A Fuzzy Set Qualitative Comparative Analysis Of ERP Rollouts: Deciphering Critical Success Factors from Lessons Learned in Multiple Valmet Locations

Lappeenranta–Lahti University of Technology LUT

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ABSTRACT

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The enterprise resource planning (ERP) development program at a Finnish company is the main subject of this thesis, which looks at crucial success factors and difficulties in the deployment of ERP systems. Using a fuzzy version of qualitative comparative analysis (fsQCA), the study assesses how different factors—training, change management, data management, and rollout management—contribute to the overall effectiveness of ERP rollouts.

The research questions in this thesis aim to answer how all of these different factors contribute to the general performance of a rollout, as well as taking a look at how different models and user numbers contributed as well. The fsQCA study did, however, produce unexpected results. It was discovered that good outcomes were not always the result of efficient management of data, change, and rollout techniques in the company's previous ERP implementation models.

A good development trajectory in the company's ERP deployment approach is suggested by the study's observation of a progressive increase in rollout performance with the introduction of improved rollout models. This fits with more general tales in the literature on ERP regarding the necessity of flexible and situation-specific methods.

The study has some drawbacks, such as limited available data from certain rollouts and potential biases resulting from varied worldwide locations and opinions. Due diligence is required when extrapolating the results.

This thesis emphasizes how ERP implementations in international contexts are dynamic and offers insights into the use of fsQCA in ERP system investigations. It provides insightful guidance on ERP rollout management for enterprises, highlighting the significance of ongoing adaptation and strategic evolution.

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1 Introduction

Over the past couple decades, Enterprise Resource Planning (ERP) systems have proliferated, and many businesses are now using them to improve productivity and optimize company processes. However, not all ERP rollouts are considered success stories, and some organizations struggle to achieve the desired benefits from their investment or to complete the rollouts according to schedule (Mahraz, Benabbou & Berrado 2019). The success of ERP system rollouts depends on various factors, and identifying these factors is crucial for a successful rollout (Mahraz, Benabbou & Berrado 2019). The aim of this master's thesis is to identify relevant critical success factors and areas of improvement in ERP system rollouts, as well as to analyze the differences noticed in four different rollout strategies (1.0, 2.0, 2.1, and 3.0) utilized by Valmet Oyj.

The need to promote operational excellence and efficiency inside businesses serves as the driving force behind this study's motivation. Enterprises are aware of the importance of a well deployed ERP system in their efforts to improve operations, reduce costs, and increase productivity (Nkengfack Fialefack 2023). It is hoped that this research, which identifies the crucial success factors and areas that need development in ERP rollouts across diverse localities, would offer invaluable insights for carrying out subsequent successful installations for the company.

Improvement ideas for ERP rollouts may be found using the study as a tool as well. Comparing the company's rollout strategies throughout the years will not only show the development of these strategies, but also clarify the complexities involved in ERP rollouts. This comprehension will then aid in building the foundation for solid strategic planning and decision-making linked to the deployment of ERP. The study also indicates that gathering feedback in a standardized form may be valuable for further improving rollouts, as well as gives an example of how the chosen analysis methodology can be used to study similar datasets to the one used here.

This research is further enhanced by the requirement to reduce the risks related to ERP deployment. ERP deployment is a high-risk endeavor that might result in delays, cost overruns, and failure to realize anticipated benefits. A detailed analysis of earlier rollouts can help identify trends and warning signs of these hazards, enabling better risk management in later implementations.

Understanding the effect of ERP adoption on different global locations is another important part of this research. ERP systems frequently call for modifications to current workflows and procedures, which can have an impact on how employees behave and think. The research can assist the business in better understanding and managing the cultural elements of ERP adoption by looking at previous rollouts.

The corporate landscapes of today are constantly changing due to a variety of variables, including technology development, altering customer tastes, and geopolitical dynamics. Understanding the subtleties of ERP rollouts in various global contexts becomes important in such a setting, enabling firms to navigate these unpredictable landscapes (Kumar et al., 2002). Additionally, the continuous digital revolution is altering sectors, forcing a shift to corporate processes that are more connected and easier to use. ERP systems are a large part of this transformative era, acting as the foundation for digital activities across a wide range of enterprises (Hitt et al., 2002). This study looks at multiple rollout models employed by the company which differed from one another in a sense that they were improved models upon previous ones and aims to therefore analyse how the evolving world in a digital sense has affected the performance of the rollouts.

Every worldwide location has its own unique mix of cultural, governmental, and infrastructure issues. Adopting a one-size-fits-all strategy for ERP deployment can unintentionally result in less than ideal outcomes or even complete failure. It's crucial to examine ERP rollouts in various locations to gain insights that help guide customized methods that take into account these regional differences. (Sheu et al., 2004) Furthermore, ERP system shortcomings or inefficiencies may have significant economic repercussions. Recognizing the elements that support successful rollouts across international locations becomes critical given the significant investments frequently involved with ERP deployments, protecting and optimizing the return on investment. (Rothenberger & Srite, 2009). The data used in this research contains information from multiple company locations and it is not looking at a single case of an ERP rollout for analysis, there are over twenty different rollouts being studied.

The recent worldwide pandemic has highlighted the importance of reliable and flexible IT infrastructures even more. The role of ERP systems in facilitating these strong IT infrastructures appears as even more crucial, underlining the need for nuanced understanding and deliberate implementation as organizations reevaluate their operating models in the wake of COVID-19 (Bingi et al., 1999).

Researching the complexities of ERP rollouts across many worldwide locations is not just timely but essential as organizations struggle with the opportunities and problems of a linked and volatile global market. This study aims to advance this important area of study by delivering knowledge that can direct companies' global ERP trajectories.

A wide range of factors that affect the effectiveness of ERP rollouts across international locations have been thoroughly examined in relation to their complexity. An exploratory study by Sheu, Yen, and Krumwiede (2003) showed the considerable influence of national differences on ERP implementation techniques, including language, culture, politics, governmental restrictions, management style, time zone, and labor skills. Sheu, Chae, and Yang (2004) reiterated this sentiment and stressed the differences in how these elements have an impact in different nations.

With a more targeted approach, Xu, Ou, and Fan (2017) found that the following factors are significant predictors of ERP assimilation: relative advantage, complexity, compatibility, top management support, organization fit, financial commitment, and competitive pressure. Through the automation, informational, and transformational effects of ERP on business processes, Uwizeyemungu and Raymond (2009) demonstrated a method that enables organizations to assess the degree to which the firm's operational and overall performance has been impacted by the adoption and use of ERP systems.

Empirical proof that the theoretical principles of ERP deployment are followed to varied degrees was provided by Muscatello and Chen (2008). Using empirical data, Karimi, Somers, and Bhattacherjee (2007) discovered that ERP radicalness and delivery system play moderating roles in how much ERP installation affects business process outcomes. The importance of the ERP package's nation of origin and the caliber of the consultant were emphasized by Wang, Klein, and Jiang (2006) in the process of constructing a high-quality ERP system that can lessen the negative effects of mismatch issues.

According to Duplaga and Astani's (2003) findings, businesses who implemented ERP in a "big-bang" manner outperformed businesses that had a more gradual deployment. A historical perspective and a social-cultural viewpoint, according to Xue, Liang, Boulton, and Snyder (2005), can provide a rich knowledge of ERP installations. For managers at ERP-enabled and non-ERP-enabled enterprises, e-business and ERP vendors, and governments of developing countries, Ilin, Ivetic, and Simi's (2017) article provided a variety of perspectives. Finally, Hasan, Miah, Bao, and Hoque (2019) hypothesized that organizational and human-related risks—rather than the often assumed technological risks—are the critical determinants for a probable ERP failure.

Although the problems and critical success factors (CSFs) of ERP installation have been well studied in previous studies, there are still some noticeable gaps that this study aims to fill.

For instance, Mahmood et al. (2019) identified a number of implementation issues for ERP, but it is yet unknown how these challenges would play out in the context of global rollouts, especially when taking into account various rollout models. While Woo (2007) stressed the importance of adjusting to local cultures while implementing ERP, the literature hasn't gone into great detail about the complex interactions between cultural settings, rollout tactics, and the number of users at each location.

Additionally, there hasn't been as much emphasis placed on the connection between the quantity of users in a location and the success or difficulties of ERP deployment. Although studies have looked at managerial solutions in IT implementation, Menon et al. (2008) found that they did not specifically address the problems caused by different user numbers in worldwide rollouts. The data in this research paper aims to fill this gap by taking into account the varying user numbers in different locations analysed.

This research offers to provide insights into the CSFs and difficulties of ERP rollouts while focusing on the number of users, the lessons learned from international rollouts, and various rollout models. By doing this, it will offer guidance for the company in future global ERP rollouts, ensuring that they are better prepared to handle the various difficulties presented. Therefore, the research objective is to identify the most important factors from the data in the lessons learned from selected rollouts. The data in the lessons learned from the selected rollouts includes the following factors: rollout management, data management, change management and training. The factors selected are due to the availability of them in the data. The research questions are:

- How do the selected factors contribute to rollout performance?
- How does the number of users contribute to rollout performance?
- How do the different models employed contribute to rollout performance.?

2 Literature Review

This Chapter will give a literature review with sections including: Overview of ERP systems, Main tasks of ERP systems, Global rollouts of ERP systems: challenges and opportunities, Critical success factors for ERP systems global rollouts, and Previous problems for ERP systems global rollouts.

2.1 Overview of ERP systems

This section provides an overview of ERP systems, and the next section will more closely explain their functions. ERP systems are many-sided software solutions designed to integrate and manage the core processes of a business (Menezes & González-Ladrón-de-Guevara, 2010). As integrated software platforms created to combine and streamline various business operations inside an organization, ERP systems have become a pillar of the modern corporate environment. These systems, which date back to the 1960s, were initially developed as resources for planning material requirements in manufacturing organizations. However, as the years passed by, ERP systems underwent a substantial transformation that broadened their application beyond manufacturing (Davenport, 1998).

Inventory management and control systems, which mainly concentrated on keeping track of stock levels and determining reorder points, are responsible for the development of ERP in its earlier stages. These primitive systems were given the incentive to develop into Material Requirements Planning (MRP) systems by the technology advances of the 1970s. These new systems marked a major improvement in their capabilities by smoothly integrating inventory management with production planning (Wieder, Booth, Matolcsy, and Ossimitz, 2006). The next decades, in particular the 1980s and 1990s, saw the inclusion of new modules for these systems, including those for human resources, finance, and customer relationship management. This growth ushered in the development of the modern ERP system, a comprehensive answer to a wide range of business requirements (Klaus, Rosemann, and Gable, 2000).

