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Flexibility in Investment Decision-Making under Uncertainty: A Case Study of Volvo Group

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Abstract

This thesis describes how investment decisions are evaluated in practice within Volvo Group, focusing on traditional capital budgeting methods, uncertainty and managerial flexibility. The purpose is to describe how projects are evaluated, how uncertainty is incorporated into investment evaluations, and how a real options perspective can contribute to a better understanding of investment decisions within the company. The study is based on a qualitative single-case study, using semi-structured interviews with two respondents involved in investment decision-making at Volvo Group, complemented by internal investment documents.

The findings show that Volvo Group primarily uses Net Present Value, Internal Rate of Return, Modified Internal Rate of Return and Payback as part of its investment evaluation process. These methods provide a structured financial basis for assessing and comparing investment projects, but the results indicate that they do not determine investment decisions on their own. Instead, financial calculations are combined with strategic considerations, qualitative factors and the specific characteristics of each investment.

The study further shows that uncertainty is incorporated through the assumptions underlying the financial calculations. Key sources of uncertainty include market development, volume, prices, exchange rates and technological change, as these variables are central to expected future cash flows. To manage this uncertainty, Volvo Group complements traditional financial calculations with sensitivity analysis, scenario analysis, risk assessments and qualitative evaluations.

The study also finds that Volvo Group does not use real options as a formal valuation method. The concept is not part of the company's formal investment language, and the valuation models are perceived as too complex for practical use. Nevertheless, several practices resemble elements of real options logic, such as postponing, reassessing, dividing investments into stages, comparing alternative solutions and scaling down or halting investments when conditions change. The results suggest that a real options perspective is useful for understanding Volvo Group's investment process when the company has managerial discretion, but less relevant when decisions are constrained by legal requirements, environmental regulation, safety needs or long-term strategic direction.

Keywords: Capital budgeting, investment decision-making, uncertainty, managerial flexibility, real options, Volvo Group.

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1. Introduction

This chapter presents an overview of investment decision-making and the theoretical background relevant to the study. It also provides a brief introduction to traditional capital budgeting methods and the challenges related to investments under uncertainty. In addition, the purpose of the study and the research questions are presented.

1.1 Background

In corporate finance, few areas are as central to both academic research and managerial practice as investment decision-making. Firms continuously allocate large amounts of capital to investment projects, making these decisions crucial for long-term value creation.

At the core of investment decisions lies the Net Present Value (NPV) framework, which evaluates investments by discounting expected future cash flows (Armeanu & Lache, 2009). As a result, NPV has become a fundamental tool in both theory and practice, providing a clear decision-making rule for whether an investment should be undertaken (Gaspars-Wieloch, 2019). NPV provides a clear measure of the project's contribution to the firm's value. The Internal Rate of Return (IRR) method is a complement to NPV and gives an indication of the discount rate at which a project's NPV is equal to zero (Berk & DeMarzo, 2023).

The widespread use of NPV is also supported by empirical evidence. Studies show that firms rely heavily on present value techniques such as NPV and IRR when evaluating investment projects, highlighting their dominant role in real-world decision-making (Graham & Harvey, 2001). These methods offer a structured and standardized approach that allows managers to compare investment opportunities and make decisions consistent with shareholder value maximization.

Despite the widespread use of traditional discounted cash flow (DCF) valuation methods, investment decisions are often made in situations where uncertainty is present. In practice, firms operate in environments characterized by uncertainty related to future cash flows, costs, and external market conditions. Research shows that future cash flows are inherently uncertain, and that different outcomes may be difficult or impossible to estimate

(Gaspars-Wieloch, 2019). This creates challenges for traditional valuation methods, which rely on predicted values and fixed discount rates.

Over time, alternative approaches have been developed to complement the traditional present value methods. One of these alternative methods is Real Option Theory. Real Option Theory incorporates managerial flexibility in investment decision-making under uncertainty (Mun, 2006). Within the approach, investment decisions are not viewed as fixed. Investments are instead seen as dynamic and can evolve over time as new information becomes available (Ewald & Taub, 2022). The flexibility is created by the firm's ability to adapt to future uncertainties by having the option to expand a project if it performs well, contract or abandon if the project is unprofitable or the market conditions deteriorate. It is also possible to postpone an investment in order to learn or wait for more information to become available (Yeo & Qiu, 2003). The flexibility can create additional value that is not captured by the DCF methods.

Real options represent a popular and well-established theoretical framework in the academic world (Lambrecht, 2017). Despite its popularity in research, the practical application of real options theory remains limited. This can be explained by the complexity, advanced mathematics, and the necessity to tailor the approach to new investment situations. Consequently, firms tend to rely on traditional DCF methods or rules of thumb, such as profitability index, payback method and hurdle rates (Lambrecht, 2017; Berk & DeMarzo, 2023).

1.2 Problem Discussion

A key limitation of traditional DCF methods is their inability to fully incorporate uncertainty and managerial flexibility. The DCF framework is based on the assumption that future cash flows can be estimated and discounted using a required rate of return, which implies a relatively predictable investment environment (Hillier et al., 2020). However, future cash flows are inherently uncertain, as they depend on evolving market conditions and imperfect information, making such estimations subject to significant error (Chen, 2022).

This becomes particularly problematic in practice, where investment decisions are not made as one-time commitments. Traditional DCF-based approaches assume that managers follow a

predetermined course of action throughout the life of a project, without adjusting decisions as new information emerges (Yeo & Qiu, 2003). In reality, however, firms operate in dynamic environments where uncertainty unfolds gradually, and managerial decisions are continuously revised.

As a consequence, traditional valuation methods may lead to suboptimal investment decisions in uncertain environments. By relying on expected cash flows and fixed discount rates, these methods risk either undervaluing or overvaluing investment opportunities, particularly when future outcomes are difficult to predict (Gaspars-Wieloch, 2019). This reflects a deeper conceptual limitation, as uncertainty is incorporated only through the discount rate rather than through the decision making process itself (Yang & Blyth, 2007).

An additional weakness is that traditional DCF methods fail to capture the value of managerial flexibility. In practice, managers can respond to uncertainty by delaying, expanding, contracting, or abandoning projects as new information becomes available (Mun, 2006). However, the NPV framework implicitly assumes that investments are undertaken immediately and followed through as initially planned, thereby ignoring the value of adapting decisions over time (Yeo & Qiu, 2003). This can be critical, as flexibility can significantly influence investment value, particularly in uncertain environments.

To address these limitations, real options valuation extends traditional methods by explicitly incorporating uncertainty and flexibility into the analysis. Instead of treating investments as fixed and irreversible, real options conceptualize them as opportunities that can be exercised over time, allowing managers to adjust decisions in response to changing conditions (Mun, 2006). From this perspective, uncertainty not only represents risk but also creates opportunities for value when firms have the ability to adapt.

In contrast to the NPV framework, real options emphasize the value of waiting and learning before committing to an investment. This allows firms to revise their decisions as uncertainty unfolds, which is particularly important when new information can significantly alter project outcomes (Yang & Blyth, 2007). However, delaying investment can also lead to lost revenues, reduced market shares, or missed strategic advantages if competitors act first. As a result, real options can provide a more dynamic framework for evaluating investment compared to traditional DCF approaches.

Despite these theoretical advantages, firms continue to rely predominantly on traditional valuation methods such as NPV and IRR in practice. Empirical evidence shows that present value techniques remain the most commonly used methods in corporate investment decision-making (Graham & Harvey, 2001). This suggests that approaches incorporating flexibility and uncertainty appear to be less widely adopted in practice.

This further creates a gap between theory and practice. While financial theory highlights the importance of uncertainty and managerial flexibility in investment decision-making, firms continue to rely on traditional methods that do not fully capture these aspects.

Against this background, Volvo Group provides a relevant empirical setting for examining how investment decisions under uncertainty are evaluated in practice. Rather than assuming that investment decisions follow a purely theoretical framework, this study aims to analyse how uncertainty and flexibility are actually considered within the firm's decision-making process, and to what extent real options thinking is reflected in practice.

1.3 Purpose of the Study

The purpose of this study is to describe how projects are evaluated in practice within Volvo Group, with a particular focus on the application of traditional capital budgeting methods such as NPV, IRR, and the payback method.

Furthermore, the study aims to describe how uncertainty is incorporated into investment evaluations and to what extent managerial flexibility is considered in the decision-making process. This also provides a basis for examining whether elements consistent with a real options perspective are reflected in practice.

