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MODERNIZATION OF VERKKOPALKKA IDENTITY MANAGEMENT AND USER ADMINISTRATION: TOTAL COST OF OWNERSHIP AND RETURN ON INVESTMENT ANALYSIS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Aditro Oy provides robust and reliable payroll software solutions for different kind of users, such as private and public organizations. These solutions are typically Web-based applications on the top of Windows platform technologies. Verkkopalkka application (Verkkopalkka Application 2016) is one of the solutions developed within Aditro Oy in order to provide payroll contract management operations. This application is able to supply payslips to employees through electronic means and can be easily integrated to other payroll systems.

Nowadays, Web-based applications are part of daily life for every person with internet access. They are meant to provide functionalities that make the interaction with the world much easier and also open unlimited amount of options to solve different kind of problems. Web-based solutions are facing big challenges when talking about security and user's identity management (Identity management 2016).

These challenges usually involve big investments related to improvements in user's identity management and delegation operations. Different kind of authentication and authorization solutions have been proposed since Web-based software started to become popular and widely used to make business through internet.

Windows Active Directory (Active Directory 2016) is one of the most common, cheapest and popular solutions to manage users and their roles. This kind of solution is able to authenticate and authorize all users and computers in a domain.

In order to generate more revenue within Aditro Oy and possibly reduce costs, Verkkopalkka application has to be improved and generate more value by replacing Active Directory component with a more powerful and flexible user identity management solution.

In order to generate more revenue, technology and business managers have figured out that Verkkopalkka application had to become a more competitive product in order to increase organization and product value. The strategy (Yannis, Bakos J. & Treacy, Michael E. 1986:107-119) adopted to meet the business needs, was designed to transform this application into a more competitive product in terms of more flexible and easier user's identity management and role delegation (Crampton, J. & Khambhammettu, H. 2008:123-136.).

More competitive and flexible product in terms of user's identity management and role delegation are important elements that focused on providing benefit in different business areas. The biggest challenge to create value and business advantage, is making a suitable and appropriate strategic decision to fulfil business requirements that look for reducing costs and generate good revenue.

Based on the next business requirements:

1. Design Verkkopalkka's identity management and role delegation module as a loosely coupled (Loose coupling 2016) component. The main motivation behind this requirement is providing more flexibility to reduce costs related to maintenance or replacement of this component with eventually better and cheaper technologies in future.

2. Minimize the amount of work required to manage new and existing Verkkopalkka's users within Aditro Oy. This requirement looks for adopting a more flexible and semi-automated role delegation system that enables external Service Provider Administrators to manage their own users. Transferring Verkkopalkka's user management responsibility to external users, will optimize user management operations and reduce operational costs within Aditro Oy. It will also increase customer satisfaction by eliminating completely redundant user administration.

3. Replace Microsoft Active Directory technology with a better and more flexible third-party technology. This new technology will initially increase the operational costs because of licensing, but will bring more benefit when the amount of users grows because the licensing costs will be reduced accordingly. The more users the systems has the cheaper are the licenses.

4. Allow a single user authentication (Shi, S.B. et Al. 1999) process across multiple IT systems or organizations. The ultimate goal is to enable users of different domains to securely access Verkkopalkka application. This feature will provide the possibility of connecting more customers to Verkkopalkka application by allowing more flexible access.

The final investment decisions have considered the next questions based on costs and possible return on investment:

1. Develop or use an existing identity management technology considering associated costs?

2. How to enable portability of identity information across autonomous security domains to attract more users and generate more revenue?

3. What kind of technology would support the required features and face properly the challenges associated with cross-domain access, including reasonable short and long term costs, such as licensing and maintenance fees?

Verkkopalkka application required more flexible user's identity management functionalities to fulfill business strategy and create more organization value. Creating business advantage and setting up an adequate technology management procedure is a relevant part of this project which is based on proper selection and integration of a flexible and reliable identity management technology.

Technology selection has to facilitate security operations and cross-domain access. Ubisecure (Ubisecure 2016) platform is the technology that best matches the needs and provides the necessary features to keep costs low and potentially increase revenue because would enable more users to use Verkkopalkka application in a better and more secure way.

It is important to mention that this kind of integration between Verkkopalkka and Ubisecure platform, was designed and implemented in order to be easily extended to other Web-based domains. There are different kind of platforms that offer user's identity management and delegation such as Windows Active Directory, but are not able to give enough flexibility and potentially attract more users over different domains to use Verkkopalkka application. Ubisecure platform provides a good solution to fulfil the integration requirements.

In terms of user's identity management and role delegation, different kind of advantages are introduced, such as more flexible delegation model and easier integration with other Web-based applications. The delegation model was designed to enable more users to handle access and roles in their own organizations.

The project objectives are focused on the mentioned arguments and can be divided into two different categories:

1. General

   Evaluating the benefits regarding the integration between Verkkopalkka and Ubisecure is the general goal of this research. This goal focuses on analyzing the positive effects that such integration is generating regarding business and application value.

   The main purpose of this research is analyzing how the business has currently improved in terms of profitability of the overall investment.

2. Specific

   Specific goals are focused on analyzing numeric data that provides better overview of the investment in short and long term. In terms of Return on Investment and Total Cost of Ownership, there are three specific goals:

   - To evaluate Return on Investment based on the Verkkopalkka and Ubisecure integration. This goal pursues having a specific idea of the

actual and future profit in terms of the investment made to improve and make more competitive Verkkopalkka application.

- To evaluate Total Cost of Ownership depending on Verkkopalkka and Ubisecure integration. TCO provides an idea of how much long and short term cost is included during and after the integration is completed.

  The comparison of Total Cost of Ownership over different periods, is relevant to know proper information to forecast and make further decisions regarding how expensive is going to be the propose solution in the actual and following years.

Recognizing the benefit of Verkkopalkka and Ubisecure integration for the company requires exploring and defining the research problem and its most important details. Defining the research problem has to consider different angles that include the next questions:

1. What is the problem?

   The initial Verkkopalkka solution was integrated with Windows Active Directory to provide user handling functionalities. This solution wasn't flexible enough to:

   - Increase both Verkkopalkka's advantage against other products.

   - Generate more revenue.

- Reduce associated costs related to maintenance and administration.

A new business model and technology strategy demanded changes in Verkkopalkka that consider the next problems:

- According to product and technology managers, Verkkopalkka's identity management functionalities were outdated and not flexible enough to expand and increase business value.

- Aditro Oy wants to reduce Verkkopalkka's user administration costs and improve identity management by integrating a flexible and robust federated identity management solution.

- The identity management integration must be able to offer more flexibility in terms of user management and delegation that attract more customers to use Verkkopalkka application and minimize administration costs within Aditro Oy.

- Verkkopalkka requires more competitive advantage than other products in the market. Therefore the improvements related to identity management should increase the attractiveness of the product by making remarkably evident the advantages for both organization and customers.

Finally, the research problem can be defined in the next sentence:

- In terms of revenue and short-long term costs, is the integration between Verkkopalkka and Ubisecure platform going to be beneficial for Aditro Oy based on ROI vs. TCO?

2. Who has the problem?

The main problem is that several business areas of Aditro Oy consider that Verkkopalkka solution is creating too much overhead in terms of operational costs as well as limited identity management across different domains. Aditro Oy management board is looking for:

- Reducing expensive and slow Verkkopalkka's user handling processes, as well as, unnecessary allocation of human resources.

- Removing limitations related to enable more users of different organizations and domains to securely access Verkkopalkka application.

In order to do that, a robust integration with a reliable identity management platform has to be achieved. This is a complicated task that demands a flexible and sustainable solution. This solution has to be easily extended into other Web-based domains depending on Aditro Oy needs and technology requirements.