The capacity of the ERP system to provide a uniform platform that combines diverse business operations is crucial. Through this integration, data sharing and communication between organizational departments are made simple. ERP solutions efficiently reduce duplication, and make sure that all departments have access to and rely on a single, reliable data source by using an all-encompassing strategy. Informed and strategic decision-making are fostered throughout the organization thanks to this unified data approach (Hitt, Wu, and Zhou, 2002).

While using ERP systems brings about a variety of advantages, it's important to be aware of the difficulties that come with it. Enhancing operational effectiveness, raising customer service standards, and significantly lowering operating expenses are all benefits that organizations stand to gain from (Hendricks, Singhal, and Stratman, 2007). Additionally, the solid framework offered by ERP systems is favorable to advanced business analytics and intelligence, enabling firms to derive useful insights from their accumulated data (Shang and Seddon, 2002). However, there are several obstacles to overcome on the road to installing ERP systems, such as high upfront expenditures, potential resistance from users that are accustomed to legacy systems, and the inherent difficulties of fusing many business processes onto a single platform (Zhu 2006).

The complexity of ERP systems, along with their customization to organizational demands, means that users must be skilled in their functionalities to utilize them. This is important as ERP systems are deeply integrated into business operations, and users' interactions with the system can have an impact on other business areas. Consequently, a large number of users in the organization, across various roles, require comprehensive training to be sure they can navigate and use the ERP system efficiently (Monk & Wagner, 2012; Wagner & Monk, 2012; Koch, 2001; Al-Mashari, Al-Mudimigh, & Zairi, 2003).

ERP systems have cemented their status as essential instruments in the contemporary business landscape with their capacity to integrate and streamline business processes.

Despite their many advantages, their effective implementation necessitates a thorough comprehension of the problems they raise and a well-thought-out plan to deal with them.

2.2 Main tasks of ERP systems

The numerous activities that ERP systems are capable of are what define them, despite being recognized for their integrative skills. The foundation of ERP systems is made up of these responsibilities, which range from financial management to human resources, ensuring that businesses can run smoothly and effectively (Monk and Wagner, 2012).

ERP systems' key functions include financial management. These systems provide all-inclusive solutions for risk management, financial reporting, and accounting. ERP systems offer accuracy, compliance, and real-time financial insights by combining financial data and automating financial activities, empowering firms to make wise financial decisions (Bradford and Florin, 2003).

Management of the supply chain is yet another crucial duty. ERP systems automate multiple steps of the supply chain, from logistics to inventory control. They make it possible to track items in real-time, to manage inventory levels more effectively, and to improve vendor and procurement processes, all of which result in on-time delivery and lower operating costs (Stefanou, 2001).

Management of human resources (HR) is another important element. Modern ERP systems include a wide range of HR features, such as employee self-service portals, payroll, performance management, and recruitment. These systems facilitate strategic talent management, improve employee engagement, and streamline HR procedures by centralizing employee data (Hussain, Wallace, and Cornelius, 2007).

Many ERP systems incorporate customer relationship management (CRM). By ensuring a consistent view of customer data, this connection streamlines the processes for sales, marketing, and customer service. Businesses may personalize marketing initiatives, improve customer service, and boost sales forecasts with real-time customer analytics (Chen, 2001).

Reporting and data analytics are essential functions of ERP systems. They combine enormous amounts of organizational data and provide capabilities for advanced analytics, reporting, and data visualization. Organizations are able to make data-driven decisions with the use of these insights (Wieder, Booth, and Matolcsy, 2006).

In conclusion, the variety of duties carried out by ERP systems highlights their necessity in contemporary businesses. ERP systems are at the core of good organizational operations, managing money, streamlining supply chains, and boosting customer connections.

2.2.1 Global rollouts of ERP systems: challenges and opportunities

The implementation of unified systems across international borders has become necessary due to the globalization of company processes. The preferred option for multinational firms looking to standardize procedures throughout their international operations is enterprise resource planning (ERP) systems, which are renowned for their capacity to combine various organizational tasks (Sheu, Chae, and Yang, 2004).

The cultural diversity among nations is one of the biggest obstacles to international ERP rollouts. Business etiquette, work ethics, and communication methods vary by region. Lack of consideration for these cultural variations while implementing a one-size-fits-all ERP system might result in resistance and misunderstandings (Dow, 2000). Additionally, laws governing data protection, financial reporting, and corporate operations differ throughout nations. It may be necessary to modify and adapt an ERP system in order for it to conform with the laws of a different nation (Soh, Kien, and Tay-Yap, 2000). The rollout is further complicated by linguistic hurdles. Localization goes beyond simple translation and entails modifying the software to comply with regional laws, norms, and conventions (Maznevski and DiStefano, 2000). Additionally, the performance and usability of ERP systems can be impacted by considerable regional differences in technological infrastructure (Hong and Kim, 2002).

Global ERP rollouts offer various potential despite these obstacles. The standardization of business procedures across all locations is one major benefit that results in increased effectiveness, decreased mistake rates, and consistent data for decision-making (Markus, Tanis, and Fenema, 2000). Companies can receive real-time insights into their international operations with a unified ERP system, which enables improved resource allocation, demand forecasting, and strategic planning on a worldwide level (Sheu, Chae, and Yang, 2004). Another advantage is improved communication between teams scattered across the globe. Project coordination and teamwork can be enhanced by using shared data, standardized procedures, and integrated communication systems (Bingi, Sharma, and Godla, 1999). A unified ERP system can also result in significant long-term cost reductions. The efficiency gains through standardized processes, decreased redundancies, and improved decision-making can result in a positive return on investment even though the initial investment may be sizable (Bernroider and Koch, 2001).

2.2.2 Critical Success Factors for ERP rollouts

ERP systems have developed into crucial tools for multinational corporations looking to synchronize and simplify their operations. The global implementation of these systems, however, is not without difficulties. The likelihood of a successful ERP deployment can be considerably increased by identifying and resolving the key success factors (CSFs). The constant support from top management is one of the CSFs that is frequently mentioned in the literature (Umble et al., 2003). This assistance includes not only financial resources but also developing a change-friendly culture and ensuring that the initiative has the resources it needs.

The ERP implementation process has direction and purpose thanks to a clear vision and well-defined objectives. They serve as a roadmap for the project, directing it through each stage and ensuring that it is in line with the strategic objectives of the business (Akkermans and van Helden, 2002). Given that ERP systems are transformative, resistance to change is a frequent barrier. To ensure smoother transitions and higher acceptance of the new system, the company and its personnel must be adequately prepared for change (Al-Mashari et al., 2003).

ERP systems are complicated, and their efficient use depends on the end users' ability to find their way around and use them. To provide them with the requisite abilities, thorough training programs that are targeted to different user groups are vital (Somers and Nelson, 2004). An ERP system's effectiveness is only as good as the data it processes. The reliability of the system and the organization's decision-making processes depend heavily on the accuracy and consistency of the data moved to the new system (Hawking, Ying, and Javen, 2007).

The organization's relationship with the ERP vendor is crucial to the implementation's success. A collaborative approach can significantly improve outcomes if the vendor recognizes the organization's particular needs and offers prompt assistance (Esteves and Pastor, 2001). Understanding and managing cultural differences in business process approaches and technological perceptions can be a game-changer for worldwide rollouts. Regional acceptance and usefulness can be improved by adjusting the implementation strategy to recognize and account for these variations (Sheu, Chae, and Yang, 2004).

Projects involving ERP adoption are dynamic. In order to keep the project on track, continuous monitoring in conjunction with feedback systems can aid in the early detection of possible problems and course modifications (Bradford and Florin, 2003). In conclusion, even though global ERP rollouts are challenging projects, knowing and addressing these crucial success criteria can greatly increase the likelihood of a successful deployment. The significance of these elements will only increase as organizations continue to grow and operate in a world that is more linked.

2.2.3 Previous problems for ERP systems global rollouts

Global ERP rollouts are enormous undertakings for any multinational company. These system deployments may face numerous obstacles that could seriously hinder their overall success and efficiency. To successfully navigate these difficult tasks, it is essential to identify and comprehend the wide range of issues that may occur.

Underestimating the complexity of the project is a major problem that firms encounter while rolling out ERP systems in global locations. Businesses frequently underestimate the degree to which logistical, technological, and cultural quirks influence a rollout across various geographies. According to Motwani et al. (2002), this underestimating may result in inadequate planning, misallocation of resources, and impractical deadlines.

Another major obstacle is cultural differences. ERP systems are frequently created using a one-size-fits-all methodology, which may not align with regional business customs and user expectations. Insufficient localization and customization of ERP solutions to satisfy regional demands may result in low user acceptance and less-than-ideal system performance (Davenport, 1998).

One cannot stress the difficulty of standardizing and ensuring the quality of data. Integrating inconsistent data from different foreign sources frequently exposes problems with data veracity, consistency, and integrity. These data problems have the potential to erode confidence in the ERP system and, consequently, in the business information it offers (Hawking et al., 2004).

Inadequate user training and change management are two other common issues. Users will probably resist embracing the new processes if they are not properly trained and have no plan in place to handle the change that new ERP systems bring about, which will lead to low utilization and efficiency (Somers & Nelson, 2004). An further consequence of resistance to change is a misalignment between business processes and ERP system capabilities.

Global ERP rollouts are significantly hampered by communication constraints, both linguistic and organizational. In order to ensure that the project objectives are understood and met, it is imperative that heterogeneous teams coordinate well through effective communication (Kumar & Hillegersberg, 2000).

Problems with the vendors are also quite important. Dependence on the ERP vendor for ongoing assistance might present difficulties, particularly in a multinational context. The responsiveness and caliber of vendor assistance can be impacted by problems including time zone variations, communication difficulties, and disparities in service quality between areas (Esteves & Pastor, 2001).

Integration issues pose an additional challenge, since the ERP system needs to communicate with multiple systems located in disparate areas, each possessing distinct legacy procedures and technological frameworks. Because the organization's global activities have diverse IT landscapes and standards, ensuring smooth integration is imperative but frequently challenging (Themistocleous et al., 2001).

Concerns about scalability and adaptability often surface as firms expand and undergo transformation. An ERP system can easily turn into a burden, restricting the organization's agility and responsiveness, if it is not scalable or adaptable enough to meet changing business needs (Reimers, 2003).