The study seeks to contribute to the existing literature on capital budgeting by providing an in-depth empirical analysis of how investment decisions are made in a large multinational firm operating under uncertainty. By comparing established theoretical frameworks with actual decision-making processes, the study aims to provide a more nuanced understanding of the role of uncertainty and flexibility in investment evaluation, as well as to highlight potential gaps between theory and practice.

To achieve the main purpose, the study is guided by the following research questions:

- How are investment decisions evaluated at Volvo Group, and which capital budgeting methods are primarily used in practice?
- How is uncertainty incorporated into these investment evaluations, and what limitations can be identified in traditional methods such as discounted cash flows?
- How can a real options perspective contribute to a better understanding of investment decisions at Volvo?

2. Methodology

This chapter describes the methodological framework used to explore how strategic investment decisions are evaluated and how uncertainty is managed within a multinational corporation. It presents the research approach, data collection methods and analytical procedures applied in the study.

2.1 Research Approach

To answer the research questions regarding the practical application of capital budgeting methods, the study employs a qualitative, single-case study approach focused on Volvo Group. This method enables an in-depth understanding of the complex dynamics that influence financial decision-making in practice.

The study applies a qualitative approach to facilitate a deeper understanding of how investment decisions are evaluated in practice under uncertainty, and how managerial flexibility is considered in relation to these decisions. Since the research questions address complex organizational dynamics that cannot be accurately captured through statistical analysis, this methodology is considered the most appropriate. It enables the collection of in-depth, rich and contextual insights into the practical realities of the decision-making process. This aligns with Patel and Davidson (2019, p. 53), who emphasize that a qualitative method is specifically designed to provide this type of nuanced and complex result.

Although the study examines whether a real options perspective can contribute to a better understanding of investment decisions under uncertainty, it does not perform real options valuations on Volvo Group's actual investments. Instead, the analysis focuses on assessing the theoretical relevance of the approach in relation to the company's current investment evaluation practices.

Furthermore, the study employs an abductive research approach. This enables a continuous interplay between the empirical findings from the case study and the established theoretical framework. By using this approach, the study aims not only to explain how traditional DCF methods are applied in practice, but also to explore whether alternative or more advanced methods could offer improved approaches to evaluating uncertainty in specific areas.

This process is vital for fulfilling the study's purpose. While the initial focus is on understanding how traditional DCF methods are applied in practice, an abductive approach provides the flexibility to revisit and expand the literature if it is found that Volvo Group utilizes alternative or unconventional methods for evaluating uncertainty. If the empirical data reveal that the firm deviates from standard academic models, this approach allows the researchers to either identify corresponding theoretical frameworks or conclude that Volvo relies on customized assessment practices. As noted by Patel and Davidson (2019, p. 55), abductive methodology is both common and highly suitable for qualitative case studies that require this level of analytical adaptability.

2.2 Literature Review

Since this study builds extensively on previous research and comparable case studies, transparently detailing the information retrieval process is crucial for the study's reliability. During the initial phase, preliminary literature was collected via academic databases such as GUPEA and Uppsatser.se to explore similar concepts and familiarize the researchers with the subject area. Subsequently, reviews and articles were gathered from Scopus using keywords including risk management, capital budgeting, flexibility, strategic investment, decision-making, uncertainty, risk analysis and investments. This approach helped identify relevant articles and provided methodological insights, which enables a comparative analysis of similarities and differences across various firms and sectors. Furthermore, literature concerning traditional DCF methods was reviewed to establish a theoretical baseline, allowing for a rigorous comparison between established theory, existing research and our empirical data. This was done by using Google Scholar and Science Direct.

2.3 Selection and Materials

This research utilizes a single-case study design centered around Volvo Group. This multinational corporation was purposefully selected due to its capital-intensive nature and its exposure to significant macroeconomic and technological uncertainties. Notably, Volvo Group has been at the forefront of technologically complex R&D projects, such as the development of modern electric trucks, making it a highly relevant subject for this research (Volvo Group, 2022). To understand how a multinational company evaluates uncertainty in strategic investments, Volvo Group served as an ideal environment. Examining their internal

capital budgeting processes and investment selection criteria will provide the critical insights necessary to answer the research question.

The selection of Volvo Group was also influenced by practical considerations regarding data accessibility. Because one of the authors is currently employed at the firm, establishing contact with the appropriate financial departments was significantly easier. Gaining access to sensitive data regarding strategic and risky investments has proven to be difficult. Although incorporating additional companies for comparison was explored, the project's time constraints and the inherent difficulties in building new corporate relationships to access confidential data prevented this option. Therefore, the research was structured as a single-case study that builds extensively on theoretical literature and prior research to ensure analytical depth.

Given the complex organizational hierarchy of a multinational corporation like Volvo Group, a snowball sampling method was implemented to identify the most qualified participants. Snowball sampling is a technique where the researchers initially contact a small group of relevant respondents, who subsequently identify and refer to other suitable participants for the study (Patel & Davidson, 2019, p. 141).

The process was initiated by presenting the research proposal to the Director & Head of Financial Control & Accounting (FCA). Recognizing the study's specific requirements, this contact provided a referral to a highly experienced senior colleague with 14 years of cross-departmental expertise. Utilizing the comprehensive internal network, the researchers were subsequently introduced to the Director of Business Control, who acted as a vital contact for the project as well as respondent A in the study. Ultimately, this individual strategically selected respondent B who possessed the specialized knowledge required, while also authorizing access to internal empirical documents. This method resulted in two interviews.

2.4 Data Collection

To develop an understanding of how the firm makes investment decisions in relation to uncertainty, a case study of Volvo was conducted. Case studies are in-depth investigations of a specific and limited case in its natural environment. The primary aim was to gain a deep

understanding of a complex phenomenon, rather than generalizing the results to an entire population (Patel & Davidson, 2019, p. 76-77). To gain insight into both the formal procedures and the practical aspects of investment decision-making, data were collected through two complementary methods.

The primary method used for data collection was semi-structured interviews, chosen to allow the participants the flexibility to elaborate on and explore the topics in their own terms (Patel & Davidson, 2019, p. 105). Interviews were conducted with two individuals involved with investment decisions in different divisions at Volvo. The main questions were standardised and neutral for all participants, while follow-up questions were adapted individually to gain a deeper understanding of specific experiences and insights (Appendix A).

The secondary method for data collection was an analysis of Volvo Group's investment policies and historical investment decision reports. The document analysis was chosen to complement the interviews and to provide a deeper understanding of the investment decision-making process.

2.5 Data Analysis

The empirical data was analyzed using thematic analysis. As emphasized in a qualitative research methodology, a thematic approach allows for significant interpretive depth and researcher reflexivity, enabling a rich and descriptive analysis of the subject matter. Initially, all interviews were audio-recorded with the explicit consent of the participants and subsequently transcribed verbatim to preserve the nuance of the dialogue. (Ahmed et al., 2025)

The researchers then engaged in a familiarization process reading through the transcripts multiple times. Following this, the text was systematically coded to identify recurring statements, patterns, and specific terminology relating to capital budgeting and risk management practices within Volvo Group (Ahmed et al., 2025).

In accordance with the study's abductive approach these initial codes were continuously refined and subsequently aggregated into broader, defining themes. These overarching themes formed the structural framework used to present the empirical findings, ultimately

enabling a structured analytical comparison against the established theoretical literature (Ahmed et al., 2025).

2.6 Ethical Considerations

To ensure the utmost research integrity, this study complies with the European Code of Conduct for Research Integrity, rooted in the four main principles of reliability, honesty, respect, and accountability. Reliability is reflected in the methodological design and analytical procedures. Honesty is maintained through transparent, unbiased reporting and clear communication of all methodological choices. Furthermore, respect is demonstrated toward all participants and stakeholders, while the researchers take full accountability for the project from its inception to publication (ALLEA, 2023).

In addition to these overarching principles, the study strictly follows the four primary ethical requirements for research. The information requirement was met by clearly communicating the study's purpose to all prospective participants. While a snowball sampling method was utilized to identify candidates, the authors ensured that formal information was provided directly to each respondent. The consent requirement was upheld by ensuring all participants independently agreed to partake. Lastly, the confidentiality and utilization requirements were strictly observed. All collected empirical data is securely stored to prevent unauthorized access, will be utilized exclusively for this specific thesis, and will be securely destroyed following the completion of the study (Patel & Davidson, 2019, p. 84).

To further ensure the ethical considerations, a clearance process has been established with the case company given the sensitive nature of the information. Prior to publication representatives from Volvo Group will be able to read and review the thesis to guarantee that no classified or strictly confidential information is disclosed. This ensures that the confidentiality requirement is met without compromising the integrity of the study.