3. Why is it important to solve?

Aditro management areas need to improve their products and strategies to attract new customers, increase revenue and reduce costs. Weaknesses in technology and operational processes have been detected. Solving these weaknesses mean that Verkkopalkka application will have more advantage in the market.

4. What are the goals?

   The main goal is to reduce administration costs, increase revenue and introduce into the market a more competitive product that fulfills Aditro's technology strategy to increase organization and product value.

   Verkkopalkka application has to move into a more flexible and modern identity management approach, such as Federated Identity Management. Furthermore this technology strategy has to be easily extendable to other Aditro Web-based application domains.

   Technically, the main purpose is migrating the actual Verkkopalkka user management and delegation solution from Windows Active Directory to Ubisecure platform. The scope of this action is facilitating management operations for all Verkkopalkka user administrators.

5. Which are the main challenges?

   The challenges are mainly related to make proper strategic and financial decisions, such as:

- Selecting an existing identity management technology or developing a custom solution that fulfills business requirements and generates more strategic advantage within the market.

  This advantage is associated to increase the company income and minimize costs mainly related to support, maintenance and resources.

- Designing a flexible and generic solution that could be potentially reused and integrated with other Aditro systems to increase and extend business value into different Aditro Web-based applications and domains.

In the first case, either buying an existing identity management solution or developing a custom component, is a decision that depends on how much organization value and return on investment can be generated. This decision looks for maximizing the benefit and market advantage for the current and future business.

In the second case, designing a flexible and generic solution which is reusable in different organization domains, is not an easy task. This requirement involves complex tasks that look for solving a problem mainly related to provide easily extendable identity management and delegation model to different Aditro Web-based applications.

The main challenge is implementing a solution that fits into the other Web-based Aditro products, and will reduce future software development and maintenance costs.

6. Which actions are available in the beginning?

   There are some decisions that had to be made by the business and technical departments regarding the approach to follow before solving the problem. Initially the most relevant concern was deciding whether to build up a custom identity management platform or integrate an existing one with Verkkopalkka application.

   Verkkopalkka and Ubisecure integration depends on the short and long term benefit that represent the investment. It is also important mentioning that allocating enough development resources and assigning relevant tasks are actions that have a big impact on the overall costs.

2. LITERATURE REVIEW

New technologies emerge to solve different kind of problems or extend existing software solutions. Integrating existing platforms with new technologies have a relevant impact on improving the productivity of a company or business in specific fields. Black, S. E., & Lynch, L. M. (2001) examine technology influence on productivity and also think that new platforms have changed the organization of work.

Information technologies are definitely relevant and valuable to make more productive processes and common practices within a company. Their extension to different domains depend on internal and external factors (Melville, N., Kraemer, K., & Gurbaxani, V. 2004). Information technology extensions usually involve improvement and benefit for different areas.

Brynjolfsson, E., & Yang, S. (1996) make a literature review of the most significant contributions regarding the effect of information technologies on productivity performance that cover different perspectives. Authors distribute research studies into four groups, identify valid productivity questions, and propose possible explanations for them.

Many researchers also question whether technology investments really improve company profitability. It is also interesting figuring out whether technology investment effects are either improving sales or reducing expensive operational processes. Technology investment effects on product profitability could also be compare to the effect of research and development when specific integrations,

such as Verkkopalkka-Ubisecure, are necessary and can be carried out by either using ready platforms or custom solutions that involve internal development to improve the product.

According to Mithas, S. et al. (2012), there is evidence that supports Information Technologies as a crucial element that provides positive impact on business profitability. They also point out that the effect of technology investments on sales and profitability is better than investing on research and development. The effect of introducing technologies to improve company profitability is visible in the revenue growth. They mention that there is no data that confirms the positive effect of information technologies regarding profitability across reduction in operational costs.

Some research results point out that companies have higher tendency to achieve profitability success by using information technologies to increase revenue growth than by using them for cost reduction. It is responsibility of the managers allocating financial resources to fulfil adequate technology expenses. Regarding information technology expenses, it is important mentioning that companies should give more priority to projects that have better potential to grow revenue over the ones that are mainly focused on addressing and committed with cost savings.

Cloud technologies have become a popular way to enable different kind of business through internet. Companies around the world are migrating their business to Cloud based solutions that have big potential to provide more flexibility in order to achieve business goals. In some cases, integrations with other Cloud

based platforms are necessary to make products more competitive and stronger in the market.

Increasing the product competitiveness and business productivity is an important issue that has to consider the contribution and benefit of new technologies and information systems. Brynjolfsson Erik (1993) thinks that productivity is a relevant economic indicator to measure technology's contribution, and has several limitations. He also points out that identifying and removing productivity impediments requires better understanding of the causes of the "productivity paradox".

Ives, B., & Learmonth, G. P. (1984) think the competitiveness of companies can be influenced by the adoption of proper information system technologies. Information system platforms are strategically relevant to determine possible opportunities to know what specific applications or integrations should be developed to either improve or increase the profitability of the business.

Segars, A. H., & Grover, V. (1998) point out that there is significant amount of research work focused on developing methodologies to support strategic planning helped by information technologies to gain competitive advantage. Strategy is a very important element that companies should consider to ensure complete product success. Aditro Oy has adopted a competitive strategy that focuses on making Verkkopalkka solution a better and more profitable product in the actual market.

Lederer, A. L., & Sethi, V. (1988) think that strategic company planning is a process that focuses on recognizing advantage from potential software solutions that

the organization should be able to identify and implement. The integration between Verkkopalkka and Ubisecure was identified as a need to gain market advantage. Aditro organization recognized that this integration would potentially bring higher benefit and profit considering short and long term Cloud project implementation costs.

Cloud based integration projects are usually expensive and require different kind of resources to fulfil the business requirements. Han Yan (2011: 198-206) makes a review of cloud computing concept and costs comparison related to hardware platforms hosted in cloud environment and physical instances on premises. He also points out different levels of services and providers in Cloud environments, as well as case studies that implement web applications.

In order to integrate Cloud platforms with existing cloud based products, costs and technology analysis are important elements that have to be considered before making any invested to improve a product. A typical example related to the costs of owning hardware instances, is the comparison between Cloud and physical hardware instances. In most of cases, Cloud instances carry a lower TCO compared to physical ones.

Identifying short and long term costs before making technology investments is very important to ensure the success of any project. Heilala, Juhani, et al. (2006) propose a life cycle related cost approach, the main scope of this approach is to identify and analyze costs before investment decisions in early system design phase. Their analysis approach integrates:

1. Full efficiency of equipment.

2. Total cost of ownership and some other methods.

It also improves elements related to flexible design of systems that can be reconfigured. Authors make as well a comparison of products A and B in 5 years production to validate their proposal.

Webster, John. (2004) thinks that ROI and TCO provide managers with a wider view of Enterprise IT environment and how well the environment is aligned to the business. IT administrators should make ROI and TCO modelling an ongoing process to make more accurate decisions. They also consider that quality and effectiveness of ROI and TCO models are proportional to their accuracy.

Pisello, Thomas, & Strassmann, Paul (2003) propose an interesting IT value chain management methodology approach which define and explain in detail the next four steps:

1. Project ROI: Collect opportunity information that regards spending and processes analysis.

2. Project optimization and budgeting: It is performed relative to the competition.

3. Cooperate financial impact: How the project portfolio is going to impact top line revenue and gross margin.

4. Peer comparison: Provide info why certain results were not achieved in order to reveal if the company is exceeding expectations or not.

They also point out typical project costs such as:

1. IT costs concept which is similar to Verkkopalkka-Ubisecure integration costs.

2. Business unit costs which are similar to Verkkopalkka-Ubisecure integration management costs.

Silvius, A. J. G. (2006) proposes a framework to evaluate organizational impact of IT investments. His framework helps to avoid potential wrong IT investments decisions related to not complete calculations. Their work also shows relationships between company strategy and the value of information technologies, as well as, evaluates the connection between the impact of information technologies and organizational achievements.