Because of the difficulty of coordinating across several geographies, each with their own requirements and difficulties, global ERP rollouts are extremely difficult. For these rollouts to be successful, careful planning, an understanding of operational and cultural diversity, strong data management methods, efficient training and change management techniques, clear communication, dependable vendor support, careful system integration, and future-proof scalability are all necessary. For companies hoping to fully utilize ERP systems in order to attain a unified, effective, and competitive worldwide footprint, addressing these obstacles is essential.

2.2.4 Previous research on ERP systems rollouts

Previously ERP systems rollouts have been studied with multiple methods, one such being Chi-square tests and ANOVA on ERP implementation in Nepal (Chatterjee et al., 2020). Using data envelopment analysis to aid in the selection of the ERP system (Lall and Teryarchakul 2006). Questionnaire surveys as well as on-site interviews have also been used to study ERP implementation in Taiwan (Lin et al., 2006). Qualitative case study research has also been used to develop guidance for ERP implementation success (Zhang et al., 2005). Most of the studies however, focus on a single rollout or a single case study. Whereas this research focuses on multiple and uses an analysis method that has not been seemingly present in previous research, which is fuzzy set qualitative comparative analysis (fsQCA).

3 Valmet And LEAP Forward Program

This section will give an overview of Valmet, including the history of the company, as well as the industries and business lines of the company. The LEAP forward program, which was assembled to take care of ERP rollouts across global company locations, Valmet’s chosen ERP provider and plans for the future with the LEAP forward program will be explained as well. All of the information in section 3 is publicly available information from the Valmet website.

3.1 Valmet

history of Valmet, which has roots as far as the 1750s as a division of the State Metal Works (Valtion Metalli), is intricately involved with the development of Finland's industrial sector. Valmet has evolved, diversified, and merged throughout the ages to meet changing industrial demands, strengthening its reputation around the world. When it separated from Metso Corporation in 2013 to become a standalone, worldwide organization, its trajectory changed.

Valmet's strong offering in the pulp and paper industry is at the core of its business. Valmet is well known for its cutting-edge technologies that cover the whole lifecycle of pulp, paper, and board manufacturing, regularly updates its technology to meet the changing needs of the sector. In addition, Valmet is a pioneer in sustainable energy solutions, providing creative ways to transform recyclables, garbage, and biomass into clean energy. This is essential in the modern world, which is quickly moving toward renewable energy sources.

Valmet has unmatched automation skills in this age of digital transformation. Their solutions take into account the needs of contemporary industry, from process controls to business analytics, and optimize material utilization, improve environmental performance, and increase profitability. In addition to its technological offerings, Valmet offers a wide range of services, with a focus on the value of routine maintenance, plant upgrades, and spare parts availability.

Valmet has a global reach with a presence in North and South America, Europe, Asia, and the Middle East. Their activities span over 100 nations, demonstrating their capacity to respond to issues unique to each locale, and their network of service centers ensures prompt and effective after-sales care.

A fundamental component of Valmet's culture is sustainability. The business is committed to attaining resource-efficient production with a minimal negative impact on the environment. Their goods frequently contain elements that minimize energy consumption, minimize waste, and lessen environmental impacts. As a company listed on the NASDAQ Helsinki, Valmet's financial success reflects its adaptability and durability and benefits from its wide range of products, strategic partnerships, and in-depth knowledge of market dynamics.

The operating plan for Valmet includes innovation as a key component. Valmet improves its solutions via significant expenditures in research and development, assuring alignment with current industry demands. They are a top choice for international businesses because of their creative solutions to the problems facing the pulp, paper, and energy industries.

The industrial environment is constantly changing as a result of changes in the world economy, more stringent environmental rules, and the digitalization of conventional industries. But Valmet is well positioned to overcome these difficulties and turn them into opportunities because to its long history, diverse offers, and constant dedication to innovation and sustainability.

Valmet is essentially a model of superior industrial performance. Especially as industries develop and the need for sustainable, competent, and ground-breaking solutions grows, its broad range of offers, global operations, and dedication to sustainability and innovation maintain its important place in the global market.

3.2 LEAP Forward Program

Valmet launched a new Enterprise Resource Planning program called LEAP in 2016. The program was to replace a set of legacy ERP programs that were non-integrated and coming to an end of their life-cycle.

The original goal of LEAP Forward was to offer a unified ERP solution for Valmet’s various business units. The idea was that LEAP Forward is more than just a program, it is a representation of the organization’s flexibility, resiliency and forward-thinking strategy. Valmet wasn’t merely preparing for the future by combining a rigorous rollout with a targeted development roadmap, it is actively shaping it’s course. Valmet was planning to strengthen it’s position in the global market, supported by a single ERP perspective.

The promising course ran into obstacles, delaying the initial timelines and projected advantages. Instead of getting discouraged, the Valmet team began a thorough solution evalution in early 2022 to pinpoint and resolve the fundamental problems and restructure the program’s strategy. This strategic renewal, which was carried out in collaboration with numerous stakeholders made the program’s path more clear. Currently, thousands of Valmet employees use the systems globally and a substantial proportion of orders and sales is generated through LEAP.

3.2.1 Valmet’s ERP system Infor LN

Valmet went through a thorough evaluation of multiple ERP systems and landed on Infor LN which is made specifically to meet the commercial requirements of manufacturers. It makes quick and affordable integration across diverse supply chains possible. Additionally, it encourages contextual and sector-specific analytics, allowing for the collecting of real-time data and the monitoring of performance measures to improve communication for businesses. In fact, manufacturers all over the world utilize Infor LN to optimize organizational processes, increase transparency, and reduce the need for software customizations in order to compete. The current version mainly being used across Valmet is Infor LN version 10.5

Some of Infor LN's notable features include:

It is a single-instance, global ERP that can be used both on-premises and in the cloud. It provides support for repeated manufacturing, MTO (make-to-order), ETO (engineer-to-order), and MTS (make-to-stock). When a consumer places an order, the products are manufactured in MTO environments. Customizations, a unique engineering design, and the acquisition of new materials are all part of the client specifications in ETO situations.

It offers visibility into the supply chain from production to shipping, warranties, services, and refurbishing.

There are 21 distinct languages available.

Without having to alter the source code, it includes a wide range of tools for customization.

It provides local adherence for 49 nations which is important for a company with a global presence such as Valmet.

It provides a thorough assembly line control to add last-minute alterations to challenging items. (Infor.com)

Sailotech.com, a digital transformation services provider states the following as reasons for a company to decide to choose Infor LN

It enables quicker decision-making. An organization can expedite its decision-making process because of the simplicity of information availability anytime, anyplace.

It makes social networking possible. Using Infor's social media collaboration platform Ming.le, InforLN may produce tasks, alerts, and posts. It serves as a central hub for social collaboration, corporate process improvement, and contextual analytics. In fact, you can access business dialogues involving both internal and external members of the organization by using Infor Ming.le to monitor workflow, alerts, and analytics, traverse back and forth between different Infor applications, and view workflow.

It encourages simple customization. Customization is a crucial aspect that sets Infor LN apart. Through its 'customize grid' capability, it allows customization of the change appearance. Additionally, it is possible to modify screens. The task may be completed more quickly in order to meet the strict deadlines and schedules thanks to all of these user-friendly features.

It provides easy integration with other programs. Different Infor and non-Infor systems can be easily synchronized thanks to the Infor ION, also known as the Infor Intelligent Open Network. This scalable and potent solution achieves better corporate efficiency by removing operational constraints.

In conclusion, the advantages of choosing Infor LN make the time, money, and effort invested in it worthwhile, according to Sailotech.com and the Infor company website.

3.2.2 LEAP Forward Rollout Strategy

Valmet’s original rollout strategy, Rollout model 1.0 was introduced on the 29th of October 2020. The model employed a waterfall type approach where rollouts were completed in phases, with each phase beginning once the previous phase had already taken place. Rollout model 1.0 included three different phases, Phase A, Phase B, as well as Phase C. The model is visualized in Figure 1.

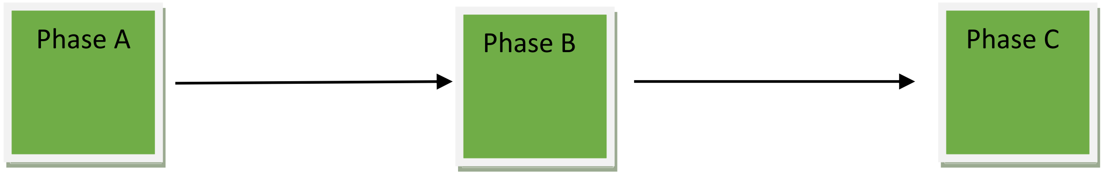

Figure 1. A visualization of the waterfall approach of Rollout model 1.0

The scope of phase A is summarized below:

- Addressing the activities which typically prolong the Rollout execution, e.g. data, surrounding system implementation, way to operate decisions
- Onboarding the management as early as possible
- Building understanding of the Template
- Detecting gaps and planning to close them

In essence, the role of Phase A was to plan and prepare everything needed as to enable a smooth as possible rollout. The schedule of Phase B was confirmed once Phase A had been completed.

The scope of Phase B is summarized below:

- Execution and follow up of Adaptation plan tasks
- Local change management activities
- Ensure that the local organization understands the new way to operate and is capable of taking the system into use
- Assessing the readiness for the go-live and business continuity after the go-live

Phase C was a reviewing and monitoring phase, which included analyzing the adaptation to the new system through data as well as possible Hypercare periods following Phase C to support implementation of functionalities that are taken into use at later stages.

Rollout model 2.0 was very similar to model 1.0, introduced on the 22nd of November 2021 to improve upon model 1.0, the main reason being to have a clear understanding of the rollout scope and strategy before beginning the deployment. however model 2.0

introduced the Enabler phase, in essence, the Enabler phase was a phase similar to Phase A in rollout model 1.0, although Phase A, B, and C were retained from the previous model, they were updated, as well as phase A was now split into the Enabler phase as well as the new Phase A, where the Enabler phase included identifying everything needed that would enable a possible rollout, after this a handover was introduced which was used to move the rollout from the Enabler phase to Phase A and check that everything in the Enabler phase had been completed. New roles were also added in model 2.0. Figure 2. Shows how the enabler phase and handover were added to model 2.0.