2.7 Limitations of the Methodology

While the chosen method provides in-depth insights into how DCF methods are used in practice, several limitations have to be acknowledged. Firstly, the use of a single-case study design limits the validity and generalization of the results. The results reflect the specific

context of Volvo Group and may not be applicable to smaller firms or firms in different industries.

Secondly, the choice of a snowball sampling method can potentially create a selection bias as the participants were chosen by internal participants rather than randomized selection. However, this approach was essential for navigating the complex organizational hierarchy of a large multinational corporation to identify subject matter experts with the necessary specialized knowledge. Given the challenges of accessing specific financial departments externally, this method proved to be the most viable way to ensure the study's empirical depth.

Although the initial ambition was to secure a larger sample size, the corporate access constraints resulted in a final selection of two respondents. While small in number, these participants represented key subject matter experts whose comprehensive insights directly aligned with the study's research questions. Consequently, the snowball sampling procedure was justified, as it prioritized the quality and relevance of the empirical data over sheer quantity.

Thirdly, because interviews rely on human memory and personal experience and perspective, the data will be subjective. Furthermore, the restricted sample size of only two interviews allows the findings to provide an exploratory perspective rather than a comprehensive view. This increases the risk of overlooking operational nuances, different interpretations or other practical challenges that occur at different hierarchical levels or different divisions of the organisation.

Finally, it must be acknowledged that one of the authors is currently employed at Volvo Group. While this helps access data it introduces a potential risk of bias. To minimize this, the researchers followed the theoretical framework and maintained a critical and objective approach throughout the data analysis.

3. Theoretical Framework

This chapter presents the theoretical framework of the study including the capital budgeting process and traditional capital budgeting methods such as NPV and IRR. It also covers key concepts such as uncertainty in investment decision-making and managerial flexibility in capital budgeting. Together these concepts provide the theoretical background needed to understand how investment decisions are evaluated under uncertainty.

3.1 The Capital Budgeting Process

Investment decision-making in firms should not be viewed as a purely technical exercise based only on financial calculations. Butler et al. (1991) argue that capital investment is better understood as an organizational process involving multiple actors, several hierarchical levels of the firm and a long-time perspective. They further show that important decisions may be taken earlier in the process, even if senior management retains final approval.

Investment decisions are therefore influenced not only by formal analysis, but also by strategy, uncertainty and politics. Similarly, Alkaraan and Northcott (2013) argue that strategic investment decision-making is more complex and less systematic than normative financial models suggest, and that practice is shaped by the interaction between procedural rationality, strategy formulation and political behaviour within the organization.

Research further indicates that investment decision-making in large firms is frequently decentralized, where project initiation may originate at lower levels of the organization while decision authority is shared depending on project size or characteristics (Akalu, 2003). This highlights that capital budgeting should not be viewed as a single financial calculation, but rather as a broader organizational process in which formal capital budgeting methods are important, yet embedded in a wider decision-making context.

Although firms may use formal capital budgeting techniques such as DCF methods, research suggests that investment evaluation in practice often differs from theoretical models and instead functions as a broader organizational process. Akalu (2003) shows that firms often rely on a combination of traditional evaluation methods and qualitative judgement, reflecting practical constraints and organizational context rather than only using theoretical models.

This further supports the view that investment decisions are shaped by both financial analysis and practical organizational considerations.

A central part of these organizational considerations are the qualitative factors. Alkaraan (2020) explains that during evaluation of investment projects firms frequently combine quantitative analysis with qualitative analysis. Qualitative factors may include environmental and social impact, legislation, technological development and ethical considerations. This suggests that investment evaluation in practice is not only dependent on traditional financial measures, it involves the implication and balance of both qualitative and quantitative factors.

3.2 Traditional Capital Budgeting Methods

Traditional capital budgeting methods continue to play a central role in both theory and practice. Empirical evidence shows that firms still rely primarily on established appraisal techniques such as NPV, IRR, and the payback method when evaluating investment projects (Graham & Harvey, 2001). These methods provide structured ways of assessing whether an investment is financially attractive and have therefore remained influential in corporate decision-making. In addition to these widely used approaches, Modified Internal Rate of Return (MIRR) may be used as a complementary measure, particularly in cases where some of the shortcomings of IRR are considered problematic.

3.2.1 Net Present Value

NPV measures the value of an investment by discounting expected future cash flows to their present value and subtracting the initial investment. A positive NPV indicates that the investment is expected to create value above the required return, while a negative NPV suggests that it should be rejected (Hillier et al., 2020, p. 148-149).

The method is widely regarded as one of the most theoretically sound approaches to capital budgeting because it incorporates both the magnitude and timing of expected cash flows. It is also directly linked to shareholder value creation, since a positive NPV implies that the investment adds value to the firm (Chen, 2022).

3.2.2 Internal Rate of Return and Modified Internal Rate of Return

IRR is the discount rate that makes the NPV of a project equal to zero. In other words, it is the rate at which the present value of future cash inflows equals the initial investment (Hillier et al., 2020, p. 155-156). Since IRR expresses a project's attractiveness as a percentage return, it is often regarded as intuitive and easy to communicate in practice. A project is generally considered acceptable if its IRR exceeds the required rate of return, whereas a lower IRR suggests that the investment should be rejected (Patrick & French, 2016).

A related measure is MIRR, which was developed to address some of the weaknesses of IRR. MIRR differs from IRR by assuming that positive cash flows are reinvested at a specified reinvestment rate, often the firm's cost of capital. At the same time, negative cash flows are discounted using an appropriate finance rate. As a result, MIRR provides a percentage measure of investment attractiveness while using more realistic assumptions regarding reinvestment (Kierulff, 2008).

3.2.3 Payback Method

The payback method is an investment appraisal technique that evaluates projects based on the time required to recover the initial investment. According to the payback rule, a project is accepted if cumulative cash flows repay the initial outlay within a predetermined payback period (Hillier et al., 2020, p. 150).

Unlike DCF methods, the payback method focuses on the speed of capital recovery rather than total value creation. It is therefore often used as an indicator of liquidity and risk, where shorter payback periods are generally preferred. In practice, firms often apply a predetermined threshold for what constitutes an acceptable payback period and accept investments that recover the initial outlay within that time frame (Lefley, 1996).

3.2.4 Limitations of Traditional Capital Budgeting Methods

Despite their continued use in practice, traditional capital budgeting methods have notable limitations. A common weakness is that they rely heavily on assumptions about future cash flows, discount rates, and external conditions, which makes the results sensitive to estimation errors and uncertainty (Chen, 2022). This is particularly relevant for NPV, since the method depends on reasonably reliable forecasts of future cash flows.

IRR also has well-known limitations. It assumes that intermediate cash flows can be reinvested at the IRR itself, which may be unrealistic and can produce misleading results when projects differ in scale, timing, or cash flow pattern (Patrick & French, 2016). MIRR addresses the reinvestment problem by using more realistic assumptions, but it still depends on managerial choices regarding finance and reinvestment rates (Kierulff, 2008). The payback method is simpler, but it ignores the time value of money in its basic form and excludes cash flows occurring after the payback period, which limits its usefulness as a measure of overall profitability (Hillier et al., 2020, p. 151).

3.3 Uncertainty in Capital Budgeting

Uncertainty represents a central challenge in capital budgeting, as investment decisions are made on expected future outcomes rather than known values. Gaspars-Wieloch (2019) emphasizes that future cash flows are inherently uncertain, since both revenues and expenditures are related to future market conditions. As a result, investment appraisal necessarily rests on assumptions regarding variables such as prices, costs, market conditions, and technological development, all of which may change over time and are difficult to estimate with precision.

Yang and Blyth (2007) argue that traditional DCF methods cannot fully capture risk and uncertainty in project evaluation. Although future cash flows are uncertain, DCF treats them as sufficiently known for valuation purposes, while the discount rate is expected to reflect future risks that are difficult to estimate accurately. Uncertainty is therefore incorporated in a simplified way, rather than treated as a dynamic feature of the investment decision itself.

3.3.1 Sensitivity Analysis

Sensitivity analysis is used in investment evaluation to examine how a project's results, such as NPV, are affected by changes in key assumptions (Hillier et al., 2020, p. 206). The method is normally based on variables having a base-case value and is often applied in investment evaluation to support decision-making under uncertainty (McCabe, 2020; Jovanovic, 1999).

The aim of sensitivity analysis is to identify which input parameters have the greatest impact on the outcome (Hillier et al., 2020, p. 206). By conducting the analysis, it is possible to identify the maximum and minimum values a variable can take while still allowing the

investment project to remain viable and acceptable (Jovanovic, 1999). The method is therefore used to assess how sensitive an investment decision is to changes in assumptions and to provide an overview of the investment's stability.