They think that ROI is not able to include every necessary element and therefore a different approach is required. This approach is called "IT investment Balanced Scorecard" which is based on the next four principles:

1. Financial perspective: Traditional Return on Investment calculation.

2. Customer perspective: The investment influence regarding the marketing field.

3. Internal perspective: The investment influence regarding the company business processes.

4. Growing and innovative elements: Possible coming options and competitive investment effects.

Hou Lun, & Xiaowo Tang (2004) analyze costs, benefits, ROI and TCO of CRM implementation to find out the correct way to accomplish a successfully CRM implementation. They propose a complete criteria and critical factors to evaluate the ROI of a CRM implementation. This criteria considers two important elements:

1. Causes of failure: Strategic, management, customer process, project and technology problems.

2. Success factors: Development plan, reorganization of the company, time schedule, changes at the management level, support of management from higher levels and system structure.

According to them, ROI is the ultimate indicator of success of a CRM implementation and comes in two forms:

1. Cost reductions from increasing efficiency: This is similar to Verkkopalkka's delegation model purpose.

2. Revenue enhancements: This is Similar to Verkkopalkka new features to increase number of users.

Regarding TCO, their work considers initial costs of licensing, hardware, software, training and consulting. Ongoing costs of support and maintenance are

also important in their analysis. This analysis has some similarities with Verkkopalkka-Ubisecure integration.

Analyzing company's business characteristics and IT resources are important factors to identify favorability in Web-based Architecture (Lindberg, H. & Hallgren, T. 2003) migration. In companies with existing IT infra, it is difficult making a cloud migration decision because of the complexity related to replace existing resources. Regarding cloud migrations of typical Inhouse solutions, there are some challenges that involve:

1. Migrate administration features to cloud model.

2. Problem with handling sensitive customer data.

On the other hand, usually startup companies are good candidates to initiate and develop cloud based businesses. Subhas, Chandra M. & Arka, Mon (2011) consider Cloud computing impacts such as finding company suitability for adopting cloud computing based on suitability index.

Cloud computing is a term that gathers different concepts, technologies and recently web services. Some software applications such as Verkkopalkka, are built on the top of technologies that help to reduce both information technology overhead and total cost of ownership. Vouk (2008: 235-246) analyses the cloud computing concept, the general issues that tries to solve, and some implementation examples.

Total cost of ownership is a topic that has become more popular to analyze different kind of models mainly related to value purchase opportunities. According to Ferrin (2002: 18-29), many companies actually use these models to calculate cost drivers to perform their TCO computations. He also thinks that generic model of TCO is not appropriate to get accurate results. Therefore, his research proposes a total cost of ownership model supported by sets of core and auxiliary cost drivers.

The main contribution of this approach is that the main costs reasons would be included in the total cost of ownership calculations. Auxiliary cost drivers can be used for particular purchase situations when performing TCO calculations. They also think that the supply chain related to total cost of ownership model is necessary to fulfil the needs. This research points out that TCO valuation is a complex process that would bring remarkable benefits to companies that are able to apply it properly.

There are different total cost of ownership approaches that propose frameworks and tools. Zachariassen (2009: 448-469) developed a differentiated TCO approach that consists of the association nature and the complexity regarding the cost reasons. This approach also shows that TCO has a big impact over the buyer-supplier relationship.

Developing a software product requires managing different kind of resources in the most efficient way to ensure on-time delivery and high product quality. Sachdev (2010: 1-10) thinks that companies have to understand the role of out-

sourced and in-house resources to deliver a product able to compete in the market. Verkkopalkka development involved also costs related to outsource and in-house resources that contribute to deliver the product.

Purchasing a ready-made platform to fulfil technical and business requirements is a decision that has to consider different investment factors. So Young Sohn (2006: 68-81) analyzes which factors influence the acquisition of a CRM system. According to his investigation, the initial purchase cost is the main element to make the purchase decision. Other elements such as operating cost and lifetime utilization are coming as less important decision factors.

In So Young Sohn (2006: 68-81) paper, authors propose also an approach to include together initial cost, operating costs and also cost related to new customer opportunities associated to not proper management. The opportunity cost is also used as relevant elements related to the influence of the system over financial area.

Information technologies are used to solved different kind of problems and create new business opportunities within specific markets. These technologies are available to make more powerful software platforms that involve a certain cost for the investor. Many total cost of ownership research studies are focused on customer relationship platforms because bring a clear overview of the factors that usually impact business cases and financial decisions.

Regina Jasilioniene & Rima Tamošiūniene (2009: 343-347) make clear the importance of total cost of ownership and benefits calculations to help companies

make right investment decisions when developing or purchasing a customer relationship system. Permanent measurement of the system benefits, ensures that the company receives market advantage and reach strategic objectives. Authors also consider weaknesses and strengths of cost-oriented approach.

Total cost of ownership concept is also used in other engineering fields such as automotive and electric. Many of these fields focus on reducing greenhouse gas emissions from transportation. Different kind of industries are interested in investing on new and better technologies to produce more efficient products that meet international environmental regulations. These technologies involve big initial costs mainly related to research and development of prototypes that can be push to the market.

Plötz P.,Gnann T., & Wietschel M. (2012) analyse the TCO based on kilometres travelled and depending on different driving profiles. The total cost of ownership estimates are relevant information to make purchasing decisions. They also compare the TCO for regular, hybrid, and electric vehicles. This comparison has been built up on four vehicle sizes to model buying decisions and look at the possible future market of these three technologies.

Moyle, Kathryn (2004) makes a detailed investigation of total cost of ownership and open source software in schools. The author introduces an overview of the implications of adopt a total cost of ownership approach within the educational field. Some processes related to total cost of ownership are outlined to show how to conducts proper TCO analysis.

The Moyle, Kathryn (2004) research also points out that total cost of ownership approaches have to be constructed on real data in realistic contexts. An overview of a total cost of ownership framework at school level is provided to have a deeper idea of the associated costs from the open source as well as proprietary perspectives.

According to Moyle, K. (2004), there are two important elements related to total cost of ownership components regarding open source compared to proprietary software:

1. Software licences, management and compliance costs.

2. Expertise required to deploy and operate properly open source software.

Some researchers inquire whether the cost included in the licences are able to balance other costs mainly related to training. Apparently, the costs regarding open source licensing are considerably smaller compared to the proprietary costs. On the other hand, it is important considering that the adequate usage of open source solutions, depends on the expertise level of the end users.

It could be interesting considering to apply a robust total cost of ownership framework over different company models based on a comparison between proprietary and open source platforms. This comparison would help to identify costs and benefits associated to adopt open source technologies, and analyse ROI generated from using open source platforms including different perspectives and business angles.

Hurkens, K. & Wynstra, F. (2004) extend the TCO concept towards the total value of ownership. They think that traditional purchasing and supply management fields have mainly focused on cost savings that could be achieved by using total cost of ownership approach. There are elements that have not been included in traditional total costs calculations when buying a certain product.

Hurkens, K. & Wynstra, F. (2004) introduce "Total Value of Ownership" as a concept that extends total cost of ownership including missing elements that influence the costs. This concept intends to increase the accuracy and enhance the information related to the purchasing costs. The information enhancement is a very important characteristic that should lead into better decisions.

It is evident that Cloud services have become very popular because apparently offer important advantages and benefits related to operational costs. These cost-related benefits are significantly visible within start-up companies that don't have internal IT infrastructure, and therefore are a relevant component that have a significant impact on new potential business.

