Cooper (2001) asserts that “there is no free lunch” in product innovation, stressing the necessity of aligning development ambitions with resource capabilities. One practical approach he recommends is a resource capacity analysis, which helps organizations determine whether they have the right mix and volume of resources to handle the current pipeline and achieve their product development objectives. Such assessments play a vital role in ensuring that strategic priorities are not only well-defined but also realistically supported by the organization's operational capacity.

2.2.6 Intellectual Property (IP)

While often overlooked, IP plays a notable role in project selection and portfolio management. An effective protection of innovations can significantly influence the commercial viability of a project by creating barriers to entry and enabling firms to capture a greater share of the value they generate.

Pinto (2019) identifies IP rights as one of the key factors influencing the project selection process. The ability to secure patents, trademarks, or trade secrets may give priority to one project over another, especially when uncertainties in other areas are high. Projects with stronger potential for IP protection can also be seen as more strategically valuable as they help safeguard returns on R&D investments.

A strong proprietary position not only enhances the long-term potential of a project but may also reduce the risk of imitation by competitors. Cooper et al. (2001) include proprietary position as a formal evaluation criterion in their portfolio management framework. This factor is assessed on a scale ranging from "easily copied" to "well protected," allowing organizations to factor in how defensible an innovation is within the competitive landscape.

2.2.7 Stakeholders

While not treated as a formal evaluation criterion in most of the literature, both internal and external stakeholders can play an important role in determining the success of project selection efforts.

Without management backing, even well designed and executed projects may struggle to gain traction across the organization according to Cooper et al. (2001). The authors also concluded that successful portfolio management is often reinforced by strong and visible support from senior management and showed that it is not only the formal process, but also the commitment demonstrated through leadership actions.

Schilling and Hill (1998) extends this view by highlighting the importance of stakeholder engagement in new product development. The author points to the use of executive champions or senior figures who advocate for high-potential projects. Moreover, strategic partnerships and alliances with external stakeholders, such as suppliers or technology partners, can enhance access to capabilities and improve project feasibility.

2.2.8 Sustainability

The relevance of sustainability in business is constantly growing although not widely emphasized in most project selection frameworks. Businesses face increasing pressure to align innovation efforts with broader environmental, social, and governance (ESG) goals. Causing sustainability to emerge as an additional theme through which projects can be evaluated.

One way to assess a project's value according to Cooper and Sommer (2023), is by examining how it contributes to the organization's broader mission, which may include reducing environmental impact or advancing ESG commitments. Projects that actively support such goals can help future-proof the business by responding to regulatory developments, stakeholder expectations, and shifting market demands. Similarly, Cooper (2001) highlights the importance of ensuring that selected projects meet key environmental, health, and safety standards. This is considered to be an essential aspect of responsible innovation management.

2.2.9 Risk

Theoretical frameworks within portfolio management and project selection emphasize the importance of understanding and managing risk not only to avoid having to kill projects that turn out less successful than predicted, but also to ensure that resource allocation decisions align with the organization's overarching strategic goals. Cooper (2001) states that total risk avoidance in new product development is impossible, unless all innovation is avoided.

Cooper (2001) proposes two components of risk in new product processes. The first component is the amounts at stake, this includes possible payoffs and possible downside losses. The second component is the uncertainty regarding the development. Usually, the amounts at stake during early development is low and increases as the development progresses (Cooper, 2001).

Silva et al. (2010) integrate risk response as a formal criterion in their evaluation model for R&D project selection. They propose to assess the perceived risks for the project and if there exists any measures to mitigate the risk. Cooper and Sommer (2023) highlight the utility of financial models to approximate a project's risk level compared to the reward, such as calculating the reward/risk ratio by the expected NPV divided by the remaining financial resources to be spent.

Cooper (2001) emphasizes the importance of evaluating projects based on the balance between risk and return, highlighting factors such as the speed of investment recovery, the cost and duration of the project, and the certainty of expected returns. Additionally, Cooper et al. (2001) stress the need to maintain a balanced project portfolio, ensuring a mix of long- and short-term initiatives as well as high- and low-risk projects, to optimize both the potential for innovation and financial stability.

These models, along with commonly used risk/reward ratios, help decision-makers evaluate whether the potential benefits of a project justify the risks involved. In essence, this involves assessing what the upside is if the project succeeds, and how significant the losses are if it fails.

2.2.10 Resources

Effective portfolio management also involves navigating the organizational dynamics that shape how projects are delivered. Teams play a central role in this process, both as executors of projects and as stakeholders affected by portfolio decisions.

Poor team morale is a recurring consequence of weak or misaligned portfolio management according to Cooper and Edgett (2003). For instance, they demonstrate that when teams are assigned to too few or unimpactful projects, it can result in disengagement and lack of motivation illustrating how portfolio decisions have a downstream effect on workforce energy and innovation capacity.

Cooper (2001) proposed that cross-functional teams that are empowered, resourced and held accountable have a positive effect on the profitability of development, how time efficient the development was, and if the launch was on time.

Also Schilling and Hill (1998) notes that project teams are increasingly composed of cross-functional members, a structure which he identifies as beneficial for effective projects related to new product development. By bringing together diverse skill sets from across the organization, cross-functional teams enhance both creativity and executional strength (Schilling & Hill, 1998). Portfolio management decisions are also people decisions. Ensuring that teams are meaningfully engaged, properly supported, and organizationally aligned is essential not just for individual project success but for sustaining long-term innovation performance.

2.2.11 Other Considerations

Additional non-monetary factors have been identified in the literature. These considerations may not translate directly into short-term profit, but they contribute significantly to long-term strategic positioning and organizational value.

One such factor is the potential for synergies, whether between technologies, marketing channels, or across projects. Cooper (2001) highlights that projects offering opportunities to leverage core competencies, such as technical know-how or manufacturing capabilities, may hold strategic value beyond their immediate financial return. These synergies can lead to improved efficiency, accelerated development, or a stronger competitive edge (Cooper, 2001).

Cooper and Sommer (2023) also highlight the importance of a compelling value proposition, referring to the extent to which a new product is perceived by users as unique and superior compared to existing alternatives.

Another important non-monetary factor is the potential impact on company image. As Pinto (2019) notes, the types of projects a company chooses to pursue send signals to both internal and external stakeholders about its identity and direction. Projects that align with brand values, emphasize innovation, or result in unique and differentiated offerings may enhance the company's reputation and perceived market leadership (Pinto, 2019).

2.3 Synthesizing the Findings

Drawing from the literature, Cooper (2001) identified three principal approaches when evaluating projects. The first approach is the benefit measurement techniques which emphasize subjective assessments of strategic factors utilizing tools such as AHP, checklists, or scoring models. The second approach is applying economic models such as payback period, NPV, or ECV. Even though economic models are powerful, it is also noted by Cooper (2001) that firms who rely heavily on financial tools tend to perform worse than their counterparts who place greater emphasis on non-financial approaches. The third approach is managing the portfolio of projects which can be divided into three goals; maximizing the value of the portfolio, having a balance between e.g., risk and time, and lastly making sure that the portfolio of projects is strategically aligned.

Through a review of the literature, ten key evaluation categories were identified as critical for assessing NPD projects and selecting R&D initiatives. These categories, alongside examples of specific criteria, are summarized in Table 2.1.

Among these ten categories, five were most frequently highlighted in the reviewed sources: financial considerations, technical feasibility, strategic alignment, market attractiveness, and resource availability.

- Financial considerations encompass traditional financial metrics such as ROI, payback period, and NPV.
- Technical feasibility assesses the maturity of the technology to be developed, the technical gap between needed and current capabilities, and how technically complex the development is.
- Strategic alignment evaluates how well a project supports the firm's broader strategy, including considerations of portfolio balance (e.g., across different innovation types) and responsiveness to customer needs, wants, and expectations.
- Market attractiveness focuses on external market conditions such as market size, growth rate, profit margins, and competitive intensity.
- Resource availability assesses whether the firm possesses, or can access, the necessary financial assets, skilled human resources, or infrastructure to support project development.

Table 2.1: Synthesized findings on criteria mentions from the literature study

Category	**Criterion Examples**	**Sources**
Financial	ROI, payback time, net present value, potential for rewards, expected commercial value, costs vs benefits	Pinto, J. K. (2020); Cooper et al. (2001); Cooper (2001); Cooper & Edgett (2003); Cooper & Sommer (2023)
Technical feasibility	Technological maturity, capabilities, assessments, technical gap, technical complexity, opportune attendance	da Silva et al. (2010); Cooper & Sommer (2023); Cooper et al. (2001); Cooper (2001)
Strategy	Operational alignment, duality, alignment with firm's strategy, strategic fit, portfolio balance, strategic alignment, compatibility with product roadmap, strategic intent, strategic leverage potential, voice of customer built in	da Silva et al. (2010); Cooper & Sommer (2023); Cooper et al. (2001); Cooper (2001); Schilling (1998); Cooper & Edgett (2003); Si et al. (2022)
IP	Possibility to protect innovation	Cooper et al. (2001); Pinto, J. K. (2020)
Stakeholder	Being part of strategic alliances, having executive champions	Schilling (1998); Cooper et al. (2001)
Sustainability	Meet environmental, health, and safety standards	Cooper (2001), Cooper & Sommer (2023)
Risk	Potential for risk response, reward vs risk, what is the perceived risk?	da Silva et al. (2010); Cooper & Sommer (2023); Cooper et al. (2001); Cooper (2001)
Market attractiveness	Market size, market growth, market margins, intensity of competition, good value for money for customers	da Silva et al. (2010); Cooper & Sommer (2023); Cooper et al. (2001); Cooper (2001); Cooper & Kleinschmidt (1987)
Team	Cross-functional teams, team is resourced and held accountable, clear leadership	Schilling (1998); Cooper (2001); Cooper & Edgett (2003)
Resources	Means availability (financial resources, human capacitation, infrastructure), resource limits, resource capacity analysis	da Silva et al. (2010); Cooper et al. (2001); Cooper (2001); Cooper & Edgett (2003)
Other considerations	Synergies between marketing, projects, and technologies, company image impact, unique & differentiated product	Cooper & Sommer (2023); Pinto, J. K. (2020); Cooper (2001)

3

Method

This chapter outlines the methods that were employed in conducting the research, including the research design, data collection methods, selection of interviewees, and the ethical considerations. The aim is to offer transparency regarding the processes and principles guiding the research, facilitating for potential replications and ensuring credibility.

3.1 Research Design

This study utilized a qualitative research methodology to gain a deep understanding of the context and complexity of R&D management in the aerospace industry and the decision-making processes. Both Bell et al. (2019) and Creswell and Poth (2018) emphasize the advantages of qualitative research and its ability to deliver rich and deep data, depth, and a contextual understanding.

The thesis utilized a single-organization case study within a specific industry. The thesis highlights the characteristics of the Company. This approach aligns with what Bell et al. (2019) refer to as an idiographic response, focusing on the in-depth understanding of a unique case rather than seeking broad generalizations. The case can be coined as a representative case since it explored an everyday situation for the Company's R&D department (Bell et al., 2019). The extensive and in-depth analysis and description of the Company made the choice of a case study relevant (Yin, 2014).

The study started with an explorative phase where internal interviews were conducted and a review of existing literature to draw upon when formulating the preliminary theory. After the exploratory phase, an iterative process was conducted including developing the theoretical framework, conducting semi-structured interviews, building a decision-making framework, and obtaining feedback from workshops.

An abductive approach was used in the study as often recommended for theory-driven innovative empirical research (Alvesson & Sköldberg, 2017). The abductive approach helps develop or refine existing theories by iteratively moving between data and theoretical explanations (Charmaz & Bryant, 2019). The inductive and deductive approaches, even though valuable, the authors feared would not fully capture the dynamic interplay between the empirical findings and the theory. Induction is grounded in empirical findings, whereas deduction is rooted in established literature

(Alvesson & Sköldberg, 2017). By using an abductive approach, the research could adapt and refine theoretical frameworks based on the data gathered from the company, leading to more nuanced and innovative insights.

This approach allowed the authors to incorporate theoretical insights with real-time industry observations and support an adaptive research process. This enabled the refinement and expansion of theories based on emerging findings, ensuring the study effectively addresses uncertainties within the given context (Alvesson & Sköldberg, 2017) .

3.2 Research Process

The research process was planned to consist of two different steps. Initially the focus was on the exploratory phase, where it was deemed important to gain in-depth understanding of the Company, the environment in which it operates, and relevant theory. The second phase concentrated on data collection, engaging a broader range of internal interviewees, conducting workshops, and employing an iterative, systematic approach to develop a framework intended to support the decision-making process. This approach is depicted in Figure 3.1.

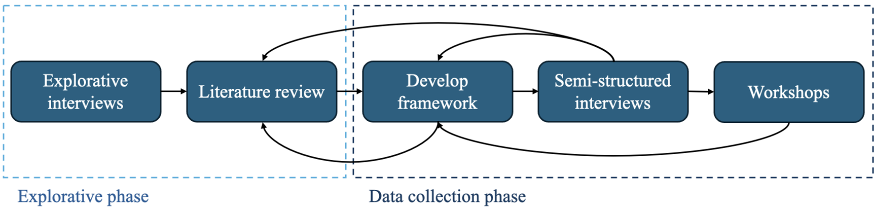


Figure 3.1: Overview of the research process.

3.2.1 Exploratory Phase

The research started in the exploratory phase where internal interviews were conducted to gain knowledge about the aerospace industry and a literature review to build a preliminary theoretical framework. The phase was critical for gaining an in-depth understanding of the real-life problems experienced by the Company and paved the path for what the framework that was-to-be-built would transform into.

In parallel to the initial interviews, a search for existing literature was conducted to build an initial frame of reference. This allowed the authors to situate the insights from the exploratory interviews within the wider academic and industrial contexts, ensuring the study was both theoretically grounded and practically relevant. As a rule, larger investigations or research tasks require an overview of the central literature within the studied field (Eriksson & Wiedersheim-Paul, 2011). This search of the overview has been done through Chalmers Library utilizing literature databases such as Scopus, ScienceDirect and WebScience. To find modern and relevant information, certain sources were occasionally excluded when their relevance could no longer be assured. According to Eriksson and Wiedersheim-Paul (2011), the requirement for contemporaneity is one of the factors influencing the reliability of sources. Patel and Davidsson (2011) agree and conclude that books provide relevant theories and models but scientific articles provide a more up-to-date perspective. However, some books have still been utilized due to their substantial contribution in the theoretical field and act as a foundation of the theory that modern literature draws upon. The search for relevant articles was guided by keywords refined during the exploratory phase, as shown in Table 3.1 below. Additionally, backward searching was conducted from relevant sources when deemed necessary. Further literature was incorporated based on recommendations from our Chalmers supervisor.

Table 3.1: Keywords used during literature review

Keywords	Decision-making Tool, Scoring model, Analytical Hierarchical Process, R&D Aerospace, Portfolio Management, R&D management, Project management, Technology Evaluation, New product development, Technology Management

3.2.2 Data Collection Phase

In the data collection phase, building upon the exploratory phase, the construction of the decision-making framework was initiated and semi-structured interviews were conducted with different stakeholders in the R&D decision-making process. The goals were to gain an understanding of what criteria the interviewee believes are important when evaluating technologies at an early stage and how the evaluation process works at the moment. Based upon the discoveries in the semi-structured interviews, the framework was continuously updated through an iterative process with the insights gained from the interviews as the foundation.

The interviews were of a semi-structured character due to its flexibility and depth allowing the interviewee a great deal of freedom to reply (Bell et al., 2019). In a semi-structured interview, the interviewer has a list of questions to ask, or an interview guide, but the questions may not follow exactly the process of the guide and new questions might arise based on the response of the interviewee (Bell et al., 2019). The semi-structured format aligned well with the exploratory character of the thesis as the study is qualitative in nature. The interviews served as a means to discover and identify aspects of the interviewee's perception of the problem (Patel & Davidsson, 2011).

The interview process began with general questions aimed at understanding the respondent's background, their role in the decision-making process, and their perspective on current shortcomings in the process. Following this, the discussion shifted toward a more in-depth exploration of the decision-making tool and the respondent's specific area of expertise. In line with Patel and Davidsson (2019) recommendations, participants were briefed beforehand on the thesis objectives to ensure they feel comfortable and prepared to share their experiences and insights.

An interview guide, see Appendix A, was created aiming to have a reasonable flow and formulate the questions such that it would help us answer the research questions (Bell et al., 2019).

Once saturation was reached regarding the critical criteria for evaluating technologies, three workshops were conducted. In preparation for the first two workshops, the identified criteria were integrated with the tools outlined in the frame of reference. To ensure a productive discussion, participants received the criteria, tools, and accompanying user guides via email in advance. This preparatory step was intended to promote informed dialogue and ensure a shared understanding among participants during the sessions. In the final workshop, the framework deemed most suitable, conclusions derived from earlier workshops, was demonstrated to gain additional feedback. The primary objective of all workshops was to collect comprehensive feedback on the framework as a whole.