A common sensitivity analysis approach is one-way sensitivity analysis, which examines how a financial measure is affected when one variable is changed while all other variables are held constant at their base-case value (McCabe, 2020).

3.3.2 Scenario Analysis

Scenario analysis is a decision-making tool that enables managers to evaluate how different future outcomes may impact an investment (Berk & DeMarzo, 2023). Unlike sensitivity analysis, which typically isolates the effect of changes in individual variables, scenario analysis considers simultaneous changes in multiple variables by constructing multiple possible scenarios, where each scenario is a combination of multiple factors (Hillier et al., 2020).

This approach is used to gain an understanding of how investment outcomes vary under different market conditions and to identify potential risks and opportunities (Hillier et al., 2020). The value of scenario analysis lies in the ability to capture the combined effect of uncertainty and to support more informed decision-making by comparing future outcomes rather than relying on a single forecast. Duinker and Greig (2007) mention that, to achieve this value, it is important not to be attached to a specific scenario.

3.4 Managerial Flexibility and Real Options Theory

3.4.1 Real Options

Real options originate from financial options theory but are applied to real investment opportunities rather than financial assets. In capital budgeting, this means that investment decisions may be understood not only in terms of expected future cash flows, but also in terms of the flexibility to adapt decisions over time as uncertainty unfolds (Mun, 2006, pp. 110-112). Therefore, a real option gives the firm the right, but not the obligation, to undertake an investment if future conditions turn out to be favourable, making flexibility economically relevant under uncertainty (Mun, 2006).

Compared with traditional DCF methods, Real Options Theory places greater emphasis on managerial flexibility, particularly regarding the timing of investment decisions and the ability to adapt to changing market conditions. Yang and Blyth (2007) argue that traditional DCF methods cannot fully capture risk and uncertainty in project evaluation, partly because future cash flow remains uncertain while the model treats them as sufficiently known for valuation purposes. They also argue that such methods do not determine the best timing of investment, which creates limitations in contexts where investment conditions may change over time.

Real Options Theory therefore extends traditional capital budgeting by treating investments as a sequence of possible decisions rather than as fixed commitments. Brach (2003) argues that managerial flexibility may take several forms, including the possibility to expand, contract or abandon a project as future conditions change. In uncertain environments, this flexibility may reduce downside exposure while preserving upside potential, which makes a real option perspective particularly relevant when investment decisions are made under partial irreversibility and changing conditions.

3.4.2 Different Types of Real Options

Real options provide managerial flexibility by allowing firms to adjust investment decisions in response to new information and changing market conditions. One important type of option is the option to defer, which enables firms to postpone investments until more information is available and thus reduces uncertainty (Brach, 2003). Firms may also benefit from the option to expand, allowing successful projects to grow through increased capacity or entering new markets (Mun, 2006). Conversely, the option to contract allows firms to scale down an investment if outcomes are unfavorable, thereby limiting potential losses. In more extreme situations, the option to abandon allows firms the possibility to fully exit a project before it becomes unprofitable and avoid further negative returns (Brach, 2003).

3.4.3 Limitations of Real Options

Real options analysis is subject to several limitations. The method is mathematically complex and highly sensitive to key input assumptions, such as volatility and discount rates, which may reduce the reliability of the results. Furthermore, real options models often need to be adapted and tailored to each project, limiting the general applicability of the method (Berk & DeMarzo, 2023). Finally, the value of managerial flexibility is dependent on firm-specific

characteristics, meaning that financially stronger firms are generally better positioned to exploit such flexibility than more constrained firms (Xie, 2009).

3.4.4 Managerial Flexibility in Practice

Previous research also suggests that flexibility is not always preserved in practice. Dalziel (2009) argues that the distinction between an option and a commitment depends on whether the firm is prepared to abandon the investment if returns prove insufficient. The study further indicates that firms may choose commitment rather than flexibility when commitment creates strategic advantages, such as mutual commitments from partners or faster action under rivalry. This suggests that managerial flexibility should not be assumed, but rather examined in relation to the strategic conditions surrounding the investment.

Recent research further suggests that the effective use of managerial flexibility not only depends on strategic consideration, but also on organisational capabilities. Organisations are better able to manage uncertainty when they combine operational flexibility with the ability to rapidly configure resources and adapt through learning (Koh et al., 2023). This perspective complements real options theory by emphasizing that the value of flexibility depends not only on the financial opportunity to change an investment decision, but also on the organization's ability to implement such changes in practice.

3.5 Summary Theoretical Framework

The theoretical framework provides the analytical concepts used in the study. These concepts include traditional capital budgeting methods, qualitative considerations, uncertainty, sensitivity and scenario analysis, managerial flexibility and real options theory. Together, they provide a basis for examining how investment decisions can be evaluated, how uncertainty can be incorporated into investment evaluation and how flexibility can be understood in relation to investment decision-making.

Traditional capital budgeting methods, such as NPV, IRR, MIRR and payback, provide concepts for understanding the financial structure of investment evaluation. However, previous research also shows that capital budgeting should not only be understood as a set of financial calculations, but as an organizational process in which formal methods may be combined with qualitative judgement, strategic considerations and organizational routines.

Qualitative considerations, such as regulatory, environmental and social factors, are therefore also relevant for understanding how investment decisions may be evaluated in practice.

Uncertainty is another central analytical concept, since traditional DCF methods rely on assumptions about future cash flows, discount rates and market conditions. Sensitivity analysis and scenario analysis provide concepts for understanding how firms may test key assumptions and assess how investment outcomes can change under different conditions.

Finally, real options theory and managerial flexibility provide concepts for understanding how investment decisions may be adjusted over time under uncertainty. Real options theory is used to understand the value of flexibility, including the option to defer, expand, contract or abandon an investment. Managerial flexibility refers to the firm's practical ability to act on such flexibility when conditions change. The framework also acknowledges that formal real options valuation may be difficult to apply in practice due to mathematical complexity and sensitivity to key assumptions.

4. Empirical Findings

This chapter presents the empirical findings from the interviews conducted with two employees at Volvo Group and findings from investment policy documents and historical investment decisions. The focus is on how investment decisions are evaluated in practice, how uncertainty is managed and how flexibility is considered within the company's decision-making process.

4.1 Investment Decision-Making and Capital Budgeting Methods

The two respondents provide insight into investment decision-making from different but related perspectives within the organization. Respondent A works within Central Group Business Control and is responsible for the policies that regulate investments and investment decisions. This includes responsibility for the templates and systems used in the investment process, as well as providing feedback on larger investment proposals before they are submitted to higher decision-making forums, such as the board. Respondent A therefore provides insight into the formal investment framework and the methods that are expected to be used across the organization.

Respondent B works within Business Control at Volvo Construction Equipment’s head office and is responsible for the investment process there, as well as being a key user of the internal investment management tool. Respondent B has also worked for several years at a component factory in Eskilstuna, described as one of the most capital-intensive factories within the organization. Respondent B participates in finance reviews for larger decisions, where the purpose is to ensure that all required information is complete before the investment request is presented to the relevant decision forum.

The respondents describe that investment decisions are supported by an internal framework, and that the use of financial calculations varies depending on the size and type of investment. Both respondents describe four main capital budgeting methods: payback, NPV, IRR and MIRR. Respondent A explains that larger investments require more extensive calculations, while smaller investments may in some cases be assessed through fewer measures. The respondent also states that the internal model and system automatically generate the calculations once the relevant information has been entered.

Respondent A explains that the organization tries to emphasize MIRR, since IRR may be misleading due to its assumptions regarding reinvestment. At the same time, IRR remains in use due to its simplicity and familiarity among users, as well as its long-standing role in investment decision-making. Respondent A also describes that financial calculations are used to evaluate and follow up investments. According to respondent A, other considerations may also affect the final decision. This is described as particularly relevant in product development projects linked to legal requirements, where the organization may need to invest in order to comply with emission standards.

Respondent B similarly states that no single financial measure is decisive in the decision-making process. Instead the measures are considered together as part of an overall assessment of the investment. According to respondent B, the financial calculations often indicate the effect of an investment on profitability and cash flow, but larger decisions are frequently influenced by strategic considerations, without specifying these considerations in detail. Respondent B describes that investments connected to electromobility are linked to the strategic direction of the organization and that they are not only based on individual profitability measures.

