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Valuation of Vertically Integrated Digital Order Processing Systems

Using a case study to develop a framework to economically evaluate IT-investments

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The authors declare that they are the sole authors of this thesis and that they have not used any sources other than those listed in the bibliography and identified as references. They further declare that they have not submitted this thesis at any other institution to obtain a degree.

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ABSTRACT

In the rapidly evolving industrial sector, companies must leverage digital technologies to enhance operational efficiency and maintain a competitive edge. This study investigates the economic evaluation of IT investments, focusing on the integration of digital order processing systems within the supply chain management of Tetra Pak. Driven by the need to understand the direct financial impacts and strategic benefits of such investments, the research aims to analyze a hypothetical future implementation using historical data to determine its financial viability. The primary problem addressed in this thesis is the economic viability and strategic benefits of integrating digital order processing systems in a firm's supply chain, specifically within the context of Tetra Pak. The challenge also lies in evaluating these investments when not all data is known or readily available, which necessitates an adaptable evaluation framework. The study employs a mixed-methods approach, combining qualitative and quantitative research techniques. Data was collected through a literature review, semi-structured interviews, and analysis of financial documents. Quantitative models, such as Cost/Benefit (C/B) analysis, Discounted Cash Flow (DCF), and Net Present Value (NPV), were utilized to assess the financial impact and overall value of the IT investment. This methodological framework was designed to provide an evaluation despite incomplete data. The results indicate that the potential IT investment would significantly enhance operational efficiency and reduce costs. The application of NPV and return on investment (ROI) models demonstrated a positive economic outcome, with an annual net benefit of 457 600 SEK per year, over five years, confirming that the benefits of digital system integration surpass the initial investment costs. The findings highlight not only cost reductions but also possible improvements in customer satisfaction and internal process efficiencies. The discussion section addresses the implications of the findings, emphasizing the relevance of traditional financial models like NPV and DCF while acknowledging their limitations in handling uncertainties. It suggests that, among other things, incorporating probabilistic methods and scenario analyses can enhance the accuracy and reliability of financial evaluations. This approach ensures that investment decisions are aligned with strategic goals and adapt to dynamic market conditions. In conclusion, the developed framework provides a solid foundation for evaluating IT investments within firms, even when data is incomplete. By integrating C/B analysis, quantitative modeling, and advanced financial evaluation techniques, the study demonstrates that such investments are economically viable and strategically beneficial and that there is much future work to be done in economics to better evaluate IT-investments.

Keywords:
Vertical integration, economic evaluation, IT investments, DCF, case study.

SAMMANFATTNING

I den snabbt utvecklande industrisektorn måste företag utnyttja digital teknik för att förbättra driftseffektiviteten och bibehålla en konkurrensfördel. Denna studie undersöker den ekonomiska utvärderingen av IT-investeringar, med fokus på integrationen av digitala orderbehandlingssystem inom Tetra Paks leveranskedjehantering. Drivet av behovet att förstå de direkta ekonomiska effekterna och strategiska fördelarna med sådana investeringar syftar forskningen till att analysera en hypotetisk framtida implementering med hjälp av historiska data för att bestämma dess ekonomiska hållbarhet. Det primära problemet som behandlas i denna avhandling är den ekonomiska hållbarheten och de strategiska fördelarna med att integrera digitala orderbehandlingssystem i ett företags leveranskedja, specifikt inom Tetra Paks kontext. Utmaningen ligger i att utvärdera dessa investeringar när inte all data är känd eller lättillgänglig, vilket kräver en anpassningsbar utvärderingsram. Studien använder en blandad metodik, som kombinerar kvalitativa och kvantitativa forskningsmetoder. Data samlades in genom en litteraturöversikt, semistrukturerade intervjuer och analys av finansiella dokument. Kvantitativa modeller, såsom kostnads-/nyttoanalys (C/B), diskonterad kassaflödesanalys (DCF) och nettonuvärdesanalys (NPV), användes för att bedöma den ekonomiska påverkan och det övergripande värdet av IT-investeringen. Denna metodiska ram utformades för att möjliggöra en utvärdering trots ofullständiga data. Resultaten visar att den potentiella IT-investeringen avsevärt skulle förbättra driftseffektiviteten och minska kostnaderna. Användningen av NPV- och return on invsetment (ROI)-modeller visade ett positivt ekonomiskt resultat, med en årlig nettoförmån på 457 600 SEK per år, över fem år, vilket bekräftar att fördelarna med integration av digitala system överstiger de initiala investeringskostnaderna. Resultaten belyser inte bara kostnadsminskningar utan också möjliga förbättringar i kundnöjdhet och interna processeffektivitet. Diskussionsdelen behandlar implikationerna av resultaten, med betoning på relevansen av traditionella finansiella modeller som NPV och DCF samtidigt som deras begränsningar vid hantering av osäkerheter erkänns. Den föreslår att bland annat inkludering av probabilistiska metoder och scenarioanalyser kan förbättra noggrannheten och tillförlitligheten i finansiella utvärderingar. Detta tillvägagångssätt säkerställer att investeringsbeslut är i linje med strategiska mål och anpassar sig till dynamiska marknadsförhållanden. Sammanfattningsvis ger den utvecklade ramen en solid grund för att utvärdera IT-investeringar inom företag, även när data är ofullständiga. Genom att integrera C/B-analys, kvantitativ modellering och avancerade finansiella utvärderingstekniker visar studien att sådana investeringar är ekonomiskt hållbara och strategiskt fördelaktiga och att det finns mycket framtida arbete att göra inom ekonomin för att bättre utvärdera IT-investeringar.

Nyckelord:
Vertikal integration, ekonomisk utvärdering, IT-investeringar, DCF, fallstudie.

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1 INTRODUCTION

1.1 Background

In Sweden's rapidly evolving industrial sector, any inefficient process within the supply chain of a firm could negatively affect the firm's competitive advantage of their supply chain and overall profitability. Hence, it is crucial for Swedish manufacturing enterprises to grasp the complexities of their operations within their supply chain and make wise strategic investment decisions to stay competitive in the market. The purpose of any firm is to yield a more significant return on invested money. This can be achieved by generating profit. Profitability is therefore an aim of all firms; profits are then distributed to shareholders as dividends. Profitability indicates management success, sustainability, and shareholder satisfaction, and it informs investors about a business's financial performance. Profitability is crucial in a market economy as it reflects how effectively a company manages its resources to maximize returns. (Alarussi & Alhaderi, 2018, p. 442). There are various methods to estimate this, but this study will focus on analyzing profitability specifically within the context of project valuation in a particular segment of the supply chain process. In a Swedish manufacturing industry's supply chain, several main processes are involved, as depicted in Figure 1. One crucial process within the supply chain that can cost companies valuable time is business communication. According to Jardini, Kyal, and Amri (2016), standard business communication methods in typical manufacturing industries often lead to inefficiencies. This inefficiency in communication processes can hinder a company's competitive advantage in the supply chain. The article highlights how implementing Electronic Data Interchange (EDI) can address these inefficiencies by improving the accuracy of data, enhancing productivity, and speeding up information transfer, ultimately strengthening a company's competitive position. (Jardini, Kyal, & Amri, 2016). In their study titled "Key obstacles to EDI success: from the US small manufacturing companies' perspective" Minjoon Jun and Shaohan Cai identify the obstacles that hinder the implementation of business communication in small sized companies in the US. They argue that such obstacles not only impede efficiency but also undermine the competitive edge that companies strive to maintain in their supply chain operations (Jun & Cai, 2003).

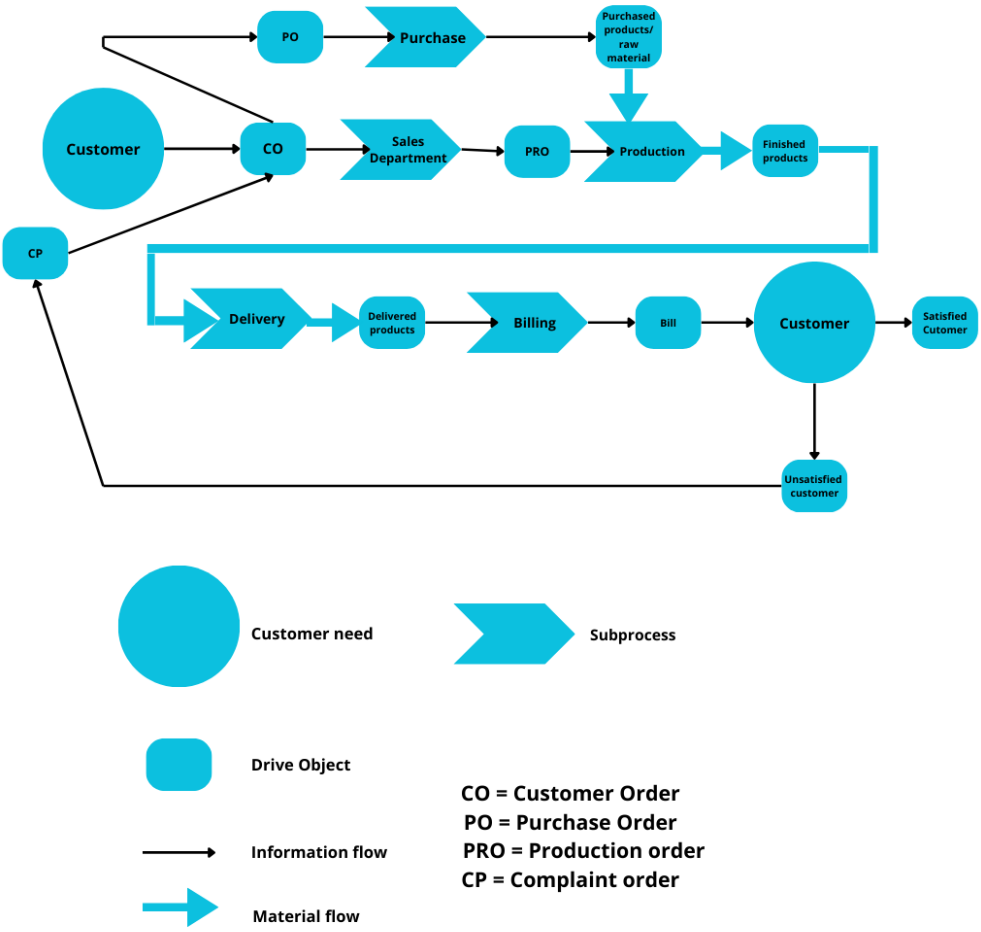

Figure 1. Shows the supply chain process of a typical manufacturing enterprise

In business communication, there are two main types, unstructured and structured. Unstructured communication includes messages, memos, and letters, while structured communication involves standardized documents like purchase orders, invoices, and payments. The focus of this study will be on the structured type of business communication. Electronic Data Interchange (EDI) comes as a solution for the mentioned inefficiency of the communication between the company and its suppliers. Electronic Data Interchange (EDI) refers to a system of electronic transmission for exchanging structured, formatted messages between businesses using the public Internet rather than physical storage media. It involves fast delivery of electronic documents directly between applications, requiring a sophisticated IT infrastructure for data processing, management, and transmission. Participants need a common connection point, electronic mailboxes, and robust security and communications management features. While direct implementation is feasible, using third-party network service providers is often advantageous. EDI offers operational benefits such as enhanced data accuracy, reduced errors, and streamlined business processes in inventory management, transport, distribution, administration, and cash management. It also provides strategic benefits by rationalizing procedures, reducing costs, and improving service speed and quality, acting as a catalyst for efficiency across organizational boundaries. Standardized formats are crucial for successful data interpretation, minimizing complexities and expenses associated with multiple formats. These elements ensure EDI's effectiveness in improving overall business efficiency. (Vrbová, Cempírek, Stopková, and Bartuška, 2018). EDI encompasses a combination of tangible and intangible components, including hardware, software, procedures, and training. Its purpose is to enhance supply chain integration by establishing seamless connections between organizations in their business communication. This facilitates the exchange of mainly purchase orders and order confirmations, optimizing operational efficiency by enabling a smooth and

efficient electronic transfer of structured data between the systems of all parties. This means that business documents like order confirmations, purchase orders, and invoices can be sent electronically, providing an alternative to traditional paper-based methods like postal mail and email. (Okano & Fernandes, 2019, p. 66). Compared to traditional methods, EDI requires less manual work because electronic transmission in standardized formats eliminates the need for rekeying and extra data checking. It's important to understand the difference between internal and external integration of EDI. Internal integration involves connecting different applications within the organization, such as order entry, invoicing, billing, and payment transfer (Vrbová, Cempírek, Stopková, & Bartuška, 2018). While external integration which this study focuses on, on the other hand, refers to connecting with trading partners like suppliers, customers, and financial institutions. When external integration is well-established, information flows smoothly between buyers and suppliers, essentially creating a virtual supply chain (Yunitarini et al., 2018, p. 122).

Tetra Pak located in Lund, Sweden, which is the case study of this research, is a global leader in food processing and packaging solutions, it plays a pivotal role in the supply chain ecosystem with operations spanning across more than 160 countries and a workforce of over 24 000 employees. Tetra Pak's operations revolve around three main streams: Packaging, Processing, and Services. Packaging includes food packaging machines and paperboard material; Processing covers equipment for dairy, cheese, ice cream, beverages, and prepared food; Services encompasses a wide range of offerings designed to enhance efficiency, optimize expenses, and maintain consistent quality and safety standards across the entire production process. This study focuses on the Services stream, specifically the supply chain operations related to the delivery of spare parts to customers. The Services Supply Network manages this flow, offering almost one million unique spare parts to customers through nine distribution centers globally, ensuring quick and sustainable fulfillment of customer demand. The primary distribution center is in Lund, where about 90% of parts are delivered from suppliers. Parts are then either shipped directly to customers or sent in bulk to regional distribution centers. The purchasing operations in Lund deal with nearly 1 000 global suppliers, sending around 200 000 purchase order lines to vendors each year. The purchasing process at Tetra Pak involves daily calculations made by the planning system, resulting in approximately 1 000 purchase order lines sent to vendors. These orders are aimed at either refilling stocked parts or fulfilling customer demand for non-stocked items. Vendors receive purchase orders via email with attached PDFs, including essential information such as Tetra Pak material reference number, vendor material reference number, quantity requested, price, and requested delivery date. Vendors are required to send back an order confirmation within three days. These confirmations, received similarly via email with attached PDFs, are handled by a smart electronic document management system that scans, interprets, and stores the data in Excel files, which are then registered in the system through robotic process automation. Despite automation, daily manual intervention is needed to address various interpretation failures. At the heart of Tetra Pak's operations lies a complex network of relationships with suppliers, as shown in figure 2, causing inefficiency in business communication within the supply chain, making it suitable as a case study for this research.

With efficiency problems arising, the adoption of modern supply chain principles has become crucial. The concept of Industry 4.0, which originated in 2011 during the Hannover Messe in Germany, represents an environment where interconnected machines, products, systems, and solutions interact. These components form intelligent production units using integrated computing and digital elements to oversee and control physical devices. Industry 4.0 incorporates emerging technologies such as cloud computing, smart sensors, big data, additive manufacturing, robotics, artificial intelligence (AI), machine learning, the Internet of Things, augmented reality, 3D printing, and blockchains. The main principle of Industry 4.0 is to harness cutting-edge technology and automation to revolutionize traditional supply chain management. This concept has become increasingly relevant for Swedish companies like Tetra Pak, particularly in enhancing the order handling process.

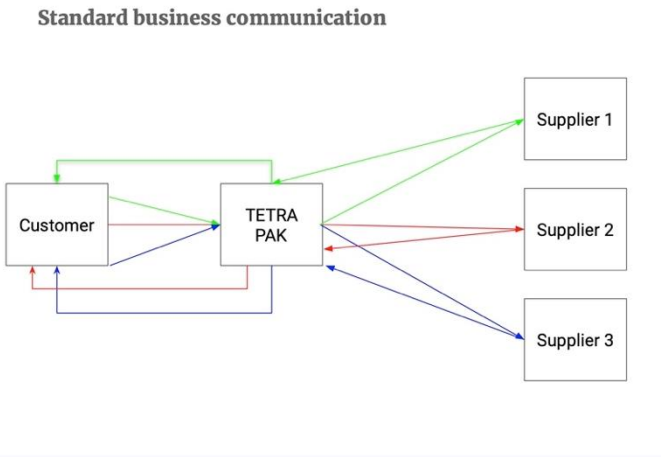

Figure 2. Business communication before ARIBA solution.

Recent studies highlight the transformative impact of Industry 4.0 on supply chain efficiency and the hurdles of digital integration. For instance, Govindan et al. (2022) and Frederico et al. (2020) emphasize the potential of technologies like IoT and AI to revolutionize supply chain management, while Jun and Cai (2003) identify significant barriers to EDI success. Masood and Sonntag (2020) further underscore the challenges firms face, including financial constraints and knowledge gaps. These insights inform the economic and operational considerations of integrating digital order processing systems, offering a nuanced understanding of their potential benefits and challenges. Here, technology such as Electronic Data Interchange (EDI), plays a pivotal role in streamlining communication between companies and its suppliers, possibly streamlining the business communication process of Tetra Pak, as shown in figure 3, thereby contributing to the realization of the industry 4.0 concept. Implementing an IT integration system such as EDI is a significant and costly investment, making it a challenging decision for companies. Recent studies identify several obstacles faced by small manufacturing firms in implementing Electronic Data Interchange (EDI) systems. These obstacles are categorized into four dimensions: lack of managerial leadership and organizational readiness, which hinders strategic vision and commitment; integration issues due to incompatibility with existing internal and external computer systems, leading to operational disruptions; technical challenges, such as system complexity and the need for specialized knowledge, which pose significant barriers; and concerns related to data security and legal compliance, which can be daunting for firms with limited resources.

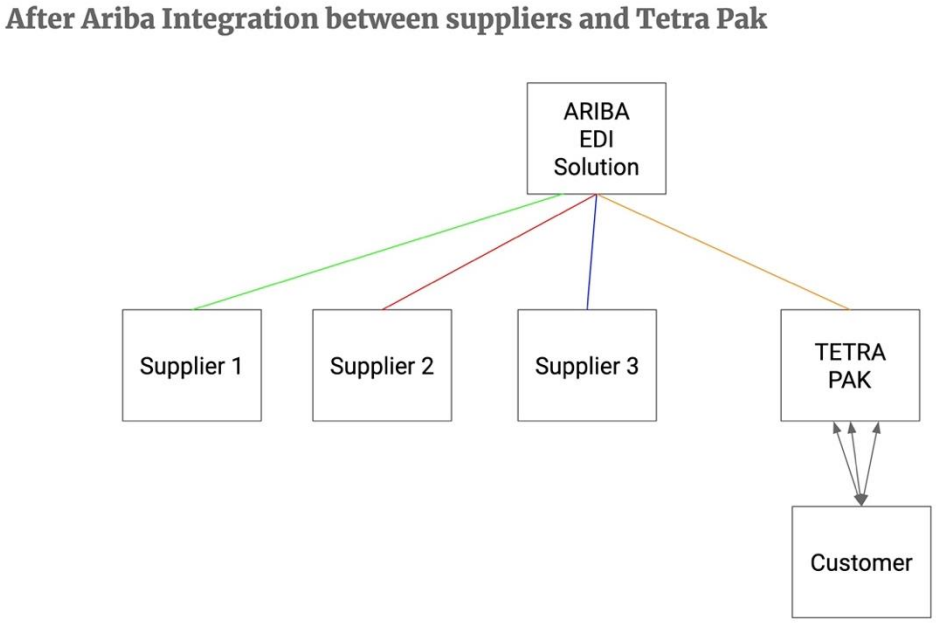

Figure 3. Business communication after ARIBA solution.

These obstacles collectively impact the potential benefits of EDI, such as the reduction of administrative and transaction costs, making it essential for companies to address these challenges to achieve the financial advantages associated with EDI implementation. (Vrbová, Cempírek, Stopková, & Bartuška, 2018) Similar implementations therefore entail assessing the viability and feasibility of both the company and its suppliers. Hence, before committing to such an implementation, companies must conduct a thorough evaluation of its potential profitability and its capacity to enhance the company's overall financial performance. This evaluation typically involves utilizing economic methodologies such as discounted cash flow analysis (DCF), return on investment (ROI), and net present value (NPV) to estimate the investment's profitability. According to the mentioned studies, exploring the economic viability of digital solutions such as EDI integration within manufacturing industries, is crucial to ensure profitability of these companies. Hence, having a stable scientific ground that companies and managers can rely on to reevaluate their investment strategies is important for their long-term success. To ensure accurate assessments, reliable methods for predicting the investment cash flows are employed, often through deterministic cash flow forecasting models, which will be further discussed in detail in Chapter 3's methodology section. There is a need to offer insights into the benefits and challenges of digital integration in modern manufacturing practices, aligning with supply chain 4.0 principles. This requires a thorough examination from a financial perspective, providing a nuanced understanding of its impact on cash flow and operational efficiency for all stakeholders involved in the supply chain.