3.3 Selection of Interviewees

The interviews conducted were an essential part of the study. Through the interviews, insights were gained which helped develop the framework and shed light on new areas to investigate in the literature. The diversity in the selection ensured that the study captured a wide range of perspectives.

The selection criteria for interviewees were carefully designed to align with the study's objectives, emphasizing stakeholders actively engaged in areas relevant to the research. Participants were chosen based on their involvement in key areas or their roles, ensuring that each interviewee could offer in-depth insights on the topics discussed. Additionally, a priority was given to individuals with decision-making authority, as their influence plays a crucial role in critical decision-making processes.

Below can be found the different roles or areas of expertise that were targeted for the interviews:

- **Partnership office:** Individuals working with and responsible for the partnerships with OEMs.
- **Project Managers:** Individuals responsible for the projects aimed at developing technologies to give an understanding of the chance of technological success, competences needed, and capacity for the project to succeed or not.
- **End-users:** Stakeholders from R&D at the Company and within the forums that new technologies are discussed.
- **Risk and Trends:** Individuals highly involved with risk assessment within the aerospace industry and individuals with a great expertise in the regulatory environment.
- **Strategy:** Individuals with deep knowledge in regards to the Company's strategy and long-term vision.

The selection process was dynamic, incorporating both purposive sampling and snowball methods. Furthermore, the selection of interview participants was carried out with strategic intent, or defined as purposive sampling (Bell et al., 2019). Initially the Company provided a list of potential interviews primarily consisting of decision-makers and domain experts within the internal environment of the company. Through snowball sampling, the authors had the possibility to extend their network through existing interviewees recruiting through their own network. Through referrals, hard-to-reach participants have been reached and has proven to be a time-efficient methodology. In total, 11 interviews were held with 9 interviewees. In Table 3.2 an overview of the interviewees can be found.

Table 3.2: Overview of interviews

ID	**Title of respondent**	**Department**	**Phase**	**Time**
I1	Research Engineer	External funding	Explorative	60 min
I2	Technology Manager	External funding	Explorative	70 min
I3	Director of R&D	GTC	Explorative	60 min
I2	Technology Manager	External funding	Data collecting	70 min
I1	Research Engineer	External funding	Data collecting	45 min
I4	Technology Project Manager	External funding	Data collecting	60 min
I5	Project Manager	Technology	Data collecting	60 min
I6	Customer Strategy Director	Partnership Program Office	Data collecting	65 min
I7	Capabilities Portfolio Director	Technology	Data collecting	40 min
I8	Program Director	Partnership Program Office	Data collecting	30 min
I9	Head of Business Area 1	BA 1	Data collecting	50 min

Table 3.3 presents the attendees of the workshops. It is important to note that some attendees had also participated in earlier interviews. Three employees participated in the first workshops, seven employees participated in the second workshop, and three attendees participated in the third workshop. Two attendees participated in all workshops. The selection of the participants in the workshops was orchestrated by the Company and involved personnel working within R&T.

Table 3.3: Overview of workshop attendees

ID	Title of attendee	Department	Workshop
WA1	Research Engineer	External Funding	1, 2 & 3
WA2	Technology Manager	External Funding	1, 2 & 3
WA3	Director of R&D	GTC	1 & 3
WA4	Technology Project Manager	External Funding	2
WA5	Technology Project Support Officer	External Funding	2
WA6	Technology Project Manager	External Funding	2
WA7	Technology Project Support Officer	External Funding	2
WA8	Senior Research Engineer	External Funding	2

3.4 Data Analysis

Qualitative research has a tendency to result in accumulation of large amounts of intense and unstructured sets of data (Bell et al., 2019). This entails challenges in managing and navigating through different types of material, being able to analyze the data in a structured manner is thus crucial to avoid being overwhelmed by it. As described in the research process, the data collection process primarily consisted of explorative interviews, a literature review, and semi-structured interviews. This iterative process of cycling between literature and empirical evidence resembles an abductive approach to qualitative data analysis as described by Bell et al. (2019). The main advantage of an iterative approach is to be able to use the empirical data collected in interviews to develop theory. Furthermore, it helps challenge preconceptions and biases generated by prior experiences or perspectives.

In this case study, the purpose of the initial phase of the study was to gain an in-depth understanding of the topic and discover new insights through the exploratory interviews. As the authors entered the study with limited experience about the case company and the industry, the goal was to collect data with the intention of generating substantive theory directly grounded in the data. As such, the data collection and analysis strategy were deeply inspired by the method of Grounded theory (Glaser & Strauss, 1967). The main advantage of this method is that it allows the authors to use actual case-specific data to build theory from the ground up, avoiding assumptions and preventing the research from being contaminated by existing models.

The grounded theory strategy offers tools and resources that can be used both in the collection and analysis of qualitative data, but they can also be employed in the research process as a whole (Bell et al., 2019). In this study, tools from grounded theory were used throughout the data collection and data analysis process to provide structure and consistency to the process.

A key consideration when collecting qualitative data has to do with the organization and management of large amounts of information. For this, the authors used a coding approach where information from interviews were categorized from an early stage to identify early patterns and help break down the data into manageable units. The coding was initially done by labeling important segments and highlighting quotes from respondents. As codes started to emerge into themes, the authors made sure to keep a close connection with the data through constant comparison. As described by Glaser and Strauss (1967), constant comparison is an ongoing process where researchers revisit previously coded data to compare it to more recent findings. This approach facilitates a refinement of the theory by ensuring that it is closely connected to the real-world findings. In addition to the benefit of having the data organized and structured, the coding process entailed a better understanding and overview of the data which proved to be useful in the next step of the analysis, the theoretical sampling. Glaser and Strauss (1967) introduced the concept of theoretical sampling, describing it as "the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyzes the data and decides what data to collect next and where to find them, in order to develop the theory as it emerges." Consequently, the data collection process is controlled by the emerging theory. This implies a key characteristic of theoretical sampling, namely that it is an iterative and ongoing process rather than a single discrete stage in the data collection process.

The coding process was conducted until a point of theoretical saturation was met. According to Bell et al. (2019) theoretical saturation occurs when the additional collection of data no longer provides new insights or when no further comparison is needed to fit the data into categories. Theoretical sampling was used to initiate a new iteration of interviews until theoretical saturation was met. The goal with this approach was to theorize on emerging insights rather than to collect as much data as possible, as such, the selection of participants was adapted to each stage of the study as the research progressed. In accordance with grounded theory strategy, it wasn't until the point of which theoretical saturation was met that the theory development phase was fully initiated.

3.4.1 Data Compilation and Derivation of Criteria

Following the point of theoretical saturation, empirical observations from the case study and insights from the literature review were compiled and merged into a common data set. This compilation served as the foundation for constructing the set of evaluation criteria central to addressing Research Question 1.

The data was systematically categorized and analyzed with the aim of identifying both alignments and discrepancies between the theoretical and empirical inputs. The process was guided by a search for recurring themes, and commonly referenced evaluation criteria across both data sources. Criteria that emerged frequently and consistently were considered to hold particular significance and were therefore prioritized in the development of the framework.

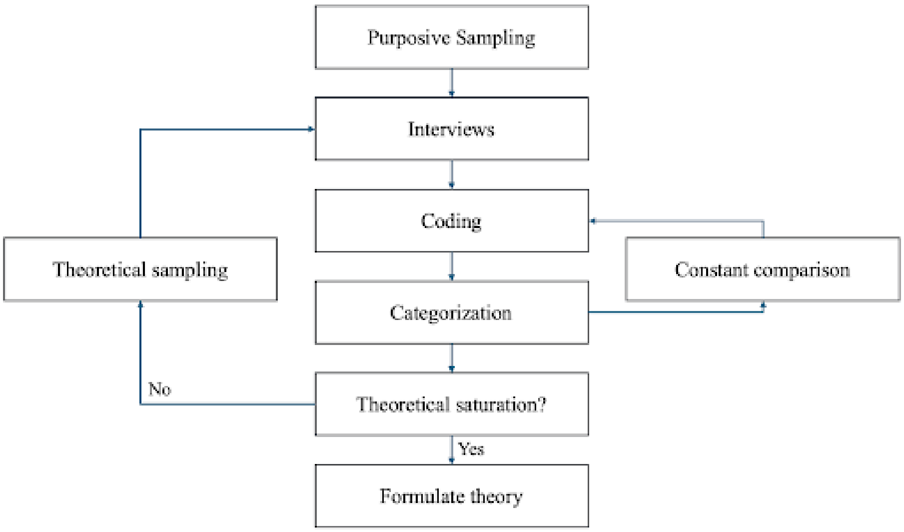


Figure 3.2: Grounded Theory model for data collection and data analysis

In order to ensure that the resulting criteria were not only theoretically grounded but also practically applicable at the case company, a few case-specific considerations were incorporated into the evaluation. First, the applicability of each criterion within the organizational environment was assessed. Secondly, the criteria were reviewed through the lens of their ability to support the intended purpose of technology investment evaluations.

The formulation of criteria descriptions was also carefully reviewed to ensure both clarity but also alignment with the case company's common terminology. This included adopting terms and phrasings already in use within the company's internal documentation and communication channels, thereby increasing the degree of fit and likelihood of adoption. These layers of consideration were essential in adapting the theoretically-informed criteria into a contextually relevant and actionable framework for the case company.

3.5 Research Quality

Discussing reliability and validity in this case study can be challenging, as these concepts do not hold the same meaning in a qualitative study as they do in a quantitative one. According to Patel and Davidsson (2011), validity in qualitative research is defined, among other things, as the ambition to identify phenomena and describe perceptions. Furthermore, they explain that reliability in qualitative studies often align closely with the concept of validity. Therefore, only the validity of this study will be discussed below.

The interpretation of qualitative data from theory and interviews carried the risk of being influenced by the authors' perspectives. To enhance the credibility of the study, interviewees were, when necessary, contacted via email or phone calls afterward to clarify interpretations or provide additional explanations. This process, referred to as communicative validity by Patel and Davidsson (2011), helps ensure accuracy. Additionally, the study's results and analysis were shared with the participants, which reduces the risk of misinterpretation.

3.6 Ethical Considerations

Each respondent was informed about the study's purpose and methodology, and their participation was entirely voluntary, with the option to withdraw at any time. Participants were assured that the collected data would be used solely for academic purposes and handled with strict confidentiality. Additionally, participants remained anonymous which provided more open and candid responses, particularly on sensitive topics. This aligns with Bell et al. (2019) four key principles to help ensure that research is conducted in a responsible and ethical manner; avoiding harm to participants, informed consent, invasion of privacy, and deception.

4

Working with Technologies and Projects at the Company Today

4.1 Technological Maturity and Strategic Partnerships in Aerospace

This chapter outlines the frameworks and structures that underpin technology development and investment in the aerospace industry. It first introduces the Technology Readiness Level (TRL) model as a tool for assessing technological maturity and guiding R&D decisions. It then explores Risk- and Revenue-Sharing Partnerships (RRSPs), a prevalent collaboration model in engine programs that enables firms to manage high development costs and long payback periods. Together, these concepts illustrate how technological progress and financial risk are jointly managed in long-term, capital-intensive aerospace projects.

4.1.1 Technology Readiness Level

The TRL framework was developed by NASA in the 1980's as an assessment tool to identify and evaluate both technical and commercial risk. The process includes assigning technologies a level on a scale of nine to determine the technological maturity of a project. The framework is meant to highlight the research and development progress of a certain technology from the very early stages of development to a finished, manufactured and sold product (EARTO, 2014). As such, by verifying the criteria at each level, one can determine the readiness level of a technology at a certain stage of development. Additionally, the TRL framework offers the possibility to verify when the research within a technical area is ready to be elevated to a higher level of maturity ("Innovair", 2014).

In order to determine the maturity of a technology, three main factors are considered and measured against the use-case requirements of that technology. The factors include performance/function, the probability of the technology's physical realization referred to by NASA as "form and fit", and predicted resilience in a physical and operational environment (NASA, n.d.). The lower TRLs are focused solely on function but in order for a technology to progress to a higher TRL, both form and function need to be proven. For the highest TRLs, technological fit with practical applications must be recognized in addition to form and function (NASA, n.d.).

At lower TRLs (level 1 and 2), practical applications may still be speculative as no proof or detailed analysis exists to support any real world applications. For TLR3 and TLR4, proof of concept and basic functionality must be achieved in a controlled environment while TRL5 and TRL6 requires validation and demonstration in an environment that is relevant to the technology's use case. At TRL7 and TRL8, the technology must be applied to a real-world operational environment and at TRL9 the technology is considered full-fledged and operational. A definition of each Technology Readiness Level is presented in table 2.

In addition to providing an aid in decision-making concerning R&D and technology management, the TRL framework offers a few concrete advantages. First of all, the framework provides a clearly communicated representation of a technology's current status and supports decision making in the transitioning of technology. Furthermore, systematically assessing the stage of development for a certain system or technology can be an asset in risk management (Dawson, 2007). However, despite the framework being relatively widespread in aerospace and other technology-heavy and product-focused industries, the generalizability of the framework is debatable. For example, in software-based technologies, the readiness of a system seldom correlates with the technological maturity which diminishes the applicability of such a model (Smith II, 2005).

Table 4.1: Technology readiness levels and their definitions(NASA TRA Best Practices Guide, n.d.)

TRL	**Definition**
1	Basic principles observed and reported
2	Technology concept and/or application formulated
3	Analytical and/or experimental proof-of-concept of critical function
4	Component and/or breadboard validated in laboratory environment
5	Component and/or brassboard validated in relevant environment
6	System/subsystem model or prototype demonstrated in a relevant environment
7	System prototype demonstration in an operational environment
8	Actual system completed and “flight qualified” through test and demonstration
9	Actual system flight proven through successful mission operations

In the aerospace industry, R&D is characterized by development times stretching up to 15-20 years and new development cycles are generally initiated every four to five years (“Innovair”, 2014). Because of this, it is crucial to maintain activity and administer research in every phase of the technology development in order to retain a diverse project portfolio. This implies that, at any given time, research is conducted on multiple TRLs in multiple different areas. To demonstrate and communicate how this project portfolio might be constructed, manufacturers in the aerospace industry employ “the incline wave principle” as presented in Figure 4.1. The principle visualizes the project portfolio as a roadmap, providing an indication of the projects' maturity levels in relation to each other as well as a prediction of the portfolio at some point in the future. Using the principle to backtrack future product applications allows for predictions about which underlying technologies will be required to facilitate that application in the future. As such, the framework can give an indication of what areas of research need to be prioritized. Furthermore, the principle facilitates a basis for efficient project portfolio planning by providing a structured and visual representation of projects at varying levels of maturity.

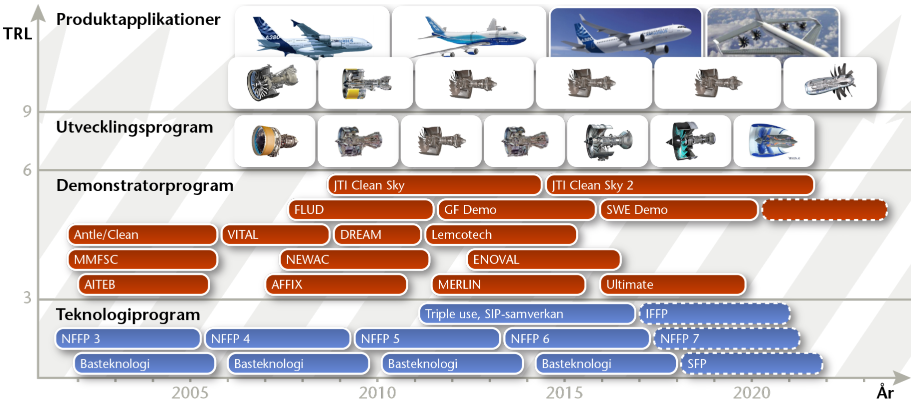


Figure 4.1: The incline wave principle for projects in the aerospace industry ("Innovair", 2014).

4.1.2 Risk- and Revenue-Sharing Partnerships

The aerospace industry is a high-technology industry. For aircraft engines, the development is characterized by intensive collaborations among firms to divide the high risks and costs needed when realizing the complex products. The realization of the end-product is not conducted by only one firm but from networks of firms from many types of industries (Corallo et al., 2014).