The respondents mention that different types of investments cannot always be evaluated through traditional profitability calculation in the same way as capacity-increasing investments. Respondent B explains that replacement investments, development workshop investments, strategic investments, and environmental investments often lack a direct revenue effect. In these cases, the organization instead compares different alternative solutions to identify the most efficient and appropriate option. This may involve assessing whether existing equipment can be used for longer periods, whether maintenance costs are increasing, whether a new machine would improve efficiency, or whether quality problems make replacement necessary.

In addition to financial calculations, both respondents emphasize the importance of qualitative factors. Respondent A explains that these include qualitative environmental impact, quality, access to labour, service, safety and legal requirements. These factors are not included directly in the profitability calculation, since the calculation should only reflect measurable and quantifiable effects. Instead, respondent A states that they are included in the

overall assessment of the investment. Respondent B also describes that qualitative and strategic arguments may weigh heavily, particularly in larger investments.

Finally, both respondents explain that NPV calculations are based on Volvo Group Cost of Capital. Respondent A states that VGCC is country-specific and applied according to where the main part of the investment spending occurs. The respondent also explains that cash flows are calculated before tax and that the cost of capital is therefore adapted to pre-tax cash flows. Respondent B similarly refers to VGCC and the rate is determined for each country based on factors such as risk and capital market conditions.

4.2 Uncertainty in Investment Evaluation

The interviews indicate that uncertainty is an important aspect of investment evaluation and that several forms of uncertainty are difficult to incorporate into financial models. Both respondents identify market development as a key source of uncertainty affecting investment evaluation. Respondent A emphasizes that many uncertainties are non-quantifiable, particularly factors related to market development and technological change. For example, the pace of technological development and the transition towards greener solutions are described as highly uncertain and difficult to estimate. Respondent A also emphasizes that assumptions about volume represent a major source of uncertainty, as they are a key part of investment calculations and are at the same time difficult to predict.

Similarly, Respondent B identifies market-related factors as one of the most critical sources of uncertainty, in particular volume assumptions, pricing and exchange rates. The respondent highlights that volume assumptions have a significant impact on investment outcomes and profitability. Respondent A also mentions that key assumptions in investment calculations are often highly uncertain and vary depending on the type of investment. For product-related investments, the pace of technological development is identified as a major uncertainty, while market-related investments depend on factors such as demand, competition, and overall market development. Respondent A identifies that, in general, volume, price, and technological changes are the most critical and uncertain variables.

Respondent A mentions that traditional DCF methods have limitations depending on how they are applied. The respondent states that relying only on a single financial calculation is

not considered sufficient and may lead to uncertainty. The models are complemented with sensitivity analyses, risk assessment, and qualitative evaluations.

To address these limitations and better manage uncertainty, both respondents describe the use of sensitivity and scenario analyses. Respondent A explains that sensitivity analysis is used to assess how a change in key variables, such as volumes, affects investment outcomes. Respondent B similarly highlights the use of best-case and worst-case scenarios to evaluate the robustness of investments. In addition, respondent B describes the use of risk analyses to identify potential risks and find strategies to mitigate risks. Respondent A mentions that the sensitivity analysis needs to remain manageable, as many different people are involved in the process. While some work with it frequently, others only do it occasionally. This makes it important to have a system that is simple and easy to use.

Respondent A states that sensitivity analysis is used in the investment decision process and that its role changes depending on the type of investment. The respondent explains that the results of sensitivity analyses are not used in isolation but are considered when assessing whether an investment should proceed.

4.3 Managerial Flexibility in Investment Decisions

The respondents describe several ways in which investments may be adjusted, postponed or reassessed during the investment process. Respondent A explains that the concept of real options was not familiar before the interview and describes the underlying calculation methods as relatively complex. The respondent argues that the organization needs investment models that can be applied by many different users, which makes highly advanced methods difficult to implement in practice. At the same time, respondent A states that the organization may use other ways to manage similar issues, even if the terminology of real options is not used.

A central form of flexibility described by respondent A is the possibility to divide larger and more complex investments into sequential stages. According to the respondent, most investments are treated as one decision followed by implementation. Larger and more complex investments, such as product development projects or investments in new facilities, may be divided into smaller steps. In product development projects, this is connected to

technical maturity, where new information becomes available over time and the project is recalculated before new partial decisions are made. For large industrial projects, the overall investment may be approved as a larger programme, while individual parts are released separately in order to maintain control throughout the process.

Respondent A also describes flexibility in relation to timing. The respondent states that there have been situations where the organization has considered whether to carry out an investment immediately or postpone it to a later point in time. The investment policy has also been adjusted so that an approved investment must now be started within one year, otherwise it has to be submitted for a new decision. According to respondent A, this change was introduced to handle uncertainty and ensure that investment decisions are still based on relevant assumptions if conditions change over time.

The possibility to pause, slow down or reassess investments is also emphasized. Respondent A explains that if external conditions change after a decision has been made, the organization may need to make a new assessment. This can involve recalculating profitability, evaluating whether additional funding is needed, or considering whether the investment can be carried out in another way. When discussing ongoing projects, respondent A states that there are examples where plans have been paused or continued at a slower pace while the organization evaluates how the situation is developing. The respondent describes that these evaluations are connected to management discussion and changes in macroeconomic conditions, rather than only formal recalculation.

Respondent B describes flexibility primarily through the comparison of alternative solutions. According to the respondent, each investment request must include alternative solutions to the proposed investment. For Property, Plant and Equipment (PPE) investments, this may involve considering whether existing equipment can be repaired, whether a temporary solution can be rented, or whether the activity can be outsourced. The respondent also explains that, in the case of machinery investments, a larger maintenance effort may sometimes allow the organization to postpone the investment for a few years.

Respondent B further explains that the possible solutions differ depending on the specific investment. In production-related investments, production technology and logistics development are often involved in identifying possible solutions. In relation to product

projects, the respondent explains that there may be discussions about whether to continue with an existing model generation for a longer period. Respondent B describes that these discussions and decisions take place at a strategic level and are not directly based on calculation for product development.

Respondent B also states that investments may be postponed when there is a high level of uncertainty. If an investment is considered too uncertain, it may be delayed and reviewed again after one or two years with updated figures. The respondent explains that the organization may decide that it is not the right time to carry out the investment, but that the case can remain and be reassessed later.

Finally, respondent B describes that projects may be adjusted during the process. The respondent states that scaling down is discussed more often than scaling up. In product projects, this is connected to feasibility studies and concept studies, where the organization first evaluates whether the intended project is possible to do and then considers the technical solution. According to respondent B, a project may be stopped, reworked or modified if the solution becomes too expensive or is not considered appropriate.

4.4 Volvo Group's Investment Policies

4.4.1 The Investment Profitability Calculation Process

According to Volvo's Investment Management Directive, the factors that need to be addressed before any investment decision is made are the profitability of the investment and the availability of funds. The same document presents NPV, IRR, MIRR and payback as the approved methods for profitability calculations. In their Investment Profitability Calculations Guideline NPV is described as always giving the correct answer and should therefore always be used in the selection process. MIRR is highlighted in the document as the preferred method to use over IRR. At the same time payback can be used alone for minor investments. The guideline also states that it is important to be aware of the limitations of each method when evaluating the profitability of an investment.

In the calculation guideline sensitivity analysis is highlighted as a more refined method and based on realistic calculations. One or more factors are replaced with more pessimistic or optimistic values to study the effect of the profitability figures. The sensitivity analysis

should show the profitability impact of changes in factors and parameters that have an impact on the project. It should reflect risk and opportunity in factors such as changes in volume, residual value, calculation period and other relevant factors.

After an investment is made a follow up is mandatory to monitor the achievements of investment targets through quantitative and qualitative measures. This is also done to achieve a greater understanding of investment calculations and to improve future assumptions.

4.4.2 Alternative Solutions

An investment request document includes a section describing alternative solutions to the proposed investment and the potential consequences of selecting these alternatives. Examples of alternative solutions include postponing the investment, keeping the current process, or refurbishing current equipment.

4.4.3 Definition of Qualitative Factors

In Volvo Group's investment profitability calculation guideline, several potential qualitative factors are identified. These include environmental requirements, quality requirements, availability of labour, service requirements, safety requirements, legal requirements, profitability calculations and other considerations.

5. Analysis

This chapter presents the empirical findings in relation to the theoretical framework presented earlier in the study. The analysis focuses on how investment decisions are evaluated in practice at Volvo Group and describes how uncertainty and managerial flexibility are incorporated in the decision-making process.