On the other hand, it is also possible that the costs associated with Cloud services are not really low and there are another factors that are not considered when calculating total cost of ownership. In some cases cloud services fit perfectly into the business model because bring the necessary elements to boost the business towards the next market level.

Martens, B., Walterbusch, M., & Teuteberg, F. (2012) introduce an interesting Cloud services approach from TCO perspective. This approach is based on the

development and further evaluation of a well-defined model supported by mathematical principles. Authors approach fulfils business requirements and helps decision making within Cloud field.

There are different cost factors in Cloud service technologies that involve important elements when making investment decision regarding the adoption of Cloud computing technologies. Martens, B., Walterbusch, M., and Teuteberg, F. (2012) think that total cost of ownership concept should be included as part of cost management, as well as, an additional tool to evaluate Cloud service investments.

3. METHODOLOGY

In order to provide a robust way to get accurate investment conclusions that point out how good was the investment decision, it is relevant to build up and use an adequate research methodology that bring the most relevant information to analyze and make proper conclusions.

There are three elements that have been considered regarding the research methodology adopted to evaluate and analyze the success of the investment made to improve Verkkopalkka as a more attractive and robust product. These three elements are:

1. Research approach.

2. Data collection.

3. Analysis method.

The selected research methodology is based on a quantitative procedure. This quantitative methodology provides information related to investment data such as revenue and project costs of different type. This methodology was selected because helps to develop a concrete hypothesis regarding the benefits of the investment.

Quantitative approach is very popular is different disciplines such as economics and marketing. This approach is usually combined with mathematical formulas

to provide better and more meaningful results. It also includes methods that generate hypothesis, collect data and analyze results. It is important mentioning that this kind of approach involves scientific data mainly to understand the problem and extract proper conclusions.

With quantitative research, business units can determine the most adequate investment decisions to make. It is relevant to see that this approach provides numeric data, which is extremely useful to make business decisions and lead the projects towards the most convenient and profitable current and future situation for the company.

Regarding the integration between Verkkopalkka and Ubisecure, the quantitative analysis of results is based on return of investment and total cost of ownership for two different years. The selected approach has been very useful to predict profitability of the integration during the following years and conclude it has been a good investment decision that has good potential to grow and provide expected results.

The data collection methods are focused on gathering data that comes from revenue and costs tables within the project. Regarding costs, data collection is focused on data reported during the project development and recurrent future expenses. On the other hand, revenue data collection is focused on current incoming profit and forecast of future business opportunities with new customers.

The method used to analyze the results is mainly related to return on investment and Total Cost of Ownership calculations. This method provides enough information to carry out a final evaluation of the investment in terms of business profitability for the current and next years.

Return on investment and total cost of ownership calculations are based on the traditional mathematical formulas that are going to be explained in further chapters. The results of return on investment and costs are extracted for 2015 and 2016 to make a comparison across the time and how the integration investment is potentially going to behave in future.

Analyzing the results is a task that involves comparison between the actual Verkkopalkka-Ubisecure integration and a potential custom integration as the second available choice for the business. This comparison shows which choice is more profitable along 2015 and 2016, and brings an idea why one choice is better than the other in terms of profit and benefit to the business.

Tables and figures are also included in the analysis method to understand better the investment decision that adopted Verkkopalkka-Ubisecure integration as the most suitable solution that fulfills the business requirements and increases business profitability. They show a graphical comparison of how return on investment changes under different integration conditions.

Finally, sensitivity analysis is the last part within the analysis that shows relevant information related to changes in variables such as costs and benefit. These variations in the variables values are important to understand what would happen

under different kind of circumstances where the return on investment in affected and there the profit would either be or not be beneficial.

The sensitivity analysis is performed following a set of steps explained in the respective chapter. This analysis is focused on partial and worst-best case scenarios that bring an interesting overview of how return on investment changes based on specific situation variations.

4. ANALYSIS AND RESULTS

This section includes analysis related to company's business strategy, technical solution overview, return on investment and total costs of ownership. Results are based on numeric data obtained from ROI and TCO calculations. This chapter is divided into Technical solution overview, Business Strategy, Return on Investment, Total Cost of Ownership and Sensitivity Analysis.

4.1. Technical solution overview

This chapter provides technical overview of the integration between Verkkopalkka and Ubisecure from a business prospective considering architectural software details analyzed from process improvement angle. This integration solves and improves specific internal processes that were obsolete and generated overhead for the company and customers administration.

The integration can be divided in two phases:

1. Design: The main purpose of this phase is setting up a flat structure within Ubisecure platform that will act as a container to hold application users associated to specific roles. Users with administrator privileges should be able to delegate and give access to new users that will be added into the previously mentioned structure.

2. Implementation: The implementation part focused on developing a business layer able to provide a communication channel between Verkkopalkka application and Ubisecure user management interface.

   In order to perform administration operations related to user's management and delegating roles, it was necessary developing a well-defined interface.

The business layer includes a client component and a well-defined business service to control the administration and delegation operations executed between Verkkopalkka and Ubisecure platform through the interface. The client component implements business logic to perform complex user management and delegation operations that will reduce overhead and improve internal company processes.

The business service (see Figure 1) provides basic operations executed on Ubisecure platform through a well-defined interface. The following diagram provides technical overview of the elements around the service interface and relationship between them.

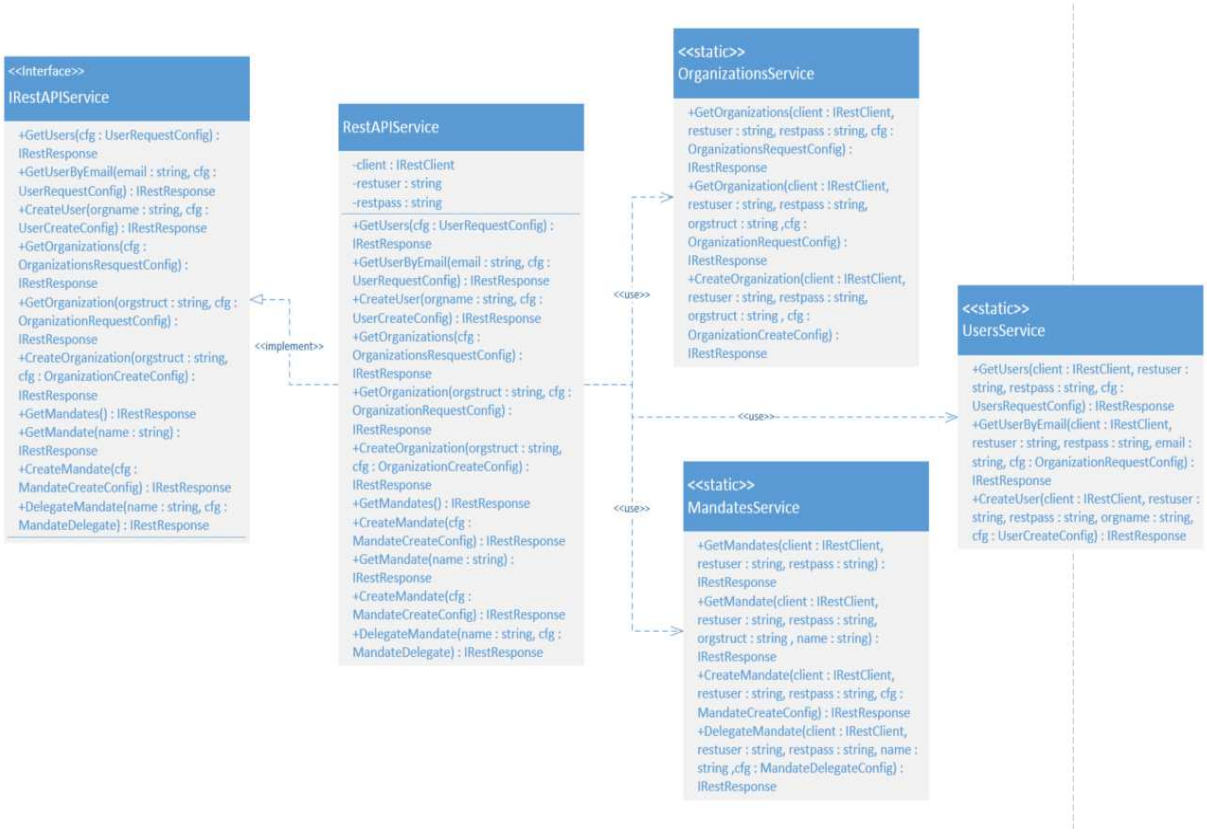

Figure 1.) Services diagram.