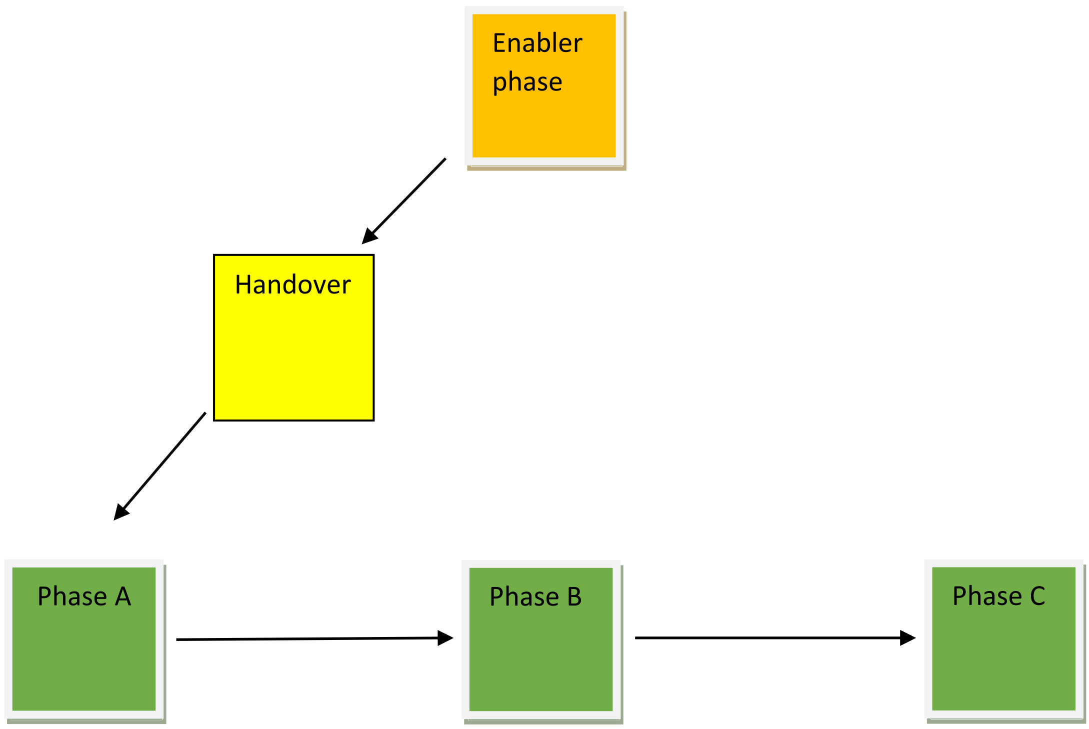

Figure 2. A visualization showing the added Enabler and handover for model 2.0

Rollout model 2.1 was again similar to model 2.0 and was introduced on the 6th of September 2022, however rollout model 2.1 emphasized the importance of collecting Lessons learned from rollouts to improve future rollouts, prevent the organization from repeating the same mistakes, as well as to share innovative approaches and positive work practices to learn from colleagues within the organization. New milestone reviews were added to model 2.1, as well as role descriptions were updated.

Rollout model 3.0 differed from the previous rollout models in such a way that the Rollout model hierarchy was improved, rollout roles were clarified further. The alignment between rollout phases and program increment development cycles were improved. ERP development is done in program increments that are roughly 3-month long time periods. The program increment consists of development sprints which are generally 3 weeks long. The LN 10.5 development content is coming through requirement process and key topics are related to enable rollouts. There is Leap level development roadmap that contains the key development areas. The roadmap is updated on quarterly basis. The rollout needs are fed in to requirement process, the development is done in agile way and the results are deployed for rollout validations and production use. Prior to each program increment, a Program Increment planning event is conducted where the content is planned on high-level. The detailed plans are done in sprint planning sessions for each 3 weeklong sprint. Figure 3 gives an understanding of how program increments are divided into sprints.

Figure 3. An overview of how program increments are divided into sprints

Leap's updated strategy gave priority to two key objectives: enabling rapid rollouts that deliver real business benefits and changing the emphasis from thorough solution optimization to system reliability. This change was stressed by upper management, who also emphasized the need for quicker rollouts and stable company operations. The goal was to construct a solid, dependable ERP system that was in line with the complex requirements of Valmet's business rather than an idealized one.

In essence, the models have been building on top of the original model 1.0, with the core idea of a waterfall model with phases being retained.

3.2.3 Rollout plans for the future

Plan for the Global Rollouts of Infor LN 10.5 (2023–2026)

The foundation of Valmet's future plans is a Global Rollout Plan that runs from 2023 to 2026. This plan is more detailed than its predecessors and is well-organized. By the end of 2026, the goal is to have Infor LN 10.5 fully implemented. This entails starting the first cloud pilots in Brazil and India, setting up a complete plan, rolling out the plan in stages, and carrying out each step in detail. This rollout plans accuracy is essential to its success since it guarantees a precise and efficient deployment.

LN Development Roadmap

The Leap Development Roadmaps link the strategy to the development. The highest-level roadmap spans for the Leap program duration and provides Leap level plan covering LN 10.5 rollouts, development and cloud roadmaps.

The level 1 development roadmap presents Leap level planning and spans for 2-year timeframe. It supports business line and function alignment as well as management level communication. The level 2 development roadmap presents stream level planning and spans for next 3 program increments timeframe. The level 1 and level 2 roadmaps are reviewed / updated quarterly.

Strategy for Cloud Migration

Valmet's ERP strategy will undergo a significant change after 2026 with the adoption of LN Cloud Edition (CE). An important ERP technical update will occur, transferring to the cloud-based version of the ERP system, following the conclusion of the LN 10.5 rollouts and the start of the first cloud pilots. The goal of this shift is to ensure the system's long-term maintenance while causing the least amount of inconvenience to end users.

3.2.4 Program and Strategy Update for Leap Forward

Leap Forward Strategy: 2022 Revision and Upcoming Events

The Leap Forward strategy received a significant change in the later half of 2022, giving the program a more defined direction. The program's strategic objectives were refined and new timelines for 2023–2026 were presented. Achieving "benefits through accelerated rollouts and secure business continuity" is the new motto for the approach, which the head of the Leap program stressed. Ensuring that the ERP system is fully utilized while sustaining continuous business operations in the face of changing market and technological conditions continues to be the primary objective.

Implementation Plans and Projects for System Development

Valmet has established logical rollout plans, methodical development projects, and well-defined priorities in order to achieve these goals. North America hosted the system's launch in 2023, which is an important step from a business standpoint. Furthermore, Finland and Sweden will host the launch of the project logistics system (VLS). China, where the system is already in use, and other EMEA nations' feedback are crucial to the system's improvement.

Prioritize rollout enablers, stability, and optimizations.

The emphasis has shifted to crucial system optimizations, rollout enablers, and stability enhancements considering the Leap Forward initiative's new direction. Increased system reliability and user happiness are the goals of this strategy. As per the updated strategy, Valmet's commitment to a single, worldwide ERP system was reaffirmed with the April 2023 system launch in North America.

3.2.5 A Vision for a Future-Ready Valmet

Global Reach and Cohesion

The Global Rollout Strategy is an ambitious project that intends to spread the innovations from the Leap Forward program to every area of Valmet's business. Through addressing Valmet's broad operational reach in multiple locations, the strategy upholds a single position on goals, enabling the organization to advance as a whole.

Development Roadmaps for Collaboration

The program's trajectory must be guided by the development roadmaps. These roadmaps are dynamic, evolving in response to market trends, technology breakthroughs, and consumer input. Through collaborative process, Valmet creates roadmaps that encompass the collective wisdom and ideas from different divisions and operations inside the firm, promoting a sense of shared ownership and loyalty.

Accepting Common Wisdom

Valmet is obviously committed to using collective wisdom. The company maximizes the variety of experiences and knowledge bases within its structure by incorporating various business units and roles in the roadmap building process. In addition to improving the roadmap, this inclusive approach fosters a commitment and participation culture throughout the entire organization.

Achieving the Leap Forward Goal

The redesigned approach is essential to the Leap Forward program, which seeks to establish Valmet as a forward-thinking company leading its sector. Valmet maintains its trajectory in line with changing market demands, customer preferences, and the international business environment by following the worldwide rollout strategy and well-informed development roadmaps.

4. Methodology

This Section will give an understanding of the research design and approach, how the data for the research was collected, how it was prepared for analysis. This section will also explain why the specific analysis technique was chosen, including general benefits of the technique.

4.1 Research design and approach

The focus of the study is to create an understanding of the relevant critical success factors involving ERP rollouts in Valmet locations, as well as to differentiate how and if they have changed in a meaningful way between the rollout models employed by the company. Considering the previously mentioned growing use of ERP systems despite their low success rate in large companies, the value of this information is realized.

The chosen analysis technique for this study is fuzzy set qualitative comparative analysis (fsQCA).

The data used for the research is compiled from Lessons Learned PowerPoint files containing text data from Valmet from different global locations, using different rollout models covering four different strategies (1, 2, 2.1, and 3) over four years. This specific dataset was chosen due to the availability of the data, as well as because the lessons learned gathered from rollouts was used as feedback for future rollouts. There are altogether six different cases where rollout model 1 was utilized, ten for rollout model 2, two for 2.1, and three for 3. This involves sixteen different locations from fifteen different countries. The data contained information about the number of end users involved with the rollout, the location of the rollout, the next variables were given a positive/negative rating based on the total number of positive and negative comments concerning the variable, these include: General performance, rollout management, data management, change management, and training. For example, if a rollout were to have 3 positive comments for data management and 2 negative ones, the score for this specific rollout in the data management section would be 3-2=1.

Analysis methods that are skilled at unraveling the complexities of complex causality include qualitative comparative analysis (QCA) and its derivative, fuzzy-set qualitative comparative analysis (fsQCA) (Ragin, 2008). QCA/fsQCA acknowledges that real-world outcomes frequently result from a combination of several interacting factors or situations, in contrast to traditional techniques that frequently evaluate causality in a linear fashion (Schneider and Wagemann, 2012).

The combinatorial logic of QCA/fsQCA is its core component. This method examines how various combinations can produce particular results rather than just looking at individual conditions in isolation (Rihoux and Ragin, 2009). For instance, the success of a corporate rollout may depend on a combination of factors, such as a location, a certain number of affected employees, and a good comment score.