5.1 Evaluation of Projects in Practice Within Volvo Group

The findings indicate that investment evaluation within Volvo Group combines formalized financial methods and managerial judgement. Respondents describe that the capital budgeting methods NPV, IRR, MIRR and payback form an important part of the evaluation process and are integrated into investment policies and internal calculation systems. This suggests that from a capital budgeting perspective, traditional capital budgeting methods provide a financial structure for evaluating and comparing investments within the organization. The continued use of these methods is consistent with Graham and Harvey's (2001) findings that traditional appraisal techniques remain widely used in practice.

The findings also indicate that these methods do not function as strict decision-making rules. Although NPV, IRR, MIRR and payback are often presented in theory as decision criteria linked to value creation, profitability and project acceptance, the empirical findings suggest that their practical role within Volvo Group is broader and less mechanical. The calculations create a common financial basis for comparison and follow-up, but they are interpreted together with strategic, qualitative and operational considerations. The role of traditional capital budgeting methods in Volvo Group can therefore be understood as providing structure to investment evaluation, rather than determining the final decision independently (Hillier et al., 2020).

This is also reflected in Volvo Group's internal investment profitability calculation guideline, where several qualitative factors are identified, including environmental requirements, quality requirements, availability of labour, service requirements, safety requirements and legal requirements. These factors are not included directly in the profitability calculation, as the calculation only reflects measurable and quantifiable effects. Nevertheless, they form part of the overall investment decision. This supports the respondents' description that investment

decisions are not based solely on measurable financial outcomes, but also include broader operational and strategic considerations.

The findings further suggest that the investment evaluation process is influenced by organizational routines and how managers interpret financial and non-financial information. Respondent A explains that calculations are automatically generated in their internal systems, creating consistency through the organisation. Respondent B highlights that no single financial measure determines the final investment decision. This can be interpreted through Butler et al's (1991) view that investment decisions should not be understood as purely technical calculations, but rather as organizational processes involving several actors, levels and stages. This perspective is useful for interpreting Volvo Group's process, where standardized financial methods are embedded in a wider decision context. The existence of formal templates and automatically generated calculations creates consistency across the organization, but the decision itself remains dependent on managerial interpretation and broader strategic assessment.

The empirical findings also indicate that the role of financial calculations is different depending on the type of investment. Respondent B explains that, for investments with a direct revenue or capacity effect, traditional profitability measures can more directly capture expected financial outcomes. In contrast, replacement investments, environmental investments, development workshop investments and strategic investments are described as more difficult to assess with only financial measures. In these situations, Volvo Group also complements financial measures with qualitative factors related to product quality, safety, legal compliance, efficiency or long-term strategic considerations. In a capital budgeting context, this illustrates how qualitative factors are incorporated into investment evaluation when conventional financial models cannot fully capture the purpose or value of the investment. This is in line with Akalu's (2003) argument that investment appraisal in large firms often combines formal financial techniques with qualitative and non-standard approaches, particularly when investments are difficult to assess through conventional financial models.

The importance of qualitative and strategic factors further shows that investment evaluation within Volvo Group is broader than financial calculations. This is particularly relevant for investments connected to legal requirements or long-term technological shifts, where the

strategic need for the investment may outweigh the outcome of individual profitability measures. Alkaraan (2020) similarly argues that strategic investment decision-making is influenced by both financial and non-financial factors, including organizational strategy, regulation and environmental considerations. In Volvo Group's case, this helps explain why some investments cannot be evaluated only by whether they generate direct financial returns. Instead, the investment may be necessary because it supports compliance, quality, safety, efficiency or the company's long-term strategic direction.

The findings also show that Volvo Group's internal policies try to emphasize the use of MIRR over IRR as the preferred method. Respondent A explains that IRR may give misleading calculations and outcomes because of the reinvestment assumptions, while MIRR is seen as a more robust and realistic method. At the same time, the respondent highlights that IRR remains in use due to its long-standing role in investment decision-making. This reflects criticism in the literature, where IRR has been questioned because its reinvestment assumption may be unrealistic and may produce misleading results under certain conditions (Patrick & French, 2016).

Kierulff (2008) explains that MIRR was developed to address some of these weaknesses by applying more realistic assumptions regarding reinvestment and financing rates. Volvo Group's attempt to emphasize MIRR can therefore be interpreted as an effort to improve the decision relevance of the financial evaluation process within the framework of traditional capital budgeting methods. However, the continued use of IRR shows that method selection is not determined only by theoretical accuracy. This suggests that method selection within Volvo Group is influenced not only by theoretical precision, but also by organizational familiarity, communicability and established routines, which may explain why IRR remains relevant despite the internal preference for MIRR.

Overall, the findings suggest that Volvo Group's investment evaluation process reflects a balance between formal financial analysis and practical organisational decision-making. Traditional capital budgeting methods in Volvo Group remain widely used in practice because they provide structure and comparability in investment evaluation (Graham & Harvey, 2001). At the same time, investment decisions in large organizations, like Volvo Group, cannot be understood as purely technical calculations, but should rather be seen as organizational processes involving several actors, levels and strategic considerations (Butler et al., 1991;

Alkaraan and Northcott, 2013). This helps explain why methods such as NPV, IRR, MIRR and payback remain important at Volvo Group, even when their results are interpreted together with qualitative factors and managerial judgement.

5.2 Uncertainty in Investment Evaluation

The empirical findings indicate that uncertainty is incorporated into Volvo Group's investment evaluations primarily through the assumptions used in the financial calculations, and through additional analyses that test how sensitive the results are to changes in those assumptions. Rather than being treated as a separate issue outside the investment model, uncertainty is reflected in the variables that determine the financial outcome. Both respondents emphasize uncertainty by highlighting that investment evaluations depend on assumptions about future market development, volume, prices, exchange rates and technological change. These variables are central to the calculation of expected cash flows, but they are also difficult to estimate with precision. This creates a fundamental tension in the investment evaluation process, with the financial models requiring numerical estimates, while several of the most important inputs are uncertain and may change over time.

This tension illustrates a central limitation of traditional DCF methods. Although DCF-based methods provide a structured and financially consistent way to evaluate investments, their reliability depends on the quality of the assumptions used in the calculation. Respondent A described volume assumptions as particularly important, since they form a central part of the calculation while being difficult to predict. Respondent B similarly emphasizes that changes in volume assumptions can strongly affect investment outcomes and profitability. This indicates that uncertainty enters the investment evaluation not primarily through the calculation method itself, but through the assumptions and forecasts on which the calculations are based. The calculated result may therefore appear precise, but it remains dependent on uncertain expectations about future conditions. This is in line with Gaspars-Wieloch's (2019) argument that future cash flows are inherently uncertain because they depend on revenues, costs and market conditions that cannot be known in advance.

The findings further show that different types of investments are exposed to different forms of uncertainty. Respondent A describes technological development as particularly uncertain in product-related investments, while market-related investments are more dependent on

demand, competition and general market development. This distinction is analytically important because it shows that uncertainty cannot be reduced to one general risk factor that can easily be incorporated into a discount rate. Instead, the findings show that uncertainty takes different forms depending on the type of investment. Regarding investments related to technological change or the transition towards greener solutions, uncertainty may concern future regulation, technological maturity and market acceptance. In other investments, the primary uncertainty may instead concern volumes, prices or exchange rate. This supports Yang and Blyth's (2007) argument that traditional DCF methods are limited because they tend to treat uncertainty in a simplified way, even though investment outcomes may depend on several interacting and changing conditions.

Volvo Group appears to address this limitation by complementing traditional financial calculations through the use of sensitivity analysis. Respondent A explains that sensitivity analysis is used to assess how changes in key variables, such as volume, affect investment outcomes. Volvo's internal guideline for investment profitability calculation also includes sensitivity analysis as a method for examining how changes in factors such as volume, residual value, calculation period and other relevant parameters affect profitability. This suggests that sensitivity analysis is used to show how dependent the investment result is on specific assumptions. Instead of relying on one expected outcome, the organization examines how dependent the investment is on specific assumptions and identifies which variables are most critical for the final result (Hillier et al., 2020).

Sensitivity analysis is a way of illuminating uncertainty, rather than a method for eliminating uncertainty. It does not provide a definitive answer regarding which future outcome will occur, but shows how the investment result changes when selected assumptions are adjusted. This reflects Hillier et al's (2020) description of sensitivity analysis as a method for examining the effect of changes in key assumptions. In Volvo Group's case, the method is valuable because several of the variables that are most uncertain, such as volume and prices, have a significant impact on projected investment profitability. At the same time, the interpretation of the analysis still depends on how decision-makers select relevant variables and assess the effect of changes in assumptions. The method can therefore support the assessment of investment uncertainty, but it does not fully capture more complex situations where several variables change simultaneously or where future outcomes cannot easily be estimated financially.