Due to the complex nature of the aircraft engine, recent aircraft programs have implemented RRSPs which focus on the collaboration between OEMs and Tier-1 or Tier-2 suppliers and are defined as collaborative relationships where risks related to development, production, and aftermarket services are shared. The aim is to manage the high costs of the aerospace projects (Wagner & Baur, 2015). Due to the high upfront investment and the program risk, engine OEMs are seeking enduring strategic partners to share the costs, risks, and returns of the program. In a typical engine program, the OEM generally owns more than 50% of the project to ensure their leadership while the partners collectively own the remaining share. The agreed upon percentage of ownership that a partner owns represents their relative contribution and typically remains the same throughout the lifetime of the program. As such, the partner carries their percentage of the costs and receives the same percentage of the returns. In addition to financing their own contribution, the partner also undertakes a commitment to supply components and provide lifetime product support for their respective components. Some common economic models in RRSPs include revenue-sharing mechanisms, fixed pricing, or the amortization of non-recurring costs during production or aftermarket activities. These contracts typically last around 50 years, covering the entire lifecycle of an aircraft engine.

What stands out in this industry is the very long payback time. A visual representation of the typical cumulative cash flow for a partner in a RRSP project's life-time is presented in Figure 4.2.

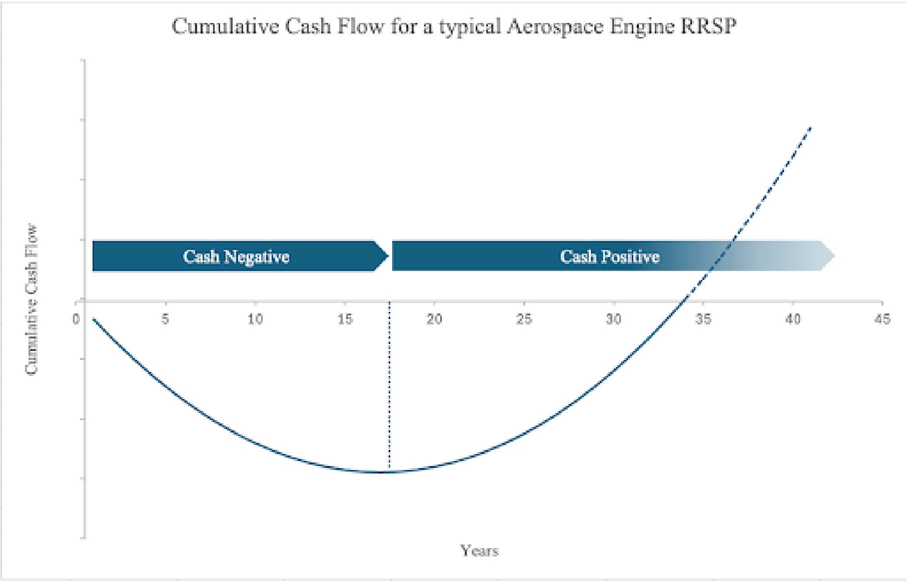


Figure 4.2: Cumulative cash flow per year for a partner in a RRSP within the aerospace industry

An average engine program can incur total development costs of around $10 Billion. While the first 5-10 years are characterized by relatively light investments in technology development, the next 5-10 years entails significant expenditure on investment in product development. It is not until after this phase that the actual product enters service and starts generating revenue for the program partners. This is the first time the project turns cash positive. However, it is not until the aftermarket and services phase that the RRSP reaches break-even and starts generating high profit margins and cash. A more detailed description of the engine program lifespan and the practical and financial implications of its different phases can be found in Figure 4.3.While the costs are generally fixed and the program ceases to carry significant cost in the aftermarket phase, the revenue generation and cash flow is dependent on a number of factors. As the business model is usually defined by service contracts where the revenue is determined by uptime, the cumulative flight hours of an engine in the RRSP correlates directly with the generated revenue. Additionally, fleet size and engine life time are contributing factors for the same reason. Although the number and scope of shop visits can determine aftermarket revenue, it is possible for partners to participate in that stream of revenue despite only supplying "fit-and-forget" components that last the lifetime of the engine (Wagner & Baur, 2015).

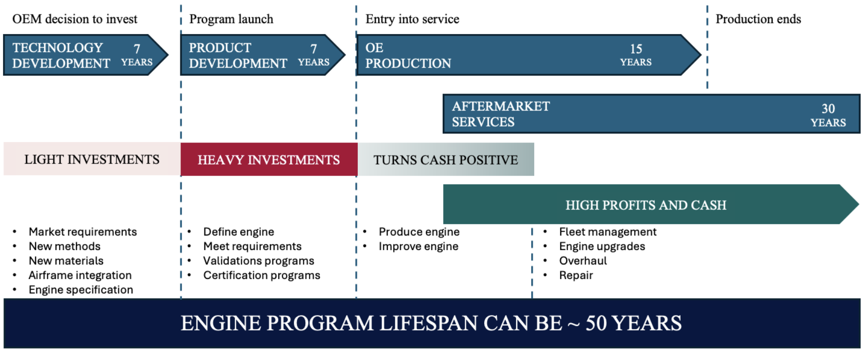


Figure 4.3: Engine RRSP lifespan

4.2 Organizational Overview

To understand the organizational context, a brief introduction of the department analyzed will be presented, as depicted in Figure 4.4. The Engines department within the Company is structured into four distinct strategic business areas, each responsible for driving and executing its respective business operations as well as an Engineering & Technology (E&T) department and a Partnership Program Office.

The E&T is divided into different engineering branches and three divisions that are jointly called the Research & Technology (R&T) division. The divisions that together create the R&T division are R&T 1, R&T 2, and R&T 3. R&T 1 is responsible for executing projects and making sure that development work is within budgetary constraints. R&T 2 is responsible for allocating resources to the different projects with engineers and exploring new technologies. R&T 3 is responsible for applying for and working with external funding, maintaining relationships, and running projects together with external clusters consisting of universities and research institutions.

The Partnership Program Office is divided into units that work directly with individual customers. Given that the industry is characterized by a small number of large clients, each major customer is typically assigned its own Program Office. Additionally, the Business Areas, E&T, and the Partnership Program Office are overseen by the President of the Engines, ensuring strategic alignment and effective management within the Company.

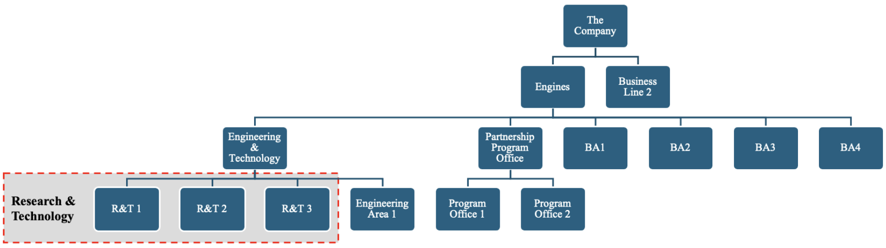


Figure 4.4: Organizational overview.

In Figure 4.5, the project portfolio governance structure is presented. The Engines Portfolio Board, the grey shaded area, is the highest level of project portfolio management within the Engines division of the Company. Beneath, each strategic business area from Figure 4.4 has their own portfolio, but also R&T has its own portfolio funded by the R&D budget. The different Program Offices depicted in Figure 4.4 can also fund projects within each different strategic Business Area or within R&T. Hence, these projects and technologies have a higher degree of external collaboration than completely internal research projects.

R&T's portfolio is divided into two different types of portfolios; a Capability Portfolio and a Demonstrator Portfolio. The Capability Portfolio is a collection of projects aimed at developing or enhancing technical skills, resources, and competencies that enable future innovation and readiness for more advanced development phases. The Demonstrator Portfolio is instead a collection of projects with emerging technologies aimed at testing and validating. These projects frequently involve the integration of multiple technologies in a system-level context. It represents the intermediate stage between research and product development, where the goal is to showcase technologies feasibility for commercial application. Reporting to the Portfolio Directors of the Capability Portfolio and the Demonstrator Portfolio are the Project Managers responsible for overseeing the active projects. Both portfolios work with technologies from TRL 1 up to TRL 6. Based on the intention of the technology, the technology is decided to move into either the Capability Portfolio or the Demonstrator Portfolio.

To illustrate the types of technologies that can be included in either the Capability Portfolio or the Demonstrator Portfolio, two examples are provided. Ceramic Matrix Composites (CMCs), which offer superior crack resistance compared to conventional ceramics (Low, 2014), represent a promising technology for application in turbine blades to enable higher operating temperatures. However, if the studied firm currently lacks the necessary competencies and capabilities — such as expertise in material science, advanced simulation, or specialized processing techniques — the technology would be placed within the Capability Portfolio. In this context, projects would focus on developing foundational knowledge and technical skills, with the long-term goal of building sufficient competence in high-temperature materials to support future integration into product-level applications.

On the other hand, if capabilities, competencies and resources exist within the studied firm and CMC is being evaluated for integration into engine components — such as turbine vanes (stationary components located in the hot section of an engine) — the technology may be advanced into the Demonstrator Portfolio. In this phase, the focus shifts from internal capability-building to instead validating the CMC's performance in a relevant operational environment in a system-level context, with the aim of demonstrating its feasibility for future commercial application.

It is within the R&T portfolio, marked with a red box in Figure 4.2, where the resulting framework of this thesis is to be applied.

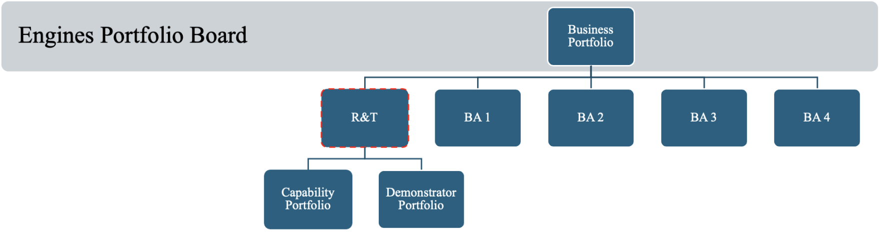


Figure 4.5: Overview of the governance structure of portfolios and projects

The purpose of the Engine Portfolio Board is to ensure that the projects within the portfolio remain aligned with the organization's overall strategy by providing appropriate oversight, leadership, and decision-making. Key inputs to the process include status reports on project health indicators within each portfolio and assessments of how each portfolio contributes to strategic targets (including any deviations). The agenda, reviewed per portfolio, covers topics such as capacity constraints, the current status of benefit realization toward strategic objectives, mitigation actions for any risks of underperformance, and potential changes to the project mix in response to strategic shifts. The outputs from these meetings include agreed-upon prioritizations and an updated action and decision log. Participants include the Engines President (serving as Chair), the Head of the Project Management Office, and the respective portfolio owners. The Engines Portfolio Board meets monthly on a recurring basis and are measured, among other things, upon respective portfolios' contribution to the strategic targets.

When new technologies are to be evaluated, there exists an evaluation process between the R&T Portfolio and the Capability and Demonstrator Portfolios. As illustrated in Figure 4.6, technologies are assessed, with approved candidates subsequently integrated into either the Capability or the Demonstrator Portfolio. The resulting framework of the thesis will be applied when evaluating whether a new technology will be admitted to the R&T portfolio and then distributed among the Capability and Demonstrator Portfolio. Upon the introduction of a new technology in either portfolio, a key responsibility for the Portfolio Director is to identify the skills, competencies, and resources required for its development or enhancement. Based on this assessment, the Portfolio Director initiates targeted projects to address these needs.

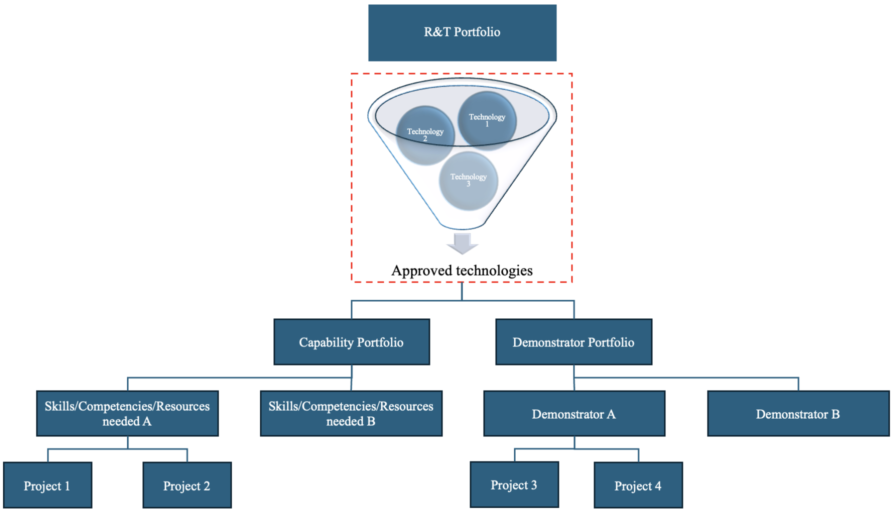


Figure 4.6: Overview of the flow of decisions from R&T portfolio to Capability or Demonstrator portfolio

4.2.1 Understanding Technologies at Company

A technology is defined by the Company as a specific application of engineering principles that has the potential to enable future capabilities or improve on existing ones. A technology in the Company's Engines division could refer to various systems or processes that are being developed or refined to enhance the performance, efficiency, and reliability of existing products, services, or processes. One of the broader purposes for engineering and technology departments is to support the advancement of relevant technologies along the TRL-ladder. Although a technology can exist independently as a concept, technology development projects are run with the purpose of developing scientific and technical capabilities within the given discipline and propel the technology forward through its development phases.

While the primary focus in this case is on evaluating technologies and their potential, it is important to acknowledge that technologies and the projects supporting their development are inherently intertwined. A thorough technology assessment must also consider the feasibility and execution of the associated projects — after all, a technology cannot advance if the projects intended to develop it cannot be realized. The projects can be seen as the vehicles transporting the technology along the maturity-levels. New technologies typically emerge from three different sources or a combination of the sources; a problem, a strategic goal, or a technological opportunity. Depending on the origin, the precision of targets and requirements can differ. The problem- or need-driven approach often arises from ongoing development efforts encountering challenges that require new sub-technologies to be developed, typically with well-defined targets and requirements. However, it can also be driven by customer expectations in the Company to conduct R&D that aligns with industry trends. Customers frequently share their perspectives on the future direction of technologies, expecting the Company to align its efforts accordingly. Additionally, the Company possesses some insight into the system-level strategies of engine manufacturers, allowing them to strategically position their components to enhance their attractiveness as a partner. The strategic quest, or need-based development, often comes from a strategic high level goal with an unknown solution. In this case, needs have been formulated at a high level requiring further development and detailing. This is often done in conjunction with iterative exploration of alternative solutions and technologies. The third source of technologies, referred to as the technological opportunity or opportunity-driven approach, originates from the identification of a promising technology that is expected to generate valuable benefits, although its specific applications and impact remain uncertain. This begins with the clarification of organizational needs, serving as the foundation for guiding R&D efforts. In both of the latter cases, the Company engages in generic R&D aimed at developing early-stage, or seeding, technologies characterized by low TRLs. This reflects a technology-push strategy, driven by the company's anticipation of future market demand rather than immediate application.

4.2.2 Evaluating Technologies at the Company

The current evaluation process at the Company in the portfolio management process is not supported by any dedicated tools. Instead, decisions are primarily based on an informal assessment of cost-benefit scenarios, the degree of strategic alignment, the presence of external commitments, resources available, and how the technology might affect the portfolio balance. Technologies involving external stakeholders are prioritized over internal initiatives that lack such external dependencies. Today's assessment is based on reasoning. The impact on portfolio balance is assessed without the support of visual tools or documented records, relying instead on individual memory. This ad hoc approach may lead to inconsistent evaluations and suboptimal portfolio prioritization over time.

In contrast to the standardized evaluation procedures employed by the Engines Portfolio Board when working with projects, there is currently no formalized forum or predefined structure guiding the involvement of specific expertise or decision-making authority when assessing new technologies. At present, technology evaluations are typically conducted through meetings involving the directors of the three divisions that collectively comprise the R&T organization. Additional stakeholders, such as the Capability Portfolio Director or representatives from the program offices, may be invited to contribute perspectives, particularly to incorporate insights related to customer needs. Furthermore, technology assessments may also occur externally, within the previously mentioned collaborative clusters in which R&T participates. The choice of cluster or division engaged in the evaluation process depends on the research domain to which the technology is deemed relevant. The technologies assessed in these clusters are generally at low maturity with an insertion date many years into the future.

The number of technologies that are needed to be assessed within the red box in Figure 4.6 differs, but usually one to a few ideas per week can be generated. Hence, upwards of 100 technologies a year must be assessed and evaluated to determine whether R&T should act upon them or not.