1.2 Research Gap

The existing literature on Industry 4.0 and electronic data interchange (EDI) reveals several gaps in understanding the financial implications and economic viability of integrating digital technologies. While studies such as Govindan et al. (2022) and Frederico et al. (2020) provide valuable insights into the conceptual framework and theoretical constructs of Industry 4.0, they lack empirical validation and detailed analysis of financial aspects, leaving a gap in understanding the profitability considerations for firms. Similarly, Masood & Sonntag (2020) and Hoogeweegen & Wagenaar (1996) highlight the challenges and benefits of digital integration, and Jun & Cai (2003) focus on obstacles to EDI adoption but do not delve into the financial implications of overcoming these barriers, especially in the context of integrating digital order processing systems using Industry 4.0 technology.

Therefore, there is a critical need for research that addresses these gaps by conducting empirical validation and financial analysis, offering practical recommendations for firms to enhance their profitability and decision-making processes in the rapidly evolving industrial landscape. This study aims to fill this gap by conducting a comprehensive analysis of the economic viability and financial effects of integrating digital order processing systems using Industry 4.0 technology within the supply chain of firms. Specifically, the authors will focus on examining the profitability within IT-system investment, emphasizing the external integration of Electronic Data Interchange (EDI) as a key tool.

1.3 Key Concepts

- **Cash flow:** The total amount of money being transferred into and out of a business, especially as affecting liquidity.

- **Discount Rate:** The interest rate used to determine the present value of future cash flows. It reflects the time value of money and the risk associated with the cash flows.

- **Discounted Cash Flow (DCF):** A financial analysis method used to estimate the value of an investment based on its expected future cash flows. The technique involves forecasting the total amount of cash that will be received over the life of the investment and then discounting those cash flows back to their present value using a predetermined discount rate, which reflects the risk and time value of money.

- **EDI (Electronic Data Interchange):** The electronic exchange of business information using a standardized format; a way to automate and streamline transactions.

- **Industry 4.0:** The fourth industrial revolution, characterized by the integration of digital technologies into manufacturing processes.

- **NPV (Net Present Value):** A financial metric evaluating the profitability of an investment, calculated by subtracting the present value of cash outflows from the present value of cash inflows.

- **ROI (Return on Investment):** A performance measure used to evaluate the efficiency or profitability of an investment, calculated by dividing the benefit (return) of an investment by the cost of the investment.

- **Supply Chain 4.0:** The application of Industry 4.0 innovations to supply chain management, enhancing efficiency and transparency.

- **Time Value of Money (TVM):** The principle that a sum of money has greater value now than the same sum will have in the future due to its potential earning capacity. This concept emphasizes that money can earn interest, hence it is more valuable when received earlier.

- **Weighted Average Cost of Capital (WACC):** Is a financial metric that represents the average rate of return a company is expected to pay to its security holders to finance its assets. WACC is commonly used as a discount rate in Discounted Cash Flow (DCF) analysis to calculate the present value of expected future cash flows.

1.4 Problematization

Despite the increasing attention given to Industry 4.0 technologies and digitalization in supply chain management, there remains a significant gap in understanding the economic feasibility of incorporating digital order processing systems, studies have not fully addressed this gap. Furthermore, there doesn't exist a clear way of getting from nothing to a complete and reliable evaluation with IT-investments. Previous studies have either had the cash flow on hand, are looking at the effects on the firm as a whole or forecast the cash flow of the investment without evaluating it. The inconsistencies and lack of cohesion among these studies highlight the need for a reliable investigation that firms can rely on to evaluate and improve their strategic investment decisions.

1.5 Purpose

Despite the growing emphasis on Industry 4.0 technologies and digitalization in supply chain management, there remains a lack of comprehensive analysis regarding the economic viability of integrating digital order processing systems, The purpose of the study is to determine the direct financial effects, assess implementation cash flows, and evaluate the hypothetical economic value of integrating digital order processing systems using historical data in a business to business (B2B) setting. The research aims to fill the gap by providing a framework to be used when evaluating and IT-investment within the firm, especially when not all data is known through the lens of this evaluation. By creating this framework, the thesis contributes to closing the gap by providing a guide to evaluate IT-investment using established methods to give a just valuation. Through a case study (Tetra Pak), the research provides a framework for evaluation IT-investments especially when far from all data is either publicly available or is well documented in financial statements, this thesis therefore aims to answer the research question (RQ):

How can a relevant investment method be practically applied to evaluate the effects of introducing a vertically digitally integrated PO system in a case study setting?

1.6 Delimitation

The research will primarily concentrate on examining and analyzing the profitability of IT investments and along the way, provide a framework of how it can be achieved, with a specific focus on the manufacturing industry through Tetra Pak. The investigation will zoom in on the segment of structured B2B business communication within the supply chain, emphasizing the external integration of Electronic Data Interchange (EDI) as a key tool. The study will leverage principles of supply chain 4.0 to explore the impact of integrating EDI from a financial perspective, with a specific emphasis on cost variables such as money and time. Notably, this study will not delve into the technical implications or other non-financial perspectives of EDI integration. While Tetra Pak will serve as a case study, the data will be limited to a specific timeframe, drawing upon recent similar investments. Specifically, the analysis will encompass data from the past several years, and projections will extend five years into the future. While Tetra Pak will serve as a case study, the data will be limited to a specific timeframe, drawing upon recent similar investments. Specifically, the analysis will encompass data from the past several years, and projections will extend five years into the future.

1.7 Outline

The subsequent sections of this thesis are organized as follows: Section 2 offers an overview of the research topic and theoretical approach through a review of related work and theories. In Section 3, the selection of research methods is explained and justified, accompanied by an assessment of research validity and reliability. Section 4 presents the results and analysis obtained from the interviews. These findings are then contextualized within the relevant theories in Section 5. Lastly, Section 6 concludes the research findings by addressing the research question and proposing recommendations for future research in the field.

2 METHOD

2.1 Research Approach

The study employs a mixed-method approach, combining quantitative and qualitative methodologies to harness the strengths of both. This approach ensures a comprehensive understanding of investment values, relevant costs and benefits, and strategic value (Ghauri et al., 2020). Research question (RQ) focuses on identifying established models and methods for assessing the value of IT-system investments, along with their strengths and weaknesses. A literature review is employed as a foundational method for this purpose. The literature review helps map out the existing academic and industry landscapes regarding financial assessment tools such as NPV, DCF, ROI, cash flow forecasting and cost-benefit analysis. By synthesizing a broad spectrum of literature, the thesis establishes a solid theoretical framework that informs the subsequent application of these models in practical settings. The literature review also aids in identifying gaps in current research, setting the stage for further investigation and innovation in financial evaluation methodologies (Rowley & Slack, 2004).

The data for the research question (RQ) is collected through a case study at Tetra Pak, where semi-structured interviews were performed, complemented by the analysis of financial records. Qualitative data collection through semi-structured interviews allows for an in-depth exploration of the types of costs and benefits associated with an investment in IT solutions that also might have been missed by the documentation of previous implementations, while the financial statements provide the concrete data on costs and benefits during previous implementations and especially fixed costs and benefits. The RQ is then initiated by quantitative methods and the utilization of a C/B-analysis to determine relevant cash in- and outflows and systematically structure them into related and usable variables. The variables will then in turn be used to create mathematical models that can calculate and forecast the cash flows relevant to the implementation (Khosrowshahi & Kaka, 2007). The results of the cash-flows are important since the RQ requires cash-flow results to be answered. The evaluation will be performed by only quantitative means, using relevant financial assessment tools found in the literature review, to determine the implementations total value in the long term (5 years). RQ as mentioned, uses the resulting cash flows and other relevant data such as the WACC, from the quantitative model as its basis relying solely on quantifiable data, the results will also therefore be quantitative and further analyzed in the analysis and discussion section, as will the results from the previous chapters as well. The investment will be determined for suppliers how have greater than 1 000 order lines annually (36) since they represent most of the order lines received, and the WACC will need to be estimated since Tetra Pak is a privately owned firm. The identified route to solve the RQ can be summarized as follows:

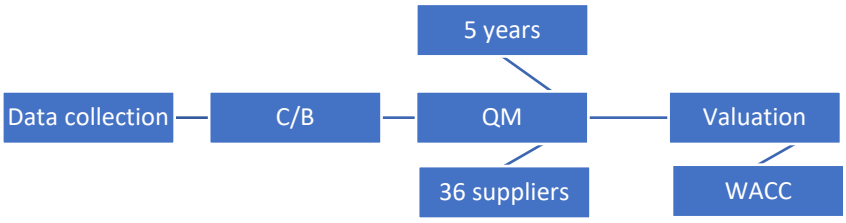

Figure 4. Path to evaluating the investment.

The integration of quantitative and qualitative methods enriches the research by allowing for a more detailed and contextual analysis. Quantitative methods provide the precision necessary for financial calculations and model validation, while qualitative methods offer depth and contextual understanding that quantitative data alone might miss. This mixed-method approach not only broadens the scope of data collection but also enhances the reliability and validity of the findings by corroborating quantitative

data with qualitative insights. Moreover, the combined approach addresses potential limitations associated with each method when used in isolation. While quantitative methods are excellent for structural and replicable analysis, they may overlook subtle qualitative factors such as organizational culture and stakeholder perceptions, which are crucial for the successful integration of technology. Conversely, while qualitative methods provide depth, they often lack the objectivity provided by quantitative analysis (Ghauri et al., 2020). By employing both methodologies, the study mitigates these issues, providing a balanced and comprehensive view that supports informed conclusions (Ghauri et al., 2020). In summary, the research approach can be shortly described by the following flow chart, where blue squares indicate a step using chosen methods, and orange squares are preparations and decisions:

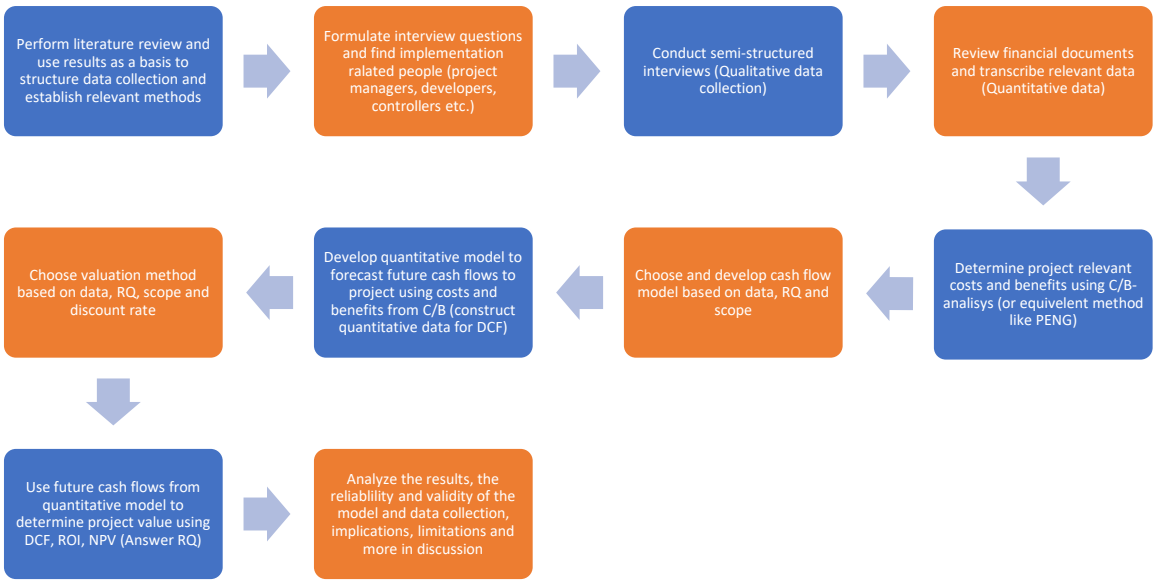

Figure 5. Research approach, step by step, with data collection and methods.

However, there are some limitations to the chosen methodologies as well, one limitation of the quantitative focus is its potential oversimplification of complex dynamics within the organization. For example, the C/B analysis primarily quantifies direct financial metrics such as costs saved or expenses incurred, but it may overlook qualitative aspects like employee acceptance, the impact on customer satisfaction, or changes in internal culture (Bengtsson & Wredenberg, 2008). These factors are crucial for the successful integration of new systems and can significantly influence the long-term viability and effectiveness of the investment. Moreover, the quantitative models used in the study, such as those forecasting future cash flows based on historical financial data, inherently assume a level of stability and predictability in the variables they measure. However, the real-world application of such systems within a dynamic business environment like Tetra Pak's can be unpredictable. Market conditions, technological advancements, and competitive pressures are continually evolving, which can render static models inadequate (Glaum et al., 2018). These models may not adequately account for these changes, potentially leading to inaccurate forecasts and suboptimal financial decision-making. Furthermore, the reliance on historical financial data to predict future performance can be problematic. This approach assumes that past patterns will continue forward. As such, while the quantitative methods provide a structured and replicable framework for assessing financial impacts, they might not fully reflect the economic realities faced by the company post-implementation, potentially skewing the results (Ghauri et al., 2020).

Qualitative methods, such as those used in the study's literature review and semi-structured interviews, offer a complement to quantitative data by providing deeper insights into the tangible and intangible factors affecting investments. These methods help in understanding the nuanced impacts of IT systems on business operations and financial metrics. However, they too have their shortcomings. Literature reviews may suffer from publication bias and are limited by the scope of existing research. Semi-structured interviews may introduce interviewer and interviewee biases, leading to variations in the quality and depth of information that can challenge the synthesis of data across different interviews. Moreover, the insights from case studies, while rich and detailed, may not be generalizable to broader contexts due to their deep focus on specific instances (Ghauri et al., 2020).

2.2 Literature Review

The literature review was utilized to establish knowledge, review previous research, provide a clear background, and develop a methodology. Additionally, it aimed to identify gaps in current research to guide the thesis and establish a clear research approach for this thesis (Torres-Carrión et al., 2018). Since the purpose of the literature review is to gain knowledge about relevant methods to determine the value of an investment, it was frequently evolving through its process. By looking at articles related to the evaluation of an investment, the realization emerged that the cash flow of the investment was needed to establish its value. Thus, the focus shifted to determining and forecasting cash flow, and evaluating in- and outbound cash flows to an investment. The literature review greatly influenced the results by determining a path to solving the research question. For example, changing the inclusion and exclusion criteria could have led to using different evaluation methods or an alternative approach to forecasting cash flow, or disregarding semi-structured interviews as a data collection method in favor of pure quantitative data. Pure quantitative research can miss potential benefits or costs that might not have been properly documented, but it also introduces another point of bias and subjectivity. Therefore, when relying on a literature review to establish the methodology, it is important to remember that there are often multiple ways to solve a problem and not blindly choose the first one. The process of selecting and defining the conditions for selecting primary studies was then outlined, along with the inclusion and exclusion criteria. Inclusion criteria encompassed all requirements for a study to be included, while exclusion criteria identified factors rendering a study ineligible (Rowley & Slack, 2004). The criteria are defined as follows:

Inclusion Criteria:

- **Economic Forecast:** Research on forecasting cash flows or future value that could ascribe some value to a firm, project, or investment.

- **Economical Dynamics and Requirements:** Studies delving into the specific dynamics, practices, costs and benefits, and technological requirements associated with IT system integration in business processes, including implementation, adaptation, and operational transition.

- **Quality of Sources:** Peer-reviewed studies published in reputable journals (e.g., Elsevier, Emerald Insight), or published via universities such as theses to ensure credibility and reliability.

- **Investment Valuation:** Research specifically geared towards determining the value of projects, investments and firms using established financial metrics and evaluation models like NPV, DCF, IRR, and cash flow analysis.

- **Methodological Relevance:** Studies that provide relevant methods, models, or equations applicable to the research question and objectives of this thesis.

Exclusion Criteria:

- **Lack of Empirical Evidence:** Research lacking empirical data support, relying heavily on theoretical models without substantial data or practical application.

- **Highly Speculative Studies:** Studies overly reliant on untested assumptions, estimations, or simulations that do not provide empirically tested results.

- **Non-Peer-Reviewed Sources:** Articles from non-peer-reviewed sources or those lacking sufficient reliability and credibility, for example a reputable journal or a university.

Searches was mostly performed on the institutions data bases (BTH Summon 2.0) as well as the Swedish database for academic publications (DiVA). Textbooks were found either through the institution's library, or previous course literature. On occasions, where selection was too scarce, google scholar was used but ensuring high quality by picking reputable authors from different course literature, published by other institutions, or published by reputable journals, like Elsevier, emerald insight and more. The selection and synthesis process are straight forward. Articles were searched for by using key words related to valuation like "cash flow", "DCF", "project valuation" and studies of implementation of digital systems, they in turn lead to further key words, like DCF which in turn again led to cash flow and so on. The selection process followed the inclusion- and exclusion criteria described above, no regards was taken to date of publications. The synthesis process consisted of summarizing the selected articles related to the different methods and concepts that would be needed to understand and use to answer the RQ, it was synthesized and structured with regards to the inclusion and exclusion critera.

Any literature review is fraught with certain reliability issues that may affect the results. Selection bias, for example, occurs when the studies included in the review are not representative of all available research. This can happen if the inclusion criteria are too restrictive or if certain types of studies are preferentially included. For example, the use of strict quality criteria may exclude valuable studies that could provide different perspectives or additional insights. Research indicates that dual review processes and iterative refinement of criteria can help reduce selection bias, though these methods can be time-consuming (Pérez et al., 2020). Database bias arises when the databases used for the literature search do not cover all relevant studies. Many databases prioritize English-language publications, which can lead to the exclusion of significant research published in other languages. This type of bias can result in the omission or underrepresentation of relevant literature, skewing the findings (Jacobsen, 2011). The criteria for including or excluding studies in a review can significantly influence the outcomes. For instance, excluding non-peer-reviewed sources or studies lacking empirical evidence may lead to the exclusion of useful data and perspectives (King et al., 2020). On the other hand, including only studies that show significant results can lead to publication bias, where studies with null or negative results are underrepresented. Publication bias occurs when the likelihood of a study being published is influenced by its results. Studies with significant or positive findings are more likely to be published and cited, while studies with null or negative results may remain unpublished or be published in less accessible sources. This can lead to an overestimation of the effects being studied (Lin & Chu, 2018; Ziai et al., 2017).

2.3 Empirical Methods

2.3.1 Determining Implementation Cash Flows

According to Sakthivel (2023), in the context of business software investments, a comprehensive cost-benefit (C/B) analysis begins with a detailed identification of costs which are divided into one-time and recurring categories, as well as tangible and intangible respectively for both. The thesis will only focus on the tangible costs/benefits since they are most reliable when viewing the economic aspect, this division also helps in understanding the initial and ongoing financial commitments associated with the implementation. The C/B analysis is useful since it is one of few methods that provide some framework to determine relevant costs and benefits towards an investment, with a division of one time and reoccurring, this idea of what type of costs that might be relevant to the work was applied to the cost structure can be segmented into the following:

- **One-time costs** may include acquisition, installation, customization, and initial training expenses. These are directly traceable and often termed as 'sunk costs' which do not recur beyond the initial phase of implementation.

- **Recurring costs** represent ongoing operational and maintenance expenses. These include regular updates, support services, and infrastructure maintenance costs which are essential for the continued functionality and optimization of the software.

- **One-time benefits** may include immediate efficiencies gained upon deployment or specific gains from a one-time use scenario of the software.

- **Recurring benefits** These include efficiency improvements, cost savings from operational improvements, and strategic advantages accrued over time. Recurring benefits should be forecasted based on realistic expectations of system performance and market conditions, considering the strategic alignment with business objectives.