Scenario analysis therefore appears to play an important complementary role. Respondent B describes the use of best-case and worst-case scenarios to evaluate the robustness of investment. This indicates that uncertainty is not only incorporated by adjusting individual variables, but also by considering how the investment may perform under alternative future scenarios. This means that Volvo Group does not rely solely on a base-case calculation, but also examines whether an investment remains reasonable if the assumptions develop more or less favorably than expected. This is particularly relevant given that the respondents identify changes in market demand, sales volume, pricing level and exchange rates as key sources of uncertainty. Since scenario analysis considers simultaneous changes in multiple variables, it provides a broader understanding of how uncertainty may affect the investment outcome than a single base-case calculation can offer (Hillier et al., 2020).

The use of best-case and worst-case scenarios also shows that uncertainty is incorporated as a part of the decision discussion, rather than only as technical adjustment in the model. Respondent B explains that risk analyses are used to identify potential risks and to find strategies to mitigate them. This suggests that the purpose of scenario and risk analysis is not only to produce alternative numerical outcomes, but also to support managerial judgement about whether the investment is sufficiently robust and how identified risks can be handled. In this way, uncertainty becomes part of the overall evaluation of the investment, where the financial result is interpreted together with possible risks, consequences and mitigating actions.

The findings are consistent with the role of scenario analysis described by Hillier et al (2020), where the method allows several assumptions to change at the same time and therefore provides a more realistic view of how different future conditions may affect an investment. It also connects to Duinker and Greig's (2007) argument that scenario analysis is valuable because it encourages decision-makers to consider different possible futures instead of becoming too attached to one expected outcome.

The findings indicate that scenario analysis and risk assessment become more difficult to apply when uncertainty is difficult to quantify. Respondent A emphasizes that several uncertainties, particularly those related to market development and technological change, cannot easily be translated into financial estimates. This is important because traditional

DCF-based methods require uncertain future effects to be expressed as expected cash flows. While variables such as volume, price and exchange rates can be adjusted and tested through sensitivity or scenario analysis, broader uncertainties related to technological shifts, regulatory development or future market positioning are more difficult to include in the calculation.

This may explain why Volvo Group combines financial calculations with risk assessment and qualitative evaluations. The empirical findings show that uncertainty is not handled by replacing traditional capital budgeting methods, but by supplementing them with analyses that make the underlying assumptions more visible. This is consistent with Alkaraan's (2020) argument that investment evaluation in practice often requires both financial and nonfinancial factors. In Volvo Group's case, DCF-based methods provide an important financial structure, but their outputs need to be interpreted together with uncertainty analyses and managerial judgement. Overall, the findings suggest that uncertainty is incorporated into the investment process by testing assumptions and evaluating risk, but not fully captured by the financial models themselves. Traditional methods therefore remain useful as decision-support tools, but their limitations become evident in situations where investment outcomes depend on uncertain, changing and partly non-quantifiable future conditions. This weakness creates a need for complementary qualitative analysis.

5.3 Managerial Flexibility

The findings show that Volvo Group does not apply real options as a formal valuation method. Both respondents stated that the concept of real options was not familiar prior to the interview, and respondent A describes the underlying calculation methods as relatively complex. This suggests that real options are not part of the formal investment language or the standardized financial evaluation model used in the organization. The absence of formal real options valuation does not imply that the perspective is irrelevant. Instead, it can help explain how Volvo Group preserves flexibility when investment decisions are affected by uncertainty.

This distinction is important because Real Options Theory does not only refer to a valuation technique, but also to a way of understanding investment decisions under uncertainty. According to Mun (2006), a real option gives the firm the right, but not the obligation, to undertake or adjust an investment depending on how future conditions develop. From this

perspective, investment decisions are not viewed as fixed commitments based only on expected future cash flows, but as decisions that may be adapted over time. This is relevant in Volvo Group's case because the respondents describe situations where investments may be postponed, reassessed, divided into stages, scaled down or modified as new information becomes available.

A central form of flexibility in the empirical findings is the possibility to divide larger investments into sequential steps. Respondent A illustrates this by explaining that larger and more complex investments, such as product development projects or investment in new facilities, may be structured in smaller stages. In product development projects, this is connected to technical maturity, where new information becomes available over time and the project is recalculated before new partial decisions are made. This can be understood through the real options perspective, where investments are treated as a sequence of possible decisions rather than as one irreversible commitment. Yang and Blyth (2007) argue that traditional DCF methods are limited because they do not fully account for the timing of investment or the possibility of adapting decisions as uncertainty unfolds. Volvo Group's staged investment process therefore illustrates a practical way of dealing with this limitation, since commitment can be gradual rather than immediate.

This staged approach is analytically significant because it allows the organization to preserve flexibility while uncertainty is reduced over time. In real options theory, the value of flexibility increases when uncertainty is high and when management has the ability to respond to new information. Brach (2003) argues that managerial flexibility can take several forms, including the possibility to expand, contract or abandon a project as future conditions change. Although Volvo Group does not formally value these options, the empirical findings suggest that similar forms of flexibility are present in practice. By dividing larger investments into partial decisions, the organization can reassess whether the project should continue in its original form before committing further resources.

5.4 The Contribution and Limitations of a Real Options Perspective

The real options perspective contributes to a better understanding of Volvo Group's investment decisions by clarifying when managerial flexibility is valuable in the decision-making process. The empirical findings show that Volvo Group does not formally

value real options, but that several investment practices reflect real options logic. The contribution of the perspective is therefore not primarily to explain which calculation method Volvo Group uses, but how uncertainty can be managed through flexibility when the organization has the possibility to adapt its decisions over time.

This is particularly visible in relation to the option to defer. Respondent A describes cases where the organization has considered whether to carry out an investment immediately or postpone it to a later point in time. Respondent B similarly explains that investments may be delayed when uncertainty is considered too high and reviewed again after one or two years with updated figures. In real options theory, the option to defer allows firms to wait until more information becomes available before committing to an investment (Brach, 2003). This helps interpret postponement at Volvo Group as more than a delay. It shows that waiting can be valuable when important assumptions, such as market development, volume or technological change, are uncertain.

The investment policy requiring an approved investment to be started within one year or submitted for a new decision, further supports this interpretation. From a real options perspective, this shows that an investment approval is not treated as permanent if conditions change over time. The decision to invest is therefore linked to whether the underlying assumptions remain relevant. This connects to Mun's (2006) view that real options allow management to adapt decisions as new information becomes available. In Volvo Group's case, this flexibility is not expressed through a formal option valuation model, but through internal governance mechanisms that require reassessment under uncertainty.

The use of alternative solutions also shows how a real options perspective can contribute to the understanding of Volvo Group's investment decisions. Respondent B explains that investment requests include alternatives to the proposed investment, such as repairing existing equipment, renting a temporary solution, outsourcing or carrying out a larger maintenance effort to postpone a machinery investment. This shows that investment evaluation is not only a question of accepting or rejecting one proposal. Instead, Volvo Group compares different possible courses of action. From a real options perspective, these alternatives are important because they preserve managerial flexibility when the outcome of the proposed investment is uncertain, which is central to the real options logic of adapting decisions as new information becomes available (Mun, 2006).

The empirical findings also show elements of the option to contract and the option to abandon. Respondent B states that scaling down is discussed more often than scaling up, and that projects may be stopped, reworked or modified if the solution becomes too expensive or unsuitable. According to Brach (2003), the option to contract allows firms to reduce the scale of an investment in response to unfavorable developments, while the option to abandon gives the firm the possibility to exit a project to avoid further negative returns. Volvo Group's practice of scaling down, modifying or stopping projects therefore resembles these forms of real options logic.

The real options perspective does not contribute equally to all investment decisions. Its explanatory value is strongest when Volvo Group has genuine room to adapt an investment decision, for example by deferring, reassessing, contracting or abandoning a project. It is less useful when investments are connected to legal requirements, environmental regulation, safety needs or long-term strategic direction. In such cases, the organization may need to proceed even when traditional profitability measures are not conclusive. These decisions are therefore better understood as commitments than as options.

This distinction is important because real options theory emphasizes the value of flexibility, but flexibility only has value when it can realistically be exercised. Dalziel (2009) argues that the distinction between an option and a commitment depends on whether the firm is actually prepared to abandon or change the investment if conditions develop unfavorably. Applied to Volvo Group, this means that real options logic is most visible in situations where the organization has genuine managerial discretion. When strategic, regulatory or operational conditions limit Volvo Group's ability to postpone, modify or abandon the investment, the real options perspective becomes less useful.