QCA/fsEach case (or rollout) is seen as a unique configuration of conditions by QCA's configurational method, which identifies which configurations are ripe for success and which might present difficulties (Schneider and Wagemann, 2012). This subtle knowledge can show, for instance, that rollouts in a country with a developed infrastructure, Country A, may succeed even with a few negative comments, whereas rollouts in a less developed country, Country B, may require a high favorable comment score to be successful.

QCA/fsQCA preserves the complexity of the data, capturing nuances and specificities, in contrast to standard statistical methods that may dilute the effects of individual circumstances (Ragin, 2008). It provides a middle ground by highlighting both peripheral circumstances that may have an impact in certain contexts and core conditions that are consistently related with a result (Rihoux and Ragin, 2009).

Decision-makers may understand the particular circumstances that lead to desired outcomes and use this information to inform future strategies thanks to the transparency and interpretability provided by QCA/fsQCA results, which are frequently presented as "truth tables" or logical statements (Schneider and Wagemann, 2012).

QCA/fsQCA emerges as a subtle tool to decipher these intricate causal links when navigating the varied data from firm rollouts. Utilizing this method, businesses can gain deeper insights into the factors supporting successful rollouts and improve their strategy for subsequent ventures.

Size of sample advantages:

The difficulty of assessing datasets that lie somewhere between huge quantitative datasets and individual case studies has long been a problem in social science research. These datasets, which are sometimes described as having a "intermediate N" (number of cases), pose particular difficulties. They are too big to perform in-depth case-by-case comparisons, which may be possible for smaller datasets, but they are also too small to satisfy the assumptions and specifications of standard statistical techniques, which are intended for bigger datasets (Goertz and Mahoney, 2012).

These "intermediate N" conundrums are particularly well-suited for QCA and its variant fsQCA. These techniques give a way to systematically compare and assess a fair number of cases, bridging the gap between qualitative and quantitative analysis (Ragin, 1987).

If an organization has carried out rollouts in a number of locations that are neither too small for in-depth qualitative research nor large enough for conventional statistical methodologies, QCA/fsQCA becomes invaluable in the context of corporate rollouts. For instance, it would be difficult to analyze each case in depth if a corporation had carried out rollouts in 20 different countries, and the dataset might not be large enough to support reliable statistical modeling.

QCA/fsBy identifying trends and configurations throughout numerous rollouts, QCA offers insights into the combinations of factors that contribute to success or difficulty. It allows for systematic comparison and analysis while capturing the depth and specificity of each case (Rihoux and Ragin, 2009). The mix of site attributes, staff involvement, and feedback ratings that regularly result in successful rollouts can be revealed, for example, using this configurational technique.

QCA/fsQCA delivers a sophisticated, methodical, and comparative analysis that standard methodologies might not adequately capture for businesses dealing with an intermediate number of rollouts.

Fuzzy advantages:

Fuzzy-set The basic QCA approach is extended by qualitative comparative analysis (fsQCA) to solve the limitations of binary or crisp-set categorizations (Ragin, 2000). Traditional QCA functions in a context of presence against absence, success versus failure, and other binary logic concepts. In contrast, "fuzzy sets" are included in fsQCA to account for different levels of set membership.

Fuzzy sets allow for varying degrees of membership as opposed to binary logic, which strictly classifies cases as either belonging or not to a set. There are various levels of partial membership in between full membership (coded as 1) and total non-membership (coded as 0; Ragin, 2008). This level of detail is crucial when examining the feedback from business rollouts. For instance, if the good-negative remark difference from rollouts is taken into account, a score of 2 (obtained from 5 positive and 3 negative comments) does not necessarily indicate success or failure. Instead, it denotes a level of achievement. fsQCA captures this nuance by interpreting such differentials as fuzzy sets and identifying scores as ranging between totally positive and entirely negative feedback.

With the ability to manage degrees of membership, one can avoid the oversimplifications of strict binary categorizations and gain a more nuanced knowledge. The ability of fsQCA to process fuzzy sets allows for a more thorough and nuanced analysis of such data since real-world occurrences, including feedback on business rollouts, frequently manifest on spectrums rather than in rigid classifications.

When compared to typical binary approaches, fsQCA's expertise with fuzzy sets ensures a more thorough and accurate analysis when faced with data like the positive-negative comment differential from firm rollouts, which inherently spans a spectrum.

Treating variables as combinations:

Understanding the success or difficulties of an effort takes more than just looking at individual aspects in isolation in the complex world of global firm rollouts. The outcome of a rollout frequently reflects the interaction and influence of a number of different factors. With its distinctive analytical methodology, QCA/fsQCA is skilled at offering a comprehensive viewpoint on such difficult cases.

QCA/fsQCA incorporates variables including geography, personnel counts, and comment scores into a seamless analysis as opposed to treating them as independent entities (Berg-Schlosser and De Meur, 2009). This strategy acknowledges that a rollout's success or difficulties may not be exclusively attributable to one aspect, like positive feedback, but instead may be the consequence of a synergy between positive feedback in a particular region and a certain number of affected personnel.

In a small-employee site, a rollout might garner overwhelmingly positive feedback, but in a larger-employee location, the same input might not convert to success. On the other hand, despite mixed reviews, a rollout may still be considered successful in a particular area due to other mitigating variables, such as the nature of the rollout or the unique obstacles that area is expected to face. The QCA/fsQCA technique captures these complex interactions and provides a thorough picture of the rollout's environment (Vis, 2012).

The power of QCA/fsQCA resides in its capacity to offer a comprehensive view of business rollouts, tying the numerous threads of elements into a logical story. Organizations are given the insights they need to make wise decisions by this comprehensive understanding, ensuring that strategies are based on a complex web of interrelated aspects rather than simply a few discrete data points.

5. Analysis and Results

This Section will explain more deeply about how fsQCA was used in this specific context, as well as give the reader an understanding of how to interpret the results/output tables of the analysis, mainly explaining the consistency and coverage (F1-F4) measures as well as explaining how the input table was fuzzified. The section will then display the most meaningful results/output tables and give a summary of the numbers related to them, first showing the rollout models separately analyzed and then all the models when analyzed together as one dataset. A maximum of three inputs were used in the fsQCA, which were the rollout model being used, the amount of end users (many versus not many), as well as the variables involved in the rollout, which include rollout management, data management, change management, and training. The output from these inputs that was studied was good general performance of the rollout, which was again, measured by comments made in lessons learned that were collected after the completion of the rollouts.

Consistency in fsQCA refers to how much a causal combination influences an outcome. Consistency is between 0 and 1. When using crisp sets, you can think of it as the percentage of cases that share a particular cause combination with the outcome set. Whereas coverage refers to the percentage of observed outcomes that may be correctly attributed to a certain cause or condition. In essence, it assesses the extent to which the suggested explanation can explain the observed outcome. high coverage means that the identified cause is responsible for the majority of the outcomes, a low coverage implies that other factors may also be involved. Originally the ideas of consistency and coverage were fuzzified by Ragin in 2008. This was due to the challenges brought forward by ambivalent observations in data that could simultaneously support and contradict a given rule. In a fuzzy context, the same data instance can provide partial support for a claim but at the same time provide evidence for contradicting it.

The original fuzzified consistency and coverage metrics by Ragin are the cornerstone metrics, but they are susceptible to ambivalent information, which may result in erroneous interpretations. By removing data that supports both an outcome and its denial, F2 consistency offers a clearer perspective of linkages by reducing the influence of ambivalent information. By weighing the evidence for and against a link, F3 consistency offers a balanced perspective. Instead of removing ambivalent data, F4 consistency redistributes the evidence between the support of a relationship and its negation. This distinction between ambivalent and absent evidence allows for more precise analysis. The argument for taking into account all of these factors is to ensure a thorough study. A comprehensive comprehension of data interactions is ensured by the distinct perspectives each measure delivers. The F2, F3, and F4 measures also offer methods for dealing with ambiguity in fuzzy data, strengthening the validity of results. Researchers can evaluate the reliability of their results and ensure that they have captured all nuances and insights by comparing the results across different measures. In essence, the F2, F3, and F4 measures handle the complexity of fuzzy data, ensuring a thorough, robust, and nuanced analysis while the original measures offer fundamental insights. (Stoklasa, Talášek, and Luukka 2018)

In the study of fuzzy systems, fuzzification is the process of turning crisp numerical data into fuzzy values, a concept introduced by Zadeh (1965). This transformation is critical when working with real-world data, which often contains ambiguities. Among the various membership functions available for this purpose, the trapezoidal function is commonly employed due to its versatility (Klir & Yuan 1995).

A trapezoidal fuzzy set is a fuzzy set used in fuzzy logic and fuzzy set theory to represent uncertain data. It is visualized by a trapezoidal shape. The shape has four points: a, b, c, and d which determine the boundaries where the membership function changes from 0 to 1 and back to 0. The membership function is 1 in the interval [b,c] in a trapezoidal fuzzy set and increases linearly from 0 to 1 between a and b and decreases linearly from 1 to 0 between c and d. This type of fuzzy set is useful in when data cannot be precisely defined and is used in fields such as decision-making, and artificial intelligence (Klir & Yuan 1995).

The data table used in the analysis was subjected to this fuzzification process. Specifically, the ‘Users’ column was fuzzified using a trapezoidal fuzzy set with parameters [50, 100, 2000, 2000]. In this configuration, values between 100 and 2000 achieve a full membership value of 1, indicating a high user count.

Similarly, the rest of the variables, for which positive/negative comments were compared were fuzzified using parameters [0, 3, 20, 20]. Here, values between 3 and 20 attain a full membership value of 1, suggesting a fully positive score. When looking at bad general performance, the parameters used were [-20, -20, -3, 0]

This fuzzification approach gives a nuanced representation of data, allowing for a deeper understanding of common uncertainties. Such an approach is important for informed decision-making (Ross, 2004). Figure 4 gives an example of the visualized trapezoidal fuzzy set with the parameters [0, 3, 20, 20].