For the remainder of the thesis one-time costs and benefits will be referred to fixed costs (FC) and benefits (FB), encompassing costs and benefits that only incur once and are not dependent on any scalability. Recurring costs and benefits will be referred to as variable costs (VC) and benefits (VB) and these will include costs and benefits that are dependent on other variables such as time or number of suppliers. Given the framework for identifying and quantifying relevant costs and benefits to the implementation, the chosen data collection methods are semi structured interviews and financial statements from the case study, which will be discussed later, and segregate the costs and benefits as either variable or fixed and either pre- or post-implementation. The figure below illustrates were different costs and benefits were gathered from, most of them in the form of time (labor) since that is what is most relevant when there are no hardware or other physical costs as per Zurong and Feng (2018), assessment:

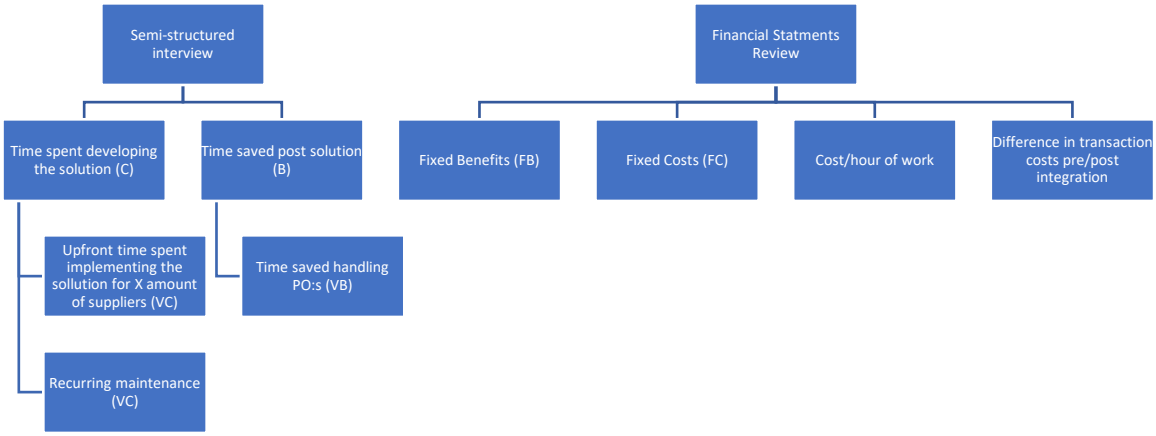

Figure 6. Chosen data collection methods in conjunction with C/B-analysis to determine and attribute relevant costs and benefits to the system.

The usage of a C/B analysis to determine what costs and benefits are relevant to the cash flow analysis of the investment will greatly impact the final evaluation of the investment. C/B analysis often struggles to quantify intangible benefits such as improved customer satisfaction, brand reputation, employee morale, or cultural alignment. This can lead to an underestimation of the benefits' true value, especially if these intangible factors play a significant role in the overall success of the investment, thus making the cash flows less significant than they might be. Other models that rely more on the intangible like PENG for example can be used in these circumstances to quantify and account for "soft benefits" which can amount to a substantial part of the overall benefits but were discarded for their lack of empirical reliability (Bengtsson & Wredenberg, 2008). Even though PENG gives a framework to evaluate the benefits empirically, this introduces yet another step of evaluator judgment and subjectivity which may hurt the reliability of the evaluation by overvaluing the cash flows in the results. C/B also rely heavily on the judgment of the evaluator for what is considered relevant or not or what is fixed or variable and since all cash-flow based evaluation methods such as DCF and NPV rely on a cash flow to work, it can significantly change the investments value based on evaluators subjectivity. Standard C/B analysis also may not adequately account for the uncertainty and risks associated with future projections.

Despite these limitations, C/B analysis remains a good tool, particularly when the focus is on 'hard numbers' or tangible outcomes. In scenarios like ours, where tangible costs and benefits are predominant, C/B analysis offers a clear, structured methodology for evaluating economic viability and making informed decisions. By providing a quantifiable framework, C/B analysis helps ensure that financial decisions are grounded in empirical data and projections, making it especially suitable for projects where financial impact is a critical measure of success. It's also important for the RQ to have concrete numbers for the empirical analysis with the models and equations thus rendering it hard to quantify data not applicable.

2.3.2 Deterministic Cash Flow Forecasting Model

Adopting a Deterministic Financial Forecasting Model proves effective when answering the RQ, especially in the context of the case study as well since it relies on historical data. This model is important in forecasting future cash flows, a process used by both Mioduchowska-Jaroszewicza (2022) and Navon (1996) to estimate future cash flows using deterministic quantitative models which is a necessity to have for evaluation methods used in the final step. A big part of forecasting cash flows was outlined by Glaum et al., (2018), is accurately determining implementation cash in- and outflows, the paper also utilizes semi-structured interviews for data collection. The purpose of the quantitative model is to use costs and benefits from the previous chapter to compute net cash flow. To attribute the correct cost and benefit, from the C/B and feed them to the model, the following structure was used:

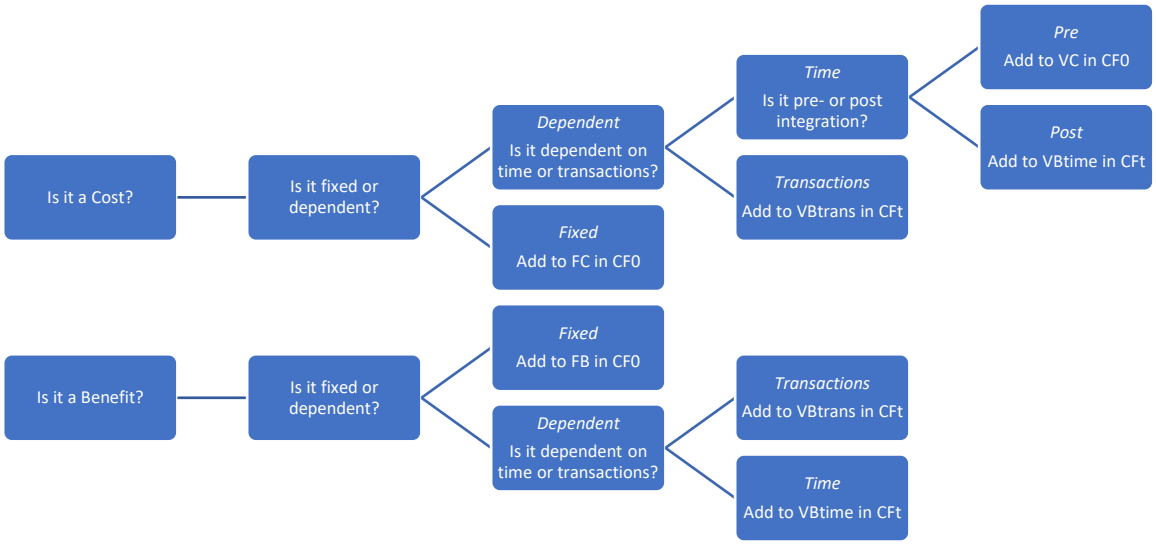

Figure 7. Identifying and quantifying variables to be introduced to the quantitative model.

Estimating and profiling the variables and the equations was performed by experience, the knowledge of related works found in the literature review, the general structure outlined in a C/B-analysis, and consultation with Tetra Pak. The deterministic financial model operates under fixed assumptions to project future cash flows. By setting specific, pre-defined inputs based on historical data and estimations from the case study, this model systematically predicts financial outcomes without the variability and uncertainty typically associated with statistical models. It also provides a clear path for calculating projected financial outcomes, allowing for straightforward validation. Its structure ensures that all relevant financial factors are meticulously accounted for, laying a foundation for financial analyses like Net Present Value (NPV) or Discounted Cash Flow (DCF). The initial investment costs equation applied in this paper is:

$$CF_0 = \sum FB - \sum FC - (\sum VC) * \frac{cost}{hour} * suppliers \quad (1)$$

FB Includes benefits such as removing outdated software, quantified in monetary terms. FC are costs associated with implementing solutions like Ariba, calculated as negative impacts. VC Represents the variable time costs, calculated as the total hours spent on implementation multiplied by the cost per hour, like development time for example, multiplied by the number of suppliers that are being implemented. For each year that succeeds the initial rollout, the cash flow can be computed as follows:

$$CF_t = VBtime + VBtrans \quad (2)$$

Where:

$$VBtime = \left((\sum time\ saved - \sum time\ spent) * \frac{cost}{hour} \right) * t * No.\ order\ lines\ affected \quad (2.1)$$

$$VBtrans = (Transaction\ cost\ pre - Transaction\ cost\ post) * No. transactions \quad (2.2)$$

VBtime represents the net time savings adjusted for maintenance and corrections, calculated in monetary terms for a period t. VBtrans captures the net savings from transaction costs, reflecting the difference between pre- and post-implementation costs per transaction.

A primary characteristic of deterministic models is the assumption of uniform cash flows throughout the analysis period. This can lead to a significant limitation in the accuracy of NPV and DCF analyses. The assumption that cash inflows and outflows will remain constant disregards the potential fluctuations due to market conditions, operational changes, or unforeseen expenses. As a result, the projected NPV and DCF may not accurately reflect the true financial health and potential risks associated with the investment (Groenendaal, 1998). Unlike probabilistic models, deterministic models do not incorporate the probability distributions of various financial inputs, such as costs, revenues, and interest rates. This exclusion means that the model cannot simulate different scenarios that reflect potential variances in these inputs. Consequently, the deterministic NPV and DCF calculations may not capture the range of possible outcomes, including worst-case or best-case scenarios, which are crucial for a comprehensive risk assessment (Laurikka, 2006). The deterministic approach provides a single-point estimate of NPV and DCF, which can be misleading for decision-makers. This single-point estimate might present an overly optimistic or pessimistic view depending on the initial assumptions. For instance, if the model assumes constant revenue growth without considering market downturns, the resulting NPV will likely be inflated. This misrepresentation can lead to suboptimal investment decisions, as the model does not provide a comprehensive view of potential risks and uncertainties (Zhao et al., 2016). In this instance, the model is strictly cost of time related for VC and VBtime and complimented by potential transactional benefits via VBtrans. Therefore, the results will be limited to a mix of time costs and transactional cost savings, and no other efficiencies or costs will affect the results. Furthermore, the variable costs are only viewed as time spent implementing one supplier and thus, the VC are also limited to time costs and will be the only variable affecting the result. FB and FC are the hardest variables to determine what is included before the case study is performed, in general it would be related mostly to agreement costs such as cancellation of old software would be considered FB and either developing or purchasing the IT-solution would be a FC, depending on case specific variables and if fixed costs and benefits are included or not, these variables will most likely affect the results the most. The model considers mostly cost of time which is the most prominent cost as identified by Zurong and Feng (2018) when excluding hardware related purchase and maintenance costs as these will not affect Tetra Pak.

A significant drawback of deterministic models is their heavy reliance on the accuracy of initial assumptions. Since the model does not account for variability in data, any errors in these assumptions can significantly impact the projections. This reliance makes deterministic models less flexible and potentially less accurate in predicting future financial outcomes if the input assumptions are not validated. Unlike models that incorporate statistical variance and probability, deterministic models do not adapt well to unforeseen changes in market conditions or internal company dynamics (Radhwan et al., 2015). This can result in significant differences between projected and actual outcomes, making it challenging to use deterministic models in environments where business conditions are volatile or rapidly evolving. This inflexibility can hinder the model's ability to provide reliable forecasts in uncertain or rapidly changing environments, examples of models that can account for these changes are probabilistic and may include a probability tree or alike to account for uncertainty (Krzysztofowicz, 1999). In the scope of this thesis, including such a tree would be far too much work given the scope of the thesis, requiring a substantial change in research question, data collection, research approach and most importantly, narrowing of scope. Therefore, probabilistic methods were discarded, but are highly

encouraged if accurate data exists and the scope is narrower. As with any model, they are subject to evaluator bias of what is included. Even probabilistic models have this problem since the evaluator might miss an important variable in the model or might not run the necessary statistical checks to ensure model reliability, making it less applicable or statistically insignificant. Deterministic models suffer from bias too, arguably more since it cannot be statistically tested, but since the dependencies are also clearer, it can be easier to verify its reliability (Fuente-Mella et al., 2015).

2.3.3 Investment Valuation

In assessing the financial viability of the RQ, the methodology incorporates several established financial evaluation techniques, namely Discounted Cash Flow (DCF), Return on Investment (ROI) and Net Present Value (NPV). These methods, grounded in financial theory and widely recognized for their robustness, provide a multi-faceted approach to understanding the economic implications of investment. The resulting cash flow from the previous chapter will be used to calculate the DCF which will be perceived as the total investment value and therefore used in ROI and NPV to get a value related to the initial investment cost (VC). To calculate DCF with the cash flow, they must be discounted using the WACC which will need to be estimated since Tetra Pak is a private firm.

2.3.3.1 Discounted Cash Flow (DCF) & Weighted Average Cost of Capital (WACC)

DCF is useful for evaluating the profitability of investments by projecting future cash flows and discounting them to their present value, which accounts for the time value of money, emphasizing the need for a nuanced approach to understanding financial outcomes over time. DCF involves estimating the expected cash flows from the integration of the digital PO system over its useful life and discounting these flows at a predetermined rate that reflects the risk profile of the implementation. This approach can be used to estimate the total value created by the implementation (Phillip J. Lederer & Tushar D. Mehta, 2005). The equation is described as follows (Damodaran, 2012):

$$DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n} \quad (3)$$

Were CF_i is the cash flow for period i, r is the discount rate for the firm and n is the number of years before future cash flows occur, resulting in a summation of yearly cash flows to period n in the form of currency, a result where DCF > 0 is therefore considered good. The precision of DCF calculations depends heavily on the accuracy of the estimated cash flows and the discount rate. Incorrect estimates can lead to significant errors in valuation, as highlighted by Hodder's critique of DCF methods in evaluating long-term implementations (Hodder, 1986). The discount rate is a way to determine the present value of future cash flows by serving as an interest rate and is often described by a firm's weighted average cost of capital (WACC). WACC in turn, can be calculated as (Damodaran, 2012):

$$WACC = \frac{E}{V} * Re + \frac{D}{V} * Rd * (1 - Tc) \quad (4)$$

Where $\frac{E}{V}$ is the percentage of equity, $\frac{D}{V}$ is the percentage of debt, Re the cost of equity in percent, Rd the cost of debt in percent, and Tc the corporate tax rate. Re can be calculated as:

$$Re = Rf + \beta * (Rm - Rf) \quad (4.1)$$

Where Rf is the risk-free rate, β is the measure of volatility compared to the market and Rm-Rf the market risk premium. Rd on the other hand is calculated as:

$$Rd = \frac{Total\ intrest\ expense}{Total\ debt} \quad (4.2)$$

The WACC can be difficult to calculate for a public firm, and almost impossible to calculate for a private firm like Tetra Pak where a lot of the required input data is not disclosed or not applicable in the case of beta since Tetra Pak isn't subject to stock market volatility. Thus, some assumptions may have to be made if a discount rate is not obtained during data collection, although the assumptions will be clearly stated. A reasonable WACC to assume for Tetra Pak could be 5.7 % as calculated by Markauskas and Saboniene (2020) for the same sector that Tetra Pak operates in (C17), but with Lithuanian firms, however WACC usually falls between 6-12 % and the greater the WACC the greater the discount per year and gives thus a lesser valuation so this is on the lower side and a higher WACC is definitely possible to consider.

2.3.3.2 Return on Investment (ROI)

ROI measures the efficiency of an investment by comparing its net benefits to its costs. It provides a straightforward metric that can be easily communicated to stakeholders. ROI is calculated by dividing the total net benefits (i.e., cost savings and efficiency gains from the digital PO system) by the total investment costs. This ratio provides a direct measure of the return per dollar invested (Hodder, 1986). The equation is defined as a ration between return and cost, like return on capital or return on asset, described as follows: (Damodaran, 2012):

$$ROI = \frac{Net\ Return}{Cost\ of\ Investment} \tag{5}$$

Were net return being the net return of the investment and the cost of investment is the total cost of the investment, both measured in currency. ROI does, however, not consider the time value of money and may oversimplify complex investment decisions, especially where benefits accrue over different time periods. There is no definitive answer on what is considered "good" but generally, a resulting ROI of 10 % (1.10) is considered worthwhile.

2.3.3.3 Net Present Value (NPV)

NPV builds on the DCF method by summarizing the net benefits of an implementation. It represents the difference between the present value of cash inflows and outflows. NPV is calculated by discounting the projected cash inflows and outflows at a rate that reflects the opportunity cost of capital. A positive NPV will indicate that the implementation is expected to generate value over and above its costs (Jenkins et al., 2011). The equation is defined as (Damodaran, 2012):

$$NPV = -Initial\ investment\ costs + \frac{R_t}{(1+r)^t} = DCF - Initial\ investment\ costs \tag{6}$$

Were R_t is the net cash flow at period t and r is the discount rate for the firm. NPV, like DCF, is sensitive to the discount rate used and the estimated future cash flows, which can vary based on external economic conditions and internal risk assessments. NPV gives a result in units of currency and a resulting NPV > 0 is considered a good investment.

The choice of evaluation method greatly affects the result and thus the answer to the RQ. DCF gives a total value for the lifetime of the project in monetary terms, NPV gives the net value after initial investment costs are subtracted and ROI gives a percentage of project value relative to the initial investment cost (Broomhead & Mars, 2012). Using alternative methods to evaluate the investment such as IRR, ROA or by looking at the firm level with CAPM or CCA will have different results. For example, a large firm like Tetra Pak would likely not be impacted so much by one single investment of a couple of million, compared to their billions in revenue. Furthermore, Tetra Pak is at its core, a manufacturing firm, thus benefiting mostly from increased production to meet its economies of scale optimal outputs. Costs savings like what's purposed by this thesis are important, but since they aren't directly linked to the main income of the firm, they are unlikely to give a substantial impact on over all enterprise value

and thus, CAPM or CCA are less applicable as a result to the RQ. However, even though the chosen methods are very applicable to basically any investment, they rely heavily on the cash flow estimation to the investment and the firm specific WACC or discount rate, giving very different results and conclusions based on these inputs to the methods (Jenkins et al., 2011). This is further compounded as an external observer since not all variables are known and firm specific information, especially for a private firm like Tetra Pak, like WACC may need to be estimated, which will have a great effect on the evaluation.

While DCF, ROI, and NPV are standardized, they are not without limitations. As mentioned, both DCF and NPV are highly sensitive to the assumptions regarding cash flows and discount rates, misestimations can skew the projected value of the investment, leading to potentially flawed decision-making. Also, ROI in its standard form does not account for the time value of money, potentially oversimplifying the return on complex investments where benefits accrue over different periods. Some alternative methods include Internal Rate of Return (IRR) and Real Options Analysis (ROA) (Duwe & Rocque, 2017). While IRR could also be used to assess the profitability of the implementation, it has its limitations, such as multiple or no IRRs for implementations with alternating cash flows, which can lead to ambiguity in decision-making. ROA could provide a valuation of future strategic options but requires complex modeling and may not be as straightforward and applicable as DCF or NPV to the research question (Baker et al., 2008).

2.4 Data collection

2.4.1 Case Study

A case study methodology involves an in-depth exploration of a specific phenomenon within its real-life context. Case studies may be an inductive approach and is therefore especially suited to research that aims to uncover the nuanced dynamics of financial investments in technology, where the impact extends beyond numbers to influence organizational strategy, operations, and competitive positioning (Ghauri et al., 2020, Chapter 7). Given the purpose of evaluating the financial viability, cost structures, and benefits associated with digital PO systems, a case study methodology allows for a comprehensive examination of the tangible aspects of such an investment. The purpose of the case study regarding the research question is to gather specific, real-world data about costs and benefits from a previous iteration of an implementation of an IT-investment. The data can be used to make assumptions of future iterations and provide a framework for what types of costs can be relevant to an IT-investment, how to collect and use them to create a good analysis and what conclusions can be drawn from the results. A case study therefore a good way to collect data since it facilitates multiple ways to collect data and different ways to do so. The usage of semi-structured interview will go into greater detail on the next chapter, and reviewing the financial documentation Tetra Pak did of previous iterations to give a deep, yet concrete analysis of the relevant costs and benefits to the implementation (Ghauri et al., 2020, Chapter 7). The case study, therefore, focuses on collecting primary data from the previous iteration of the implementation through semi-structured interviews and reviewing financial documentation. There were 3 iterations that where analyzed, they were performed from 2020-2024 in different countries such as Sweden and China. The case study is restricted to studying the entire process of the implementation apart from the development of the solution, thus, the “implementation” being analyzed is from initial contact with suppliers until its fully implemented and initial maintenance have been completed. The data collected was mostly fixed costs and benefits as well as the cost and benefit/hour that had been documented. Given that the costs and benefits applied in the cash flow forecast are case specific to Tetra Pak, it is important to note that the models developed and relevant in and outflows of cash are case specific. Furthermore, other inputs such as discount rate, number of suppliers, cost per hour and so on are also specific to Tetra Pak. This further justifies the usage of a case study method since even though the overarching methodology and RQ may be generalized and applied outside of Tetra Pak, the results, discussion, and conclusions are deeply dependent on primary data from Tetra Pak and should not be generalized to interpret potential benefits of other IT-investments outside of the specific environment.