Regarding the client, it uses business service functionalities to invoke basic operations on Ubisecure side through Ubisecure API (API: Application Programming Interface 2016) included in Ubisecure development package. These services functionalities are related to delegation model requirements focused on enabling automation of user's administration by external operators.

In figure 2, there are three components that interact with each other to execute delegation and management operations over Verkkopalkka users. DirectoryService and RestAPI Service components are part of Verkkopalkka application,

while Ubisecure platform provides a public interface to perform administration and delegation operations reflected on Verkkopalkka.

The most usual operations are related to fetch and create users and organizations, as well as delegate roles to users. User's management and delegation are requirements that look for meeting business strategy to increase product and company value.

The main benefit of this implementation is a flexible solution that improves the user interaction against Verkkopalkka user interface by allowing easier and more powerful operations request within the scope of business needs. Once this functionality is in place, internal costs should be reduce in terms of less needed resources to handle manually users and roles.

The integration investment is supposed to create the adequate environment to attract customers and give them enough flexibility to manage more efficiently their own users. User's management functionality has been improved to solved inefficient processes within the company.

Figure 2.) User's Management Sequence Diagram.

On the other hand, improvements in authentication and authorization functionalities are also part of the investment and the strategy to genera more value. User's authentication and authorization module (see Figure 3) is included into the development expenses that influence the Return on Investment. The Authentication module looks for meeting requirements regarding more flexibility to integrate other applications within Verkkopalkka's authentication scope.

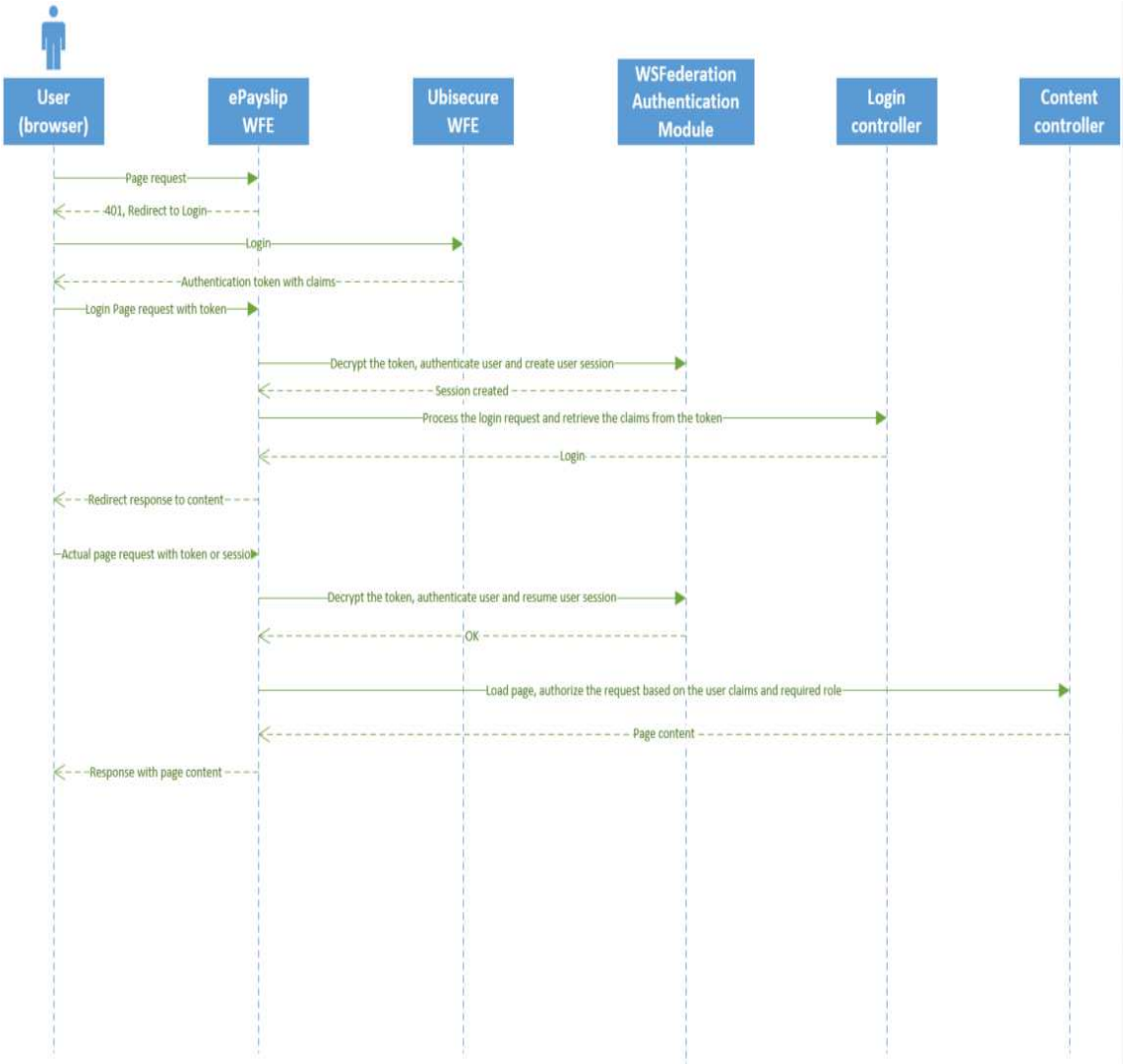

Figure 3.) Verkkopalkka's authentication process.

According to requirements, depending on roles assigned to the users, they can perform administrative operations such as user management and role delegation. This functionality enables different kind of users and privileges to operate Verkkopalkka application in a more secure and easier way.

In Figure 4, the use case scenario shows the interaction that a regular Service Operator Admin can perform in order to manage users and assign roles to them. Such roles allow specific users executing operations over certain organizations. Roles are usually assigned to users in order to provide certain permissions to either perform administration operations or visualize specific data.

A role gives the user privileges that are validated in Verkkopalkka application side. Once the identity and privileges associated to the user, he has the right to delegate roles to another users and perform management operations.