The need for a structured way to discuss and make decisions about new technologies is therefore critical. It's not just about facilitating a single decision point, but about establishing a shared process logic that supports both short-term efficiency and long-term strategic alignment. This issue is further amplified by the fact that this step often receives disproportionately little attention compared to later phases of the project lifecycle — such as planning, execution, and follow-up — even though the decision to initiate the development of a technology sets the direction for everything that follows. There is thus a clear need for a framework that not only enables structure, but also creates a foundation for shared language and decision-making criteria. Such a framework could help ensure more well-informed, transparent, and strategically anchored decisions — and thereby serve as a valuable support in the decision-making process.

5

Empirical Findings

This chapter presents the empirical findings gathered from interviews with key personnel as well as information found in internal documents at the Company. From the interviews with different stakeholders, multiple distinct criteria were revealed that are deemed important when evaluating technologies. Ensuring strategic alignment with the Company's overarching goals and the evolving demands of the aerospace market is crucial. The growing importance of sustainability is also featured, and particularly its interrelatedness with strategic intents and external funding opportunities. Furthermore, the potential for IP generation and the need to navigate the IP landscape are found to be important considerations.

The practical aspects of executing the necessary projects to develop technologies, including the availability of resources and capabilities within the Company, alongside budget and affordability, are also identified as critical factors in decision-making. Additionally, the framework of contracts, particularly in collaborative programs like RRSPs, adds another layer of complexity. Finally, the overarching concerns of risk and compliance, encompassing technical feasibility, market uncertainties, and adherence to industry regulations, are key in the evaluation process.

The subsequent sections of this chapter will delve into the perspectives of various stakeholders and what different principles and specifications are currently considered within the Company's technology evaluation and decision-making processes. Finally, the voiced conditions and aspirations for the decision-making framework are outlined based on interviews at the case company.

5.1 Criteria to Consider When Evaluating Technologies

A wide area of topics were discovered from the semi-structured interviews and the investigation of the internal documents of existing processes. The criteria that were discovered and deemed of high importance when evaluating whether a technology has been or will be successful or not is presented in table 5.1. As proposed earlier in the study, each interviewee and workshop attendee has an abbreviation. Internal documents are given the abbreviations D1 or D2.

Table 5.1: Criteria that emerged from the empirical study

Category	**Criterion Examples**	**Respondents**
Financial Considerations	Expected benefits and costs, capital expenditure, market attractiveness, source of funding	I1, I3, I6, I7, I8 I9, D1, D2
Technical Feasibility	Probability of success, time-to-market, competence, number of technical domains	I1, I3, I5, I7 D2
Strategic Alignment	Strategic rationale, gap between development time and market insertion, reputation, fit within portfolio	I3, I4, I6, I8, D2
Funding and Research Collaborations	Degree of external funding, long-term relationship with the Company's ecosystem	I2, I4
Intellectual Property	Mapping of IP landscape	I1, I2, WA5
Support from Management and Stakeholders	Management support, external stakeholders, supplier/-contractor support	I3, I5, D2
Alignment to Sustainability	Does this make the firm's work more sustainable?	I2, I6
Risk	Potential legal implications, technical and functional risk	I1, I8, D2, WA8

5.1.1 Financial

The projected benefits and costs of developing a technology were consistently emphasized as highly important by many of the interviewees. Given the nature of the aerospace industry — marked by high entry barriers and substantial investment requirements — the financial viability of new technologies is a critical consideration.

Several interviewees highlighted the value of standardized financial metrics as useful indicators in evaluating technologies. For instance, I1, working as a Research Engineer, pointed to NPV, ROI, and payback time as particularly significant when assessing the potential of technologies and their related projects. This sentiment was also cited by I8 and I6, both from the Partnership Program Office, who agreed that financial indicators, especially ROI, are important to ensure that a technology delivers future value. However, I6 also acknowledged the challenge of applying such metrics to early-stage or “seeding” technologies, where uncertainties make accurate forecasts difficult. This concern was reinforced by I3, who cautioned that relying solely on NPV can be misleading in the context of aerospace R&D. Due to the long development timelines typical in the industry, most technologies and their development projects might appear financially unviable from the perspective of the present. Still, I3 argues these investments are essential for the long-term competitiveness and survival of companies like the one studied in this report.

Beyond financial metrics, interviewees stressed the importance of understanding the expected qualitative benefits of a technology. I7 emphasized that these benefits don't need to be precisely quantified; rather, they should indicate a direction. Key questions include: Can the technology enable major savings in production or fuel efficiency? Might it support the launch of a new product?

When it comes to cost, both I3 and I6 emphasized the importance of considering development costs and investment size in the evaluation process. I7, who oversees the projects and the project managers within the Capability Portfolio, specifically highlighted the role of capital expenditure- (CAPEX) investments in physical assets like machinery or facilities. Even when a business case appears promising, high CAPEX can become a major barrier to implementation and deter investment.

Another recurring theme was market attractiveness. For I8, a simple yet powerful question—"Is this sellable to customers?"—can significantly influence investment decisions. I8 also pointed out that new technologies may impact the engine as a whole, potentially increasing the firm's share in future RRSPs. Similarly, I9 stressed the need to evaluate the commercial potential of a technology and its future market value.

Financial aspects are also addressed in internal documents used for business case evaluations. In document D1, financial calculations for expected benefits and costs are conducted before a new project is presented to the Engines Portfolio Board, common financial metrics are expected payback time and ROI. Document D2, on the other hand, assesses perceived development complexity, linking it directly to budget size. Development projects with larger budgets are considered more complex and resource-intensive. D2 assesses the budget on a scale ranging from \$50K to \$100M.

5.1.2 Technical Feasibility

Multiple aspects of feasibility play a critical role in evaluating technologies and their coherent development projects within the Company. Several interviewees emphasized its importance as a key criterion in decision-making processes and multiple respondents explicitly mentioned technical feasibility as one of the primary factors considered when assessing technology potential.

I3 explains in an interview how portfolio- and technology evaluation should take into account things like feasibility, customer interest, and market exploration. While technical feasibility is not the sole determinant, it is interrelated with broader feasibility assessments that guide the assessment of future endeavors. I7 provided a similar perspective, noting that technical feasibility is a crucial aspect when evaluating the business case for new technology development. TRL gate decisions at the Portfolio Director level are currently influenced by considerations such as technical feasibility, specifications of requirements, and the availability of necessary resources.

The feasibility of developing a technology through projects, including timeline, costs, and resource availability, was another recurring theme in discussions. I4 emphasized that a development project's feasibility is closely tied to how long it will take, what it will cost, and whether the necessary resources are in place. These factors collectively determine whether a technology can progress beyond initial conceptualization to practical implementation. I3 further underscored the importance of TTM considerations, explaining that TTM provides a comprehensive picture of a technology's attractiveness. A technology with excessively long TTM may be deemed undesirable, especially so if the required time to insertion for that technology is shorter than the projected TTM. I6 further mentions that for RRSPs the firm is already participating in, time constraints become a significant factor in decision-making. This perspective aligns with the broader emphasis on ensuring that technological advancements are not only feasible but also timely in their implementation.

Resource constraints were also frequently mentioned as a challenge in evaluating technical feasibility. I7 pointed out that there exists constraints on critical employee competencies and financial resources and that these are allocated through a structured allocation system for long-term projects. Additionally I5 identified the ability to secure the right personnel at the right time as a potential pitfall, reinforcing the notion that feasibility is often contingent on organizational capacity. However, I6 countered this viewpoint, arguing that prioritization should never be dictated by resource availability. Instead, the ability to execute a project should be considered in terms of strategic importance and long-term objectives.

I7 also argues that multiple dimensions are important to consider and that successful development execution depends on both the resources at hand and the organizational capabilities needed to carry out complex projects. I7 cited Artificial Intelligence (AI) as an example, explaining that while AI-driven projects may be appealing, they are difficult to initiate if the necessary expertise and infrastructure is lacking. This underscores that technical feasibility is not merely about whether a project can be realized from a technical standpoint but also about whether it aligns with the organization's existing competencies and resource base.

D2, examines the complexity of a project in terms of how novel the technology is ranging from little that is new or using established technology to significant areas of novelty. Moreover, it states that a higher number of technical disciplines results in increased complexity.

5.1.3 Strategy

Strategic alignment in technology selection has been identified as a critical factor in ensuring efficient resource allocation and long-term overall competitiveness. According to I3, a recurring consideration in strategy alignment involves maintaining a continuous pipeline of technologies across all TRLs to achieve a mix of different maturity levels across the portfolio of current and future technologies. This facilitates a balance between short-term market needs and long-term technological advancements. Additionally, the Company's Engines division seeks alignment of technologies with the company's four strategic business areas. I3 explains that, by also evaluating the relevant competence and knowledge generated by individual projects, internal capabilities can not only be strengthened, but spillover effects can be generated that benefit multiple business areas and product lines. This way the Company can leverage technological synergies across its business units to reinforce its position in multiple areas at once.

I6, working as a Customer Strategy Director and hence close to the customers, mentions that another key strategic consideration is market alignment. The maturity level of a technology can help determine its strategic relevance, with some technologies and development projects being prioritized based on immediate market needs, while others are pursued for their potential long-term impact. Additionally, the strategies and technological road maps of aerospace engine OEMs creates an indicator for the direction in which the industry is moving. Because of this, I6 verifies the importance of customer strategy alignment even when evaluating internal incentives. I5 confirms that the Company is making an effort to be in tune with market signals and stay ahead of the curve, indicating that the technology road-map strategy is characterized by an ongoing combination of market pull and technology push. Furthermore, I3 emphasizes that time to insertion plays a crucial role as the development of the technology must fit within the strategic timeline and align with market entry requirements. Ensuring that a technology is introduced at the right time is essential, if the projected development timeline of a technology exceeds the required time to insertion, the delayed market entry can effectively lead to commercial obsolescence.

An evaluation of strategic alignment must also involve mapping the gap between potential future endeavors and long-term strategic objectives. By assessing how well a technology contributes to long term strategic ambitions, the Company can determine the attractiveness of an investment in the technology. According to I7 however, it is also worth noting that technologies with significant future potential may be considered even if the gap to the strategic roadmap is currently large, provided that their development trajectory aligns with the expected evolution of the industry or the technological road map of the Company's strategic partners. This approach ensures a technology pipeline that remains relevant over a long period of time, rather than being constrained by short-term strategic goals. I7 also presents a component of this assessment that is already present at the Company which is the classification of projects into three different technology horizons: today, tomorrow, and beyond. This approach is also verified as an important consideration by the Customer Strategy Director, I6. Technologies categorized under "today" focus on incremental improvements and implementation and mostly consist of existing product lines. "Tomorrow" encompasses emerging technologies that require further development but has a clear alignment with the anticipated technological direction of the industry. "Beyond" refers to high-risk, high-reward innovations that could redefine aerospace engineering in the long run. By balancing investments across these horizons, the Company can maintain a steady flow of innovation that align with both immediate commercial needs and long-term strategic goals.

D2 also incorporates strategic considerations when assessing perceived development complexity. Two primary aspects are examined: First, the strategic importance of the technology and its associated development project. This involves evaluating whether the technology's success or failure will have a significant impact on the company's business plan, and whether a failure would visibly affect the firm's overall performance. Second, D2 considers the potential impact on the firm's reputation. Specifically, it assesses whether the outcome of the development project, either success or failure, will attract the attention of key customers, and if a successful outcome might positively influence customer behavior or strengthen strategic relationships. However, I3 explains that complexity doesn't have to be a deterrence. Instead, sometimes technologies in need of complex development are undertaken just to enhance the firm's capabilities and competencies within a specific area.

Finally, maintaining a broad portfolio of low-maturity technologies has previously been recognized as a successful approach (Högman & Berglund, 2007). I6 verifies the presence of this approach. By strategically investing in early-stage seeding technologies, the Company can identify key priorities and allocate case-specific resources, ensuring rapid adaptation to shifting market conditions. This strategy allows the Company to explore novel concepts without immediately committing to full-scale development, providing the flexibility to pivot or further pursue promising technologies based on market feedback and projected technological feasibility (Högman & Berglund, 2007). A diversified approach to technology investment allows the Company to be well positioned to capitalize on emerging opportunities while mitigating the risks of sunk cost fallacy associated with technological uncertainty of early stage project development.

5.1.4 Intellectual Property (IP)

Like in many industries, IP management in the aerospace industry plays an important role in maintaining competitiveness and securing long-term technological advantages. I1 explains that for the Company, continuously assessing the IP landscape is also a way to gain insights into how customers and competitors are moving, especially when direct information is scarce. It provides a broader understanding of technological directions and potential market shifts. Furthermore, I2 emphasizes that in an IP landscape that is saturated with patents, the importance of collecting thorough information about the adjacent IP environment increases in order to evaluate the feasibility of a new technology. Although mapping of the IP landscape can give the company an idea of how existing IP might interfere with innovation efforts, WA5 emphasizes that despite thorough effort, it is usually difficult to confidently assert that freedom to operate exists.

Clearly defining IP rights is of specific importance when engaging in research and program partnerships, such as with universities or customers, to ensure that future disputes are mitigated. When going into partnerships, knowledge sharing and generation is unavoidable, therefore, the IP is structured into background, foreground, and sideground IP according to I1. Granstrand and Holgersson (2013) defines Background IP as the know-how, design practices and engineering practices that the company brings into the partnership. Foreground IP refers to new innovations, IP and patents that are generated by the development, while sideground IP covers independent technologies that are developed parallel to the technology but might still be relevant for the ongoing work.

In order to protect its innovation, the firm can employ multiple defensive IP protection strategies such as patents, trade secrets, and know-how. For technologies in the aerospace industry however, patents are particularly important to secure exclusivity over new innovations and technologies. Nevertheless, patents must be balanced with trade secret protection to appropriately protect processes or certain engineering practices that might be better protected through confidentiality and non-disclosure agreements.

5.1.5 Support from Management and Stakeholders

Much of the decision-making at the Company related to new technologies is influenced by multiple internal and external stakeholders whose backing is crucial for a technology's success. I9 notes that external stakeholders can influence development prioritization as important customer needs may create an urgency for certain technologies.

Internally, strong managerial backing has been mentioned as essential for a technology to secure the necessary resources and advance through development stages. I5 emphasized the importance of internal backing, meaning that having a dedicated champion within the organization, who supports the technology, can ensure efficient resource availability and allocation for projects.

D2 investigates dependencies in the form of needed interfaces. The meaning of interfaces is the predicted external stakeholders that are needed to develop the technology. This can be partners within the RRSPs, airframers, certification authorities, suppliers or contractors. Hence, the tool investigates the number of external interfaces but also their perceived support, if they will benefit from the development, and if any of the interfaces are expected to change during the duration of the development. Another key aspect in D2 is the support of the management team. If the technology and its projects have a high profile sponsorship, roadblocks and potential problems that will be encountered can swiftly be removed. If instead the level of support is mixed, the development complexity increases.

5.1.6 Risk

A recurring theme throughout the interviews is the inherent challenge of assessing risk in the aerospace industry. This difficulty is particularly pronounced due to the extended development timeline characteristic of the industry, where projects can span many years from initial conception to market implementation. Evaluating the potential risks and returns over such a long horizon introduces significant uncertainties, making accurate and robust assessment both critical and complex.

The complexity of risk assessment in the aerospace industry is reflected in various dimensions, as highlighted by the interviewees. The Company manages risk in many different areas such as technological development stages, supplier relationships, intellectual property, and financial structures, each of which require consideration to ensure a holistic approach to risk assessment and mitigation.

One of the primary concerns in aerospace RD is technical and functional risk. The TRL framework is a fundamental tool for managing these risks, as outlined by I2. The Company employs the inclined wave principle, showcased in Figure X, to monitor the maturity of technologies and their alignment with market demands. I2 highlights a particularly critical phase called "valley of death" between TRL 5 and TRL 6, where technologies face significant challenges in securing funding and partnerships to advance towards commercialization. Successfully navigating this stage requires collaboration and shared risk-taking among stakeholders.

I2 also elaborated on the role of RRSP, which is a key financial and strategic mechanism for distributing risk among stakeholders. While these programs allow the Company to prolong financial benefits, they also introduce long-term dependencies and constraints on strategic flexibility.

Another recurring theme in risk management is dependency risk, particularly in supplier relationships and manufacturing choices. I5 emphasized that procurement decisions must account for not only cost efficiency, but also negotiation leverage, supplier reliability, and the potential for risk response. One strategic consideration relating to risk in project evaluation can be to assess the possibility of using a single large casting versus multiple smaller parts, as each approach carries different implications for supplier dependence and overall risk exposure. To mitigate this, procurement representatives have a stakeholder role in development projects to ensure that these risks are integrated into broader strategic decision-making. Also, D1 presents risk in the form of dependencies and constraints. Here, the dependencies and constraints can be both internal, such as dependence on the availability of specific resources, or external, being dependent on parallel development with partners or supplier dependence. WA8 further enforces the notion that internal dependencies also are of high importance, and even at times worse than external dependencies. D2 also evaluates the perceived risk of legal implications, providing examples such as risks involving IP such as patent disputes over infringement or ownership or contractual risks where if targets in contracts can't be reached penalty clauses might come into effect.