While the case study methodology offers a detailed and context-rich view, there are inherent limitations that may hinder its effectiveness in answering the research question. One significant drawback is the potential for limited generalizability of the findings. Case studies typically focus on a single organization or a very small number of entities, which can provide deep insights into specific instances but may not necessarily be applicable to other contexts or settings. For instance, the financial impacts observed at Tetra Pak may be influenced by unique factors such as its corporate culture, market position, or specific operational practices, negotiation power, discounts, which are not representative of other companies or industries. Moreover, case studies can be subject to researcher bias, where the investigator's subjective interpretation of the data could influence the analysis and outcomes. This subjectivity can lead to conclusions that reflect the researcher's preconceived notions or expectations rather than the data itself, potentially skewing the research results. (Ghauri et al., 2020, Chapter 7)

2.4.2 Semi-structured interviews

Quantitative data was also gathered through semi-structured interviews and complimented with financial records from Tetra Pak to conduct regression and empirical analyses, aiming to quantify the direct financial impact of digital order processing integration, with a focus on investment costs and benefits. The case study documenting the implementation of vertical integration of the supply chain in industrial was examined (Guan & Rehme, 2012), providing contextual insights and highlighting practical challenges and successes encountered by firms. Furthermore, internal data from participating firms was analyzed, focusing on order processing times, costs, and efficiency pre- and post-integration. These steps were crucial to incorporate real data into models to determine the investment's value. Quantitative methods also facilitate the generation of statistically significant findings, enhancing the credibility and reliability of the research outcomes (Ghauri et al., 2020).

The purpose of the semi-structured interviews is to gather relevant costs and benefits resulting of the integration, specifically in the unit of time. Fixed costs and cost/hour and alike costs with currency were available in financial documentation. However, time spent and then gained is harder to document, thus, the interviews provide a structured approach to highlight time spent by people how actually spent it. Moreover, it gave the ability to view time spent and gained through different iterations, with different people, allowing triangulation and providing a reasonable interval of how long it might take and what might be gained. The interviews are therefore mostly a way to collect data about time but are purposely open-ended in case the interviewee had something to share that was not documented. This data serves as the basis for answering RQ and by association, RQ. An interview guide was prepared that was used as a basis when conducting the semi structured interviews with relevant implementation managers and implementation implementers. The questions were purposely open-ended to facilitate discussion and were subject to unstructured follow-up questions (Danielson, 2017, Chapter 9). The guide was structured as follows:

Table 1: *Interview guide for semi structured interviews regarding time associated with the implementation.*

Topic Area	**Questions**
Time costs with implementing the implementation	How many meetings did you have to attend to set up the implementation and how long were they? in hours
	How much time did you have to spend yourself to implement the given requirements? in hours
	Did you have to change the fundamental software to meet the requirements, if so, how many hours did you spend?
Time costs with maintaining the implementation	Did you have to spend any additional time maintaining the new solution that you didn't have to spend before? in hours
	How much time do you spend troubleshooting and post implementation? In hours
Time benefits post integration	What is the difference of handling PO: s if you compare pre- and post-implementation? In hours
	Are there aspects that take longer post implementation? If so, how much? In hours
	Are there still benefits yet to be captured post implementation? If so, what are they and how much effect would you assume them to have? In hours

The questions were formulated after the literature review was conducted to ask appropriate questions and especially follow-up questions. It's important for the interviewer to be well rehearsed in the topic to gather the necessary information in a short time span (Ghauri et al., 2020, Chapter 7). Thus, the focus was mostly on time-related questions since the associated cost of time would be given as a financial statement. The interviews were recorded with consent and later, relevant answers were transcribed into the results. Not all follow-up questions and answers will be presented with respect to the individuals and Tetra Pak as a competitor. While pure qualitative methods have their merits, they are not suitable for research objectives. Qualitative approaches, such as unstructured interviews or focus groups, prioritize exploring subjective experiences and perspectives (Ghauri et al., 2020, Chapter 8). While valuable for generating in-depth understanding and exploring nuances, qualitative methods lack the precision and replicability required for the quantitative analysis. Moreover, qualitative methods may be more time-consuming and resource intensive, they also lack precision which is required to answer the research question. Since semi-structured interviews are a big part of the data collection, potential interviewee bias and or poor interviewee selection may greatly affect the results that are based on the data collected. Trying to mitigate these potentials as much as possible through triangulation of interview answers, comparing them to what was documented in the case study and sending the results back to Tetra Pak for analysis before publishing to correct any misinterpretation, but some data may inevitably be lost with time and human error.

2.5 Reliability & Validity

2.5.1 Reliability

Reliability refers to the consistency and repeatability of the research methods and outcomes. It ensures that if the study were replicated under similar conditions, it would yield comparable results. The data collection involves semi-structured interviews and reviews of financial documents at Tetra Pak. To enhance reliability, the interview process was standardized using a guide, which helps maintain consistency across all interviews. This approach minimizes variance in data collection and ensures that

differences in findings are due to genuine differences among participants and not discrepancies in how data is gathered. For financial data, consistent procedures were employed for analyzing financial records, ensuring that the quantitative analysis is repeatable by other researchers with similar data sets, the document has also been shared with Tetra Pak on numerous occasions that have caught misunderstandings that have been corrected. The deterministic model used for forecasting cash flows is based on fixed inputs derived from both empirical data and expert estimates. To ensure reliability, the model's parameters are clearly defined, and the calculations are transparent and reproducible. Studies such as those by Guetterman et al. (2017) emphasize the importance of clearly defined parameters and transparent calculations to ensure the reliability of mixed methods research. Despite the efforts, potential limitations exist:

- **Interview Bias:** Despite partial standardization, interviews may still reflect subjective biases of respondents. Mitigate this by using multiple interviewers and cross-verifying responses.
- **Model Assumptions:** Changes in the external business or technological environment could impact the assumptions used in the deterministic model. It is recommended to update assumptions based on the latest market and case-specific data.

Furthermore, the reliability of evaluation methods such as NPV, DCF, and ROI is critical. According to Duwe and Rocque (2017), ensuring consistent data input and a clear methodology in financial evaluations significantly enhances the reliability of ROI calculations in various contexts. Additionally, consistent and accurate use of discount rates and cash flow estimations in DCF and NPV calculations helps maintain the reliability of these methods.

2.5.2 Validity

Validity refers to the accuracy of the findings in reflecting the real-world phenomena they are intended to represent. It ensures that the methods, approaches, and data are suitable for addressing the research question. The validity of the literature review is ensured by adhering to a methodological framework that defines explicit inclusion and exclusion criteria. This approach helps mitigate bias and enhances the comprehensiveness of the literature coverage. The literature review findings are used to underpin the theoretical foundation of the case study, ensuring that the application of financial assessment models is grounded in well-established scholarly research. Qualitative data from semi-structured interviews and the case study are enhanced by triangulating these data sources with quantitative findings from financial analyses. This mixed-methods approach allows for a more comprehensive understanding. By correlating qualitative insights with quantitative outcomes, validating hypotheses derived from theoretical models against actual operational data, enhancing the empirical grounding of the conclusions. According to McKim (2017), the integration of qualitative and quantitative methods enriches the validity of mixed methods research by providing deeper insights and confirming findings across different data sources. The validity of the quantitative model is critically dependent on the accuracy of the input data and the assumptions underlying the model. Ensure this by basing the inputs on verified financial records and corroborated estimates from subject matter experts. Furthermore, the model's assumptions are continually reviewed against industry standards and empirical data to ensure they remain relevant and realistic. Varlik et al. (2021) highlight the importance of ongoing validation and review of assumptions to maintain the validity of quantitative models in mixed methods research. Moreover, the validity of NPV, DCF, and ROI as financial evaluation methods depends heavily on the accuracy of cash flow projections and the selection of appropriate discount rates. According to a study on investment evaluation methods, accurate and reliable input data are crucial for the validity of these financial models, as misestimations can lead to significant deviations in the evaluation outcomes (Glaum et al., 2018).

3 RESULTS

3.1 Results of Literature Review

The literature was gathered through credible sources, articles were found though the institutions database (BTH Summon 2.0), theses were found trough the Swedish national database for theses (DiVA) and textbooks were found through the institution library, or previous course literature. Occasionally, when selection of articles was too limited from summon, the authors resorted to google scholar but ensured high quality by only selecting articles from reputable journals that are also common in summon like Elsevier, Emerald Insight and alike and making sure all articles have been peer reviewed. Regarding the search process, some key words were used from the project plan such as "investment valuation", "project evaluation", "IT-investment" and various combination of the words, a realization after reading a couple was that estimating cash flow would be a necessity and thus "cash flow", "discount rate" and "WACC" was also added as a key word. Since the purpose of the thesis isn't to provide a systematic literature review of the methods, RQ and the literature review serves more as a guide to understand how one can approach the purpose, the focus is ultimately to apply these methods in a case study and provide a framework to economically evaluate IT-investments between a firm and its suppliers, especially when not all variables are known, documented or quantified. This is important since search blocks with clear information on what was searched, how many results it got, where it was searched, what time-period was chosen, what articles were chosen and why, was never performed. Furthermore, the selection process didn't follow any strict guidelines, more than if the literature provided relevant methods, models or equations for the research question and purpose, thus, the literature review only contains relevant articles to the research question regarding methods and models. The literature doesn't encompass all literature used in the thesis since some literature serves as a method guide for theses, in the textbooks case, and some provide only an equation or a statistic and so on, thus, not directly relevant to the research question. The articles that were chosen were categorized into topic areas that correspond to the inclusion and exclusion criteria in the method.

3.1.1 Investment Valuation Methods

This section focuses on establishing methods and models that can determine the value of a firm, project, asset and so on. Some methods mentioned include NPV, DCF, ROI, ROA and CAPM, with time value of money being the most applied method and the most versatile, being used both for projects and firms. Time value of money refers to discounting the future expected value and are thus mostly liked to methods such as NPV and DCF, these are also very often applied to other theses with the aim of establishing the financial value of something. This section ends with a summary of how other theses approach a similar problem regarding valuation.

3.1.1.1 Investment Valuation

The article by Hodder (1986), explores the differences in investment evaluation techniques between U.S. and Japanese firms, focusing on manufacturing investments. Hodder delves into the criticisms leveled against the Discounted Cash Flow (DCF) methods like Net Present Value (NPV) and Internal Rate of Return (IRR), which are often cited for being conceptually flawed and biased against long-term projects. Despite these criticisms, Hodder and Riggs argue that while misapplications of DCF techniques exist, the techniques themselves are conceptually sound and valuable analytical tools. Japanese firms, according to Hodder, seldom employ DCF techniques such as NPV or IRR in evaluating investments. Instead, they tend to assess a project's profitability based on cash flow projections that include imputed interest charges on the investment, effectively incorporating the time value of money. Hodder presents two main approaches observed in Japanese firms: detailed year-by-year projections and simplified one-year Return on Investment (ROI) calculations. These techniques, while not as sophisticated as DCF

methods, still account for the time value of money. Moreover, some Japanese practices are equivalent to or approximations of DCF techniques, suggesting that the key issue might not be the sophistication of the processing technique but how the technique is employed and the quality of input assumptions. U.S. firms, on the other hand, have seen a significant growth in the use of DCF techniques over the years. Despite their dominance, these techniques are often used in conjunction with other methods such as payback or ROI. Risk-adjusted discount rates are common in U.S. firms, but Hodder highlights the potential for misuse and the difficulties in accurately assessing project risks. The Japanese practice of using a low discount or interest rate for all projects avoids these issues and may explain the greater willingness of Japanese firms to undertake risky projects.

Jenkins, Harberger, and Kuo (2011), provide a comprehensive guide to applying cost-benefit analysis in investment decisions, emphasizing the economic opportunity cost of capital. It explains why the economic cost of capital is crucial for evaluating long-term investment projects, advocating for a discount rate that reflects the economic opportunity cost of capital for the country. The methodology presented focuses on maximizing the potential economic net present value (NPV) of projects by carefully selecting the project's scale, timing, and technology. It argues that the discount rate, used to calculate the economic NPV, should be the economic opportunity cost of capital, ensuring that the project generates a higher return than the resources could have achieved if invested elsewhere in the economy. The article also discusses different methods for choosing discount rates for public sector project evaluation, advocating for a weighted average of the marginal productivity of capital in the private sector and the rate of time preference for consumption. This method helps in ensuring that funds are optimally allocated between the public and private sectors. This systematic and detailed approach to determining the value of investment projects within firms is directly relevant to the thesis on the importance of investing in digital firm infrastructure. It underscores the necessity of a rigorous analysis to ensure that such investments not only yield a positive net present value but also contribute to a firm's competitive edge in the digital era.

In contrast, Lederer and Tushar (2005) examine the impact of financial risk on the economic evaluation of projects, particularly those involving decisions about capacity. The study underscores the significance of considering the scale of a project in relation to its financial risk, as increased scale not only affects the upfront investment, operating costs, and constraints on output but also influences the financial risk of the project through its effect on operating leverage. The authors highlight how traditional discounted cash flow (DCF) analysis might lead to suboptimal decisions by not accounting for the relationship between project scale and risk. By employing the Capital Asset Pricing Model (CAPM) for risk adjustment, their analysis reveals that project risk, as measured by the required rate of return, is inversely related to the expected profit per unit sold. Moreover, the research shows that project risk varies with the scale choice, contradicting the common practice in DCF analysis of using a fixed, prescribed rate to evaluate projects and choose their scale. The article illustrates the consequences of neglecting the endogenous nature of financial risk in projects where risk is inherently linked to project design. By analyzing the decision problem of a firm facing uncertain future market prices, Lederer and Mehta emphasize the importance of incorporating financial risk considerations into capacity planning and technology investment decisions to avoid misestimating project value and choosing suboptimal capacities.

Ekström and Björnsson (2003) on the other hand, focus on the importance of strategic flexibility when investing in IT applications within the Architecture/Engineering/Construction (AEC) sector. Traditional financial models like discounted cash flow (DCF) do not fully capture the value of managerial flexibility inherent in IT investments, which can adapt and evolve as business and technological landscapes change. The authors argue for the use of probabilistic models, such as real options and decision analysis, to explicitly model risks and quantify the value of flexibility in monetary terms. In the realm of AEC, where project outcomes heavily depend on the coordination and performance of various external parties, the adoption of IT technologies can be fraught with uncertainty, particularly concerning user adoption. Real options analysis is highlighted as a potent method for quantifying the value of future investment opportunities or "flexibility," tied to initial IT investments. However, its application is mainly suitable for modeling external risks, like market changes or technology adoption rates by external parties, as it

requires linking the investment to an underlying traded asset. For internal risks, such as the feasibility of technical implementation or internal adoption rates, the decision analysis approach is more appropriate. This method, which doesn't need an underlying traded asset, relies on the decision-makers' estimates of subjective probabilities, and can adapt to the nuanced and often internal risks associated with IT projects in the AEC sector.

The paper provides case studies to illustrate how these methodologies can be applied. For instance, the decision to invest in an ERP system with the potential for future expansion through additional applications is analyzed using a real options model. This approach quantifies the value of having the option to expand the system as external adoption rates and technological landscapes evolve. Another case study uses decision analysis to evaluate the worth of a pilot project aimed at implementing a new IT system, focusing on the value of the information that the pilot project would provide about the feasibility and potential adoption of the system on a larger scale. These methodologies underscore the significance of considering strategic flexibility and the ability to adapt to future changes when evaluating IT investments in the AEC sector. They provide a framework for AEC managers to make more informed decisions by quantifying the value of options that traditional financial models cannot capture, thus aligning IT investment decisions more closely with long-term strategic goals and the inherently uncertain environment of construction projects.

3.1.1.2 Methodological Relevance

Altebro and Esmailiyan (2011) explore the application of two primary business valuation models, specifically Discounted Cash Flow (DCF) and Net Present Value (NPV), in comparing the internal valuation of companies to their publicly traded market values. The research meticulously details the process by which these models are applied to several firms across different industries. For instance, the DCF model is utilized to estimate the value of a tech company by forecasting its future cash flows and discounting them back to present value using a risk-adjusted discount rate. This example explicitly demonstrates how the DCF model accommodates fluctuations in cash flow projections, emphasizing the importance of accurate and conservative estimation in financial forecasting. Similarly, the study applies the NPV method to a manufacturing firm, where the present value of expected future cash inflows from operations is calculated and offset against the initial capital expenditures. The example highlights how NPV is particularly sensitive to the choice of discount rate and the projections of long-term cash flows, showcasing the method’s reliance on the economic environment and industry-specific growth rates. In both examples, the resultant valuations are then compared to the companies' market values as listed on stock exchanges. The study finds a persistent variance between the theoretical valuations derived from DCF and NPV models and the actual market values. This discrepancy is discussed in the context of market sentiment, investor expectations, and external economic factors that DCF and NPV might not fully account for, such as market liquidity and speculative trading behaviors. The discussion section of the article delves deeper into why these discrepancies might occur, suggesting that while DCF and NPV are grounded in financial fundamentals, market prices often reflect a wider range of non-financial influences, including investor psychology and market timing. This analysis provides a nuanced view of the limitations of traditional valuation models when used in isolation to gauge market values.

Blomberg (2020) evaluates the impact of market capitalization on stock valuation accuracy using the Dividend Discount Model (DDM) and Free Cash Flow to Equity (FCFE) models on Swedish stocks. The study specifically contrasts the valuations between large cap and small cap companies within similar industries to determine if size influences how accurately these models can predict market prices. Blomberg's methodology involves applying the DDM and FCFE models to ten Swedish firms, categorized equally into "large" and "small" cap companies. Each large firm is paired with a corresponding small firm from a similar industry. Historical data is utilized for future growth projections, with the discount rate derived using the Capital Asset Pricing Model (CAPM). The results demonstrate that both valuation models yield similar figures across companies of varying sizes, with discrepancies in valuations between large and small caps within a 1-2% range. This suggests that market capitalization does not significantly affect the valuation differences produced by DDM and FCFE

models. Blomberg concludes that, within the limitations of this study, the market does not distinctly value firms based on their market cap size when these valuation models are employed. This finding challenges assumptions about the influence of size on valuation accuracy and suggests a potential uniformity in how stocks are valued across different market caps in Sweden. He argues that it contributes to financial literature by highlighting the potential uniform application of DDM and FCFE models regardless of firm size, suggesting that market capitalization might not be as critical a factor in valuation accuracy as previously thought.

Stolzenbach's (2019) thesis investigates the impact of regional development funds and private venture capital on R&D expenditures in the Netherlands, focusing on the period 1998-2018. It reveals that regional development funds positively influence R&D spending, indicating that government involvement in venture capital can effectively support high-risk companies in overcoming credit constraints. The study employs probit regressions, ordered probit regression, and panel data regression to assess investment activities and their effects on R&D expenditures, they then use NPV to determine the value of the project. This research is relevant as it provides empirical evidence on the role of government-funded venture capital in fostering innovation, contrasting with private venture capital's investment behavior. It suggests that regional development funds tend to invest in riskier companies and significantly contribute to R&D investment, supporting the notion that government intervention can be beneficial for fostering innovation within regions.

3.1.2 Cash Flow Estimations

This section focuses on establishing methods and models that can determine the cash flow to a system which is a necessity to use most accredited valuation methods such as DCF and NPV. The most used methods to forecast cash flows include deterministic models, or probabilistic models such as OLS-regressions. There are also methods that include soft costs and benefits that are harder to quantify into cash like the PENG-model and simpler models that only look at raw financial data like C/B-analysis, both these models rely heavily on the judgment of the person interpreting both what is relevant to the system and not, but also the value of especially the benefits since the point of the models is in reality to serve as alternatives to valuation methods like NPV, but in the scope of this thesis, are viewed more as tools to determine cash flow with their framework. This section ends with a summary of how other theses approach a similar problem regarding cash flow estimations.