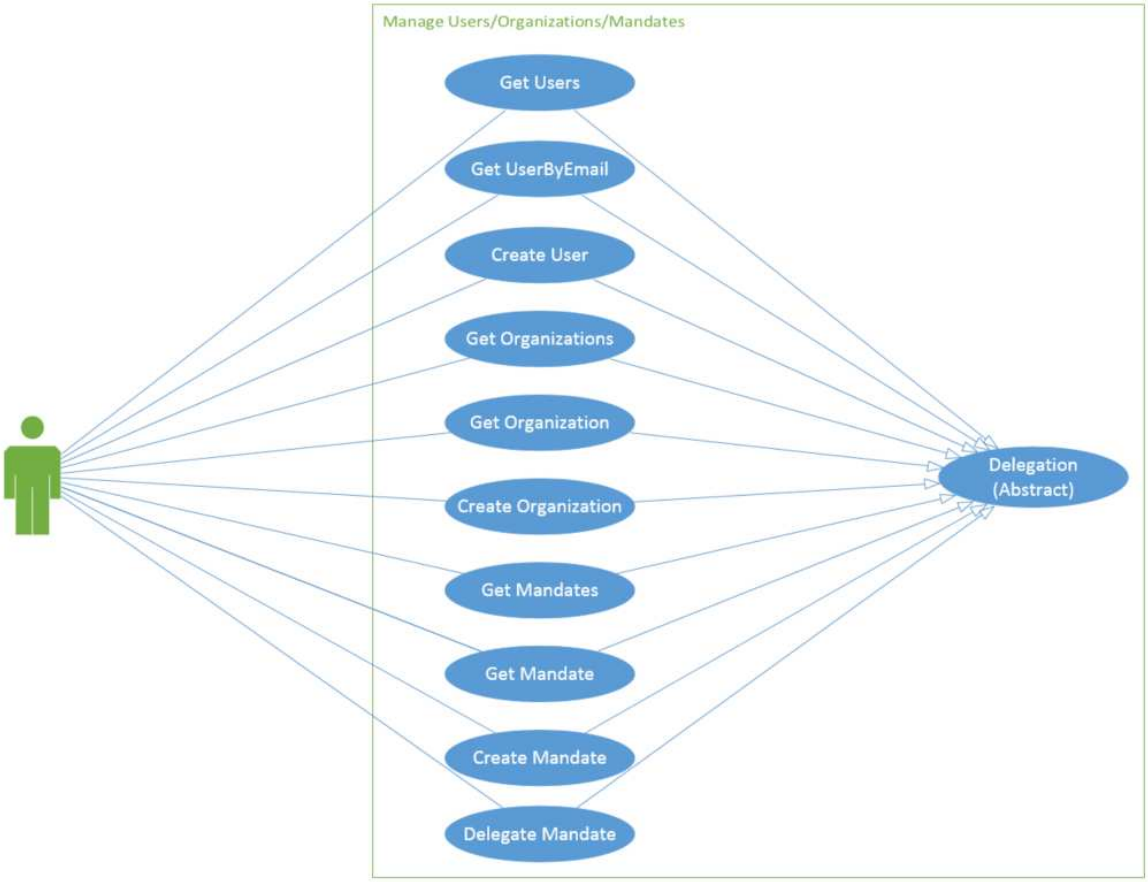

Figure 4.) Use case.

4.2. Business strategy

In order to generate more revenue, reduce costs and market advantage, it is extremely important making proper decisions that meet a robust and successful business strategy. The integration of technologies that create more organization value, are based on a set of decisions intended to generate advantage from different angles.

The ultimate scope of Aditro's technology strategy is maximizing revenue, as well as minimizing internal costs by improving the identity management component within Verkkopalkka application. The technology strategy implemented within this project, is structured into internal and competitive strategies. These strategies are based on advantages brought through the integration between Verkkopalkka application and Ubisecure platform.

4.2.1. Internal Strategy

This strategy focuses on improvements that brings more efficient and effective processes within organizational structures related to Verkkopalkka administrative tasks. Integrating Verkkopalkka application with Ubisecure platform, is a task that involves design and implementation of a reliable delegation model to manage Verkkopalkka users from outside Aditro Oy domain.

Improving operational efficiency and functional identity management capabilities within Verkkopalkka application, requires proper vision of the actual and future business. Design and implementation of a successful internal strategy are

action items that have to consider possible changes that should improve Verkkopalkka business areas.

Automated delegation model is the main goal of the internal strategy because reduces organizational costs in terms of money and processes. It also improves the efficiency of internal operations which is a relevant component within the strategy. The delegation model enables users to handle by themselves administrative tasks which leads into simplifying organization processes.

Traditionally, improving organizational efficiency and effectiveness is the main scope of information technology. A proper identity management technology and delegation model have important implications for the company within the competitive field and the market position.

The internal strategy is focused on generating a positive impact over organizational management processes and operational tasks. Supporting management and administration processes through the integration of Verkkopalkka and adequate information technologies, required the identification of new business opportunities to increase organization and business value.

Improving the integration with the customers is also part of the company's strategy that leads into better customer's self-service through the implementation of a delegation model. This delegation model is relevant investment that automates and optimizes internal processes. In order to achieve successfully the strategy goals, proper technology initiative has been focused on meeting internal requirements.

Investment decisions were made on the basis of the business strategy that is driven by the business units. These decisions are motivated on developing Verkkopalkka's architecture to support process improvements rather than only a change in technology. The internal company's strategy delivers better value to the customers and improves bottom-line benefits.

4.2.2. Competitive Strategy

This kind of strategy focuses on generating competitive moves that create advantage for Verkkopalkka application within the payroll market. Aditro's management units have identified Ubisecure platform as an opportunity to create competitive advantage for the organization. Rockart J. & Scott M. (1984: 84-95) mention three types of opportunities that are based on (1) improve value, (2) link with customers and suppliers and (3) create new businesses.

In Aditro organization, creating competitive advantage is based on different types of opportunities that have been identified by management and technical units. These opportunities are related to (1) improve business and organization value by adding more powerful software application functionalities and (2) create a new service-oriented business model.

Improving business and organization value by enhancing new and better application functionalities requires adequate decisions in terms of financial investment. This investment focuses mainly on successfully integrating Ubisecure platform with the payslip management application. The integration enables automatically new application functionalities that create substantial business advantage in the market and increase the chance of potential new business opportunities.

Creating a new service-oriented business model is not an easy task that looks for building up a robust delegation model to carry out administrative operations regarding users and privileges within Verkkopalkka application. This business model improve obsolete practices regarding delegation and generate relevant advantage in terms of automation and user management.

In Verkkopalkka business market, technology is a dominant element that has to be considered in order to make accurate decisions that lead into a proper business strategy. Releasing a reliable and competitive product is the ultimate goal that has to be achieved by analyzing the market and the product features that attract and enable convenient business opportunities.

Competitors are also considered when setting up a business strategy that involves big investment of capital that expects acceptable profit in short and long time. Companies that invest wisely and handle these investments to maximize the return, have good chances to increase the benefits through the capabilities that technology is able to deliver.

Information technologies are extremely important to organize an adequate strategy that considers improvements in customer services. Creating and maximizing competitive advantage requires knowledge of not only how to implement correctly technology, but also how to use technologies to improve business processes.

Software solutions have evolve to create new businesses and opportunities in different markets. Selecting the right technology to improve existing products is

a task that involves knowledge of the market and customer needs. Investing in technology is crucial to ensure competitive company success in the market.

Competitive advantage is used from people who know how to implement technology to the ones who know how to use it to improve the business. Pisello, Thomas, & Strassmann, Paul (2003) propose four levels of investment:

1. Computing Infrastructure: The main goal is to enhance individual and corporate productivity, such as increasing efficiency and reducing overhead. This kind of investment goes mainly to data centers, networks, PCs and applications.

2. Internet and Enterprise Software: It is mainly related to improvements over the corporate domain and the value chain. These investments focus on integrating customers and supply chain into the company. The integration's goal is improving the relationships through business process optimization.

3. Knowledge Capital Management: IT investments are focused on gathering different kind of assets that benefit in short and long term the company's interests. For example, data warehouses and business intelligence are emerging solutions that fulfil the needs.

4. Information Warfare: The main element is proactivity regarding the control of information as a competitive tool to succeed into the information technology management.

Verkkopalkka's investment focuses mainly on Software that improves the integration between the company and the customers, as well as optimizes corporate business processes. Optimization of business processes involves reducing overhead related to administrative and maintenance tasks that can be easily distributed outside the company boundaries.

In order to make the product more competitive, optimization of corporate Verkkopalkka processes was considered to meet the customer and market needs. In terms of product competitiveness, the strategy met business and customer requirements. Technology has been extremely useful to increase the corporate and customer benefits.