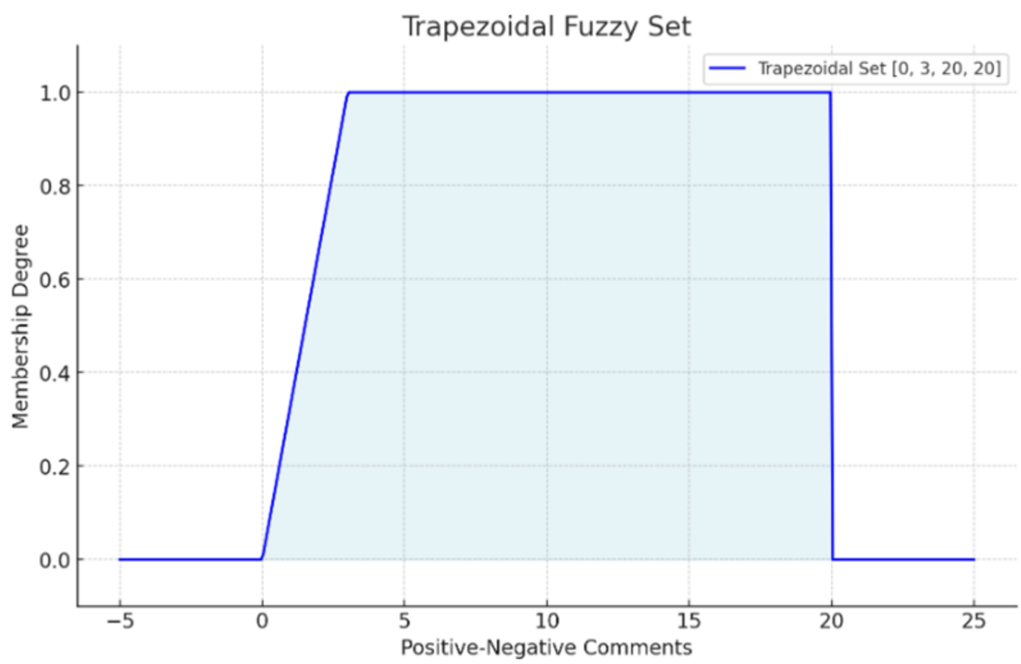

Figure 4. An example of a visualized trapezoidal fuzzy set used to represent “good performance” in variables general, rollout management, data management, change management and training

In essence, a trapezoidal fuzzy number can be thought of a bit like a mountain with a flat peak, at the base of the mountain the membership value is 0, so in this case it would be at the score of 0 for the positive/negative comments scored variables, and when moving towards the peak of the mountain the score starts to rise towards 3, the membership value can be anywhere between 0 and 1 before the peak is reached at value 3, then it remains at 1 from there on as the last two parameters are both 20. Therefore, a value of 3 would give the variables being considered as causes a full membership value of 1.

Table 1. “Model 1.0 rollouts with many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0,082508	0,1	0	0,1	0	0	0,082508	0,1
A=>notB	0,917492	0,209811	0,834983	0,155472	0,834983	0	0,917492	0,209811

Table 1. shows quite strongly that model 1.0 rollouts many end users did not perform well in general, looking at the second row “A=>not B”, which indicates in this case that A (model 1.0 rollouts with many end users) were a cause for not B (a not good general performance). Considering that the consistency is quite high at a minimum 0,83 across all four F1-F4 consistencies in this case it can be confidently said that model 1.0 rollouts with many end users did not have a good general performance.

Table 2. “Model 1.0 rollouts with good data management/change management and many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0,5	1	0	0	0	0	0,25	0,5
A=>not B	1	0,12	0,5	0	0,5	0	0,75	0,09

In the case of Table 2. The data shows the F1-F4 consistencies when A is model 1.0 rollouts with many end users and good data management, the table also shows the values for when A is model 1.0 rollouts with many ends users and good change management, as the results were the same. Once again B is good general performance as is the case for almost all of the tables. Table 2. Suggests that when data management as well as change management performance was rated favorably in model 1.0 rollouts with many end users, it lead to a not good general performance. This shows that perhaps data management and change management were not important factors in the general performance of model 1.0 rollouts with many end users.

Table 3. “Model 1.0 rollouts with not many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0	0	0	0	0	0	0	0
A=>not B	1	0,11	1	0,06	1	0	1	0,11

Table 3. is similar to Table 1. However, it suggests more confidently that A (model 1.0 rollouts with not many end users) was a cause for not B, as all the F1-F4 consistencies were 1, therefore looking at Table 1. And Table 3. it is possible to confidently say that model 1.0 rollouts lead to a not good general performance, with model 1.0 rollouts at locations with not many end users showing a slightly higher support for this claim.

Table 4. “Model 1.0 rollouts with good change management and not many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0	0	0	0	0	0	0	0
A=>not B	1	0,06	1	0	1	0	1	0,06

In Table 4, A is Model 1.0 rollouts with good change management and not many end users. The table suggests that when change management was rated favorably, it lead to a not good general performance in model 1.0 rollouts with not many end users. The table is similar to Table 2. However, the consistencies are 1 across the board for all the F1-F4 consistencies. Therefore it can be said that change management in model 1.0 rollouts with not many end users was a cause for not good performance. No other variables for model 1.0 rollouts besides change management and data management provided any meaningful results.

Table 5. “Model 2.0 rollouts with many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0	0	0	0	0	0	0	0
A=>not B	1	0,17	1	0,14	1	0	1	0,17

Table 5 shows that model 2.0 rollouts with many end users did not perform strongly, the consistency for A being a cause for not B, Model 2.0 rollouts with many end users being a cause for not good general performance has a 1 consistency across all four F1-F4 consistencies. Quite a similar situation to the model 1.0 rollouts with many end users in Table 1, however here the numbers show an even stronger support for A causing not B.

Table 6. "Model 2.0 rollouts with many end users and good data management lead to a good general performance"

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0	0	0	0	0	0	0	0
A=>not B	1	0,04	1	0	1	0	1	0,04

Table 7. "Model 2.0 rollouts with many end users and good change management lead to a good general performance"

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0	0	0	0	0	0	0	0
A=>not B	1	0,04	1	0	1	0	1	0,04

Table 6 and 7 show the results for model 2.0 rollouts with many end users and good data management in Table 6, and good change management in Table 7. When looking at the other variables (training and rollout management) substituted for data/change management, the numbers were 0 in all of the tables for all of the values, the reason for this was that there were no model 2.0 rollouts with many end users that had a good rating for any of them, therefore it is not possible to study how they affected general performance as there were no values present to study. However, for data and change management, the values are 1 for both in all four F1-F4 consistencies, which shows that good data and change management were a cause for not a good general performance in model 2.0 rollouts with many end users.

Table 8. “Model 2.0 rollouts with not many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0,14	0,3	0	0,3	0	0	0,14	0,3
A=>not B	0,86	0,34	0,71	0,3	0,71	0	0,86	0,34

Continuing with the trend from most tables presented, model 2.0 rollouts with not many end users lead to a not good general performance, as is visible from Table 8. However, the consistencies are not quite as high in previous tables with 0,86 being the highest and 0,71 being the lowest, therefore the claim cannot be made as confidently.

Table 9. “Model 2.0 rollouts with not many end users and good rollout management lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0,27	1	0	0,67	0	0,67	0,23	0,83
A=>not B	0,82	0,33	0,55	0,26	0,55	0	0,77	0,31

The case for model 2.0 rollouts with good rollout management is interesting, although once again, it does look like model 2.0 rollouts with good rollout management and not many end users did lead to a not good general performance, however the consistencies are not as high as in previous tables, ranging from 0,82 to 0,55 for A causing not B. The coverages on the other hand are the highest out of all previous tables for A causing B, however when looking at the consistencies for A causing B, which is the more important measure of the two, it is very low, ranging from 0 to 0,27. Therefore it can be said that generally, model 2.0 rollouts with not many end users and good rollout management lead to a not good general performance, but not as confidently as with previous models and user counts, however it certainly was a factor in all of the model 2.0 rollouts with not many end users.

Table 10. “Model 2.0 rollouts with not many end users and good data management lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0	0	0	0	0	0	0	0
A=>not B	1	0,07	1	0,04	1	0	1	0,07

Table 11. “Model 2.0 rollouts with not many end users and good change management lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0	0	0	0	0	0	0	0
A=>not B	1	0,07	1	0	1	0	1	0,07

In essence, Table 10 and 11 are quite similar to Table 6 and 7, which are for model 2.0 rollouts concerning data and change management as well, however Table 10 and 11 are for locations with not many end users, and the same conclusions can be drawn from them, and this is that they were perhaps reasons for a not good general performance, as shown by the consistencies of 1 for A causing not B in both tables.

Table 12. “Model 2.1 rollouts with many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0	0	0	0	0	0	0	0
A=>not B	1	0,06	1	0,06	1	0	1	0,06

Table 12 is similar to Table 10 and 11 (which were similar to Table 6 and 7), however in Table 12 model 2.1 rollouts are introduced, and in this case they are concerning model 2.1 rollouts with many end users. Considering the similarities to the mentioned tables, the same interpretations can be made, and they are that model 2.1 rollouts did not perform strongly, when looking at the ratings for general performance. There was only one model 2.1 rollout with many end users in the dataset, and none of the variables considered (General performance, rollout management, data management, change management, training) received positive ratings, therefore it is not possible to study how different good performances in model 2.1 rollouts with many end users lead to a good general performance from this dataset.

Table 13. “Model 2.1 rollouts with not many end users and good data management lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0		0		0	0	0	
A=>not B	1	0,33	1	0,17	1	0	1	0,33

Table 13, the only table of relevance regarding three variables and model 2.1, shows that good data management was a variable that caused not a good general performance, as shown by the consistencies of 1 for A not causing B.

Table 14. “Model 3 rollouts with many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	1	0,3	1	0,3	1	0	1	0,3
A=>not B	0	0	0	0	0	0	0	0

Table 14 is the first table that in a sense completely differs from what has been seen in previous tables, as it shows that model 3 rollouts with many end users performed actually quite well, this is seen with all of the consistencies being 1 for A being a cause of B, however it should be noted that the dataset did only contain one model 3 rollout with many end users. Something quite interesting as well about this model 3.0 rollout with many end users is that although it received a positive general performance rating, it did not receive positive ratings for any other variable.

Table 15 “Model 3.0 rollouts with not many end users lead to a good general performance”

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0,5	0,3	0,5	0,3	0	0	0,5	0,3
A=>not B	0,5	0,06	0,5	0,06	0	0	0,5	0,06

Both tables 14 and 15 for model 3.0 rollouts with many and not many end users differed from the previous rollouts' tables in a sense that they do not point towards the rollouts performing badly, however Table 15 does not also point towards the rollouts performing as well as in Table 14. It looks like quite an even mix as seen with the 0,5 consistencies, however the coverages are a bit higher for A causing B (Model 3.0 rollouts with not many end users causing a good performance). This does not mean however that Model 3.0 rollouts performed well according to the table; the results are very mixed.