This also nuances Xie's (2009) argument that financially stronger firms are generally better positioned to exploit flexibility within a real options perspective. The findings from Volvo Group show that the relevance of real options logic cannot be explained only by a firm's financial position. Rather, the perspective is most useful when Volvo Group has genuine managerial discretion to postpone, modify or abandon an investment. This suggests that financial strength alone is not sufficient to explain how real options logic is reflected in investment decision-making practice.

The absence of formal real options valuation can also be understood in relation to both theoretical and practical limitations. Real options analysis is often considered difficult to apply in practice because it is complex, sensitive to input assumptions and requires adaptation to each individual project, which may limit its practical usefulness in large organizations (Brach, 2003; Berk & DeMarzo, 2023). This corresponds with respondent A's explanation that the underlying calculations are relatively complex and that Volvo Group requires investment models that can be applied by many different users. This indicates that the value of a real options perspective in Volvo Group's investment process lies in its ability to explain how flexibility is used under uncertainty, rather than in its formal application as a valuation method.

Overall, a real options perspective contributes to a better understanding of Volvo Group's investment decisions by explaining when flexibility has value under uncertainty, even though it is not applied as a formal valuation method. The perspective is most relevant in situations where Volvo Group has genuine room to defer, reassess, scale down or abandon an investment over time. Its explanatory value is weaker when investment decisions are constrained by legal requirements, environmental regulation, safety needs or long-term strategic commitments. The main contribution of the perspective is therefore not to explain which formal calculation method Volvo Group uses, but to explain when and how managerial flexibility becomes relevant in practice.

6. Conclusion

6.1 Investment Evaluation and Capital Budgeting Methods at Volvo Group

The study shows that investment decisions at Volvo Group are evaluated through a formalized investment process supported by internal policies, templates and calculation systems. The main capital budgeting methods used are NPV, IRR, MIRR and Payback. These methods provide a common financial structure for evaluating and comparing investments across the organization.

At the same time, the findings show that the financial methods are not used as the sole basis for decision-making. They are interpreted in relation to the size and type of investment, the strategic relevance of the project and qualitative factors that cannot always be quantified. This is particularly evident in investments related to replacement, environmental requirements, research and development activities and strategic positioning, where the value of the investment may not be fully captured through direct profitability effects. The conclusion is therefore that traditional capital budgeting methods are important at Volvo Group, but mainly as decision-support tools within a broader organizational investment process.

6.2 Uncertainty in Investment Evaluation and Limitations of Traditional Methods

The study further shows that uncertainty is incorporated into Volvo Group's investment evaluations primarily through the assumptions underlying the financial calculations. Key sources of uncertainty include market development, volume, prices, exchange rates and technological change. Since these variables are central to expected future cash flows, uncertainty enters the evaluation through the forecasts upon which the financial models are based.

To manage this uncertainty, Volvo Group complements traditional financial calculations with sensitivity analysis, scenario analysis, risk assessments and qualitative evaluations. Sensitivity analysis is used to examine how changes in key variables affect investment outcomes, while scenario analysis allows the organization to evaluate how investments may perform under different future conditions. Risk assessments and qualitative evaluations

further support the decision-making process by addressing uncertainties that are difficult to quantify.

The main limitation of traditional DCF methods is therefore that they depend on uncertain assumptions about the future. While these methods provide structure and comparability, they cannot fully capture uncertainty that is multidimensional, changing or non-quantifiable. The study concludes that Volvo Group addresses uncertainty in its investment evaluation process by making it more visible and manageable through complementary analyses and managerial judgement.

6.3 Real Options Perspective and Managerial Flexibility in Practice

This study shows that Volvo Group does not use real options as a formal valuation method. The concept is not part of the company's formal investment language, and the underlying valuation models are perceived as too complex for practical use. At the same time, the findings show that several practices within Volvo Group resemble elements of real options logic, even though they are not formally described or applied in those terms.
More specifically, the findings show that a real options perspective is most useful for understanding Volvo Group's investment process in situations where the company has genuine room to adapt the decision over time. This applies when an investment can be postponed, reassessed, divided into stages, compared with alternative solutions, scaled down or stopped if conditions change. In these situations, the perspective helps explain how Volvo Group preserves managerial flexibility under uncertainty, even without using a formal real options model.

The findings also show that the perspective is less useful in the types of investment decisions where Volvo Group is constrained by legal requirements, environmental regulation, safety needs or long-term strategic direction. In such instances, the company may need to proceed even when uncertainty remains high and traditional profitability measures are not decisive. These decisions are therefore better understood as commitments rather than as option-like choices.

The main conclusion is therefore that a real options perspective is relevant in Volvo Group's case only when the company has genuine managerial discretion. Its value lies not in

explaining which formal valuation method Volvo Group uses, but in clarifying when flexibility is available in practice throughout the investment process and when Volvo Group is effectively committed to proceed.

6.4 Limitations and Future Research

This study is based on a qualitative single-case study of Volvo Group and includes two interviews, complemented by internal investment documents. As a result, the findings provide in-depth insight into one organizational context, but they cannot be generalized to all firms or industries. The study is also limited by the fact that investment decision-making may vary across divisions, hierarchical levels and types of investments within Volvo Group.

While the findings are based on a single case study and therefore cannot be statistically generalised, the findings may have analytical relevance for similar capital-intensive firms. Capital budgeting theory suggests that investment decision-making in large capital-intensive firms is often characterised by a combination of formal financial models, qualitative judgement and uncertainty management (Akalu, 2003; Alkaraan, 2020; Butler et al., 1991). This implies that similar patterns may also be observed in comparable organisations operating under similar structural and environmental conditions.

Future research could therefore examine a larger number of respondents across different parts of the organization in order to capture a broader view of how uncertainty and flexibility are handled in practice. It would also be valuable to compare Volvo Group with other capital-intensive firms to examine whether similar patterns can be identified in other organizational contexts. Further research could also investigate how firms can develop practical tools for incorporating managerial flexibility without relying on complex formal real options valuation models.

In addition, future research could build on the conceptual framework developed in this study by using the identified concepts in a broader empirical study. Since there is extensive theoretical and empirical research on the use of DCF methods, future studies could examine how concepts such as uncertainty, sensitivity and scenario analysis, qualitative considerations and managerial flexibility are reflected in contemporary investment decision-making practices. This could include analysing how these concepts are incorporated into formal

investment guidelines, decision templates and practical evaluation processes. Such research would make it possible to further describe the current role of these concepts in practice and assess whether the findings from Volvo Group reflect a broader tendency among capital-intensive firms.

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8. Appendix

8.1 Appendix A: Interview Guide

The guide below presents the core questions used in the semi-structured interviews with Respondent A and B. The original interview guide was written in Swedish, but has been translated into English for clarity and accessibility in this study.

Introduction & Background

- Can you describe your role at Volvo and how you are involved in investment decisions?
- What types of investments do you primarily work with?
- What does the typical decision-making process look like for a major investment project, from idea to final approval? What steps are usually included in the process?

Theme 1: Traditional Methods in Practice

- Which financial evaluation methods are mandatory according to Volvo's investment policy?
- How are these methods applied in practice?
- How are situations handled where different evaluation methods point in different directions?
- How is the discount rate used in NPV calculations determined?
- How is the payback method used in the decision-making basis?
- How do you perceive the usefulness of NPV as a decision-making tool in practice?
- Are there situations where NPV is not sufficient as a decision-making tool? If so, why?

Theme 2: Uncertainty and Risk Management

- Which types of uncertainty are most difficult to incorporate into financial models?
- How do you account for uncertainty in investment evaluations?
- Do you use sensitivity or scenario analyses? If so, what types of sensitivity analyses are used?
- Which variables are typically analysed?
- How do these analyses influence the final investment decision?
- How do you handle uncertainty in forecasts of future cash flows?

- Which assumptions do you consider to be the most uncertain?
- What shortcomings do you see in using traditional cash flow models in projects with very high uncertainty?

Theme 3: Flexibility and Real Options Thinking

- Do you view investments as one-time decisions, or as a multi-stage process over time?
- Are there projects where you have deliberately delayed an investment in order to obtain more market information?
- Do you explicitly discuss options to scale up, scale down, or abandon a project if conditions change?
- Are you familiar with the concept of real options?
- Is the term “real options” used formally, or is it more of an informal way of reasoning about managerial flexibility?

Conclusion & Reflection

- Is there anything important about how investment decisions are made that we have not covered?
- How do you view the relationship between financial theories and the practical decision-making process?
- Do you think Volvo would benefit from more advanced methods for valuing flexibility, or are current models sufficient?