3.1.2.1 Economic Forecast

Firstly, Mioduchowska-Jaroszewicza (2022) decided to employ deterministic methods to analyze the influence of various types of cash flows—operating, investing, and financing—on overall financial decision-making. The deterministic cash flow model used in the study helps in assessing the direct impact of these cash flow types on the financial health and decision-making processes in a company. Key findings suggest that deterministic models, by removing the uncertainty and providing a fixed outcome based on the input variables, allow for clearer decision-making paths. These models are particularly beneficial in stable environments where inputs are predictable, and variances are low. This aids managers in understanding the impact of their financial decisions in a controlled setting, allowing for strategic planning, and forecasting with a higher degree of confidence. The discussion section of the article further elaborates on the merits of deterministic models in managerial decision-making. It argues that these models are essential for firms looking to implement straightforward, risk-averse strategies that require stable, predictable outcomes over time. The results from the application of the deterministic cash flow model show that it is an effective tool for financial forecasting and planning in business contexts where uncertainties are minimal. This effectiveness is attributed to the model's ability to provide a clear, unambiguous picture of financial outcomes based on specific input conditions, which is crucial for strategic decision-making in finance and investments.

F. Khosrowshahi and A. P. Kaka (2007) also highlight the use of a deterministic quantitative model to forecast and manage cash flow in construction projects. The authors argue for the effectiveness of deterministic models by focusing on their capacity to provide precise, reliable financial forecasts, critical for strategic planning in construction management. They developed a model integrating three key components: Control, Kurtosis, and Distortion, using exponential and polynomial expressions to manage the complex dynamics of construction cash flows. The benefits of using deterministic models, as described in the article, is that models utilize fixed inputs to produce forecasts, greatly reducing the uncertainty often associated with more probabilistic approaches. This approach is particularly valuable in the construction industry, where precise budgeting and financial planning are essential due to the high costs and risks involved. The deterministic model's ability to consistently produce accurate financial forecasts helps in developing robust financial strategies and making informed investment decisions. Furthermore, the model's simplicity and clarity enhance its usability and comprehensibility, making it accessible to a wide range of stakeholders, including those without deep expertise in statistical analysis. This accessibility facilitates clearer communication and more effective decision-making within an organization. The deterministic approach also ensures that the results are consistent when the same inputs are used, which is beneficial for scenario analysis and strategic planning. This reproducibility is crucial for comparing different financial scenarios and making strategic decisions that align with the company's long-term goals. Moreover, the deterministic model described by Khosrowshahi and Kaka (2007) requires less computational power and data processing capabilities compared to more complex probabilistic models. This makes it a cost-effective solution for many organizations, particularly smaller firms, or projects with limited financial analysis budgets. Some negatives associated with mathematical models include that it's mostly useful for the specific data given and that they are entirely dependent on its architect for its construction.

Navon (1996) then provides an in-depth analysis of the importance of cash flow management in construction projects, highlighting the complexities due to the variable nature of project execution and resource utilization. Navon emphasizes the crucial role of cash as a resource, particularly for supporting day-to-day activities in construction projects, and discusses the consequences of poor cash flow management, including the potential for company failures due to liquidity problems. Navon details a comprehensive approach to cash flow forecasting that incorporates both cost flow and expense flow projections. The method leverages detailed project data such as schedules, bills of materials, and cost estimates, although it recognizes the challenges of data availability particularly in the early and planning stages of projects. The approach is designed to be adaptable to varying levels of detail availability, making it applicable across different stages of a project's lifecycle. A significant portion of the article is dedicated to mathematical models for forecasting cost flows. These models are crucial for enabling effective cash flow management at both the project and company levels. Navon critiques the typical S-curve model used in construction cost forecasting, proposing instead a polynomial model that more accurately captures the nuances of cost accumulation over time. This model adjusts cost projections based on actual project progress, thus allowing for more accurate and dynamic financial planning. Navon's argument for using deterministic quantitative models hinges on their ability to provide precise, clear, and reliable cash flow projections that are essential for strategic planning and risk management in construction projects. These models minimize uncertainty by using fixed inputs, which simplifies the forecasting process and enhances the comprehensibility and usability of the financial forecasts. This is particularly beneficial for stakeholders who may not have specialized knowledge in statistical methods. Furthermore, the deterministic approach is praised for its cost-effectiveness, especially in structured environments where changes are minimal, making it a suitable choice for projects or firms with limited budgets for financial analysis. The use of deterministic models also aids in strategic decision-making by providing consistent and reproducible outcomes, essential for scenario analysis and policy development. Overall, Navon advocates for a structured and methodical approach to cash flow management in construction projects, underscoring the value of deterministic models in enhancing the accuracy and reliability of financial forecasts. These models not only facilitate better financial planning but also contribute to more informed and strategic decision-making processes within the construction industry.

On the other hand, Al-Attar and Hussain (2004) delves into the capability of current accounting data, specifically under UK's Financial Reporting Standard 1 (FRS1) of 1991, to predict future cash flows.

Utilizing a methodology inspired by Barth et al. (2001), the study applies Ordinary Least Squares (OLS) regression models to assess the relationship between currently available financial data—comprising earnings, cash flows, and accruals—and future cash flows. This approach marks a departure from relying solely on price data, which requires implications for future cash flows, instead examining actual future cash flow data. The core of Al-Attar and Hussain's methodology is the enhancement of the OLS regression framework, which not only replicates Barth et al.'s primary OLS analysis but also extends it to include considerations for fixed effects and time trends within cash flow data. This allows for a nuanced analysis that accounts for firm-specific variations and time shifts in cash flow levels over the study period. The paper argues for the explanatory power of disaggregating earnings into its parts—cash flows and accruals—over aggregated earnings figures alone. This disaggregation yields a more accurate predictive model for future cash flows, thereby affirming the utility of detailed accounting data in forecasting financial health and performance. To structure an OLS model for determining future cash flows from a project, Al-Attar and Hussain suggest a multivariate regression approach where future cash flows serve as the dependent variable, and a combination of current earnings, cash flows, and accruals act as independent variables. This model is tested against data for UK firms across different time horizons (one-year, two-year, and three-year forecasts), reflecting the model's versatility in accommodating short- to medium-term financial planning and analysis. Key to their approach is the disaggregation of earnings into more components, including cash flows from operations and various types of accruals (short-term and long-term). Each component is analyzed for its individual contribution to predicting future cash flows, offering insights into how different aspects of a company's current financial position influence its future liquidity and cash operations. This detailed breakdown aids in understanding the dynamics of cash flow generation and the impact of accounting practices on financial forecasts.

Van den Boomen et al. (2020) focuses on enhancing probabilistic life cycle cash flow forecasting for infrastructure by incorporating price uncertainty and its evolution, modeled through a Geometric Brownian Motion (GBM). This method is a significant shift from traditional approaches that often overlook price escalation, which can lead to underestimations of future costs, particularly in public sector projects that utilize low discount rates. The research integrates expert-based triangular distributions for uncertainties in life cycle activities but innovates by adopting GBM to model price escalation, a method borrowed from financial forecasting. This move allows for the modeling of prices as time-variant variables, capturing the reality that costs do not remain static but tend to increase over time due to factors like inflation. Using GBM, the authors could demonstrate how neglecting price increases in life cycle cost estimations might underestimate the total costs by about 13%. The methodological shift to GBM enables the generation of numerous cost scenarios, which are then aggregated to form a probabilistic view of possible future costs, offering a more data-driven and less subjective approach to forecasting. The paper discusses a case study involving a concrete bridge, where the GBM-enhanced method is applied and compared to the traditional approach. The case study highlights the importance of considering price escalation in long-term infrastructure projects to avoid significant cost underestimations. The authors suggest that this approach can be extended to other areas of infrastructure management, advocating for a broader adoption of dynamic and realistic financial modeling techniques in public project management.

Lastly, the study by Ng and Tiong (2002) on cash flow forecasting and risk analysis for contracting firms introduces a computer-based model designed to forecast project cash flows and analyze the impact of five major risk factors: duration over/under measurement risk, variation risk, and material cost variances. Their model, CAFFS (Cash Flow Forecasting System), uses internal rate of return (IRR) and capital requirement as indicators of project performance, adjusting for real-time data on project progress. This research underscores the importance of understanding cash flow trends and risk impacts in construction projects. It emphasizes the necessity of accurate cash flow forecasting for managing profitability and mitigating risks associated with project cash flows.

3.1.2.2 Economical Dynamics and Requirements

Sakthivel (2023) offers an in-depth examination of the cost-benefit (C/B) analysis process as it pertains to business software investments, emphasizing the importance of incorporating software maintenance costs more accurately. It argues that traditional C/B analyses often fail to consider significant recurring maintenance costs, potentially leading to incorrect investment decisions and missed business opportunities. The paper proposes a revised C/B analysis framework that aims to address these shortcomings by including various types of maintenance costs (corrective, preventive, adaptive, and perfective) and benefits, especially those arising from software enhancements throughout its lifecycle. The revised C/B analysis suggested in the paper includes the costs and benefits associated with different types of software maintenance:

- Corrective maintenance costs are included as they are necessary for the software to function as originally intended.
- Preventive maintenance costs are considered to maintain the software's planned quality and performance.
- Adaptive maintenance costs, caused by changes external to the software, are not included in the C/B analysis as they are not directly related to the software's inherent features or performance.
- Perfective maintenance costs and the benefits of each enhancement made during the software's lifecycle are included to capture the full economic impact of software investments.

This detailed approach to C/B analysis emphasizes the significance of recognizing all potential costs and benefits over the software's lifecycle to make more informed investment decisions. By highlighting the need for a more nuanced understanding of software maintenance costs and benefits, this paper contributes to the discourse on software investment analysis, proposing a methodology that better reflects the complexities of modern software use and maintenance in businesses. To properly do a C/B-analysis, it's important to understand the typical costs associated with an IT-investment, Zurong and Feng (2018) identified several common costs that are important to consider:

1. Engineering Costs:
    - Direct Costs: These are expenses directly related to the construction and installation processes of IT projects. They include:
    - Labor Costs: Payments to technical professionals who are directly involved in the project. This includes basic and auxiliary wages along with surcharges.
    - Materials Costs: Costs for materials used in the construction and installation processes, including amortization, packaging, transport, and insurance.
    - Machinery Costs: Expenses related to the use and depreciation of machinery during the project implementation, which also includes repair, fuel costs, and taxes on equipment.
    - Field Costs: These costs arise from the need to manage and operate construction sites. They include expenses for temporary facilities, site management, office supplies, travel, and insurances.

2. Other Costs of IT Project:
    - Organization Costs: Expenses incurred for setting up the office and living facilities and other costs associated with running the office.
    - Ordinary Expenditure: Regular expenses such as staff wages, labor protection, office supplies, utilities, and depreciation of assets.
    - Design and Supervision Costs: Fees paid for project design and oversight, which vary depending on project size, complexity, and supervision scope.
    - Intellectual Property Costs: Relates to the rights associated with the software developed, including costs for securing or transferring these rights depending on the project agreements.

3. Reserve Cost:
    - Basic Reserve Cost: Funds set aside to handle unexpected changes or emergencies that might increase the project cost.
    - Cost Reserved for Inflation: A provision for possible increases in wages, materials, and equipment costs over the project duration due to inflation.

4. Financing Interest:
    - This category includes the interest payments on funds borrowed for the project's duration, reflecting the cost of financing as part of the total investment.

5. Static and Dynamic Investment Costs:
    - Static Investment Costs: The summation of engineering costs, other project costs, and basic reserve costs.
    - Dynamic Investment Costs: This includes all static costs plus the additional reserve for inflation and the total financing costs over the project period.

These detailed cost breakdowns provide a thorough understanding of the financial planning necessary for IT projects. Each category reflects a critical aspect of cost control and budgeting that project managers and stakeholders must consider ensuring the project's financial feasibility and success.

3.1.2.3 Methodological Relevance

Bengtsson and Wredenberg (2008) model presents a structured approach to evaluating IT investments, highlighting the importance of both financial and qualitative assessments. The PENG model, developed by senior consultants specializing in organizational development and IT investment evaluations, focuses on quantifying the soft and hard benefits of IT projects. By transforming all IT aspects into monetary terms, PENG differentiates itself from other models by providing a comprehensive view that goes beyond cost reduction. The PENG model, devised for IT investment evaluation, focuses on both financial and "softer" values, promising to translate all IT aspects into monetary terms for a comprehensive assessment. This model differs from others by quantitatively measuring all IT facets, not just cost reductions. The methodology involves a ten-step process, ensuring a thorough evaluation from various perspectives. However, it lacks a detailed framework for executing each step. Despite its promise, the model's effectiveness heavily relies on the evaluators' judgments, raising concerns about its credibility. Yet, PENG can be a valuable tool for illustrating IT investment implications and comparing different IT investments to optimize resource allocation. This insight suggests the importance of adopting systematic approaches like PENG for a nuanced understanding of IT investments, aligning with the methodology adopted in the systematic quantitative empirical case study. This study's qualitative methodology includes a literature review and interviews with practitioners, emphasizing the model's application in real-world scenarios. Through the case study of Kalmar County council, the research examines PENG's effectiveness in capturing IT investment complexities and the model's ability to present clear, understandable results across the organization. The study concludes that while PENG's outcomes heavily depend on evaluators' judgments, leading to credibility issues, it offers valuable insights for discussing IT investments and comparing different projects, particularly in sectors were soft benefits crucial.

Afrim and Ekdahl (2016) focus on examining how various factors, particularly cash flow stability, influence the accuracy of stock analysts' target prices. Using quantitative methodology, the study employs regression analysis, specifically Ordinary Least Squares (OLS), to assess relationships over three-time horizons. The study's methodology is built around a detailed regression framework where cash flow variation and other factors such as the number of stock analysts, goodwill as a percentage of total capital, and company size are analyzed as independent variables to predict the absolute margin of error in target prices. The dependent variable in these regressions is the accuracy of the target price, measured by its deviation from actual stock prices. Significantly, the article reveals that companies with

stable cash flows demonstrate a positive relationship with the accuracy of target prices, which supports theories posited by the Discounted Cash Flow (DCF) model regarding firm valuation. This outcome aligns with the theoretical expectation that stable cash flows facilitate more accurate business valuations. The OLS method used in the study was chosen due to the unbalanced nature of the data, and it is integral in evaluating the strength and significance of the relationship between cash flow stability and target price accuracy. The regression models, detailed in the appendix of the article, indicate that other factors, beyond those investigated, also influence target price accuracy, particularly over shorter time horizons, suggesting higher predictive accuracy when the forecast period is shorter. In discussing the results, the article contextualizes the findings within the broader literature on stock valuation and highlights the utility of incorporating less frequently examined variables into the analysis. This comprehensive approach not only enhances the robustness of the study's conclusions but also provides a nuanced understanding of the dynamics affecting target price accuracy in financial markets.

Viklund and Mattsson (2019) uses the Ordinary Least Squares (OLS) method to determine future cash flows, focuses significantly on the structure and effectiveness of their methodological approach and presents specific examples from their results. This study investigates the relationship between goodwill impairment and future cash flows, challenging the conventional wisdom that impairments simply reflect past overpayments for acquisitions. The OLS model employed is designed to parse out the actual impact of goodwill impairments on the predictability of future cash flows. By including variables such as company size, industry, and economic conditions, the model aims to provide a more nuanced understanding of the underlying dynamics. This approach allows the researchers to make more precise adjustments for factors that might skew the basic relationship between goodwill impairments and future cash flows. Specific examples from the results highlight that companies with goodwill impairments tend to report systematically lower future cash flows compared to their non-impaired counterparts. However, this relationship is not uniform across all sectors. For instance, in technology and healthcare sectors, the impairments are more closely related to strategic re-alignments and do not necessarily signal a permanent reduction in cash flow capability. In contrast, in more stable industries like utilities and consumer goods, impairments more directly correspond to future cash flow decreases. The discussion section of the article critically analyzes these findings, suggesting that while the OLS method provides valuable insights into the average effects of goodwill impairments, it may not capture all nuances of individual company scenarios. The method assumes a linear relationship which might not hold in cases where impairments are due to strategic rather than economic reasons. The authors suggest that further research could explore non-linear models that might better account for the complexities of goodwill impairments in predicting future cash flows.

3.1.3 Analysis of Literature Review

The strengths of the chosen articles include their analysis and diverse perspectives on financial valuation and cash flow forecasting, providing a well-rounded view of the field with different methods and different cases. These articles support a comprehensive understanding of traditional and modern valuation techniques, facilitating a detailed examination of the various cost and benefit components that influence cash flow estimations. The weaknesses of the chosen articles relate primarily to their general focus on broad financial models without sufficient details on digital systems' specific implications, which are central to the RQ. While these sources illuminate the general principles of investment valuation and cash flow management, they may lack detailed insights into digital integration's nuanced impacts, thus providing limited direct guidance for applying these models in the digital context specified in the RQ. This gap underscores the need for supplementary research specifically targeting digital systems integration to ensure the findings are fully applicable to the modern digital business environment. In conclusion, the literature demonstrates a broad spectrum of methods available for implementation valuation and cash flow forecasting, each with its own advantages and challenges. The selection of an appropriate method is contingent upon the implementation's specific conditions and the strategic objectives of the investment. This diversity in methodologies reflects the complex reality of financial analysis, where multiple approaches may need to be employed or adapted to suit particular investment scenarios. Thus, while models like NPV, DCF, and ROI are valuable tools, they are part of

a broader toolkit from which analysts must choose, often requiring customization and expert judgment to align with the unique aspects of each investment scenario. Given the complexity and rapid evolution of financial evaluation methods, further research is recommended to explore the integration of advanced probabilistic models and machine learning techniques in financial forecasting. This future work could provide deeper insights into the dynamic interplays of risk, return, and strategic decision-making in investment evaluations.

3.2 Results of Data Collection

3.2.1 Case Study

In 2020, Tetra Pak implemented SAP's Ariba Network at one of its sites in China, focusing on a long-standing major supplier, to streamline supply chain operations. The implementation, which is still active, centered on cloud-based modules such as Sourcing and Contracts, Buying P2O, Supplier Lifecycle & Performance (SLP), and Supply Chain Collaboration (SCC). Previously, Tetra Pak's point-to-point EDI communication with suppliers resulted in fragmented processes across business units. The Ariba Network replaced this with a unified platform, enabling seamless electronic collaboration. The implementation began with the Purchase Order Collaboration module, enhancing order management and visibility by including order confirmations and advanced shipping notices (ASNs). Additional modules were rolled out, such as Forecast Collaboration for improved planning, Inventory Collaboration for vendor-managed stock levels, and Quality Collaboration for handling quality issues. By connecting to the Ariba Network, Tetra Pak enabled suppliers to join a centralized, efficient, and scalable platform, replacing traditional EDI communication and enhancing transparency, efficiency, and collaboration across Tetra Pak's global supply chain. This integration has been successful, and the project continues to function effectively to this day. This case study analyzes Tetra Pak's implementation of the mentioned digital Purchase Order (PO) system, focusing on financial variables from their latest Ariba implementation project in China. The project involves multiple stakeholders that were involved in the project, including Tetra Pak, suppliers, and the system provider, aiming to streamline procurement processes and reduce operational costs.

Project Overview

The IT system integration project includes the following key components:

- Tetra Pak: Implementing the digital PO system to improve efficiency and reduce costs.
- Suppliers: Partners in the procurement process, expected to interact more efficiently with Tetra Pak.
- System Provider: The vendor supplying and supporting the digital PO system.

Financial Variables

The analysis incorporates financial variables provided by Tetra Pak:

- Fixed Cost Savings: Canceling fixed costs amounting to 25 000 SEK per month over a five-year period.
- Implementation Costs: Hourly implementation cost of 400 SEK (35 Euros), involving nine personnel.

These variables are crucial for understanding the costs and benefits of the digital PO system implementation, demonstrating how integration reduces operational expenses and enhances procurement efficiency.

Implementation Context

The roles and interactions among key stakeholders:

Tetra Pak: Leads the project, manages integration, and trains personnel.
Suppliers: Adapt to the new system for seamless transactions and communication.
System Provider: Offers technical support and ensures the system meets Tetra Pak's requirements.