Table 16 "Model 3.0 rollouts with not many end users and good rollout/data/change management and training lead to a good general performance"

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	1	0,5	1	0,5	1	0	1	0,5
A=>not B	0	0	0	0	0	0	0	0

Table 16 shows that when model 3.0 rollouts performed well, it was due to all variables performing well. Table 16 does not show the results when good rollout, data, and change management as well as good training were considered together, but rather they are all provided in the same table. Which when looking at the consistencies in the first row for A causing B, shows exactly that they all contributed to a good general performance.

Table 17 "Model 2.0 rollouts with many end users lead to a bad general performance"

	F1 consistency	F1 coverage	F2 consistency	F2 coverage	F3 consistency	F3 coverage	F4 consistency	F4 coverage
A=>B	0,89	0,41	0,89	0,37	0,78	0	0,89	0,41
A=>not B	0,11	0,02	0,11	0	0	0	0,11	0,02

Table 17 is the only table that shows the outcome (B) as being a a 'bad general performance', more tables would have been presented if there would have been more concrete evidence such as table 17 that points towards a bad general performance and not a neutral performance. As all other models and user count combinations were studied however model 2.0 rollouts with many end users were the only case where A was a strong cause for B, as shown by the consistencies. From this it can be quite confidently said that excluding model 2.0 rollouts with many end users, although many other input combinations did not cause a good general performance, they also did not cause a necessarily bad one either.

6 Conclusions

The research questions were to identify how rollout management, change management, data management, and training contributed to general performance of the rollout, as well as how the number of users and rollout model being used contributed. Considering the results of the fsQCA analysis showed that most rollouts did not have a good general performance, it cannot be confidently answered which variables were of importance. In earlier models employed by Valmet, good data management, change management, and to a lesser extent rollout management did not seem to positively influence the general performance of the rollout. And they do not seem to be sufficient to reach a good general performance, as there were no good general performances present in the earlier models.

It is a good sign that the performance of the rollouts improved as new models were introduced, and as mentioned in the introduction, not all ERP implementations are success stories, with high percentages of implementations considered to not achieve the desired business benefits, so some of the poor results of the analysis were to be expected, however it is a good finding that the program is headed in the right direction. It is also not a bad sign that there was only one table of significance when looking at what caused a bad performance, many tables pointed to a rollout having a not good general performance, but when looking at rollouts that lead to an actual bad performance, only one table was of relevance supporting it, which was for model 2.0 rollouts with many end users. Therefore the rollouts were mostly in a sense neutral, at least under the definitions of good and bad used in this research.

One large possible limitation of the study is that the data used in the thesis were from different global locations, different employees, and different viewpoints of different individuals were considered, something that was viewed as a negative by a certain individual could have been viewed as a positive by another individual, for example an experienced employee who does not have much trouble learning new concepts would appreciate a brief and straight-forward training whereas another individual might view it as less than sufficient and one would give a positive rating whereas another would give a negative one. Another limitation of the study was the availability of data, as mentioned in the previous section of the thesis, there were some tables presented that only contained a single rollout as the subject of the table, which questions the validity of the conclusions being drawn from the table, as a single rollout can not be used as basis for an assumption for all rollouts. However, considering that many previous studies have been made only considering one rollout, it is a strong point of the thesis that many rollouts were considered in this case. For future research it could be of use to have a standardized method of collecting feedback to make the analysis of the data more accurate when using fsQCA. It could also be of use to have a certain classification of whether rollouts were successful or not.

The thesis gives an understanding of how fsQCA can be used to study datasets of this nature, as well as gives an idea of how the development of the models has influenced the general performance of rollouts made by the company, which points towards the models performing better as newer models are introduced, which is a good sign for Valmet. The thesis also contributes to previous research by adding a study that has taken into account many rollouts. The study provides a blueprint for how future research can approach datasets of this nature for utilizing fsQCA.

References

Akkermans, H. and van Helden, K., 2002. 'Vicious and virtuous cycles in ERP implementation: a case study of interrelations between critical success factors'. European Journal of Information Systems, 11(1), pp.35-46.

Al-Mashari, M., Al-Mudimigh, A., and Zairi, M., 2003. 'Enterprise resource planning: A taxonomy of critical factors'. European Journal of Operational Research, 146(2), pp.352-364.

Berg-Schlosser, D. and De Meur, G., 2009. Comparative Research Design: Case and Variable Selection. In: Rihoux, B. and Ragin, C.C., eds. Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques. SAGE Publications, pp.19-32.

Bernroider, E.W. and Koch, S., 2001. ERP selection process in midsize and large organizations. Business Process Management Journal, 7(3), pp.251-257.

Bingi, P., Sharma, M.K. and Godla, J.K., 1999. Critical issues affecting an ERP implementation. Information Systems Management, 16(3), pp.7-14.

Bradford, M. and Florin, J., 2003. 'Examining the role of innovation diffusion factors on the implementation success of enterprise resource planning systems'. International Journal of Accounting Information Systems, 4(3), pp.205-225.

Chen, I.J., 2001. Planning for ERP systems: analysis and future trend. Business Process Management Journal, 7(5), pp.374-386.

Davenport, T.H., 1998. Putting the enterprise into the enterprise system. Harvard Business Review, 76(4), pp.121-131.

Dow, D., 2000. A note on psychological distance and export market selection. Journal of International Marketing, 8(1), pp.51-64.

Duplaga, E., & Astani, M., 2003. Implementing ERP in Manufacturing. Information Systems Management.

Esteves, J. and Pastor, J., 2001. 'Enterprise resource planning systems research: An annotated bibliography'. Communications of the Association for Information Systems, 7(1), pp.1-52.

Goertz, G. and Mahoney, J., 2012. A Tale of Two Cultures: Qualitative and Quantitative Research in the Social Sciences. Princeton University Press.

Hawking, P., Ying, S.L., and Javen, M., 2007. 'ERP post-implementation strategies'. Industrial Management & Data Systems, 107(1), pp.37-56.

Hendricks, K.B., Singhal, V.R. and Stratman, J.K., 2007. The impact of enterprise systems on corporate performance: A study of ERP, SCM, and CRM system implementations. Journal of Operations Management, 25(1), pp.65-82.

Hitt, L.M., Wu, D.J. and Zhou, X., 2002. Investment in enterprise resource planning: Business impact and productivity measures. Journal of Management Information Systems, 19(1), pp.71-98.

Hong, K.K. and Kim, Y.G., 2002. The critical success factors for ERP implementation: an organizational fit perspective. Information & Management, 40(1), pp.25-40.

Hussain, Z., Wallace, J., and Cornelius, N.E., 2007. The use and impact of human resource information systems on human resource management professionals. Information & Management, 44(1), pp.74-89.

Ilin, V., Ivetic, J., & Simić, D., 2017. Understanding the determinants of e-business adoption in ERP-enabled firms and non-ERP-enabled firms: A case study of the Western Balkan Peninsula. Technological Forecasting and Social Change.

Karimi, J., Somers, T., & Bhattacherjee, A., 2007. The Impact of ERP Implementation on Business Process Outcomes: A Factor-Based Study. Journal of Management Information Systems.

Kent, R. (2008). Using fsQCA. Department of marketing University of Stirling, 45, 489-503.

Klir, G.J. & Yuan, B., 1995. Fuzzy sets and fuzzy logic: theory and applications. Prentice Hall.

Klaus, H., Rosemann, M. and Gable, G.G., 2000. What is ERP?. Information Systems Frontiers, 2(2), pp.141-162.

Kumar, K., van Hillegersberg, J. and Kuruppuarachchi, D., 2002. ERP experiences in European and Asian companies. European Journal of Information Systems, 11(2), pp.144-156.

Lucas, S.R. and Szatrowski, A., 2014. Qualitative Comparative Analysis in Critical Perspective. Sociological Methodology, 44(1), pp.1-79.

Mahmood, F., Khan, I. and Ghafoor, O., 2014. Analytical study of open source ERP systems. Life Science Journal, 11(6), pp.81-86.

Marnewick, C. and Labuschagne, L., 2011. An investigation into the governance of information technology projects. South African Journal of Information Management, 13(1).

Nah, F., Tan, X., and Teh, S., 2004. An empirical investigation on end-users' acceptance of enterprise systems. Information Resources Management Journal, 17(3), pp.32-53.

Parr, A. and Shanks, G., 2000. A model of ERP project implementation. Journal of Information Technology, 15(4), pp.289-303.

Petter, S., DeLone, W., and McLean, E., 2013. Information systems success: The quest for the independent variables. Journal of Management Information Systems, 29(4), pp.7-62.

Ragin, C.C., 2008. Redesigning Social Inquiry: Fuzzy Sets and Beyond. University of Chicago Press.

Rikhardsson, P. and Kræmmergaard, P., 2006. Identifying the impacts of enterprise system implementation and use: Examples from Denmark. International Journal of Accounting Information Systems, 7(1), pp.36-49.

Robey, D., Ross, J., and Boudreau, M., 2002. Learning to implement enterprise systems: An exploratory study of the dialectics of change. Journal of Management Information Systems, 19(1), pp.17-46.

Ross, J.W. and Vitale, M.R., 2000. The ERP revolution: surviving vs. thriving. Information Systems Frontiers, 2(2), pp.233-241.

Shehab, E.M., Sharp, M.W., Supramaniam, L. and Spedding, T.A., 2004. Enterprise resource planning: An integrative review. Business Process Management Journal, 10(4), pp.359-386.

Shrivastava, S. and Pande, V., 2016. ERP systems’ usage and benefit a model of antecedents and outcomes. Computers in Human Behavior, 62, pp.50-58.

Somers, T. and Nelson, K., 2001. The impact of critical success factors across the stages of enterprise resource planning implementations. In System Sciences, 2001. Proceedings of the 34th Annual Hawaii International Conference on (pp. 10 pp). IEEE.

Somers, T. and Nelson, K., 2004. A taxonomy of players and activities across the ERP project life cycle. Information & Management, 41(3), pp.257-278.

Stefanou, C.J., 2001. A framework for the ex-ante evaluation of ERP software. European Journal of Information Systems, 10(4), pp.204-215.

Stensrud, E., Myrtveit, I., 2003. Identifying high performance ERP projects. IEEE Transactions on Software Engineering.

Thong, J., Chee-Sing, Y., and Raman, K., 1996. Top management support, external expertise and information systems implementation in small businesses. Information Systems Research, 7(2), pp.248-267.