It is relevant keeping in mind that in order to boost the corporate business in future, new and better technologies will play more a relevant role within the success of any company. At some point, the actual company's strategy has to update according to changes in the market and customer requirements. Future competitive strategy also has to evolve along the technology changes that will bring more competitive advantage and product value.

4.3. Return on Investment

According to literature, return on investment involves how much money it would be possible to save or make after purchasing an item. In Verkkopalkka's scenario, the integration with Ubisecure is based on a business strategy that looks for reducing costs and increase the total revenue.

Investment decisions are always risky because there are different factors that influence and affect the overall financial situation. Improving existing software with newer and better technologies is a decision that has to consider how much revenue is going to generate the investment.

From the business point of view, Verkkopalkka generates revenue mainly based on the amount of payslips processed during the year. Total revenues include also licenses and start-up fee. Verkkopalkka application is sold as a cloud service that charges the customer with an initial start-up fee, as well as, a monthly fee depending on the number of processed transactions.

Return on investment is an important tool to have deeper and better information regarding the efficiency of investing on improving Verkkopalkka's identity management and administration features. The main goal is measuring the amount of return on Verkkopalkka's investment relative to the total cost. In order to calculate the return on investment, the benefit is divided by the total of the costs, and the result is a percentage value.

The ROI formula:

$$ROI = \frac{Gain\ from\ investment - Cost\ of\ investment}{Cost\ of\ investment}$$

Return on investment is a very popular metric mainly because of simplicity and also can be used as an elemental indicator of investment's profitability. It is very easy to calculate and interpret and can be used in different kind of investments. In case the return on investment returns a negative value, or there are other ways to reduce the costs to increase the ROI, then these values can orientate the investor to make better decisions.

In Verkkopalkka's case, Aditro Oy invested 3.997.415 SEK in 2015 and sold Verkkopalkka service to different customers for a total of 8.410.500 SEK. To calculate the return on the investment, the result would be calculated by dividing the profit by the investment cost:

$$Verkkopalkka's\ ROI = \frac{Gain\ from\ investment - Cost\ of\ investment}{Cost\ of\ investment}$$

In 2015, the return on investment is 110,3985%. It means that for every SEK invested, the company receives 1,103985 SEKs. On the other hand, the estimate for 2016 is 113,5885%. Similarly to 2015, it means that for every SEK invested, the company receives 1,135885 SEKs.

4.4. Total cost of ownership

Om, Pal et Al. (2013) think that TCO models related to suppliers consist of aggregation of costs regarding the selection of specific vendors and also negative or positive variations of the supplier unit price. “Total Cost of Ownership” (Ellram, Lisa M. 1995: 4-23) is defined as a method that considers more than the purchase price to include different kind of costs.

The total cost of ownership related to improving Verkkopalkka’s identity management and user administration considers not only the direct cost of purchasing Ubisecure platform to substitute the identity management component within Verkkopalkka application.

The total costs are mainly associated to:

1. Development: Custom software development was necessary during the integration between Verkkopalkka and Ubisecure platform. Costs related to software development are mainly distributed into:

    a. Inhouse: Costs associated to software developers within Aditro Oy. It shows how much cost generates developing the integration between Verkkopalkka and Ubisecure platform inside Aditro Oy.

    b. External consultants (abroad): Costs related to software developers from abroad.

c. Other consultants (local): Costs related to external resources located in Finland, such as Ubisecure platform specialists.

d. Internal unit: Internal costs related to Aditro business units, such as resources from other departments.

2. Maintenance: Costs associated to bug fixing and features requested after development was completed. Maintenance costs are distributed into:

   a. Inhouse: The maintenance has been carried out mainly with internal Aditro resources. The costs have been related to further development of new features requested by the customers and eventual bug fixing of existing functionalities.

   b. Others: This cost is related to minor maintenance tasks.

3. Operations: These costs are related to different kind of tasks that involve delivering Verkkopalkka in preproduction and production environments, as well as, hosting and keeping Verkkopalkka running 24/24. Operational costs are distributed into:

   a. Inhouse: Costs related to manage Verkkopalkka application at production environment level. This is mainly monitoring, administration and deployment operations.

   b. Internal unit: Costs associated to collaboration with other teams and departments within Aditro Oy.

   c. Hosting costs: These costs are expenses related to physical and virtual machines, operating systems and different kind of software licenses.

4. Support: Second level support for customers. This is related to solve technical and administrative problems that occur while Verkkopalkka application is running in production environment.

5. 3rd parties: This is associated to services provided by external parties. These costs are mainly related to (1) integrations with banks to receive and process payslips information and (2) Ubisecure service support provided by consultants.

6. Internal: These are running costs within Common Development unit, such as equipment and business trips.

4.5. Findings

There are different approaches to identify whether a specific investment is a good choice before making any real injection of money to the projects. Management units usually use this kind of analysis to recognize whether a specific investment is going to bring the expected results in terms of profit.

It is important to mention that every approach focuses on different purposes and meet different needs depending on the information that business units want to analyze. As mentioned previously, this approach is based on analyzing return on

investment for two different years considering two different integrations, the actual Verkkopalkka-Ubisecure integration and the custom solution which is proved to be the least convenient.

In order to make a more extensive analysis of the reasons for which return on investment has been chosen to perform the analysis and no other approaches such as "Internal Rate of Return (Internal Rate of Return 2016)", it is relevant to evaluate the most important characteristics of every approach.

Return on investment (ROI) was chosen for the next reasons:

1. More common: It is commonly used and more popular approach because of easy interpretation of results.

2. Total investment growth: It provides a clear overview of the investment growth from start to end.

3. Matches business scope: This approach meets the business needs to get relevant information to make proper investment decisions.

"Internal Rate of Return (IRR)" was not suitable within this analysis for the next reasons:

1. More confusing and difficult to calculate.

2. Annual growth rate.

Within the analysis it is important to see if the obtained results are robust enough to support the decisions made? Answering to that question, requires to make a comparison, considering results for 2015 and 2016, between the integration with Ubisecure and the potential integration with a custom solution regarding three different metrics:

1. Revenue.
2. “Return on investment”.
3. “Total cost of ownership”.

This comparisons analysis is based on two different integrations:

1. Verkkopalkka and Ubisecure platform.
2. Verkkopalkka and custom solution.

The first integration is the actual adopted solution, while the second integration is used to make the comparison and see whether the investment decision was correct or not.

4.5.1. Revenue comparison

In table 1, the revenue has been calculated for year 2015 and estimated for year 2016. There is also a comparison of the obtained revenue between the actual Verkkopalkka-Ubisecure integration and the estimated Verkkopalkka-Custom integration. The revenue estimate for 2016 year has been calculated based on statistical data and comparisons from previous years.

The results show that the revenue is obviously the same independently of the integration. According to estimates, revenue should grow from year 2015 to year 2016. The number of payslips should increase between 2015 and 2016 because the integration with Ubisecure enables easier interaction with new customers.

	2015	**2015**	**2016**	**2016**
Number of payslips, averagely in period	*260 000*	*260 000*	*270 000*	*270 000*
Total revenues, licence	8 343 000	8 343 000	8 760 150	8 760 150
Revenues, other	67 500	67 500	67 500	67 500
Total revenues for the period	**8 410 500**	**8 410 500**	**8 827 650**	**8 827 650**

Table 1.) Revenue comparison between Ubisecure and custom integration.

4.5.2. Return on investment comparison

Regarding the integration between Verkkopalkka and Ubisecure, return on invest was 110,3% in 2015, and 113,5% in 2016. The custom integration has a return on investment of 63,5% in 2015, and 111,8% in 2016.