Assessing the commercial viability of aerospace projects is inherently difficult due to long development cycles and market uncertainties. During one of the workshops, participants highlighted the challenge of evaluating both the potential value and risk of new projects. During the workshop, I3 underscores the need to incorporate risks in relation to market trends, financial projections, and technological feasibility. On a similar note, I7 noted in a different conversation that risk plays a crucial role in project assessment as it ties into achieving an efficient portfolio balance where trade-offs between high-risk, high-reward innovations and more stable, incremental improvements must be carefully managed.

5.1.7 Funding and Research Collaborations (Network)

At the Company's Engines division, technology development is seldom funded exclusively by internal resources. I4, working as a Technology Project Manager, states that the majority of technology projects at a very early stage of maturity are conducted in collaboration with external research institutes and universities. Given the high capital intensity and innovation centricity of the aerospace industry, external grant funding plays a critical role in facilitating faster and less costly research as well as enabling long term strategic initiatives. I4 states that the relationship between internal and external funding for technology projects is usually evenly distributed. The complexity evaluation tool, D2, also considers the source of funding for development projects. It adopts a distinct approach: a higher proportion of external funding increases the need for external reporting and accountability, which in turn contributes to greater overall complexity for the development of the technology and the coherent projects.

One of the main benefits of leveraging external grant funding is the mitigation of financial risk. This allows the Company to pursue innovative, high-risk development projects that would otherwise have been deprioritized due to resource constraints. Additionally, external grants where the Company can lead and coordinate research encourages close collaboration with universities, research institutes, and other industry partners. I4 claims that there are multiple benefits of such collaborations. Not only can it lead to improved development outcomes, but it also allows for maintaining the network of partners to ensure sustainable long-term technical collaborations laying the foundation for knowledge relationships that might be of significant importance in the future. This is considered a key priority rather than focusing solely on short term commercial and financial metrics. When engaging in these collaborations, it is important for the Company to ensure a fit within resource commitment as well as identifying potential synergies and conflicts that may arise. Because of the significant impact on budget and resource consumption that external grants and collaborations can give, the availability of such funding can have a direct influence on the prioritization of technologies and the subsequent technology development projects according to I4. As such, I4 notes that technologies and development projects with higher potential for external funding can be given priority over those that are unlikely to be funded by external resources.

5.1.8 Alignment with Sustainability

Sustainability is another central consideration in the Company's technology development and strategic planning. Multiple interviewees emphasized the role of sustainability in shaping R&D investments, technology evaluations, as well as trends in the industry as a whole. I2 highlighted that the next-generation engine constantly aims to be 20% more efficient, indicating that the industry has a general commitment to reducing emissions and improving fuel efficiency. I2 mentioned hydrogen propulsion as an example of a technology with high sustainability focus, although there are still many technical challenges to overcome before this can become a reality. While flying on hydrogen is technically feasible, things like large-scale production and supporting infrastructure restrict near term implementation.

The Company is involved in two major engine development projects, both of which incorporate sustainability as a key driving factor. These projects exemplify how sustainability considerations are integrated into technological innovation. Furthermore, at the corporate level, the Company's parent company has set an overarching objective that 80% of R&D investments should be allocated toward sustainability-related initiatives. This further underscores the strategic priority given to sustainable innovations.

I6 stressed the importance of considering environmental, social, and economic sustainability aspects when assessing new developments. This includes evaluating whether the technology will help an engine to become more environmentally sustainable, whether the production process itself improves in terms of sustainability, and whether the project aligns with broader strategic sustainability ambitions. I6 also underscored that the ambition is not to view sustainability purely as an environmental issue, rather the sustainability standpoint at the Company closely resembles that of the triple bottom line framework, with simultaneous acknowledgement of people, planet, and prosperity.

5.2 Stakeholder Requirements for a Technology Evaluation Framework

Interviews with key stakeholders revealed the conditions under which a decision-making framework should exist according to their own ambitions and objectives. First of all, there is a shared understanding that the framework should not primarily aim to serve as a quantitative model, but rather a structured basis for discussion. I1 pointed out that numerical scores serve little purpose on their own, but instead they should be used to foster informed discussions in collaborative decisions. I2 further enhances this notion by emphasizing the difficulty of quantifying every aspect of a technology. The framework must therefore act as a supportive tool rather than providing definitive objectivity. I3 further stressed the importance of not reducing complex decisions to simplistic metrics. To accommodate this, I3 suggested that criteria should be rated on a more qualitative scale, for example assessing based on descriptive attributes such as low, medium high on a three-point scale, rather than assigned – hard numerical values. This approach is seen as more flexible and better reflects the detailed judgements required in R&D prioritization. However, a total score is still relevant to aid in the process of having to prioritize between multiple technologies.

An additional perspective that was revealed during an interview with I3 was that internal stakeholders believe a robust framework should be able to provide support in portfolio balancing over time and across TRLs. This is in order to ensure a stable balance of projects at various maturity stages. The robustness of the framework is closely related with its flexibility and adaptability in use. Because of this, I4, I7, and WA8 mention the need for a mechanism to assign different weights to different criteria based on the nature and scope of the technology that is being evaluated. One example mentioned by I4 is a technology being evaluated due to strategically building competencies within its network, but with a poor financial business case. Here, the financial aspects of the technology should be assigned a lower weight to give a fair score.

In addition to structured inputs, visual representations were highlighted as an important output feature by I3 as it aids in comprehension and supports communication of the results. The importance of clarity and usability is further reflected in I7's parable to a concept selection matrix. He stressed that the framework should include criteria that are non-negotiable, clearly visible, and not obscured by an overall aggregated score. This would help avoid decisions being driven solely by a high total rating while overlooking critical weaknesses.

Collectively, the interviews pointed at the need for structure and standardization of processes in decision-making. Additionally, including this type of support in current operations can ensure consistency and alignment with overarching strategic goals.

Synthesizing the empirical findings, multiple criteria were revealed as essential for evaluating early stage technologies. Dimensions such as the potential for financial return, the technical feasibility of developing the technology, the technology's level of alignment to both the Company's strategy and its customers, and assessing potential risks. Furthermore, the interviews revealed a consensus that the evaluation framework should serve primarily as a structured platform for informed discussions rather than a purely quantitative tool, with a clear preference for qualitative scoring models over complex financial calculations due to the high uncertainty in early-stage evaluations. Stakeholders also emphasized the importance of visual tools to support communication, highlight divergences, and assess portfolio balance. Moreover, they stressed the need for flexibility, including optional weighting of criteria and an archival feature to ensure transparency, traceability, and organizational learning.

6

Analysis

This chapter presents the analysis of the presented data from the frame of reference and the empirical findings. The analysis is divided into three different sections that analyze the findings based on the research questions.

6.1 Analysis of Evaluation Criteria

To answer Research Question 1, an analysis and categorization of the evaluation criteria revealed in the frame of reference and the empirical findings is presented in this section.

There existed some discrepancy between what criteria to consider during evaluation between the frame of reference and the empirical findings. For instance, market attractiveness was discussed as a singular criterion focusing on perceived commercial potential in the interviews rather than the more comprehensive evaluation of market size, market growth, and intensity of competition as suggested by the literature. Similarly, resources were associated with the technical feasibility of developing the technology, whereas the literature more explicitly differentiates the availability of various resources. Furthermore, criteria related to teams which were emphasized in the literature were not mentioned in the interviews. However, the empirical findings introduced additional, context-specific, criteria such as the availability of external funding and the role of research ecosystems when conducting technology development.

From the frame of reference, the criteria that were considered to be applicable and of significance for the aerospace industry were compared and merged to criteria that emerged frequently during discussions at the Company. This evolved into four overarching areas; Bang for the Buck, Technical Feasibility, Strategic Alignment, and Risk.

6.1.1 Bang for the Buck

Bang for the Buck refers to how much value, benefit, or return the Company can obtain for the amount of money, effort, or resources invested. It's about maximizing efficiency.

Multiple authors discuss financial metrics as an important criterion when evaluating projects (Pinto, 2019; Cooper et al., 2001; Cooper and Edgett, 2003). Metrics mentioned include ROI, payback period or payback time, NPV, and ECV. Some interviewees at the studied firm also emphasized these standardized financial metrics as useful tools for ensuring that technologies create value. However, much as described by the literature, doing complex financial calculations at early stages yields a possibility that only low-risk projects will be undertaken. Additionally, it threatens to undermine long-term strategic goals in favor of short-term financial returns (Cooper et al., 2001; Cooper and Edgett, 2003). Likewise, this view was shared by some of the interviewees. They explained that because early-stage technologies involve high uncertainty and are difficult to forecast, and since the industry typically has long development cycles, using financial metrics can make many of these technologies appear unattractive during evaluation. Instead, what was proposed was that the financial benefits don't need to be precisely quantified, instead a direction or a scale of the perceived financial benefits is enough when evaluating a technology at such an early stage.

Beyond internal financial metrics, the empirical findings showcased that interviewees discussed external financial influences, particularly the role of external funding. External funding — not commonly addressed in the literature — holds an important share of the total budget towards development of new technologies. Hence, the access to external funding can make or break the development of a technology. External funding can facilitate faster and less costly research while mitigating the financial risk the Company takes on in the development of new technologies. However, this also increases the complexity of development since the number of interfaces, both internal and external, increase.

It was also raised during discussions that a technology doesn't have to be isolated from other technologies but can rather benefit multiple business areas and product lines. This possibility of spillover effects was deemed of high relevance and could greatly affect the financial prospects of the technology. For example, a seeding technology at TRL 1 with a time to insertion many years into the future of prospective engine programs, might be able to benefit existing engine programs much earlier such as in possible repair solutions.

To summarize the findings within the expected value generated compared to the investment needed, four criteria were generated to give a holistic perspective; cost vs benefits, expected commercial value, spillover effects, and availability of funding. The Criteria categorized as Bang for the Buck can be found in Table 6.1.

Table 6.1: Bang for the Buck Criteria

Category: Bang for the Buck
Costs vs. Benefits
Expected Commercial Value
Spillover Effects
Availability of Funding

6.1.2 Feasibility

Feasibility refers to the degree to which the development of a technology can be successfully executed or implemented given the current constraints. It assesses whether something is practical, achievable, and realistic.

Firstly, when assessing feasibility, the concept of a technical gap — the distance between current capabilities and those required for a new technology — was emphasized by Cooper et al. (2001) and Cooper and Sommer (2023) as a critical evaluation factor. This is in concurrence with the statement of I7 that successful development execution depends to a large degree on the organizational capabilities — especially when it comes to carrying out complex projects. If the organizational capabilities are lacking, such as expertise or infrastructure, initiating and executing a project can often prove difficult from a technical standpoint.

Another theme that became apparent in the empirical findings is the relationship between the time it will take for the technology to reach the market or be integrated with other technologies compared to when the technology is needed. This was discussed shortly in the theoretical framework by Silva et al. (2010) as the opportune attendance which evaluates the difference between development time and customer expectations. This relationship was reckoned to be of great importance at the Company by I3 and I6. I3 underscored that a technology's TTM provides a comprehensive picture of a technology's attractiveness and that it must align with the required time to insertion. I6 mentioned that the projected TTM is a significant factor for existing engine programs where external pressure is present. A large gap between TTM and time to insertion risks leading to an unattractive technology if a delayed market entry occurs while simultaneously decreasing the feasibility of a successful development.

Another potential pitfall for developing technologies was noted by I5 — securing the right personnel at the right time. As noted in the literature, inadequate resources are seen as one of the most persistent weaknesses in new product development (Cooper & Edgett, 2003). Resources can be of different types, such as; financial, skilled personnel, technological capabilities, and infrastructure resources (Silva et al., 2010; Cooper et al., 2001). The possibility that a lack of resources hinders the development was also noted by I4 and I7. I4 noted that a project's feasibility is closely linked to whether the necessary resources are in place. I7 pointed out that there exists constraints on certain critical employee competencies and financial resources to undertake certain development projects. Hence, at the studied firm, it seems like the most critical resources needed to be accessible are personnel with the right competencies and capabilities as well as financial resources.

Another point closely related to financial considerations and if required resources are available is the level of CAPEX investments. I7 stated that even if a business case might look promising, high CAPEX investments could be a major implementation barrier and act as deterrence to investments. Compared to the criteria revealed under “Bang for the Buck”, deterrence due to large investments does not look at the ratio between reward versus resources invested. Instead, it considers only how feasible it is to make the investment.

The importance of strong managerial backing and stakeholder engagement was acknowledged in the literature as critical to the success of new product development and technology projects. Cooper et al. (2001) emphasize that without visible and consistent support from senior management, even well-designed and executed projects may struggle to gain organizational traction. They further highlight that successful portfolio management is often underpinned by strong executive involvement. Schilling and Hill (1998) extends this view by underscoring the value of stakeholder engagement, noting that executive champions or senior figures who advocate for promising projects can help secure essential resources and build organizational momentum. Additionally, strategic partnerships with external stakeholders, such as suppliers or technology partners, are seen as beneficial in enhancing project feasibility and accessing key capabilities. These insights were likewise revealed in the empirical findings, where internal managerial backing was consistently mentioned as crucial for progressing technologies through development stages. I5 stressed the role of internal champions in ensuring efficient resource allocation, while internal documents such as D2 noted that high-profile sponsorship from the management team can facilitate problem-solving and mitigate roadblocks. Conversely, when management support is inconsistent, the complexity of development significantly increases, further underscoring the central role of leadership commitment.

The level of complexity was not discussed during the interviews to the same extent as in the literature. Cooper and Sommer (2023) discuss how technical complexity can influence the probability of success while Cooper et al. (2001) discuss the complexity as a key element when assessing technical risk. Even though Silva et al. (2010) do not mention complexity explicitly, they state that technologies at higher maturity levels are more predictable and feasible. From the empirical findings, complexity as a criterion was only discussed by I3 of the interviewees. I3 stated that complexity doesn’t have to be a deterrence but a complex project can be undertaken to enhance the Company’s capabilities and competencies. However, the internal document D2, aimed at assessing project risks, affirm that the level of external reporting, size of the budget, the novelty of the technology or work undertaken, and number of technical disciplines all affect the complexity of the work that is to be undertaken. Hence, complexity can take many different forms in development projects and a higher level of complexity decreases the feasibility and prospects of successful development.

Further, Silva et al. (2010) states that a technology that has a strong fit with existing capabilities can reduce development time and improve the odds of successful implementation. As revealed in the empirical findings, the probability of succeeding with developing a technology depends on a multitude of factors. A misalignment between TTM and customer needs, the complexity of developing a novel technology, or minimal support from stakeholders are all factors that affect the probability of success. However, the probability of success has only been mentioned as a criterion by I7. Still, many of the factors mentioned overlap with the larger theme of being successful with the development. Hence, the most important factors to consider when assessing the feasibility of developing a technology are taken into considerations are isolated criteria but in order to gain a holistic perspective, the probability of success is integrated as its own criterion. The final set of criteria for the Feasibility category are found in Table 6.2.

Table 6.2: Feasibility Criteria

Category: Feasibility
Capabilities
Probability of Success
TTM vs. Insertion
Resources
CAPEX and Investments
Support
Complexity

6.1.3 Strategic Alignment

Strategic alignment refers to the degree to which a technology supports and reinforces the overarching goals, mission, and long-term strategy of the organization.

Portfolio balance is widely recognized in the literature as important when it comes to portfolio management. Lack of strategic alignment in the portfolio can lead to barriers in innovation portfolio management as well as ineffective portfolio performance (Si et al., 2022; Cooper et al., 2001). Potential criteria to utilize when evaluating the portfolio balance are high-risk and high reward vs. more incremental and technically secure investments, predefined strategic areas such as market segment or product class, project sizes, and projects that are at different stages in development (Cooper et al., 2001; Cooper and Edgett, 2003; Archer and Ghasemzadeh, 1999; Schilling and Hill, 1998). At the Company, the portfolio balance was also seen as an important criterion for evaluating a technology. I3 stated that a recurring consideration in strategic alignment is to have a continuous pipeline of technologies across the maturity levels. This leads to a portfolio that balances short-term market needs and long-term technological advancements. I7 agree with the balance of risk discussed by many authors, the portfolio must balance innovations with high risk and reward with the more stable, incremental improvements. Further, I3 explained that another metric to be considered for the portfolio balance is the strategic business areas within the Engines division. Each strategic business area should have technologies currently in development.