Uwizeyemungu, S. and Raymond, L., 2012. Impact of an ERP system's capabilities upon the realisation of its business value: A resource-based perspective. Information Technology and Management, 13(2), pp.69-90.

Verville, J., Bernadas, C. and Halingten, A., 2005. So, what's your point? A guide for managers and users to understand the research process of selecting a decision tool for ERP software selection. Management Decision, 43(1), pp.19-36.

Wang, E., Klein, G., & Jiang, J. J., 2006. ERP misfit: Country of origin and organizational factors. Journal of Management Information Systems, 23(1), pp.263-292.

Yusuf, Y., Gunasekaran, A., & Abthorpe, M., 2004. Enterprise information systems project implementation: A case study of ERP in Rolls-Royce. International Journal of Production Economics, 87(3), pp.251-266.

Motwani, J., Subramanian, R. and Gopalakrishna, P., 2005. Successful implementation of ERP projects: Evidence from two case studies. *International Journal of Production Economics*, 96(3), pp.419-429.

Nkengfack Fialefack, J., 2023. The impact of ERP systems on business processes: How the implementation of an ERP system automates business processes, improves efficiency, productivity, and profitability.

Menezes, P.A.C. and González-Ladrón-de-Guevara, F., 2010. Maximizing the benefits of ERP Systems. Jistem Journal of Information Systems and Technology Management, 7, pp.5-32.

Zhu, Z., 2006. A systems approach to developing and implementing an ERP financial subsystem. Systems Research and Behavioral Science, 23, pp.237-250. DOI: 10.1002/SRES.757.

https://sailotech.com/blog/what-is-infor-ln/

https://www.infor.com/nordics/solutions/erp/ln

Monk, E. F., & Wagner, B. J. (2012). Concepts in Enterprise Resource Planning. Boston, MA: Course Technology Cengage Learning.

Wagner, B., & Monk, E. (2012). Enterprise Resource Planning. In M. Khosrow-Pour (Ed.), Encyclopedia of Information Science and Technology, Third Edition (pp. 1339-1345). Hershey, PA: Information Science Reference.

Koch, C. (2001). BPR and ERP: Realizing a Vision of Process with IT. Business Process Management Journal, 7(3), 258-265.

Al-Mashari, M., Al-Mudimigh, A., & Zairi, M. (2003). Enterprise resource planning: A taxonomy of critical factors. European Journal of Operational Research, 146(2), 352-364.

Stoklasa, J., Luukka, P. and Talášek, T., 2017. Set-theoretic methodology using fuzzy sets in rule extraction and validation-consistency and coverage revisited. *Information Sciences*, *412*, pp.154-173.

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Appendix 1. Dataset used as input

Rollout	Location	Users	Model	General/misc	Rollout man	Data manag	Change man	Training
1	1	14	1	-1	-2	-1	-1	-1
2	2	76	1	-1	0	-2	1	0
3	2	76	1	-7	-1	-13	-5	-6
4	3	1101	1	1	1	1	1	1
5	4	646	1	0	0	0	0	-4
6	4	646	1	0	0	1	-3	0
7	5	25	2	1	1	0	0	0
8	6	3	2	1	3	-3	0	4
9	7	19	2	1	3	-3	0	4
10	4	175	2	-6	-2	-1	-4	-4
11	8	48	2	-5	3	-2	1	1
12	9	87	2	-3	-1	-3	-1	0
13	10	67	2	0	0	2	1	0
14	11	17	2	0	1	0	0	0
15	3	1	2	-1	-4	-1	0	-1
16	4	175	2	-5	-4	-4	-4	-5
17	2	14	2,1	0	-2	2	-1	0
18	12	493	2,1	0	-1	-1	0	-1
19	13	2	3	7	9	4	5	6
20	14	5	3	-2	-2	-3	-3	0
21	15	298	3	3	0	-3	-3	-1

Appendix 2. MATLAB code for the fsQCA analysis

Models with user count as two inputs

```
data=[14      1      -1      -2      -1      -1      -1      -6
      76      1      -1       0      -2       1       0      -3
      76      1      -7      -1     -13      -5      -6     -12
    1101      1       1       1       1       1       1       1
     646      1       0       0       0       0      -4       0
     646      1       0       0       1      -3       0       0
      25      2       1       1       0       0       0      -2
       3      2       1       3      -3       0       4       0
      19      2       1       3      -3       0       4       0
```

```
      175         2        -6        -2        -1        -4        -4         0
       48         2        -5         3        -2         1         1         2
       87         2        -3        -1        -3        -1         0         3
       67         2         0         0         2         1         0         3
       17         2         0         1         0         0         0        -1
        1         2        -1        -4        -1         0        -1         0
      175         2        -5        -4        -4        -4        -5        -5
       14         4         0        -2         2        -1         0         0
      493         4         0        -1        -1         0        -1         0
        2         3         7         9         4         5         6         8
        5         3        -2        -2        -3        -3         0         0
      298         3         3         0        -3        -3        -1   1];


largeCOMP=trapmf(data(:,1), [50 100 2000 2000]);
model1=data(:,2)==1;
model2=data(:,2)==2;
model3=data(:,2)==3;
model4=data(:,2)==4;

goodRoM=trapmf(data(:,4), [0 3 20 20]);
badRoM=trapmf(data(:,4), [-20 -20 -3 0]);
goodGENERAL=trapmf(data(:,3), [0 3 20 20]);
goodDM=trapmf(data(:,5), [0 3 20 20]);
goodCM=trapmf(data(:,6), [0 3 20 20]);
goodT=trapmf(data(:,7), [0 3 20 20]);
goodBV=trapmf(data(:,4), [0 3 20 20]);

[largeCOMP goodGENERAL];
B=goodGENERAL;
%model 2 large+small
A=min(largeCOMP,(model2));
B=goodGENERAL;
C=min(1-largeCOMP,(model2));
[output,other]=FullSupDispTable([A B],'eero_resultsmodels.xlsx','A->B')
[output,other]=FullSupDispTable([C B],'eero_resultsmodels.xlsx','D->B')
%model 3 large+small
Adm=min(largeCOMP,(model3));
Ddm=min(1-largeCOMP,(model3));
[output,other]=FullSupDispTable([Adm B],'eero_resultsmodels.xlsx','Adm->B')
[output,other]=FullSupDispTable([Ddm B],'eero_resultsmodels.xlsx','Ddm->B')
%model 4 large+small
Acm=min(largeCOMP,(model4));
Dcm=min(1-largeCOMP,(model4));
[output,other]=FullSupDispTable([Acm B],'eero_resultsmodels.xlsx','Acm->B')
[output,other]=FullSupDispTable([Dcm B],'eero_resultsmodels.xlsx','Dcm->B')

%model 1 large+small
At=min(largeCOMP,(model1));
Dt=min(1-largeCOMP,(model1));
[output,other]=FullSupDispTable([At B],'eero_resultsmodels.xlsx','At->B')
[output,other]=FullSupDispTable([Dt B],'eero_resultsmodels.xlsx','Dt->B')
```

Models with user count and rollout management, data management, and training as three inputs (Model 1.0, user count, and then the remaining variables one by one), when accounting for different models, the variable model1 in the code was simply changed, for example from variable name model1 to model2.

```
data=[14     1    -1    -2    -1    -1    -1    -6
      76     1    -1     0    -2     1     0    -3
      76     1    -7    -1   -13    -5    -6   -12
    1101     1     1     1     1     1     1     1
     646     1     0     0     0     0    -4     0
     646     1     0     0     1    -3     0     0
      25     2     1     1     0     0     0    -2
       3     2     1     3    -3     0     4     0
      19     2     1     3    -3     0     4     0
     175     2    -6    -2    -1    -4    -4     0
      48     2    -5     3    -2     1     1     2
      87     2    -3    -1    -3    -1     0     3
      67     2     0     0     2     1     0     3
      17     2     0     1     0     0     0    -1
       1     2    -1    -4    -1     0    -1     0
     175     2    -5    -4    -4    -4    -5    -5
      14     4     0    -2     2    -1     0     0
     493     4     0    -1    -1     0    -1     0
       2     3     7     9     4     5     6     8
       5     3    -2    -2    -3    -3     0     0
     298     3     3     0    -3    -3    -1  1];

largeCOMP=trapmf(data(:,1), [50 100 2000 2000]);
model1=data(:,2)==1;
model2=data(:,2)==2;
model3=data(:,2)==3;
model4=data(:,2)==4;

goodRoM=trapmf(data(:,4), [0 3 20 20]);
badRoM=trapmf(data(:,4), [-20 -20 -3 0]);
goodGENERAL=trapmf(data(:,3), [0 3 20 20]);
goodDM=trapmf(data(:,5), [0 3 20 20]);
goodCM=trapmf(data(:,6), [0 3 20 20]);
goodT=trapmf(data(:,7), [0 3 20 20]);
goodBV=trapmf(data(:,4), [0 3 20 20]);

[largeCOMP goodGENERAL];
B=goodGENERAL;
%rom model 1
A=min(largeCOMP,min(model1,goodRoM));
D=min(1-largeCOMP,min(model1,goodRoM));
%rom model 1
[output,other]=FullSupDispTable([A B],'eero_resultsm1.xlsx','A->B')
[output,other]=FullSupDispTable([D B],'eero_resultsm1.xlsx','D->B')
```

```
%dm model 1
Adm=min(largeCOMP,min(model1,goodDM));
Ddm=min(1-largeCOMP,min(model1,goodDM));

%dm model 1
[output,other]=FullSupDispTable([Adm B],'eero_resultsm1.xlsx','Adm->B')
[output,other]=FullSupDispTable([Ddm B],'eero_resultsm1.xlsx','Ddm->B')

%cm model 1
Acm=min(largeCOMP,min(model1,goodCM));
Dcm=min(1-largeCOMP,min(model1,goodCM));

%cm model 1
[output,other]=FullSupDispTable([Acm B],'eero_resultsm1.xlsx','Acm->B')
[output,other]=FullSupDispTable([Dcm B],'eero_resultsm1.xlsx','Dcm->B')

%t model 1
At=min(largeCOMP,min(model1,goodT));
Dt=min(1-largeCOMP,min(model1,goodT));

%t model 1
[output,other]=FullSupDispTable([At B],'eero_resultsm1.xlsx','At->B')
[output,other]=FullSupDispTable([Dt B],'eero_resultsm1.xlsx','Dt->B')
```