3.2.2 Analysis of Case Study

The case study of Tetra Pak's implementation of SAP's Ariba Network aligns with findings from related theses on IT investment evaluation, highlighting the need for accurate cash flow projections, sensitivity to discount rates, and government or venture capital support for enhancing IT projects. The PENG model's evaluation of soft and hard benefits and the importance of stable cash flows for valuation accuracy are crucial for assessing improvements such as better supplier relationships. The study focuses on the economic viability and financial effects of digital order processing systems, using methods like NPV, DCF, CAPM, and Real Options Analysis to understand cash flow and operational efficiency. Tetra Pak's implementation demonstrated cost savings and enhanced procurement efficiency, validating theoretical models and addressing the RQ.

Several assumptions underpinned the analysis. First, the accuracy of the financial data provided by Tetra Pak has been assumed, such as fixed cost savings and implementation costs. Second, the use of discount rates and projections of future cash flows relied on stable market conditions and accurate forecasting. These assumptions are critical as they directly impact the validity of the financial models. Qualitative benefits have also been assumed, such as improved supplier relationships and enhanced operational efficiency, which would translate into measurable financial gains over time. These assumptions were necessary to apply the chosen financial models effectively but also introduce potential limitations if the actual conditions deviate from these assumptions. Further, the approach involved a detailed literature review to establish the theoretical models, followed by a practical case study to apply these models. The case study provided a real-world context to the theoretical framework, enabling to test the applicability and robustness of financial assessment methods in a practical setting. By integrating qualitative insights from semi-structured interviews, it was ensured that the analysis captured the full spectrum of benefits and challenges associated with digital integration. This approach ensured a comprehensive evaluation of Tetra Pak's digital PO system, balancing quantitative rigor with qualitative depth.

3.2.3 Semi-Structured interviews

For the semi-structured interviews, the methodology described in the methodology section in chapter two was followed to ensure the reliability and validity of the data collected through these interviews. To ensure the interviewees were well-informed about the questions of the semi-structured interviews, the interviewees provided detailed explanations of the interview process and the topics to be covered. Prior to conducting the interviews, the interviewees were contacted through e-mail or Microsoft Teams to explain the purpose of the study, the relevance of their participation, and the specific topics that would be discussed during the interviews.

As outlined, a structured interview guide was prepared (see table 1) to standardize the interview process and maintain consistency across all interviews. This guide served as the basis for selecting questions that would facilitate discussion and provide relevant insights into the costs and benefits of the supplier implementation. The questions were intentionally open-ended to encourage participants to share their experiences and perspectives freely. Table 2 presents the demographics of the participants involved in the semi-structured interviews conducted for the study. The participants were selected based on their roles and involvement in the implementation project under analysis, which focused on supplier

integration via Ariba in China. The occupations of the participants varied, including Supply Network Specialist, Service Support Representative, Project Coordinator Expert, and Project Manager. Furthermore, the answers to the interview questions have been categorized into three different phases, pre-integration phase, implementation phase and post-integration (hypercare phase). The Pre-integration Phase focused on preparatory activities such as meticulous planning, testing, and alignment meetings to ensure data consistency and system alignment; the Implementation Phase centered on the rollout and deployment of the integration system, including the creation of the first order and troubleshooting activities postimplementation; and the Post-integration (Hypercare) Phase involved transitioning to a live environment, engaging in hypercare meetings, and implementing continuous improvement initiatives to enhance system efficiency, with a focus on lessons learned and ongoing optimization efforts

Table 2: *Participant demographics of the semi-structured interviews*

Participant ID	Occupation	Implementation	Country	Date of interview
P1	Supply Network Specialist	Supplier integration via Ariba in China	China	10/4/2024
P2	Service Support Representative	Supplier integration via Ariba in China	China	12/4/2024
P3	Project coordinator expert	Supplier integration via Ariba in China	China	12/4/2024
P4	Project manager	Supplier integration via Ariba in China	Sweden	23/4/2024

3.2.3.1 Pre-integration Phase

P1, a Supply Network Specialist at Tetra Pak China who was mainly involved in the pre-integration phase, he emphasizes the significance of meticulous planning during the pre-integration phase. He notes that between 2 to 3 meetings 1 hour each were scheduled over a 2-month period with their 2 suppliers specifically for testing various scenarios was essential to the implementation of the ARIBA integration system. These scenarios included testing "POs with multiple lines," "order confirmation," and "price discrepancies." This rigorous testing was crucial to ensure alignment of master data across systems and to guarantee consistency in pricing, thereby preventing POs from being placed on hold. P1 highlights that meeting time was evenly divided among suppliers, with more suppliers involved necessitating additional meeting time. Meaning, for one supplier, half of the total meeting time would've been allocated. During the pre-integration phase, as described by P2, a service support representative at Tetra Pak China, the time spent implementing requirements varied depending on the volume and complexity of the orders. For simpler orders, P2 estimated Participant ID Occupation Project Country Date of interview P1 Supply Network Specialist Supplier integration via Ariba in China China 10/4/2024 P2 Service Support Representative Supplier integration via Ariba in China China 12/4/2024 P3 Project coordinator expert Supplier integration via Ariba in China China 12/4/2024 P4 Project manager Supplier integration via Ariba in China Sweden 23/4/2024 that implementation could possibly be completed within half a day. However, there was no need to change fundamental software to meet requirements, as the system automatically handled changes. P2 noted that recipients needed to check email notifications triggered by the system, which typically took only seconds to a few minutes. P4, the implementation manager for the China implementation, provides insights into the preparatory phases before implementation, emphasizing the significance of alignment meetings with managers. According to her, around 4-6 hours were spent initially on alignment work, which involved identifying and

contacting relevant personnel from different sites. P4 highlights the importance of weekly alignment meetings with managers throughout the implementation period to address any issues. Additionally, she mentions 2-hour risk meetings and 1-2 hours of preparation for test activities. The testing activities discussed by P4 correspond to the pre-integration phase, initially taking 2-3 months to complete but later optimized to shorter durations. These activities included test case review sessions and ongoing testing sessions of 2 hours per week for around 6 weeks, along with additional time for test case preparation. Lastly, she mentioned that the fixed costs to develop the solution amounted to ca 100 000 EUR.

According to Gu, no extra time was spent on his side on the maintenance of the ARIBA system unless new price deviations or errors were detected. Both P2 and P3, an implementation coordinator expert, highlighted that minimal to no additional time was spent maintaining the new solution. The system's automation of updates and processing significantly reduced the need for manual maintenance. Troubleshooting post-implementation was similarly efficient, with recipients spending only seconds to a few minutes checking email notifications to identify changes. In the implementation phase, P4 indicates that the rollout lasted approximately 1 week, with sessions for moving to production and the creation of the first order lasting 1-2 hours. However, she does not specify the duration of troubleshooting activities in the post-implementation phase. According to P1, no extra time was spent on his side on the maintenance of the ARIBA system unless new price deviations or errors were detected. Both P2 and P3, an implementation coordinator expert, highlighted that minimal to no additional time was spent maintaining the new solution. The system's automation of updates and processing significantly reduced the need for manual maintenance. Troubleshooting postimplementation was similarly efficient, with recipients spending only seconds to a few minutes checking email notifications to identify changes. In the implementation phase, P4 indicates that the rollout lasted approximately 1 week, with sessions for moving to production and the creation of the first order lasting 1- 2 hours. However, she does not specify the duration of troubleshooting activities in the post-implementation phase.

3.2.3.2 Post-integration (Hypercare Phase)

In the post-integration (Hypercare Phase), P2 and P3 highlighted their involvement in hypercare meetings, which occur when the implementation transitions to a live but still improvable environment. These meetings typically lasted 30-60 minutes daily, with the duration varying based on the order volume. Additionally, they participated in weekly meetings over a span of 2 weeks. They also emphasized the substantial difference in handling purchase orders (POs) pre- and post-implementation. According to P3 automation brought about by the new solution led to a significant reduction in manual effort, potentially saving hours of work. Additionally, no aspects were identified as taking longer post-implementation, as the system effectively handled updates independently. Looking ahead, both P2 and P3 suggested that continuous improvement in efficiency and reduction in manual tasks could lead to further time savings in the long term, although quantifying these benefits in terms of hours remained challenging. During the post-integration (Hypercare) phase, P4 discusses hypercare sessions lasting for 2 weeks to 2 months, starting with daily 30- minute sessions, and transitioning to 2 sessions per week for 2 weeks. She also emphasizes the importance of lessons learned sessions, which lasted for about an hour, indicating a focus on continuous improvement post-integration.

Table 3: *provides a consolidated view of the time costs associated with different phases of the implementation, as reported by P1, P2, P3, and P4.*

Time costs (in hours)	Pre-integration Phase	Implementation Phase	Post-integration (Hypercare Phase)
Alignment meeting with managers	10 hours	1 hour / week (8 weeks)	1 month (30 mins/week)
Risk meetings	2 hours (total)	-	-
Test case review session	-	1 hour	-
Weekly testing sessions	-	2 hours / week (8 weeks)	-
Preparation for test sessions	-	2 hours / week (8 weeks)	-
Master data maintenance	-	4 hours / week (8 weeks)	-
Troubleshooting	-	-	-
Rollout	-	8 hours	-
Moving to Production	-	1-hour session	-
Hypercare sessions	-	-	Daily 45 min session (2 weeks) weekly 45 min (2 months)
Lessons Learned	-	-	1 hour
Contingency week	2 weeks (40 hours total)	-	-
Total	52 hours	82 hours	16.5 h

3.2.4 Analysis of data collection

There are inherent limitations related to interview bias and the selection of interviewees that must be considered. Semi-structured interviews are susceptible to various forms of bias. Interviewer bias can occur when the interviewer's beliefs or expectations influence the questions asked or the interpretation of responses. The structured interview guide was used to standardize the process across different participants and minimize the risk of biasness. However, the open-ended nature of the questions and the potential for unstructured follow-up questions could still introduce variability in how the data was gathered and interpreted. Interviewee bias is another concern, where respondents might provide socially desirable answers or underreport negative aspects due to concerns about confidentiality or repercussions. Using multiple interviewers and cross-verifying responses were strategies employed to reduce these biases, but they cannot be eliminated. Choosing the right questions is therefore crucial for the results; asking the wrong questions could lead to incorrect insights and data, potentially affecting the overall findings.

The selection of interviewees is crucial for the reliability and validity of the findings. Participants were chosen based on their roles and involvement in the implementation project, including Supply Network Specialists, Service Support Representatives, Project Coordinator Experts, and Project Managers. This selection ensured that diverse perspectives from different stages of the implementation were captured. However, relying solely on individuals directly involved in the project might lead to a biased view, as they may have a vested interest in portraying the implementation positively. Furthermore, focusing only

on key personnel might overlook the experiences of other stakeholders, such as end-users or external partners, who could provide different insights into the process. Choosing the wrong person to interview can significantly affect the results. For example, interviewing someone with limited involvement or understanding of the project might result in incomplete or inaccurate information. If an interviewee is selected based on convenience rather than relevance, their responses might not reflect the true complexities and challenges of the implementation. Conversely, excluding individuals who faced significant issues could result in an overly optimistic assessment of the project's success. Thus, careful consideration in selecting interviewees is essential to ensure comprehensive and balanced insights into the implementation process.

3.3 Results of C/B-Analysis

Having reviewed and consolidated the answers from the interviews and the financial documentation supplied by Tetra Pak at the request regarding the costs and benefits from the implementation, the next step is to separate and standardize the different variables acquired into similar segments as described in the method. Based on the data acquired and the equations developed in the method as well as the equations to be used in later chapters to calculate DCF, the first variable cost observed where during the interviews since the authors spoke to people directly linked to one or more implementations using the developed solution. Thus, depending on what type of supplier was implemented and how recent it was, it varied the cost of implementation. Moreover, this segment is also dependent on how many implementations are performed in the future, the previous segments are companywide since the money is already spent in the case of the fixed costs, and the old software is canceled if it replaced. Therefore, the most recent and efficient implementation will be used in the calculations since it was clear that with each implementation, the cost per implementation lowered through efficiency gains and experience, time is also the only cost associated with the implementation apart from the fixed ones. The equation, therefore, incorporates the lowest amount of time observed per implementation for future relevance, Tetra Pak estimates that the average cost / hour is 35 EUR which at the time of writing (April 2024), is about 400 SEK. In reviewing the transactional volume for the case with Tetra Pak Services, there are 36 suppliers that meet or exceed the 1 000 annual transactions, these suppliers represent 55% of order lines received, thus a majority. The variable costs of implementing one supplier in the form of time costs are considered as the sum of time spent on the latest implementation from table 3 in the chapter above, multiplied by the average cost of time (400 SEK), multiplied by the amount of suppliers being invested into (36), and are thus:

$$VC = (52 + 82 + 16{,}5) * 400 * \ 36 = 2\ 167\ 200\ SEK$$

In the same way as the fixed and variable costs, the main benefits observed with IT-investments are efficiency gains in the form of time. Tetra Pak observed 1 hour saved per day per person, and there are 8 people working on the team, the same hourly rate at 400 SEK is applied. Since the evaluation requires cash flow per year, it multiplied from per hour to annual benefits using 260 (workdays for a year), and as stated, there are 55% of order lines affected by the investment, thus multiplying the gains by 0,55 and reoccurring or dependent on another variable. The benefits are the cancellation of 25 000 SEK per month and using 5 years as the evaluation period since Tetra Pak's oldest implementation has lasted 4 years thus far and is not being replaced any time soon, thus making the investment lifecycle equal to or greater than 5 years. The net benefit of an implementation using equation 2.1 is therefore:

$$VBtime = 1 * 8 * 260 * 400 * 0{,}55 = \ 457\ 600\ SEK$$

Lastly, it was stated by Tetra Pak that there are more benefits as well. Soft benefits such as ease of use, employee workload, and specifically transactional cost per order line are areas that the ARIBA solution is better at than the current method. However, these were hard to estimate, and Tetra Pak could not reliably find and separate the cost data to be admissible to the thesis, it is however assumed to be a net profit when mowing to ARIBA and should be subject to economics of scale for increased benefit the more transactions and the more ARIBA is used. Thus, the net transactional gain is non-applicable.

$$VBtrans = 0$$

The first variable related to initial investment cost is the fixed benefit of canceling old software that is obsolete with the implementation of ARIBA. According to Tetra Pak, these are the only fixed benefits associated with the implementation. This is viewed as a fixed benefit since it's a fixed agreement that is canceled or not renewed and thus not. Given that the investment covers 55% of all order lines received, the fixed benefits could be adjusted proportionally to 55% of original cost (25 000 SEK). However, the tier-based pricing system used by the old solution doesn't linearly decrease or increase with the usage, it tapers off with increased usage, thus making it more expensive per PDF the lower one uses it (). Getting an exact estimate of the studies hypothetical of 55% lower would not be provided by the owners of the old solution and is therefore being estimated. IT professionals, who are used to pricing structures of IT solutions, spoken to both in and outside of Tetra Pak for the given hypothetical gave similar answers that the costs saving should be around 20% with a best case of 30% and worst case of 15% decrease in costs, but they all agree that it varies greatly and that it should be lower than 50% at least. Therefore, the estimate will be the consensus of 20%. The monthly benefit of 25 000 SEK will be multiplied by 12 months (1 year), then by 5 years, and finally by 25% to reflect the scope of the investment:

$$FB = 25\,000 * 12 * 5 * 0{,}20 = 300\,000\,SEK$$

To replace all the old software, a substantial half a year of development was required from Tetra Pak: s side to create a broad framework that could then be customized to individual supplier needs in the future. These are the only fixed costs Tetra Pak associated with the solution and are considered fixed since it isn't linked to any individual implementation and isn't dependent on other variables. These costs are *not included in the valuation* but are also important to consider as a decision tool for investing, especially when other circumstances are applicable. The case study reviled that it cost approximately 100 000 EUR to develop it, which at the time of writing (April 2024) converts to:

$$FC = 1\,157\,218\,SEK$$

3.3.1 Analysis of C/B-Analysis

The VC was quite high at 2 167 200 SEK while the annual costs savings (VBtime) amounted to 457 600 SEK. The main variables that may be called into question are the usage of 36 suppliers that represent a majority (55%) of order lines received, and the usage of an average cost per hour at 400 SEK. 55% were chosen since a majority will make the investment have a meaningful impact as an investment while still being economically reasonable. For example, there are a great number of suppliers that only have between 1-10 order lines annually and while they would take significantly less time to incorporate, the benefit gained would be significantly less as well. It is therefore deemed that the best economical approach would be to incorporate the biggest suppliers that also best align with the data obtained and are thus most reasonable to analyze. Using an average cost per hour of 400 SEK simplifies the calculation of variable costs but may not accurately reflect the true costs involved. Labor costs can vary significantly depending on the specific tasks performed, the expertise required, and the phase of the project. For instance, initial setup and integration may require higher-skilled (and therefore higher-paid) workers compared to routine maintenance tasks. This variability could lead to underestimations or overestimations of both VC and VBtime, affecting the overall cost calculation and potentially leading to budget overruns or understated costs. The decision to use an average cost per hour of 400 SEK

therefore simplifies the calculation to be within the scope of the thesis with regards to time, but may not fully capture the variability in labor costs over time or between different types of tasks. Future analyses could benefit from a more detailed breakdown of labor costs, perhaps distinguishing between different roles or phases of the project.

Estimating a 20% cost reduction for the old solutions costs is a conservative and reasonable approach, given the lack of precise data. An estimation is not ideal but given the conversations had with IT professionals, and that it is on the conservative side, it is deemed accurate enough to be incorporated. It's important since it is highly realistic that some future benefits will be gained through this conversion since Tetra Pak is using a tier-based pricing model, but that they would be less than 55% thanks to either a base fee to be paid regardless of usage, or through a reduction in bulk discounts, using a conservative approach mitigate the effects this estimation might have on the evaluation since the likelihood of it not surpassing the 20% saving increases. To enhance the robustness of the analysis, a sensitivity analysis or Monte Carlo simulation could be conducted. These methods would allow for a range of potential outcomes based on different assumptions about cost reductions and other variables, providing a more better understanding of the financial impact.

The fixed costs of 1 157 218 SEK are considered sunk as they were incurred four years ago and support multiple uses beyond this investment. This approach aligns with the principles of sunk cost theory, which advises against considering past expenditures in future decision-making (Drury, 2018). This would have an impact on the evaluation since it could increase the initial investment costs by a substantial amount but is in this case, not relevant. If these costs were only going to be used for this specific instance, they could have been included in the evaluation, so they should not be discarded from the C/B-analysis, but given the specifics in this case, are disregarded from further analysis. Soft benefits can have substantial long-term impacts on organizational efficiency and employee satisfaction (Bengtsson & Wredenberg, 2008), contributing to a more positive result on the evaluation. Certain costs, such as those related to employee training or system downtime, can also lead to an underestimation of the actual variable costs, these might have been missed and therefore might impact the result negatively. Future analyses should strive to quantify these benefits and costs more accurately, trough a PENG-model for example.

3.4 Results of Quantitative Model

Now that the costs and benefits have been summarized, they can be introduced to the quantitative model. The purpose of the models is to separate and summarize the net initial investment cost (CF0), and the net cash flow per year (CF1) to create a 5-year cash flow forecast to be inputted into the DCF in the next step. The models follow the structure laid out in methodology which defines the initial investment cost as:

$$CF_0 = \sum FB - \sum FC - (\sum VC) * \frac{cost}{hour} * suppliers \quad (1)$$

Thus:

$$CF_0 = \ 300\,000 - 2\,167\,200 = -1\,867\,200\,SEK$$

Each year's net savings in was defined in the method as:

$$CF_t = VBtime + VBtrans \quad (2)$$

Since only cost of time (VBtime) was applicable, CF_1 is equal to VBtime and thus:

$$CF_1 = 457\,600\,SEK$$

Since the model is linear, each individual year's cash flow remains the same as CF_1, thus, $CF_2 \rightarrow CF_5 = CF_1$. This concludes that the investment cash flow together with the previous section and the main contributors in costs and benefits in the scope of an IT-investment is mostly time related, given no hardware-related costs. The cash flow for the case study is a net benefit of 457 600 SEK per year that the implementation is active (5 years).