Cooper et al. (2001) explained that strategic fit is one of the most critical project evaluation criteria. For a project or technology to be strategically fit it must align with the firm's long-term vision, be compatible with the product roadmap, and be able to leverage existing competencies (Cooper et al., 2001). In the empirical findings, I7 described that an assessment of how well a technology contributes to the long term strategic ambitions of the Company is a good indicator of the attractiveness of the technology. However, in contrast to the literature, technologies that have a large gap to the strategic roadmap are considered if their development trajectory aligns with the expected evolution of the industry or the technological roadmap with the Company's strategic partners.

Alignment with the Company's strategic partners leads to another important evaluation criterion that was brought up in the empirical findings. According to I5 and I6, the technological road maps of aerospace engine OEMs create an indicator for the direction in which the industry is moving. Hence, when evaluating a technology, strategic roadmaps of the industry and the Company's customers are taken into consideration. From the frame of reference, alignment with customers' technological roadmaps is not mentioned explicitly. However, Cooper et al. (2001) and Cooper and Sommer (2023) stress the importance of incorporating the voice of the customer into the strategic alignment. Thus, a strong market orientation that is anchored in customer needs are seen as important both at the studied firm and the literature. However, this requires a flow of information between the Company and their customers. I1 described that continuously assessing the IP landscape is one way to circumvent this issue and an approach to gain insights into the technological directions of customers and competitors.

Sustainability has been briefly mentioned in both the frame of reference and in the empirical findings. Cooper and Sommer (2023) discussed examining a project based on how it contributes to the organization's broader mission, including ESG commitments. Projects that actively support such goals can aid in responding to regulatory developments, stakeholder expectations, or shifting market demands. In the empirical findings, sustainability was brought up by I2 and I6. I2 highlighted that the aerospace industry has a general commitment to reducing emissions and improving fuel efficiency. I6 conform but, in alignment with the literature, assessing sustainability is larger than the environmental impact. How the technology can aid with social and economic aspects is equally important.

As with sustainable work, the impact on the company's image is concisely mentioned in both the literature and the empirical findings. Pinto (2019) points to the fact that the types of projects a company chooses to pursue send signals to internal and external stakeholders about its identity and direction. On the other hand, the internal project complexity evaluation tool D2, considers the potential impact the development can have on the Company's reputation. It asks the evaluator, based on the outcome of the development, if it will attract the attention of key customers and whether this can influence the customer's behavior or strengthen the relationship between the Company and the customer.

When discussing the impact of external funding, I4 claimed that another important consideration is the benefits of the ecosystem. Within these ecosystems, the Company conducts research in close collaboration with universities, research institutes, and industry partners. When working in the ecosystems, knowledge relationships and long-term technical collaborations are built and treated which is reasoned to be of high strategic value by I4. By caring for these external ecosystems, competencies of the future are invested in, high performers are attracted, and technology proposals are presented. Meanwhile, this is not explicitly discussed in the literature. One can connect it to Cooper and Sommer (2023) discussion about strategic intent — that projects should be chosen, beside being aligned with the firm's strategy, such that it can also influence and shape the future direction of the company. It can also be connected to Schilling's (1998) consideration of strategic alliances which can enhance access to capabilities and improve a project's feasibility.

Much of the discussion in the literature regarding competencies are centered around leveraging existing core competencies within the firm (Cooper, 2001; Cooper et al., 2001). It is argued that it can lead to an improved efficiency, accelerated development, or a stronger competitive edge. However, this has been contemplated when evaluating the feasibility of developing a technology. But it also became clear in the empirical findings that complex technologies are undertaken even though the feasibility is low. Instead there seems to exist a strategic rationale to build internal competencies and capabilities. I3 explained that the perceived complexity in development doesn't have to be a deterrence, but rather be seen as a strategic decision to obtain the necessary competencies and capabilities for the future. Criteria categorized into the Strategic Alignment category can be found in Table 6.3.

Table 6.3: Strategic Alignment Criteria

Category: Strategic Alignment
Portfolio Balance
Strategic Fit
Contribution to Sustainable Work
Customer Strategy Alignment
Impact on Company Image
Ecosystem
Building Competencies

6.1.4 Risk

Compared to feasibility which looks at the likelihood of success, risk refers to the uncertainty surrounding outcomes given the current knowledge. It involves identifying threats, what is unknown, and if these risks can be mitigated.

Pinto (2019) and Cooper et al. (2001) both identify the importance of IP as an evaluation criterion. The authors note that the ability to protect the firm's innovations by securing patents, trademarks, or trade secrets are important considerations. As the aerospace industry is characterized by the RRSPs and close partnerships, I1 describes that knowledge sharing and generation is unavoidable. In order to combat this, IP is divided into what know-how and practices the Company brings into the partnership, what IPs are generated when developing jointly within the partnership, and what IP is generated by parallel work. Even though protecting IP in the industry is deemed a complex task, it is still of high relevance according to multiple interviewees.

Assessing the perceived risk is seen as a critical task when evaluating technologies. I2 explained that technical and functional risk are two major risks that need to be accounted for. Technical risk includes the risk that the technology cannot be developed. Functional risk revolves around the risk that the technology won't perform its intended function. Technologies at different TRL's meet different risks, I2 highlighted the "valley of death" where technologies at TRL 5 to TRl 6 face significant challenges in attaining funding and partnerships to further advance the technology. In the empirical findings it also became evident that risk of legal implications, such as patent disputes or contractual risks, are accounted for. From the frame of reference, understanding risk is seen as vital. Cooper (2001) proposed two components of risk, the amounts at stake and the uncertainty. He noted that there needs to be a balance between risk and return within the project and Cooper et al. (2001) stressed the need for balancing different levels of risk in the overall portfolio to optimize innovation and financial stability. Cooper and Sommer (2023) briefly discussed utilizing financial models to approximate risk levels compared to the reward. However, as several interviewees pointed out, due to the same issues highlighted in the financial considerations — namely high uncertainty and the difficulty of making reliable forecasts — this was considered irrelevant in the context of this case study.

Understanding what risks exist is of high importance, but equally important is the ability to mitigate and control the risk. Today, risks at the Company are managed by utilizing the TRL framework as a tool to monitor the maturity of technologies and their alignment with market demands to make sure that technologies in development do not turn obsolete. Another risk mitigating strategy utilized are the RRSPs which distribute the risk of development among stakeholders. Silva et al. (2010) proposed integrating risk response as a formal criterion in evaluation. Utilizing this approach allows organizations to assess not only the perceived risk, but also whether there are measures in place to mitigate them.

Given the way of working in the aerospace industry with close collaborations within partnerships during development, the empirical findings revealed that there exists a risk of being dependent on external partners. These risks can include being dependent on suppliers or parallel development with partners. A higher degree of external interfaces seem to result in a higher degree of dependency risk. Further, as noted by WA8 and D1, internal dependencies can also act as a major obstacle in development. These internal dependencies can emerge when there exists a lack of internal resources such as personnel or competencies. Hence, the higher degree of external and internal dependencies of the evaluated technology increases the risk of encountering barriers during development. Criteria that fall under the Risk category are presented in Table 6.4

Table 6.4: Risk Criteria

Category: Risk
Intellectual Property
Potential for Risk Response
Perceived Risk
Dependencies

6.2 Identifying Tools for Technology Evaluation

This section focuses on answering Research Question 2 by presenting the tools and methods that were deemed as most appropriate for this context and use-case. This process was consistently guided by the convergence between theoretical findings and the results from the empirical study. Alignments and nonconformities between the two are analyzed in order to devise a framework that can confidently exist as a relevant complement to current decision-making processes.

6.2.1 Benefit Measurement Techniques

The creation of the framework was inspired by a review of a few existing evaluation models presented earlier, including the AHP, Scoring Models, and Checklists. Each approach was considered with respect to its applicability in an environment where technologies are assessed individually and where decisions are not always comparative in nature at the early evaluation stages.

The AHP method, while previously acknowledged for its structured decision-making capabilities and relative accuracy in establishing priorities, was ultimately deemed less suitable in this specific context. AHP's strength lies in comparative analysis between alternatives which is something that does not align with the case company's ambitions for an evaluation process according to I3, where at least initially, technologies are typically considered in isolation. Furthermore, AHP's reliance on expert judgement for both weight assignment and scoring as described by Palcic (2009) poses challenges in early-stage assessments where such input is either unavailable or inconsistent. Although the method does offer a more formalized structure for objectivity, its practical complexity and resource demands were for the most part considered misaligned with the needs described by the case company.

Checklists, by contrast, offer a highly accessible and easily implementable structure for technology evaluation that makes them compatible with the existing processes at the Company. It also allows for technologies to be assessed individually and without extensive background data which aligns with what both I2 and I3 says about the lack of accurate, numerical input in early stage technology development. However, as Cooper (2001) describes, the method does not provide a high degree of objectivity in the results as the input is usually purely subjective. Thus, the method does not demonstrate reliable results. Additionally, the binary nature of the method makes it less reliable in providing a basis for discussion which is one of the main features that I3 favors in a reliable evaluation process.

Scoring models emerged as the most appropriate source of inspiration for this context. Building on the simplicity of checklists, scoring models introduce a quantitative dimension through a predefined rating scale, enabling evaluators to express degrees of confidence across various criteria. The use of a rating scale as opposed to numerical values as input are preferred by I3 since it provides the evaluator with the opportunity to apply informed judgement without requiring too much confidence in the predictions. This structured and flexible approach promotes more accurate evaluations without demanding higher data quality. Importantly, scoring models enable consistent assessment across technologies while remaining adaptable to changing priorities.

A key feature of the implemented elements comes from Cooper and Sommer (2023)'s version of the scoring model, more specifically, its ability to support stakeholder dialogue which aligns well with the case company's own ambitions for an evaluation tool. Rather than producing definitive answers, the tool is intended to stimulate discussion and surface different perspectives on what constitutes potential in various domains. One key stakeholder, I3, specifically advocates for a structured way of fostering valuable discussion among stakeholders in technology evaluation processes. By generating a composite score, the method also provides a basis for relative comparison and prioritization, which, while not expressed by the case company as essential in these assessments, can become valuable in a case where multiple initiatives compete for resources.

6.2.2 Economic Models

Various economic models used in project selection and portfolio management have been examined in this study with particular attention paid to their relevance and limitations for the use case in this research setting. While financial metrics such as NPV, ROI, and payback time are common tools in traditional investment decision-making, their applicability in the context of early technology assessment has proven to be limited.

Empirical data from the interviews clearly indicated a shared hesitation toward using quantitative financial models in this setting. One crucial insight was that early-stage evaluations are not to be viewed purely as investment decisions, but rather assessments of potential. As such, the precision and robustness required for economic modeling often exceed the quality and availability of data at this stage. Technologies under consideration typically face long development timelines and high degrees of uncertainty, conditions under which traditional financial models struggle to provide meaningful outputs according to Cooper (2001).

Nonetheless, several respondents acknowledged the communicative power of financial metrics. Their intuitive appeal and ease of interpretation make them useful as general reference points. Despite their familiarity, financial measures are often misleading in early-phase evaluations. As highlighted in the literature by Cooper (2001), applying metrics like NPV in early R&D or seeding projects can systematically undervalue promising but high-risk technologies, frequently resulting in negative projections that do not reflect long-term potential. This was also expressed by various interviewees who described such metrics as inadequate or even counterproductive in the early phases of the technology development process.

At the same time, the need to reflect some form of cost-benefit or risk-return relationship in evaluations was acknowledged both in the empirical data and in the literature. Cooper (2001) points to the value of understanding the financial dimension of technology investments, not necessarily through detailed economic modeling, but through mechanisms that still capture expected value and commercial potential. In this regard, the scoring model developed in this study offers a suitable alternative. By allowing for the inclusion of subjective assessments related to economic potential such as expected commercial benefits in relation to investment size, the model acknowledges financial considerations without relying on precise numerical inputs.

This approach ensures that economic aspects are not overlooked, while also recognizing the inherent limitations of financial models in uncertain, early-stage contexts. Ultimately, as both the literature and empirical findings confirm, purely financial methods are not well suited to guide early technology evaluations as they risk prioritizing low-risk, short-term projects at the expense of long-term potential which is an outcome that also contradicts the strategic objectives of the case company.

6.2.3 Portfolio Selection and Management

In developing the evaluation framework for the case company, portfolio-level considerations were integrated to support not only the assessment of individual technologies, but also to provide insights into the composition of the technology portfolio as a whole.

The literature emphasizes that a strong portfolio is not simply a collection of promising individual projects and Chien (2002) highlights that optimal portfolio outcomes rather arise from adequate balance of projects within the portfolio. Furthermore, Cooper (2001) identifies three overarching goals of portfolio management: value maximization, strategic alignment, and balance. These principles served as foundational design criteria in shaping the tool to reflect both theoretical insights and practical needs.

Empirical findings strongly align with this literature. Several respondents emphasized the importance of maintaining a balanced portfolio, particularly with respect to technological maturity and time-to-insertion. For instance, I3 and I7 described current practices that consider these factors, albeit in an informal and unstructured manner. This highlights a key gap in current portfolio practices at the Company: while the mindset around balance exists, the tools to support it are either absent or underdeveloped. Respondent I8 also stressed the importance of distributing technologies across maturity levels to ensure readiness for both current and future technological demands which is a perspective that reflects the close connection between balance and strategic alignment.

To address this, the framework incorporates features designed to visualize and communicate portfolio characteristics. These include visual portfolio representations such as bubble diagrams and pie charts, methods recommended in literature by Cooper (2001) and Cooper et al. (2001). These elements help identify imbalance in risk levels, resource allocation, and development timelines at a glance, thus enabling stakeholders to act on early signals of misalignment. Notably, the tool also includes a timeline visualization, inspired directly by empirical input, which highlights the insertion horizon of each technology (Figure 6.2). This feature responds to the need for a more structured understanding of the temporal distribution of technology implementation as described in the interviews.

While the strategic buckets model, as described by Si et al. (2022) and Cooper (2001), was not directly implemented in the tool, the concept of this framework was still captured. Technologies are categorized into relevant strategic areas, allowing for analysis that align with broader organizational priorities. This supports strategy-based decision-making without introducing the rigidity of predefined allocation rules.

While not all portfolio management frameworks were implemented in full, their principles have affected the structure and function of the tool. It offers both a means of assessing individual technologies and a mechanism for understanding how these technologies contribute to a balanced and strategically aligned portfolio.

6.3 The Framework

In this section, the aim is to present an answer to Research Question 3, where previous learnings are aggregated and compiled into a framework uniquely designed for use in technology evaluation at the Company. First, a review of the most important considerations in creating the framework will be presented followed by a description of the frameworks constituting parts.
The final framework was developed using Microsoft Excel to facilitate integration with the Company's existing operational processes. Figure 6.1 presents the structure on which the framework is built and illustrates its components.

Figure 6.1: The Framework and its Constituing Components

6.3.1 Framework Design Considerations

In order to align the framework with the Case Company's existing processes and foster the level of dialogue needed to guide more strategic R&D investment decisions, the resulting framework for a new technology evaluation process is grounded in a set of requirements formulated on the basis of the convergence between theoretical guidance and empirical needs.

Firstly, inspired by Souder (1994)'s five factors for effective project and portfolio management, the framework needs to fit with the case company's current ways of working in order to increase the probability of adoption. This requires a solid understanding of the company's fundamental operational structure. Relating to this, a goal was to keep the threshold for implementation low in order to facilitate diffusion of the framework within various decision-making structures. This included the deliberate use of terminology familiar to the Company in order to ensure internal relevance and acceptance.

Another important consideration, arising from the recognition of the inherent uncertainty of data in general and quantitative data in particular, is that evaluation results do not need to speak for themselves, rather they can serve as a foundation for discussion and be reconsidered in light of emerging arguments and debate.

Lastly, one of the main purposes of the framework is to provide a way of working that facilitates structure as well as some degree of objectivity to the currently unstructured and ad-hoc processes. This requirement emerged as a critical consideration from the empirical study, as key stakeholders specifically emphasized the need for structure and consistency in evaluations.

6.3.2 Technology Evaluation

The first main part of the framework is the technology evaluation which consists of two components, a modified scoring model and a basis for discussion.

6.3.2.1 Scoring Model

In this stage, the previously defined criteria are applied within a structured evaluation model based on a modified scoring model, whereby each criterion is rated on a three-tier scale ranging from 1 to 5. For each category, an average score is calculated based on the ratings assigned to the individual criterion within that category. To enhance the framework's flexibility and applicability across various technologies and contexts, users are given the option to mark specific criteria as “Not Applicable.” When selected, these criteria are excluded from the calculation of the final score. Table 6.5 illustrates the user interface used for assessing the technology in accordance with the predefined evaluation criteria.

6.3.2.2 Basis for Discussion

Once the technology has been evaluated and scores have been generated within each category, these scores are transferred to a dedicated worksheet where a compiled score is calculated. This is done by averaging the category-specific scores. To facilitate comparability and enable subsequent visual modeling, the compiled score is normalized to a scale in which 100 represents the maximum achievable score.

The idea of this part of the framework is that each stakeholder performs their own evaluation in isolation from the other stakeholders, but under the same conditions and with identical prerequisites. Thereafter, the involved evaluators meet to compare their scores. As the scores from remaining evaluators are inserted, their compiled score will be added to the table and a mean score as well as a standard deviation will emerge within each column representing a category of criteria as seen in table 6.6. The standard deviation is applied as a measurement of consensus (or lack thereof) between the evaluators. A low standard deviation represents high consensus while high standard deviation represents strong disagreements.

To identify and address significant discrepancies in evaluation, predefined threshold values for standard deviation are applied. These thresholds trigger different recommended actions depending on the degree of consensus. A standard deviation between 0.00 and 0.49 signifies strong agreement and is highlighted in green, with no further action required. Values between 0.50 and 0.99 suggest moderate disagreement; these are flagged in yellow and indicate that a follow-up discussion may be beneficial. A standard deviation of 1.00 or higher reflects significant disagreement and is marked in red, prompting a structured discussion among evaluators to reconcile differing perspectives.

The goal of the standard deviation threshold limits is to capture significant disagreements without nitpicking small differences. The chosen limits are thus not chosen arbitrarily, but rather the reasoning behind selecting these specific limits is as follows: If three people score a 1 and two people score a 5, the standard deviation is around 2,0. If the scores are more moderate but still spread out, (for example; 2, 2, 3, 4, 4) the standard deviation is about 0,84. In practice, a limit of 1,00 to strongly recommend a discussion emerged as a good starting point.

To visualize the degree of consensus and divergence, each evaluator's results are plotted on two visual models: an Opportunity/Risk matrix and a radar chart. Opportunity is calculated as a composite of the "Strategic Alignment" and "Bang for the Buck" categories, while Risk reflects a combination of the "Risk" and "Feasibility" categories (note: a higher score in the Risk category corresponds to lower actual risk).

This part of the framework aims to provide a forum for discussion where evaluators are more or less forced to defend the reasoning behind their assessment. Consequently, this part of the technology evaluation acts as a workshop tool where discussion between decision-makers facilitates a more thorough and structured process.

Although the resulting output from each evaluation is a score, which is quantifiable by nature, the primary practical advantages of the scores is not to be able to manifest the true potential of a technology, but rather to provide support for decision-makers by promoting communication and collaboration between stakeholders.

Table 6.6: Basis for Discussion

Evaluator	**Strategic Alignment**	**Feasibility**	**Bang for the Buck**	**Risk**	**Adjusted Score (out of 100)**
E1	3,33	3,57	2,50	3,00	62,02
E2	2,67	3,40	2,91	2,91	64,50
E3	3,76	3,87	4,56	4,06	81,25
E4	2,91	4,23	2,65	4,55	71,7
E5	4,64	4,55	4,76	3,13	85,4
Mean	**3,46**	**3,92**	**3,48**	**3,73**	**72,97**
Std. Devtn	**0,78**	**0,47**	**1,09**	**0,65**	**10,20**

6.3.3 Portfolio Management

In addition to supporting individual technology evaluations and facilitating stakeholder discussions, the framework also incorporates a portfolio management tool. The portfolio management tool built into the framework consists of two components; Portfolio Input and Portfolio Overview.

6.3.3.1 Portfolio Input

The first step is to insert four types of basic technology data into the Portfolio Input table shown in Table 6.7. These data points are either known in advance or can be reliably estimated prior to initiating the formal assessment process. Specifically, the user is required to input: (1) the current TRL, (2) the estimated investment necessary to reach TRL 6, (3) the relevant business area, classified according to the organization's strategic growth categories (the classification has been censured in this report for confidentiality reasons), and (4) the projected time frame for the technology to reach TRL 6. Following the completion of the technology evaluation, Risk, Opportunity, and composite Score are entered into the corresponding columns of the table. As more technologies are evaluated, the collection of technologies constitutes the technology portfolio a whole. The technology data from this table is then applied to create an overview of the current portfolio balance in a separate sheet.

Table 6.7: Portfolio input table

Technology Title	**Technological Maturity**	**Investment required to reach TRL6 [1-5]**	**Growth Area**	**Expected time to reach TRL6 [Years]**	**Risk**	**Opportunity**	**Score**
Technology 1	TRL 2	3	Area 1	21	61	49	55
Technology 2	TRL 5	5	Area 2	16	80	76	76
Technology 3	TRL 3	3	Area 1	11	55	65	59
Technology 4	TRL 2	3	Area 3	25	78	84	81

6.3.3.2 Portfolio Overview

The second component of the portfolio management tool is referred to as the Portfolio Overview and is designed to assist decision-makers in prioritizing both active technologies within the existing portfolio and potential future investments.

One of the core visualizations within the Portfolio Overview is a series of pie charts, which illustrate the distribution of technologies by maturity level, strategic growth area, and allocated resources. These visualized summaries are designed to provide an immediate understanding of how the current portfolio is structured across key dimensions.

A second component consists of a timeline visualization that displays the estimated time remaining for each technology to reach TRL6. Technologies are categorized into three temporal horizons Today, Tomorrow, and Beyond to support strategic planning and identify short-, medium-, and long-term opportunities.

The third visualization is a bubble chart that maps each technology on a Risk–Opportunity matrix. This chart illustrates the balance of the overall portfolio with respect to risk exposure and potential. Each bubble represents a specific technology, with its size corresponding to the estimated investment required.

Together, these visual elements shown in Figure 6.2 aim to provide a comprehensive overview of the portfolio, enabling a more structured and data-informed decision-making process regarding technology development and investment prioritization.

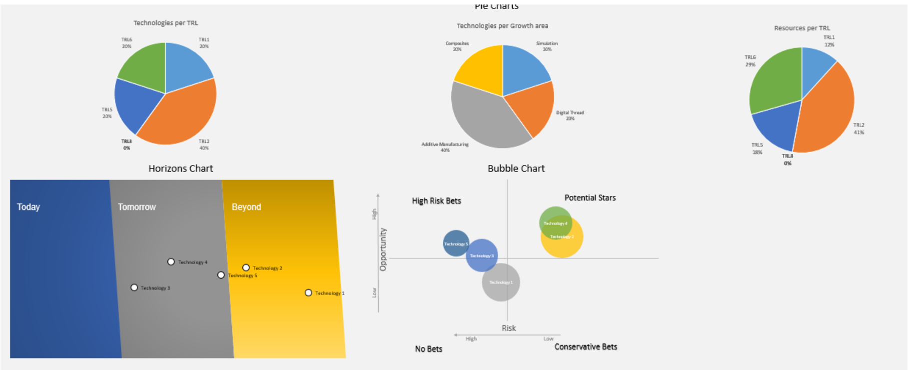


Figure 6.2: Portfolio Overview

6.3.4 Additional Features

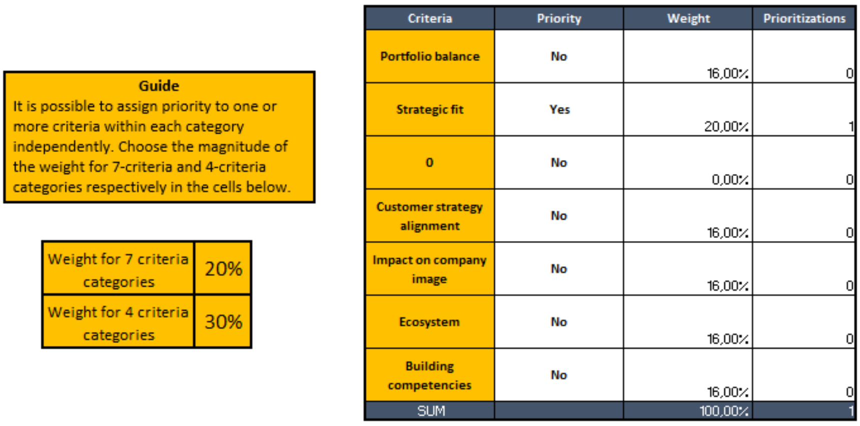
Upon stakeholder request, two additional auxiliary features were added to the framework with the purpose of enhancing its flexibility and practical applicability. The first feature is a weight assignment option connected to the technology evaluation and the second feature allows the user to save previous technology evaluations in a tab called Technology Archive.

6.3.4.1 Weighting

The option to assign weights to evaluation criteria emerged from the empirical study as a relevant feature to improve the framework's flexibility and adaptability. Moreover, weighting is a central feature in Saaty (1987)'s AHP, which is widely used to determine the relative importance of multiple decision factors. Palcic (2009) however, argues that a major drawback of the weighted score methodology is that it may add significant effort to the evaluation process, especially if it requires involved stakeholders to achieve consensus on the magnitude of relative importance for each criterion. This stands in contrast to the objective of promoting user accessibility by ensuring a low entry barrier throughout the framework.

Although the inclusion of weighting was not part of the initial requirements for this framework, it was later incorporated in response to stakeholder input during the interviews. However, the framework is designed to permit flexible and, if necessary, autocratic assignment of weights and thereby avoiding the need for extensive negotiation or consensus among participants.

The implemented weighting mechanism allows users to assign relative importance to one or more criteria within a given category. This is operationalized through a dropdown menu in the evaluation interface (Figure 6.3), where the user may select “Yes” to prioritize a particular criterion. When selected, the chosen criterion receives a predefined weight, corresponding to a fixed percentage of the category’s total weight. The remaining criteria within that category are automatically assigned the residual percentage, distributed equally among them. This approach enables a streamlined weighting process that preserves adaptability while minimizing additional cognitive or procedural burden for evaluators.



Guide
It is possible to assign priority to one or more criteria within each category independently. Choose the magnitude of the weight for 7-criteria and 4-criteria categories respectively in the cells below.

Weight for 7 criteria categories	20%
Weight for 4 criteria categories	30%

Criteria	Priority	Weight	Prioritizations
Portfolio balance	No	16,00%	0
Strategic fit	Yes	20,00%	1
0	No	0,00%	0
Customer strategy alignment	No	16,00%	0
Impact on company image	No	16,00%	0
Ecosystem	No	16,00%	0
Building competencies	No	16,00%	0
SUM		100,00%	1

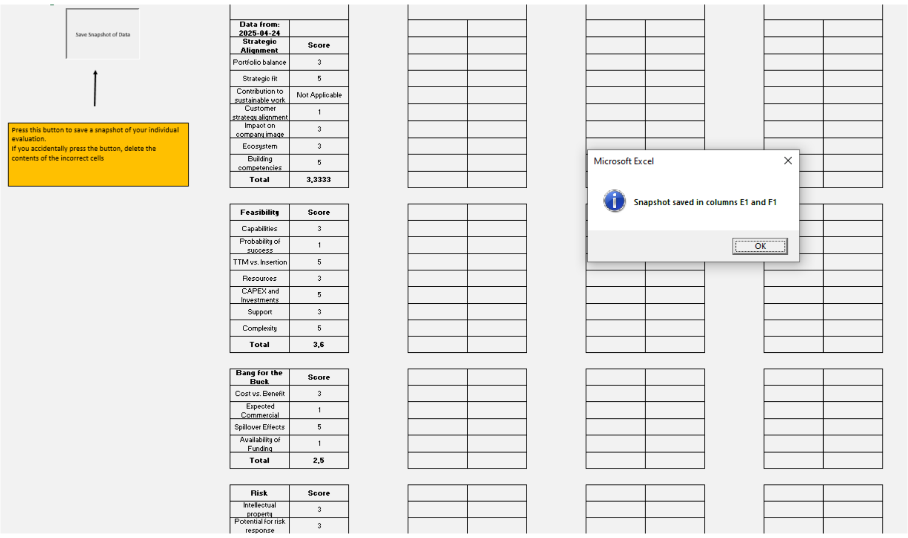
Figure 6.3: Weighting feature

6.3.4.2 Archiving Technology Scores

In response to stakeholder requests, an auxiliary feature was integrated into the framework to enable the archival of evaluation data. The primary purpose of this feature is to allow users to preserve a snapshot of each completed technology evaluation for future reference and retrospective analysis.

This functionality is implemented through a macro-enabled button, located on a dedicated sheet. When activated, the button captures the relevant data from the most recent evaluation and records it alongside a timestamp indicating the date of the assessment. The intention is to establish an archive of past evaluations, thereby enabling stakeholders to revisit previous assessments and reflect on the reasoning behind their earlier judgments.

As illustrated in Figure 6.4, the archive displays the most recently saved evaluation. Each time the button is pressed, the system automatically stores the new snapshot in the next available column set to the right of the previous entry, maintaining a chronological record of evaluations over time.



Press this button to save a snapshot of your individual evaluation.
If you accidentally press the button, delete the contents of the incorrect cells

Snapshot saved in columns E1 and F1

Data from: 2025-04-24	
Strategic Alignment	**Score**
Portfolio balance	3
Strategic fit	5
Contribution to sustainable work	Not Applicable
Customer strategy alignment	1
Impact on company image	3
Ecosystem	3
Building competencies	5
Total	**3,3333**

Feasibility	Score
Capabilities	3
Probability of success	1
TTM vs. Insertion	5
Resources	3
CAPEX and Investments	5
Support	3
Complexity	5
Total	**3,6**

Bang for the Buck	Score
Cost vs. Benefit	3
Expected Commercial	1
Spillover Effects	5
Availability of Funding	1
Total	**2,5**

Risk	Score
Intellectual property	3
Potential for risk response	3

Figure 6.4: Technology Archive

Table 6.5: Technology evaluation input table

Strategic Alignment	**1**	**2**	**3**	**Score**
Portfolio Balance	The technology contributes to poor portfolio balance	The technology does not affect the portfolio balance significantly	The technology has a positive impact on the portfolio balance	3
Strategic Fit	No clear alignment with long term strategic goals. Little strategic rationale to pursue the technology	Some alignment with strategic goals exists, but additional justification is needed to integrate it into the company's long-term plans	The technology directly support the Company's core strategy, providing a competitive advantage or reinforcing key business priorities	5
Contribution to Sustainable Work	The technology has minimal or negative impact on sustainability goals, with limited improvements in environmental, social, or financial sustainability	The technology offers some sustainability benefits but requires additional effort to maximize its positive impact	The technology strongly supports sustainability efforts, contributing significantly to environmental, social, and financial sustainability goals	N/A
Customer Strategy Alignment	Limited or no consideration of customers' strategic intent	No immediate fit with defined customers' technological roadmaps but future alignment is possible	Strong technological collaboration with strategic partners. Desired conditions are clearly defined	1
Impact on Company Image	Success/failure of this technology unlikely to be of specific interest to any key engines BL customer	Success/failure of this technology likely to be of moderate interest to any key engines BL customer	Success/failure of this technology will be seen by and influence behavior of key Engines BL customers	3
Ecosystem	Low probability for collaborative R&D efforts	Possibility for ecosystem collaboration with institutes, universities or SMEs but not currently established	Existing network and relationships with partners within relevant areas of research	3
Building Competencies	No new competencies are expected to be generated from this technology	The technology is expected to generate some useful capabilities	The technology is expected to generate novel and useful capabilities that align with strategic goals	5

7

Discussion

7.1 RQ1: Developing Evaluation Criteria for Early-Stage Technologies

At the intersection of the theoretical and empirical findings, four categories comprising a total of 22 criteria emerged as best suited for the aims of this study. See Table 7.1 below for an exhaustive synthesis of the resulting categories and criteria. The resulting criteria reflect an interesting combination of the pronounced generalizability of some evaluation principles that unfolded in the literature and the distinctive contextualized perspectives manifested in the empirical findings. While generic principles and case specific considerations aligned on multiple levels, discrepancies emerged where context-specific dimensions led to the formation of novel but crucial technology evaluation criteria.

The technical gap between current state and desired state is repeatedly highlighted in the literature as an important consideration on which to base investment decisions. Additionally, the projected success of projects is often considered to depend heavily on organizational capabilities and available resources. However, the concept of intentionally developing challenging technologies without having access to accurate predictions of their commercial applicability, solely to build competencies and create spillover effects emerged as a new perspective. In the context of the Company's strategic goals, these results imply that there is strategic value in embracing complexity, and that the probability of commercial success factors alone does not necessarily determine the optimal investment decisions. Consequently, the findings suggest that the concept of complexity calls for a more thorough theoretical treatment. This observation highlights the need for reconsidering current approaches to account for the duality that the concept of complexity offers, both as a consideration in risk management but also as a capability-building opportunity.