3.4.1 Analysis of Quantitative Model

Using a deterministic, quantitative model simplifies the analysis by assuming that costs and benefits will remain constant over time. This approach ensures clarity and relevance to empirical data from the C/B analysis, but it might oversimplify the real-world scenario where benefits and costs can fluctuate. (Khosrowshahi & Kaka, 2007). While the linear model is appropriate for the stable impact phase post-implementation, incorporating elements of non-linear models, such as the S-curve, could improve accuracy by accounting for initial inefficiencies and subsequent optimizations (Navon, 1996). Furthermore, the deterministic model's simplicity might omit critical aspects such as unforeseen costs or incremental benefits arising from further system integration. Including probabilistic methods or scenario analysis can help in accounting for variability and uncertainty, thereby providing a range of potential outcomes rather than a single fixed projection (van den Boomen et al., 2020). This also applies to potential increases in benefits as more employees or processes are integrated into the system over time. Historical data shows that each iteration of the implementation tends to be more cost-efficient, and subsequent implementations could yield higher returns due to economies of scale. Incorporating a growth factor in benefits into a probabilistic model would provide a more realistic projection of long-term value (Afrim & Ekdahl, 2016; Viklund & Mattsson, 2019).

Despite the limitations of deterministic models, the one applied in this thesis does adequately capture the costs and benefits typically associated with IT-investments and separate them into initial investment cost (CF0), and annual cash flow (CFt) which is important when later applied to an NPV calculation. It also highlights the importance of transparency, judgement, and reliance on data since the cash flow is costs and potential benefits, all needing to be either quantified, segregated, or scaled according to the investment when not looking at a firm. A probabilistic model like OLS might be preferred if done correctly with relevant statistical testing, but where beyond the scope of this thesis, especially with regards to data collection or simulation to derive probabilities.

3.5 Results of Investment Evaluation

Using the calculated cash flows and initial investment costs from the previous section, the DCF, ROI and NPV of the implementation can be calculated. To perform the DCF which will serve as an input for both the NPV and ROI, a WACC for Tetra Pak needs to be estimated, which is hard to do since it's a private firm and a lot of the data needed to compute a firm specific WACC, isn't available to the public and Tetra Pak would not disclose their WACC upon request. As stated in the method, a firm specific WACC can be estimated using the following equations:

$$WACC = \frac{E}{V} * Re + \frac{D}{V} * Rd * (1 - Tc) \quad (4)$$

Where $\frac{E}{V}$ is the percentage of equity, $\frac{D}{V}$ is the percentage of debt, Re the cost of equity in percent, Rd the cost of debt in percent, and Tc the corporate tax rate. Re can be calculated as:

$$Re = Rf + \beta * (Rm - Rf) \quad (4.1)$$

Where Rf is the risk-free rate, β is the measure of volatility compared to the market and Rm-Rf the market risk premium. Rd on the other hand is calculated as:

$$Rd = \frac{Total\ intrest\ expense}{Total\ debt} \quad (4.2)$$

AB Tetra Pak is listed in Sweden and therefore, some of their figures are public in their annual report (AB Tetra Pak, 2022), their interest applicable debt (1,9 billion SEK), equity (2,633 billion SEK), tax rate (20,8%) and interest payments (70 million SEK) are disclosed, and their interest rate could therefore be calculated as their interest payments divided by their debt as such:

$$Rd = \frac{Intrest\ payments}{Intrest\ applicable\ debt} = \frac{70 * 10^6}{1{,}9 * 10^9} = 3{,}7\%$$

Tetra Pak: s beta is the hardest part since its AB Tetra Pak publicly traded and thus not subject to volatility in the stock market. It will be substituted for 1,10 which was the levered beta of 40 industrial manufacturing firms, the closest market segment to Tetra Pak, in Germany in a report published by KPMG, a highly regarded firm in financial consulting (KPMG, 2022). The average market risk premium for Sweden in 2022 was 6 % (Statista, 2023), and the average risk-free rate in 2022 was 1,25 % (Riksbanken, 2024). Using this data, estimate Re to:

$$Re = 1{,}25\% + 1{,}10 * 6\% = 7{,}85\%$$

Using Re and Rd together with the information in the annual report regarding their equity, interest applicable debt and tax rate, the WACC can be estimated to:

$$WACC = \frac{2{,}633 * 10^9}{(2{,}633 + 1{,}9) * 10^9} * 7{,}85\% + \frac{1{,}9 * 10^9}{(2{,}633 + 1{,}9) * 10^9} * 3{,}7\% * (1 - 0{,}208) = 5{,}78\%$$

The WACC is therefore estimated to be 5.78 % which is on the lower side but ultimately not unreasonable for a stable, profitable, and low debt firm such as Tetra Pak, it also aligns with Markauskas and Saboniene (2020). Using the WACC as the discount rate, the DCF can be calculated for the investment over a 5-year period as mentioned, thus making it relevant to the actual lifespan of the investment:

$$DCF = \frac{457\ 600}{(1 + 5{,}78\%)^1} + \frac{457\ 600}{(1 + 5{,}78\%)^2} + \cdots + \frac{457\ 600}{(1 + 5{,}78\%)^5} = 1\ 939\ 169\ SEK$$

The DCF value is viewed as the implementation's total value and can thus be used to calculate both the ROI and the NPV of the implementation, giving a definitive answer to the RQ by comparing it to the initial investment costs. The initial investment cost chosen is the amount of time it will take to implement the solution for all suppliers at or above 1 000 order lines per year as mentioned. The ROI is therefore equal to the DCF divided by the initial investment cost CF0:

$$ROI = \frac{1\ 939\ 169}{1\ 867\ 200} = 1{,}0385 = 3{,}85\%$$

The NPV is equal to the DCF subtracted by the initial investment cost CF0:

$$NPV = 1\ 939\ 169 - 1\ 867\ 200 = 71\ 969\ SEK$$

The results from the ROI show a slight positive return on investment after 5 years of 3,85 %. The NPV is also slight net positive with a return of 71 969 SEK, concluding the RQ that the investment is worth considering and should break even after 5 years of being active.

3.5.1 Analysis of Investment Evaluation

The Weighted Average Cost of Capital (WACC) is a common metric used to discount future cash flows in investment evaluations. It represents the average rate of return that a company is expected to pay its security holders to finance its assets. Using WACC is appropriate as it reflects the opportunity cost of investing capital in the firm compared to alternative investments (Brealey, Myers, & Allen, 2020). However, the accuracy of WACC depends on the reliability of its components, which include the cost of equity (Re), cost of debt (Rd), and the corporate tax rate (Tc). A lower WACC, like the 5.78% estimated here, biases the future cash flows in favor of the investment by discounting them less, which inflates the present value (PV) of the cash flows. Typically, WACCs range between 6-12% for many companies (Fernández, 2019). If Tetra Pak's actual WACC were higher, the calculated DCF, and consequently the ROI and NPV, would be lower, potentially making the investment less attractive. The financial data used for the WACC calculation, including equity, debt, and interest payments, were taken from Tetra Pak's Swedish division. This segment is substantially smaller than the global group, which may have different risk profiles, debt structures, and operational costs (Tetra Pak Annual Report, 2022). Using data from only the Swedish division may not accurately reflect the global company's financial structure, potentially skewing the WACC calculation. A more comprehensive global WACC might be different, impacting the discount rate applied to the cash flows and therefore altering the DCF, ROI, and NPV calculations. Other figures in the WACC estimation, such as the beta (β), are derived from comparable companies. This approach is not ideal because it assumes that these companies have similar risk profiles and market behaviors to Tetra Pak. The beta value used (1.10) was from a group of 40 industrial manufacturing firms in Germany, which might not perfectly match Tetra Pak's risk exposure. If the actual beta for Tetra Pak were different, the cost of equity (Re) would change, leading to a different WACC. A higher beta would increase Re and WACC, reducing the DCF and making the investment appear less favorable. Tetra Pak is not publicly traded, making it difficult to determine an accurate beta. The beta used in this analysis is a proxy from comparable public companies, which may not fully capture Tetra Pak's risk. The inapplicability of a precise beta introduces uncertainty in the WACC calculation. An inaccurate beta affects the Re, which in turn impacts the WACC, potentially skewing the investment evaluation. Some numbers like the market risk premium and risk-free rate are also derived from averages rather than specific datapoints, which might in a similar way to the beta, effect the WACC either positively or negatively with regards to the valuation,

The NPV (71 969 SEK) and ROI (3.85%) are positive but not by a large margin. This modest return indicates that while the investment may be profitable, it is not significantly outperforming other potential investments. Given the modest positive results, the opportunity cost of not investing in potentially higher-return projects becomes significant. The small margin also means that any small changes in the input assumptions could easily turn the NPV and ROI negative, like a higher WACC for instance which is likely. The investment evaluation relies on a cash flow-based model, which depends heavily on the accuracy of the quantitative model that forecasts future cash flow that in turn, rely on the C/B analysis. Any inaccuracies or omissions in estimating cash flows compound and directly impact the investment evaluation. If the cash flows are overestimated or certain costs underestimated, the model will present an overly optimistic picture of the investment's value, some examples from the previous example that impact the evaluation may be the estimated cost savings of FB at 20%, the reliance on qualitative data and the average cost per hour. Additionally, the deterministic nature of the cash flow model does not account for potential future variances in costs and benefits, such as unforeseen expenses or efficiency gains. This could be mitigated through the usage of a probabilistic model such as OLS. The inclusion of fixed benefits (FB) like software cost savings significantly impacts the positive NPV and ROI. Without these fixed benefits, the break-even point would be delayed, requiring an additional year of cash flows. The reliance on fixed benefits means that if these benefits do not materialize as expected, the financial attractiveness of the project diminishes, that also applies to the FC since if they were to have been included in the evaluation, it would not have been positive.

4 DISCUSSION

4.1 Data Collection

4.1.1 Case study

The case study reinforces the importance of accurate cash flow projections and sensitivity to discount rates, echoing Altebro and Esmailiyan (2011) and Blomberg (2020). The conducted study aligns with Stolzenbach's (2019) emphasis on the role of government or venture capital support in enhancing IT projects, suggesting potential avenues for further improvement. Bengtsson and Wredenberg's (2008) advocacy for the PENG model, which evaluates both soft and hard benefits, resonates with Tetra Pak's objective of assessing qualitative advantages like improved supplier relationships. Additionally, Afrim and Ekdahl's (2016) emphasis on stable cash flows for valuation accuracy underscores the necessity for predictable financial benefits from Tetra Pak's digital PO system. By integrating these theoretical models with practical case study data, a comprehensive assessment of the project's financial and strategic benefits has been achieved, which enriches the understanding of the economic impacts of digital order processing systems. Furthermore, incorporating more detailed sensitivity analyses could improve the understanding of how changes in key variables, such as discount rates or market conditions, affect financial outcomes. Sensitivity analysis involves systematically varying these key assumptions to observe how changes impact the study's conclusions. This would provide a more nuanced understanding of the risks and uncertainties involved. For example, if market conditions were to fluctuate significantly, it would be valuable to know how resilient the financial benefits of the integration are under different economic scenarios. This kind of analysis would help stakeholders make more informed decisions by understanding the range of possible outcomes and the factors that most significantly influence these results.

Moreover, extending the study period to track long-term financial impacts would offer deeper insights into the sustained benefits and potential challenges of digital integration. While the current study provides valuable information on the initial phases of the integration process, the long-term effects are equally important. Tracking the financial performance and operational efficiency over several years would reveal whether the initial benefits persist, diminish, or even grow over time. This extended analysis could uncover trends such as cost reductions, productivity improvements, or unforeseen issues that may arise post-implementation. Understanding these long-term impacts is crucial for accurately assessing the true value of digital order processing systems and for planning future integration projects. Finally, involving a broader range of stakeholders in the interviews could enrich the data collected. While the study included key roles such as Supply Network Specialists, Service Support Representatives, Project Coordinator Experts, and Project Managers, adding perspectives from end-users, IT support staff, and executive management could provide a more holistic view of the integration process. These additional viewpoints might highlight different challenges and benefits that were not fully captured in the initial study, offering a more rounded and detailed understanding of the project’s impact.

4.1.2 Semi-structured interviews

The study delved into the types of costs and benefits essential for a systematic assessment of cash flows related to an implementation at Tetra Pak. Through a combination of semi-structured interviews and analysis of financial records, the authors aimed to provide a comprehensive understanding of the cash flow dynamics associated with IT solution investments. The findings shed light on various aspects such as fixed costs, time costs, and benefits accrued throughout different phases of the implementation process. By utilizing qualitative data collection methods alongside quantitative analyses, the study was able to systematically structure cash flows into usable variables and develop mathematical models for forecasting future cash flows.

Contributors like P1, P3, and P4 underscored the significance of meticulous planning, alignment, and thorough testing with suppliers to ensure system compatibility and data consistency. Their emphasis on structured planning, including weekly alignment meetings and risk discussions, highlights the critical role of coordination in successful project implementation. Transitioning to the implementation phase, minimal additional time spent on maintenance and troubleshooting due to system automation is noted, corroborating the benefits of streamlined processes. However, the lack of detailed exploration into troubleshooting activities suggests a potential area for further investigation to better understand the challenges encountered during this phase. Finally, during the post-integration (Hypercare) phase, participants like P1, P2, and P3 highlighted the efficiency gains achieved, particularly in handling purchase orders post-implementation, attributed largely to automation. P4's emphasis on continuous improvement efforts underscores the importance of ongoing optimization in maintaining and enhancing system efficiency. The qualitative findings complement the quantitative data collected, offering a deeper understanding of the time costs associated with different project phases. While numerical data provide insights into financial impacts, qualitative insights capture nuanced experiences and perspectives, enriching the analysis. This mixed-methods approach enhanced the comprehensiveness of the evaluation, which allowed for a holistic assessment of costs and benefits. The qualitative insights have influenced the cash flow forecasting model by providing a nuanced understanding of time costs. Incorporating these insights into the financial analyses to capture the full spectrum of project costs accurately. This holistic approach improves the accuracy of the cash flow forecasts and facilitates informed decision-making regarding resource allocation and project planning. Moreover, qualitative insights have enriched the understanding of operational dynamics, identifying areas for improvement in the forecasting model. Finally, integrating qualitative data enhanced the reliability and robustness of the cash flow forecasting methodology, providing stakeholders with more accurate and actionable insights.

The findings of this study align with conclusions drawn from related studies on IT implementations and supplier integrations. Previous research highlights that the purpose of the semi-structured interviews is to gather relevant costs and benefits resulting from the integration, specifically in the unit of time, and has highlighted the importance of careful planning, rigorous testing, and continuous improvement initiatives, which were also evident in these findings. (Danielson, 2017, Chapter 9). For example, the significant focus on the pre-integration phase, involving extensive alignment meetings and testing scenarios, parallels best practices identified in similar studies. These activities are crucial for ensuring data consistency and system alignment, thereby preventing issues during the implementation phase. Moreover, the reduction in manual effort and the emphasis on automation during the post-integration (Hypercare) phase reflect broader trends in IT implementations. The efficiency gains and time savings reported by the participants align with the benefits of automation and continuous improvement initiatives documented in related literature.

4.2 Determining Cash Flow Using C/B-framework

In this study, a Cost/Benefit (C/B) analysis was employed to determine the investment in and outbound cash flows associated with the implementation of digital order processing systems within Tetra Pak. This method could quantify the tangible financial impacts of the investment, focusing on direct costs and benefits. C/B analysis is widely used due to its straightforward approach to financial evaluation, making it easy to apply and understand. It provides clear, quantifiable data that can be used to make informed decisions about the feasibility of an investment (Boardman et al., 2018). However, the C/B analysis has limitations when assessing investments that do not encompass the entire firm, a common theme when trying to identify investment cash flows. Usually, cash flows are viewed at the firm level where they are clearly documented, but for the instance the thesis is studying by just looking at the investment system, there are few methods available and is clearly a subject that needs further studies, to develop models that are specialized at looking at systems bellow the firm level. These methods should also include improvements in employee satisfaction, ease of use, and enhanced organizational efficiency, which can be critical in the context of IT investments. While these softer benefits can have substantial long-term impacts, they are difficult to quantify using a traditional C/B analysis. The primary limitation of the C/B analysis lies in its focus on tangible, quantifiable data. This approach can overlook significant intangible benefits that, while difficult to measure, contribute greatly to the overall value of an investment. For example, improvements in employee morale and satisfaction can lead to higher productivity and lower turnover rates, which are valuable outcomes but are not easily captured in a C/B framework (Drury, 2018). A more comprehensive approach to evaluating investments could involve the PENG model. The PENG model is designed to incorporate both tangible and intangible benefits, systematically evaluating the potential impact of an investment. This model provides a more holistic view by considering factors such as employee satisfaction, user experience, and other qualitative benefits that are often overlooked in traditional financial analysis (Bengtsson & Wredenberg, 2008). While the PENG model offers a more thorough evaluation, it is also more time-consuming and relies heavily on qualitative data. This poses challenges for the reliability of quantitative studies like ours, where the emphasis is on objective, replicable results. The reliance on subjective assessments in the PENG model can introduce variability and bias, potentially undermining the objectivity of the analysis (Bengtsson & Wredenberg, 2008). Furthermore, the qualitative nature of the PENG model can make it difficult to standardize across different evaluators, leading to inconsistent results (Ghauri et al., 2020).

Sunk cost theory also plays a significant role in investment decisions, particularly in IT projects. Sunk costs refer to past expenditures that cannot be recovered and should not influence current decision-making (Drury, 2018). In the study, the initial development costs for the digital order processing system, which amounted to SEK 1,157,218, were considered sunk costs. These costs were incurred four years ago and support multiple uses beyond the current investment, making them irrelevant for the present financial evaluation. Adhering to the principles of sunk cost theory, excluding these costs from the C/B analysis to focus on the future benefits and costs directly associated with the implementation. This approach aligns with best practices in investment appraisal, ensuring that past investments do not bias the evaluation of current and future projects (Hodder, 1986). In IT investments, the predominant costs and benefits are typically related to time when hardware related costs are not applied (Zurong & Feng, 2018). This aspect was prominently observed in the study of Tetra Pak's integration of digital order processing systems. The primary variable costs identified were the hours dedicated to implementing and maintaining the new system. Conversely, the main benefits derived from this investment were the significant time savings realized post-implementation. Tetra Pak estimated an average cost of SEK 400 per hour for labor. This figure was applied across various activities related to the implementation and subsequent maintenance of the digital order processing system. The study found that the efficiency gains post-implementation amounted to SEK 457,600 annually. The emphasis on time necessitates accurate tracking and valuation to fully comprehend the impact of IT investments. Accurate time tracking ensures that every hour spent on implementation and maintenance is accounted for, providing a comprehensive view of the investment's total cost. Similarly, precise valuation of time savings allows for a clear comparison of costs and benefits. Phillip J. Lederer and Tushar D. Mehta (2005) support this perspective by emphasizing the importance of monetizing time in investments. They argue that by converting time

into a monetary value, organizations can more effectively evaluate the return on investment. This approach not only aids in financial planning but also provides a tangible measure of efficiency improvements, making it easier to justify IT investments to stakeholders. Furthermore, the nature of IT projects often involves iterative processes where initial implementations pave the way for more efficient subsequent deployments. As noted in the study, the costs per implementation decreased with each successive project due to gained efficiencies and improved methodologies. This iterative improvement further highlights the importance of time management and its direct correlation with the financial viability of IT investments.

Many evaluation methods, whether they involve Cost/Benefit (C/B) analysis, Discounted Cash Flow (DCF), Net Present Value (NPV), or Return on Investment (ROI), inherently depend on the judgment and assumptions made by the evaluator. This reliance introduces a subjective element to the analysis, impacting its accuracy and reliability. In this study, the assumptions made included an average labor cost of SEK 400 per hour and conservative estimates for cost savings. These assumptions were intended to provide a realistic and grounded assessment of the investment. However, they also introduced a degree of subjectivity. The accuracy of the analysis is contingent upon the validity of these assumptions. For instance, labor costs can vary significantly based on the specific tasks performed, the required expertise, and the phase of the project. Initial setup and integration tasks may require higher-skilled (and therefore higher-paid) workers compared to routine maintenance tasks, leading to potential overestimations or underestimations of costs and benefits. Glaum et al. (2018) highlight the critical nature of accurate data and reasonable assumptions in financial forecasting. They argue that even slight deviations in assumptions can significantly alter the projected outcomes, thereby affecting strategic decisions based on these projections. This is particularly relevant in IT investments, where the rapidly evolving technology landscape can introduce unexpected variables and changes. To mitigate the impact of evaluator judgment, it is important to employ good data collection methods and validate assumptions through techniques such as sensitivity analysis, Monte Carlo simulations or triangulation. Sensitivity analysis involves varying key assumptions to observe the resulting changes in the analysis outcomes, providing a range of potential scenarios. This approach helps identify which assumptions have the most significant impact on the results, allowing evaluators to focus on refining those variables. Monte Carlo simulations, on the other hand, use probabilistic models to account for uncertainty and variability in assumptions, offering a distribution of possible outcomes rather than a single deterministic result. Triangulation of interview results were used in the thesis to ensure accurate data collection, which was very important to ensure that the estimations could be applied reasonably. By incorporating these techniques, evaluators can enhance the quality of their financial analyses, providing a more comprehensive and reliable assessment of IT investments. This approach not only helps in mitigating the subjectivity inherent in evaluator judgment but also offers a clearer understanding of the potential risks and rewards associated with the investment.

4.3 Deterministic Quantitative Model

A deterministic model was employed to analyze the investment in digital order processing systems at Tetra Pak. The deterministic model simplifies the investment analysis by assuming that costs and benefits remain constant over time. This approach is beneficial for its clarity and ease of use, particularly when empirical data from the Cost/Benefit (C/B) analysis is available. Deterministic models are widely used due to their straightforward nature, providing a clear, linear projection of costs and benefits. They are particularly useful when the primary variables, such as time and cost, are well-understood and stable. This model's simplicity ensures that the analysis remains transparent and easily replicable, facilitating clear communication of results to stakeholders (Khosrowshahi & Kaka, 2007). However, one of the primary criticisms of deterministic models is that they can oversimplify real-world scenarios where benefits and costs often fluctuate. For instance, while the model assumes that the annual net savings (CF1) of SEK 457,600 will remain constant over the five-year period, this may not reflect potential variations due to changes in the market, technology, or operational efficiency. Such oversimplifications can lead to inaccurate projections if unexpected costs arise or if the benefits do not accrue as anticipated

(Navon, 1996). Despite the criticism leveled at a deterministic model, many industry professionals, especially in economics use Microsoft excel as their main work tool where the linear regression is often used that uses historical data and a constant value for increase to give an output. It is therefore not unreasonable to assume a similar approach as proposed by this thesis when looking at cash flows to an investment as well. Furthermore, it might also illustrate that common tools such as excels regression function, should be replaced in favor of probabilistic variants such as OLS in professional work to increase accuracy and strategic decision making for firms. Probabilistic models, such as Ordinary Least Squares (OLS) regression and scenario analysis, offer a more nuanced approach by accounting for variability and uncertainty in the data. These models incorporate a range of potential outcomes based on different assumptions about costs and benefits, providing a more comprehensive view of the investment's financial impact. OLS regression, for example, can analyze the relationships between multiple variables and forecast future values based on historical data. This method is advantageous for its ability to handle complex datasets and provides insights into how different factors might influence the investment's performance. However, OLS and similar models require extensive data and rigorous statistical testing to ensure accuracy, which can be time-consuming and resource-intensive (Ghauri et al., 2020, Chapter 11) While probabilistic models can enhance the robustness of the analysis by providing a range of potential outcomes, they also come with limitations. The accuracy of these models heavily relies on the quality and relevance of the input data. Inaccurate or insufficient data can lead to unreliable projections, making it crucial to validate assumptions and ensure data integrity. Moreover, the complexity of probabilistic models can make them less accessible to stakeholders who may not have a background in statistical analysis (Glaum et al., 2018).

The initial investment cost (CF0) is a critical component in evaluating the financial viability of an investment and results in a cost of -1 867 200 SEK, indicating a significant upfront expenditure. The fixed costs (FC) and fixed benefits (FB) play a substantial role in this calculation. Including or excluding these elements can drastically alter the initial cost assessment. For instance, in cases where fixed costs are high, the net initial investment will appear less attractive unless offset by significant fixed benefits or anticipated future savings (Boardman et al., 2018). Incorporating fixed benefits, such as cost savings from decommissioned software, can improve the overall financial outlook. However, accurately estimating these benefits can be challenging, especially when dealing with intangible factors or future uncertainties. Good data collection and conservative estimation are therefore important to provide a realistic financial projection that is also fair to the potential future gains that might incur (Phillip J. Lederer & Tushar D. Mehta, 2005). Decision trees offer another approach for evaluating investments, particularly in scenarios with multiple potential outcomes and decision points. This method visualizes different pathways and their associated probabilities, allowing for a more dynamic analysis of potential risks and rewards. Using a decision tree can help identify the most favorable investment strategies by comparing different scenarios, including best-case, worst-case, and most likely outcomes. This approach can be particularly useful in IT investments where future benefits and costs may be uncertain. However, decision trees can become complex and require careful consideration of all possible outcomes and their probabilities.

As stated, in IT investments, time-related costs and benefits are the primary factors when disregarding hardware. The study highlighted this aspect by focusing on the time spent on implementation and maintenance (costs) versus the time savings achieved post-implementation (benefits). Tetra Pak estimated an average cost per hour of 400 SEK, with significant annual time savings amounting to 457 600 SEK. Despite their usefulness, forecasting models, whether deterministic or probabilistic, heavily rely on the quality of input data and the assumptions made by the evaluator. This reliance introduces a degree of subjectivity that can impact the accuracy and reliability of the analysis. Robust data collection methods and validation techniques, such as statistical testing, triangulation, sensitivity analysis or Monte Carlo simulations, are essential to mitigate these effects and enhance the robustness of the financial projections (van den Boomen et al., 2020). Moreover, current models often fail to account for non-quantifiable factors, such as employee satisfaction or user experience, which can significantly impact the overall success of an IT investment. Incorporating these intangible benefits into the financial analysis remains a challenge, highlighting the need for more comprehensive evaluation frameworks that can capture both tangible and intangible impacts (Bengtsson & Wredenberg, 2008). This is a recurring

problem with how cash-flow based evaluation methods are structured, particularly in the usage of an investment in a vacuum and not on a firm. The cash flow is based on the input data that in turn is based on data collection, evaluator judgment and model limitations, it is therefore a compounding problem for which there isn't a clear framework for how it should be performed when not all data I know. It might stem from the fact that most evaluations happen on the firm level or on project organizations, rather than within a firm in ambiguity.

4.4 Implementation Valuation

A significant challenge was the WACC, estimated at 5.78%, integrates various metrics, including public data from Tetra Pak and industry averages. The assumption of a beta value at 1.1, adapted from similar industrial firms in Germany, serves as a critical placeholder due to Tetra Pak's private status, which precludes a direct market-derived beta. Tetra Pak's specific operational risks and market dynamics, which could significantly differ from those of the referenced German companies, may not be accurately reflected in this assumed beta. This misalignment could skew the WACC, leading to potential underestimation or overestimation of the discount rate used in financial evaluations. The reliance on generalized industry data to estimate the beta value for a company in a distinct market (Sweden) introduces further potential discrepancies. Market dynamics, economic conditions, regulatory environments, and financial stability vary significantly between countries, potentially impacting the accuracy of the WACC calculation. Additionally, the choice to use an assumed beta due to the absence of a publicly traded beta might overlook specific risk factors inherent to Tetra Pak's operations, such as their geographical spread, product diversity, and market penetration. Given these challenges, a large part of the WACC is established in solid empirical data from annual reports and public data such as the MRP and the risk-free rate. Further research into a solid framework to establish a discount rate or equivalent for privet firms without relying on internal data or comparable companies is desperately needed.

The calculated ROI suggests a profitable outcome from the implementation. However, this figure's reliability is contingent upon the precision and realism of the cash flow projections and the DCF (Jenkins et al., 2011). The projections assume linear cash flow generation, which may not capture the variability and potential scalability of benefits from the new system. This assumption may lead to an overly optimistic ROI, especially if the actual benefits scale non-linearly with further integrations and optimizations. The NPV similarly underscores the project's viability but remains tethered to the accuracy of the DCF calculations from which it is derived. It is also worth noting if the fixed costs were accounted for. Given the DCF's sensitivity to the chosen discount rate and projected cash flows—both influenced by significant assumptions—this positive NPV might not fully encompass the economic benefits or risks. The problems consolidates through the process and begin with the C/B-analysis, whereas discussed, missed soft benefits as well as some hard numbers that might have been missed by both Tetra Pak and the authors, as well as potential biases in selecting data, have cascade effects into the cash flow analysis that then introduces another problem with how one segregates and attribute different costs and benefits, and lastly the chosen valuation time and discount rate in this section. This is a systemic problem with estimating a value in general, especially when it's built upon subjectivity in data collection and estimations of cash flow and is potentially unsolvable if one doesn't have total information, which is rare especially for someone outside of the organization. Despite the challenges, the authors are confident that they've provided a satisfactory answer to RQ at least in the lens of time. The thesis provided a solid framework, taking the best part from both quantitative (C/B, forecasting, DCF etc.) and qualitative methods (semi-structured interviews, case study) to give a broad idea of how to approach an IT-investment valuation within a firm, when not all data is known or easily structured. The given results show that if these 36 suppliers were to be integrated, in financial terms of cost of time versus benefit of time, this case would be a net positive investment by choosing to implement the suppliers. Opportunity costs are a factor to consider in investment evaluations, as they represent the benefits foregone by choosing one investment over another. In the context of Tetra Pak's IT investment, the opportunity cost involves the potential alternative uses of the resources allocated to this project. For instance, the time employees spend on the new system could alternatively be used for other productive activities that may

generate higher returns. The importance of considering not just the direct costs and benefits of an investment, but also what is sacrificed by not pursuing other opportunities should not be ignored (Layard & Glaister, 1994). Employees spending less time on administrative tasks due to the new system can lead to significant productivity gains as they can focus on higher-value activities. Conversely, the substantial initial investment required for the system could potentially be allocated to other projects with a higher return on investment. This trade-off should also be evaluated to ensure that the chosen investment maximizes the overall value (Brigham & Ehrhardt, 2013).

While the DCF, ROI, and NPV focus on hard financial metrics, the evaluation could be further enriched by incorporating soft benefits and potential scale economies. Soft benefits, such as enhanced employee satisfaction, improved supplier relations, and brand strengthening due to the digital integration, could significantly influence the long-term success and financial health of the project but are not captured in traditional financial analyses. Including these factors could elevate the ROI and NPV figures beyond the current projections. Moreover, as the system is rolled out across more suppliers, operational efficiencies are likely to improve, reducing the cost per integration. This scalability effect could lead to higher-than-projected ROI and NPV figures as the system matures, suggesting that initial estimates might be conservative or optimistic given unidentified risks (Lederer & Mehta, 2005). Thus, RQ could also benefit from having implemented probabilistic methods and qualitative methods like PENG in the earlier stages, as stated, the cascade effect from these previous steps is ultimately felt here as well. Future research could focus on developing new methods like DCF that from its onset, incorporates aspects of probabilistic and qualitative methods such that it's always considered, thereby creating a complete framework for the entire evaluation process, rather than relying on inputs that differ so much from case to case. The model could also differ by not relying so much on firm specific information, like ROI but broader in scope, to facilitate its usage in more scenarios than on a firm level.

5 CONCLUSION AND FUTURE WORK

5.1 Conclusion

This thesis has explored the financial evaluation of IT investments within a firm, focusing on the implementation of a digital order processing system at Tetra Pak. By employing a mixed-method approach that integrates both quantitative and qualitative methodologies. The methodology included a literature review that highlighted key financial models such as Net Present Value (NPV), Discounted Cash Flow (DCF), and Return on Investment (ROI) in evaluating the economic viability of IT investments. The quantitative analysis further enriched the application of deterministic cash flow forecasting models, which, despite their limitations, provided clear insights into the financial impacts of the digital system implementation. The results from the case study at Tetra Pak and the application of the methodology revealed significant efficiency gains and cost savings from the digital integration, with an annual net benefit of around 450 thousand SEK over five years, amounting to a positive NPV around 70 thousand SEK and a positive ROI of about four percent. These benefits were primarily attributed to reduced manual labor costs and improved order processing efficiency. However, the analysis also showed the sensitivity of NPV and DCF models to assumptions about cash flow projections and discount rates, highlighting the importance of accurate data collection and realistic assumptions. Discussion within the thesis addressed the broader implications of these findings, suggesting that while traditional financial models like NPV and DCF are effective, they can be enhanced by incorporating probabilistic methods and scenario analyses to better handle uncertainties and dynamic market conditions. This comprehensive approach ensures a more realistic and adaptable evaluation of IT investments, aligning with the strategic goals of digital transformation in manufacturing.

In conclusion, the framework developed in this thesis provides a solid foundation for evaluating IT investments within firms, even when data is incomplete. By integrating cost/benefit analysis, quantitative modeling, and financial evaluation techniques, this approach not only justifies the economic viability of such investments but also highlights the potential for significant operational and strategic benefits. The research question is therefore answered and while the research gap is not filled, it has a better foundation now. Using the information in this thesis, a person can have a clear understanding of what methods and data are needed to evaluate their IT-investment, even if not all data is documented, and they are not viewing the investment for the entire firm. A person can get from nothing to a complete evaluation using the process laid out in the thesis and provide a satisfactory valuation with robust methods that this thesis has provided. It is however important to note that this is only a framework, not a perfect solution. As stated in the case study section of the method, given different circumstances or inputs, the models may not be adequate but the general idea of finding relevant costs and benefits, quantifying them and forecasting the cash flow to then evaluate is.

5.2 Future Work

5.2.1 Data Collection & Case Study

Even though the mixed-method approach did well in complementing what was documented with aspects that haven't been documented in order to ensure high reliability, the data collection methodology could be further improved by for example, implementing tools that capture real-time performance metrics of the system—such as system uptime, error rates, and rates of manual versus automated interventions—can significantly aid in quantifying the operational improvements. These metrics offer objective data points that help in evaluating the system's performance and identifying areas for optimization. On the qualitative front, conducting follow-up interviews with a range of stakeholders several months after the system goes live provides valuable insights into the long-term sustainability and effectiveness of the system. These interviews can uncover user satisfaction levels, operational challenges, and unforeseen benefits or issues arising from the system integration. Additionally, organizing focus groups with users, such as supply network specialists and service support representatives, allows for detailed feedback on the system's usability and effectiveness. This feedback is crucial for continuous improvement and for tailoring the system to meet user needs more effectively.

Employing advanced analytics, such as predictive analytics, can furnish foresight into potential future scenarios based on current trends, which assists in proactive decision-making. Similarly, data mining can reveal underlying patterns and correlations that may not be apparent through traditional analysis methods, uncovering hidden costs or benefits that can impact the overall assessment of the system. Benchmarking studies are essential to gauge Tetra Pak's system performance against industry standards or similar implementations in other organizations. Such comparative analyses not only highlight performance gaps but also showcase best practices and lessons learned from other contexts. Case comparisons with organizations that have implemented similar technologies can further provide a clearer perspective on different implementation strategies and their outcomes, facilitating a more informed approach for future improvements. Finally, establishing a longitudinal study to monitor the system's performance and its financial impacts over an extended period will provide insights into the long-term viability and return on investment of the digital PO system. This ongoing assessment helps in understanding the enduring impacts of the system, supporting strategic decisions regarding further investments or system modifications. By integrating these enhanced data collection methods, the research will not only address immediate financial assessments but also contribute to a deeper understanding of the strategic and operational implications of digital system integrations in corporate environments. This holistic approach ensures that the financial analyses are robust, comprehensive, and reflective of the true value the system brings to an organization like Tetra Pak.

5.2.2 Cash Flow

The current cost-benefit (C/B) analysis focused on direct and indirect financial metrics, most notably in the aspect of labor time spent and gained. Future work could benefit from integrating a broader range of costs and benefits, including indirect and non-financial impacts. The revised C/B analysis proposed by Sachidanandam Sakthivel (2023) offers a broader framework for this purpose. By including costs such as corrective, preventive, adaptive, and perfective maintenance, and recognizing benefits from software enhancements throughout its lifecycle, future analyses could provide a more comprehensive economic evaluation of IT investments. Incorporating probabilistic models, as discussed by van den Boomen et al. (2020), could also enhance the quantitative model by accounting for uncertainties in life cycle costs and benefits. This method would allow the modeling of scenarios where costs and benefits could vary, providing a range of expected outcomes rather than a single estimated value. This approach would be particularly beneficial in forecasting the long-term financial impacts of the digitally integrated PO system, considering factors like price escalation and economic conditions that influence cost estimates.

While the current project effectively quantifies the direct financial benefits and costs associated with the implementation of the ARIBA system, it could be expanded to consider broader business impacts. Future research could explore how the system affects overall business processes, supply chain efficiency, and customer satisfaction. These aspects could be quantified using the PENG model, which translates various IT facets into monetary terms, as highlighted by Bengtsson and Wredenberg (2008). This approach not only captures direct financial metrics but also includes qualitative assessments that provide deeper insights into the overall impact of IT investments. The current analysis uses the most recent and efficient implementation costs to project future savings, which may not accurately represent cost variations across different types of supplier integrations. Future studies could standardize variable costs and benefits across multiple implementations, in conjunction with a decision tree, to develop a more reliable cost model. This could involve creating a benchmark or average cost model based on historical data from multiple implementations, as seen in the structured approach to evaluating cash flows in projects as discussed by Navon (1996). Building on the initial findings from the cost-benefit analysis and quantitative model of Tetra Pak's ARIBA solution, future research could greatly benefit from refining data collection methods, expanding the cost-benefit analysis model, and integrating broader business impacts into the financial evaluation. By adopting these approaches, researchers can provide a more nuanced understanding of the economic and strategic value of IT investments, facilitating better decision-making and strategic planning in digital transformation initiatives.

5.2.3 Valuation

To address the challenges and opportunities identified in the financial evaluation of Tetra Pak's digital system implementation, future research should focus on advancing methodologies that provide a more nuanced understanding of IT investments, particularly in the context of private firms. This involves developing a comprehensive framework that integrates improved financial metrics, acknowledges the value of intangible benefits, and adapts to the unique characteristics of each implementation scenario. Future research should prioritize the creation of a valuation framework specifically designed for private firms, which often cannot rely on publicly available market data to the same extent as publicly traded companies. This new framework would involve refining the Weighted Average Cost of Capital (WACC) calculation by incorporating sector-specific risk profiles and alternative proxy variables that more accurately reflect a firm's market dynamics and operational risks. For instance, instead of using generic industry betas, the framework could utilize customized risk assessments based on detailed operational data from the firm or similar private entities. This approach would better capture the unique financial landscapes private firms operate within, providing a more precise tool for investment appraisal. Recognizing the limitations of traditional financial models, future studies should explore the integration of probabilistic methods and qualitative assessments right from the early stages of the valuation process (Ekström & Björnsson, 2003). By creating a hybrid model that leverages both quantitative and qualitative data, researchers can provide a more holistic view of an investment's potential impacts. This model would be particularly useful in scenarios where project outcomes are highly uncertain or where soft benefits—such as improved operational efficiency, employee satisfaction, or customer loyalty play a significant role in the overall valuation (Bengtsson & Wredenberg, 2008).

In addition to refining existing methodologies, there is a compelling case for developing a new variable to replace the traditional discount rate used in DCF calculations for private firms. This innovative approach would involve creating a bespoke metric that reflects the specific financial and operational risks associated with private firms, potentially integrating alternative financial data points that are more indicative of private firms' realities than the traditional market data used for publicly traded companies. Lastly, comparing IT investment outcomes across different industries could uncover valuable patterns and insights that are not evident when studying a single sector or company. This comparative analysis could inform industry-specific adaptations of the valuation models, making them more versatile and applicable across a broader spectrum of market conditions. There is also a pressing need for methodologies that systematically quantify soft benefits and assess scale economies. Future research should focus on developing methods to measure and incorporate these intangible benefits into financial evaluation models. Additionally, studying the scalability of digital systems and their impact on

operational efficiencies could offer deeper insights into the long-term financial benefits of IT investments. Understanding how these systems scale could lead to more accurate projections of ROI and NPV, reflecting the true value of digital transformations over time, like the new model presented by Hodder (1986). To ensure the practical applicability of these newly developed frameworks, empirical validation through case studies or real-world implementations is crucial. Collaborating with companies to apply and refine these models will provide essential feedback on their effectiveness in diverse operational contexts. This step is critical for refining the models based on real-world data and outcomes, ensuring they remain relevant and robust under various market conditions. Conducting longitudinal studies to track the performance and financial impact of IT investments over time would provide invaluable insights into their long-term viability and returns. Such studies would allow for the adjustment of financial models based on actual performance data, enhancing their accuracy and reliability.

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