The findings are consistent with previous research in that strategic alignment is an essential consideration when evaluating potential future endeavors. In comparison to similar studies however, this research offers new insights on how the strategy of external stakeholders also plays a decisive role in shaping the evaluation process. This observation led to the inclusion of "customer strategy alignment" as a key criterion for guiding investment decisions. The analysis reveals that strategic alignment must be assessed not only internally but also in the broader context of the aerospace industry. The unique environment in which the Company operates combined with its distinctive business model, shapes the way the company functions and implies that poor alignment with the external environment could lead to certain unfavorable consequences. The Company's network of partners, along with the importance of securing involvement in future engine programs, exerts a substantial influence on the Company's strategy and must therefore be carefully considered. These findings suggest that strategic alignment frameworks should be expanded to explicitly incorporating external strategic partners and the evolution of the broader ecosystem. This is particularly important as the dynamics of industry networks and partnerships can significantly influence decision-making. Moreover, traditional technology evaluation models, which primarily emphasize internal organizational factors, may not fully capture the complexities of today's interconnected business environments and therefore require adaptation to reflect these external influences.

This research suggests that companies, including the company studied in this report, could benefit from incorporating a greater emphasis on non-financial value measures earlier in the evaluation process. However, it is important to acknowledge that economic considerations cannot be entirely disregarded in contexts involving financial resources. As such, the measurement of financial impact remains a factor within the resulting framework, albeit not in strictly quantifiable terms. Additionally, the role of funding availability emerged as an unconventional perspective, contrasting with the more generic considerations typically discussed in existing literature. External funding could represent a crucial yet overlooked dimension in decision-making models, particularly for the Company, which relies heavily on funding for large-scale, high-investment decisions. Furthermore, this research highlights a possible gap in the existing literature regarding the role of external funding in technology development evaluation, suggesting that further exploration of this aspect is necessary.

An established theory of project evaluation considerations has been applied within the specific context of aerospace technology R&D, developing valuable insights into how they can be adapted to address the unique challenges of this industry. In doing so, it challenges several assumptions commonly found in the literature, particularly the generalizability of traditional evaluation criteria across industries. While many models tend to present a set of factors as universal, this research highlights that such criteria may not fully capture the complexities of aerospace innovation, where both external strategic alignment and stakeholder considerations play a significant role. Moreover, the findings suggest that in aerospace, a balance must be struck between internal technological capabilities and the external demand signals, which collectively shaped the basis for the set of evaluation criteria applied in the final framework.

Table 7.1: A complete synthesis of the evaluation criteria

Category	**Criteria**
Bang for the Buck	Cost vs. Benefit Expected Commercial Value Spillover Effects Availability of Funding
Feasibility	Capabilities Probability of Success TTM vs. Insertion Resources CAPEX and Investments Support Complexity
Strategic Alignment	Portfolio Balance Strategic Fit Contributions to Sustainable Work Customer Strategy Alignment Impact on Company Image Ecosystem Building Competencies
Risk	Intellectual Property Potential for Risk Response Perceived Risk Dependencies

7.2 RQ2: Risk- and Uncertainty Management in Aerospace Technologies

Within the frame of reference, the evaluation process was assumed to operate under a constant lack of resources, necessitating a strict prioritization between development initiatives. However, within the context of the Company, the analysis revealed a deviation from this assumption. While the Company is indeed constrained by resource limitations, the process of prioritization between initiatives is not as critical as suggested by the literature. Instead, technologies tend to be evaluated individually rather than comparatively. Moreover, the analysis indicated that the primary purpose of the evaluation tool is to facilitate structured discussions rather than to strictly prioritize competing alternatives.

This generates some implications to what tool or tools are best suited for evaluating technologies at the R&T-division. The three common approaches to evaluating projects presented in the literature have been tested within the specific context of the R&T-division at the Company. Utilizing economic models have been deemed irrelevant within this context due to their requirement of qualitative data, which do not exist or are misleading for technologies at low maturity levels. Hence, to manage the risk and uncertainty that new technologies bear, what has been revealed is that the tool employed ought not to yield only a quantitative output. Rather, the tool must aspire to enable discussion between key stakeholders within the R&T-division. From the analysis, it can also be concluded that evaluating technologies at low TRLs is not a straightforward task. Many factors of different categories have to be considered in an industry recognized by advanced technologies and deeply interconnected partnerships. Reaching a set of criteria that recognize all possible outcomes and utilizing a tool which provides a quantitative assessment, risks leading to a narrow and inflexible process. This strengthens the argument that evaluation should be conducted through discussions. Further, personnel from different functions should take part in the discussions to encompass multiple views resulting in an holistic approach.

With the argument of evaluating technologies in isolation, AHP was deemed to be of limited relevance due to its inherent focus on prioritization. It was also seen as too complex with many parameters and weightings to compare and evaluate. This suggests that a tool that is complex not only lessens the chance of being utilized, it also restricts the qualitative level of discussion. What is sought is discussing opposing views on the assessments of criteria rather than achieving consensus on the relative importance of each criterion. On the other hand, the checklist is a more simplistic tool but due to its binary nature it allows only for a low degree of discussion. Instead, the scoring model allows a more flexible evaluation where the technology is graded on a qualitative scale enabling discussion between stakeholders. Utilizing a qualitative scale also hinders the emergence of discussions about quantitative metrics which often, once initialized, risks making up a dominant part of the evaluation.

The findings regarding portfolio selection and management are consistent between the studied firm and the established literature. Having a balanced portfolio emerged as an important consideration for the Company. A balanced portfolio in this context indicates having ongoing technology development across different TRLs and times to insertion. Further, utilizing bubble charts, pie charts, and timelines helps manage systemic portfolio risk rather than just technology-specific risks. However, the Company lacks the clearly defined and structured approach suggested by the literature in their evaluation of technologies. This leads to portfolio management integrated into the scoring model.

Previous studies in the aerospace industry utilizes AHP as a tool for evaluating R&D projects. However, this research suggests that for evaluating technologies for a supplier in the aerospace industry, low entry barriers and user adoption is prioritized where the primary role of evaluation tools is to enable and structure multidisciplinary discussions rather than to generate definitive quantitative rankings making the scoring model the most suitable tool. Hence, this research proposes a scoring model as a practical and structured tool to incorporate and manage uncertainty through formalizing expert judgement rather than forcing unreliable precision from data that does not exist in early aerospace R&D. Further, portfolio considerations such as having a balanced and strategically aligned portfolio were deemed as the most important considerations within portfolio management.

7.3 RQ3: Designing a Framework for Technology Evaluation and Portfolio Management

The development of the technology evaluation framework emerged through the integration of structured, theory-informed approaches with the practical requirements of the specific organizational context. Drawing selectively on established models such as AHP and scoring models, the resulting framework was designed to offer a comprehensive yet accessible structure to support decision-makers in evaluating early-stage technologies. The findings of this study align with the Company's strategic ambition to strengthen its innovation pipeline by implementing a more systematic and integrated approach to technology investment prioritization. The findings align well with the Company's initial ambition to strengthen its innovation pipeline by providing a structured framework with an integrated way of working for prioritizing technology investments under uncertain conditions.

One of the most important findings for achieving robustness and consistency in the framework was the incorporation of discussion-based validation. This concept was initially introduced by Cooper and Sommer (2023) in their model which closely resembles a scoring model in structure. The authors make sure to emphasize however, that the advantages of this method does not lie in its ability to generate a reliable score, but rather its strength in calling for valuable debate. This insight is further supported by the Company's internal objectives, which place significant emphasis on promoting cross-functional engagement during the evaluation process. In practical terms, the application of discussion-based validation through mechanisms such as disagreement thresholds and collaborative workshops shifts the emphasis away from strictly quantitative assessment toward the facilitation of strategic dialogue. This shift is particularly important in the context of early-stage technology evaluation, where available data may be limited or ambiguous and relevant expertise is dispersed across organizational functions. By involving both technical and commercial stakeholders in the process, the framework not only improves decision quality but also contributes to strengthening cross-functional understanding and alignment.

In contrast to much of the existing literature, the findings of this study underscore the value of discussion-driven decision support in technology evaluation. A key contribution lies in the introduction of a quantified approach to stakeholder disagreement, an aspect that remains relatively underexplored in both project and technology evaluation research. Rather than relying solely on numerical scores, this approach broadens the theoretical understanding of evaluation models by emphasizing the importance of social processes in decision-making. Notably, the framework treats disagreements not as deficiencies in the evaluation process, but as valuable indicators that can act as a signal to explore underlying assumptions and stimulate deeper reflection among stakeholders.

Throughout the development of the evaluation framework, user acceptance and the likelihood of adoption were identified as critical design considerations. These concerns directed the framework's design toward one that emphasizes simplicity, clarity, and ease of use. In the context of the Company, this translates into tangible benefits, as the resulting framework aligns with the organization's culture and existing operational practices. By incorporating familiar terminology and widely used metrics, the framework reduces the cognitive and procedural barriers to adoption, thereby increasing the probability of consistent application. While this provides a valuable insight, it is important to note that there might exist a tradeoff between simplicity and complexity. It is possible that a more complex version of the framework would produce more accurate results, albeit at the cost of user acceptance and likelihood of adoption.

A feature incorporated into the framework was the assignment of relative weights to evaluation criteria. While this feature introduces a degree of complexity, it was included at the request of stakeholders and was deemed essential for ensuring robustness and, by extension, the credibility of evaluation outcomes. Importantly, one of the primary objectives of the framework is to facilitate constructive discussions around the evaluation of technologies. Therefore, discussions among evaluators should focus primarily on the assessment of criteria rather than achieving consensus on their relative importance. Reaching agreement on weights should not be viewed as a necessary precondition for using the framework; instead, weight assignment may be determined unilaterally or omitted entirely in cases where uncertainty exists regarding appropriate distribution. This consideration is especially relevant in early-stage evaluations,where assigning reliable weights may require a level of insight and information that is not yet available. A potential limitation to the weighting feature is that it only permits the assignment of relative weights within individual categories. As a result, it implicitly assumes tradeoffs between the levels of performance within that category. Consequently, the weights may fail to account for any interrelationships among criteria in other categories. This limitation introduces a risk of oversimplification and incomplete representation of how certain factors influence each other in the overall evaluation.

The portfolio management aspects incorporated in the framework is consistent with the key benefits of portfolio management tools introduced by Cooper et al. (2001). For the Company, the use of visual tools contributes to increased tangibility and accessibility in portfolio-level decision-making, offering a clearer overview that helps maintain a strategic perspective amid individual technology evaluations. The integration of portfolio management into the evaluation framework also carries several theoretical implications that extend beyond the practical use case for the Company. Firstly, it emphasizes the importance of aggregating individual technology assessments into a holistic view, supporting the growing recognition in the literature that innovation and R&D investments should not be evaluated in isolation (Cooper et al., 2001). Secondly, the use of visual tools such as risk-opportunity matrices and temporal distribution charts introduces a semi-quantitative approach to portfolio analysis that enhances strategic decision-making under uncertainty. Finally, the framework challenges the implicit assumption in many technology evaluation models that decisions are discrete and final. Instead, it positions evaluation as a discussion-based, iterative process, where portfolio-level insights guide not only selection but ongoing dialogue and reprioritization. This reconceptualization has implications for both evaluation theory and innovation management, suggesting a shift from binary go/no-go models toward more adaptive, learning-oriented decision environments.

7.4 Limitations and Future Research

This research has been limited to the context of evaluating technologies within a subdivision of the Company, acting as a supplier in the aerospace industry. The findings around the presented criteria and the framework are therefore affected by this environment. Applying it in different industries or in larger, more complex multinational contexts might require further modifications. An example includes the criteria concerning external factors such as the close collaborations between suppliers and OEMs through RRSPs and the heavy influence of external funding. These are likely to differ based on the context. Another potential shortcoming of the criteria is based on the sample size and characteristics of the interviewees. The exploratory power of the semi-structured interviews is limited by the low sample size and, to a large degree, homogeneous characteristics.

Another limitation regards subjectivity within the framework. Even with a structured process and scoring, subjectivity cannot be eliminated given the reliance on individual evaluations before discussions. It has also not been investigated whether there exists a trade-off between choosing a more simplistic tool compared to more complex ones when accommodating to adaptability and user-friendliness.

Additionally, the framework has not yet been fully validated in a reliable manner. Although its criteria, tool, and process have been refined through workshops with employees at the Company and multiple iterations with key stakeholders, full validation requires applying the framework to the evaluation of an actual technology in a real-world setting.

Investigating whether the criteria should be modified based on interviewing employees from other departments is an interesting area for future research. This research lacks input from departments such as finance, procurement, and production. Another interesting area for future research would be to enhance the validation of the resulting framework by applying it when evaluating a technology in a real-world setting. Finally, future studies could explore the applicability of the results from this research in other industry-sectors.

8

Conclusion

This thesis set out to develop a structured and systematic framework for evaluating early-stage aerospace engine R&D technologies. To guide this objective, three research questions were formulated. The first aimed to identify the technical, strategic, and financial criteria that are critical for evaluating technologies within the specific context of the aerospace industry. The second sought to explore the tools and methods most suitable for managing risks and uncertainties inherent in early-stage technology assessments. The third research question focused on how the resulting insights could be integrated into a coherent and practical framework to support and structure the evaluation process in a real-world setting.

By synthesizing theoretical insights with empirical findings from the Company, the study identified four overarching evaluation categories — Bang for the Buck, Feasibility, Strategic Alignment, and Risk — and distilled these into 22 specific criteria. Context-specific dimensions such as spillover effects, customer strategy alignment, and ecosystem participation were combined with more traditional measures like cost-benefit estimation, feasibility, and organizational capabilities to form a comprehensive set of evaluation criteria reflecting the unique context of the Company.

Through critical analysis of evaluation methods, the scoring model emerged as the most appropriate tool, offering a balance between structure and flexibility. Unlike rigid economic models or complex comparative tools like AHP, the scoring model enables individual assessments and adapts to high uncertainty in early-stage evaluations. Further, it supports discussion-based validation, recognizing disagreement as a productive input rather than a flaw.

The final framework integrates evaluation criteria, stakeholder interaction, and portfolio visualization into a unified framework. It supports not only technology-specific decisions but also broader portfolio management, incorporating visual tools like radar charts, opportunity/risk matrices, and time-to-insertion timelines. Importantly, it serves as both a decision support mechanism and a platform for cross-functional engagement, thus addressing the complexity and uncertainty characteristic of aerospace R&D.

From a theoretical standpoint, this study expands existing evaluation literature by integrating external strategic alignment, funding availability, and non-financial value considerations into early-stage technology assessment.

Practically, the framework provides a low-barrier, discussion-oriented tool that supports structured evaluation without requiring high quality data. It equips the Company with a systematic way to assess R&D technologies individually and across the portfolio, aligning well with the company's strategic ambitions.

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Appendix: Interview Guide for Semi-Structured Interviews

Purpose:
The purpose of this interview is to explore your experiences and perspectives on R&D decision-making processes. We are particularly interested in understanding which criteria are used to evaluate early-stage technology projects and how decisions are made within your organization. Your input will directly contribute to the development of a decision-making framework.

Interview Format:
The interview is semi-structured, allowing flexibility to explore your responses in greater depth. The session is expected to last approximately 45–60 minutes. You were informed in advance about the purpose of the study.

Section 1: Background and Role

1. Can you briefly describe your role in the organization and your involvement in R&D activities?
2. How are you typically involved in technology evaluation or decision-making processes?
3. In your view, what are the main challenges your organization currently faces in R&D project evaluation?

Section 2: Portfolio Management

4. How do you define an optimal portfolio balance within your R&D projects?
5. What factors are considered in your portfolio balancing process?
6. How do you handle competing priorities, such as resource constraints, budget, profitability, etc.?
7. How are technologies in your backlog prioritized, and who makes those decisions?

Section 3: Project Evaluation and Decision Forums

8. How is a technology's desirability or potential value evaluated today?
9. Are there any tools, frameworks, or support systems used in these evaluations?
10. In which forums or meetings are such decisions typically made? Who are the key stakeholders or influencers?
11. What are the biggest challenges in today's decision-making process for technology evaluation?

12. How are Go / No-Go / Pivot decisions made in practice?
13. Are there any common “red flags” that suggest a technology should not be pursued?
14. What are some typical conflicts in priorities when selecting the right technologies?

Section 4: Evaluation Criteria and Tool Design

15. Based on your experience, what do you consider the most critical success factors for new technologies?
16. What are the key elements or conditions that lead to a “Go” decision?
17. Conversely, what typically justifies a “No-Go” decision?
18. Reflecting on the tool we are developing (as described in the briefing), what do you think would be most valuable for it to provide?
19. Are there any specific features, criteria, or visualizations you believe are essential for this kind of tool?

Closing

20. Is there anything else you would like to add that we haven’t covered?
21. Would you be open to reviewing the preliminary framework or participating in follow-up validation?

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