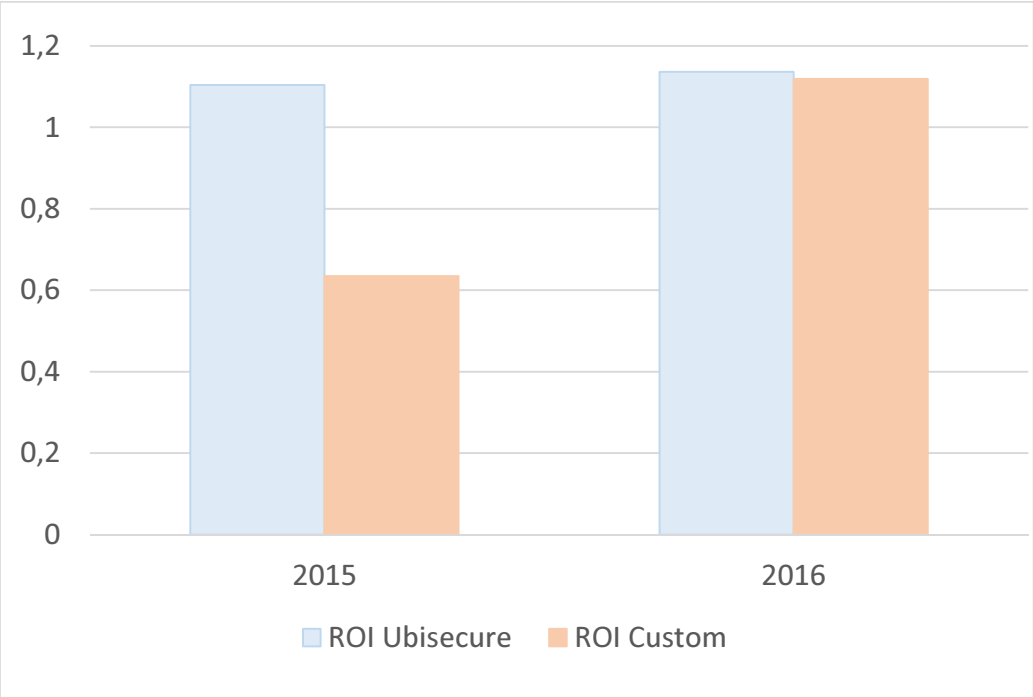

Figure 5.) Comparison return on investment between integrations.

4.5.3. Total cost of ownership comparison

The impact of the costs considering the decisions made, requires making a comparison (see Table 2) between the total costs of Ubisecure integration and an estimate of total costs of a potential custom integration that considers the same cost elements as the Ubisecure integration.

The custom integration cost values have been estimated according to information calculated mainly from inhouse and external human resources in charge of developing the product and the necessary features to fulfil the integration requirements. In the custom solution, the development costs are increased substantially while the maintenance, operations and other costs are going to be the same across the integration.

The next table includes the cost elements mentioned previously. The total cost cases are calculated in 2015 and 2016 for the integration cases mentioned. The first column describes the cost types, while the next columns contain costs by year and type of integration.

	2015	2015 (Custom)	2016	2016 (Custom)
Development	**1 082 038**	**2 228 214**	**1 114 499**	**1 147 530**
Inhouse	613 138	1 839 414	631 532	947 298
Arcadia / Gateway	129 600	388 800	133 488	200 232
External consultants, other (ubisecure)	339 300	0	349 479	0
Maintenance	**68 126**	**68 126**	**70 170**	**70 170**
Inhouse	68 126	68 126	70 170	70 170
Operations	**470 654**	**470 654**	**484 773**	**484 773**
Inhouse	368 464	368 464	379 518	379 518
U69216 OH	102 190	102 190	105 255	105 255
2nd level support	333 536	333 536	343 542	343 542
External services	1 853 280	1 853 280	1 924 560	1 924 560
Common Development OH	189 781	189 781	195 474	195 474
Total costs (SEK)	**3 997 415**	**5 143 591**	**4 133 018**	**4 166 049**

Table 2.) Costs comparison between Ubisecure and custom integration.

The total cost of ownership was 3.997.415 SEK in 2015, and 4.133.018 SEK in 2016 for the Ubisecure integration. The custom integration has a total cost of ownership of 5.143.591 SEK in 2015, and 4.166.049 in 2016.

Figure 6 shows a detailed comparison of total cost of ownership between the actual integration and a potential custom integration. It is visible that the first year would be more expensive for the custom due to development associated costs. During following year the costs would be slightly higher for the custom integration due to maintenance and other costs.

In terms of expenses, apparently the Verkkopalkka-Ubisecure integration has been a good choice due mainly to reduction in development software costs and allocation of resources from internal and external providers. These resources would be mainly employees and external consultants that develop functionalities on daily basis for different project within the company.

There is a big different mainly in the first which give good idea to support the integration with Ubisecure due to the fact that this platform is ready and does not need further development within the company.

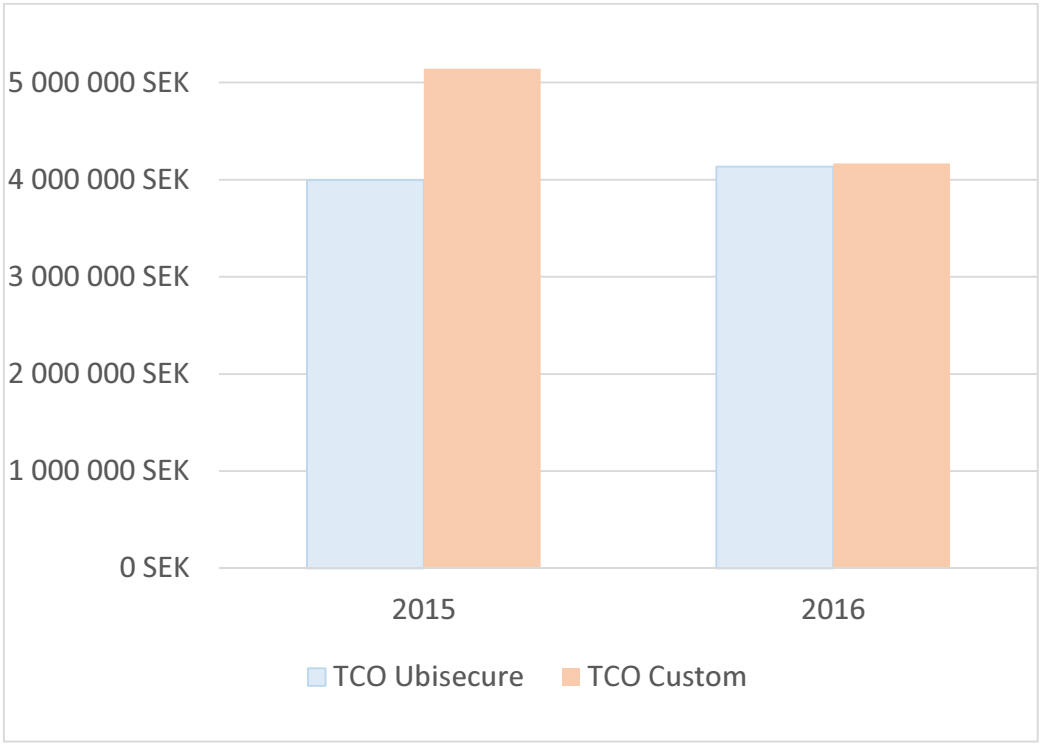

Figure 6.) Comparison total cost of ownership between integrations.

4.6. Sensitivity Analysis

Providing a deeper and better understanding of the results, requires performing a sensitivity analysis regarding the investment made for the integration between Verkkopalkka and Ubisecure. Before going into the sensitivity analysis details, it is relevant to understand what is sensitivity analysis, most common types of sensitivity analysis and how useful is for the purposes of this work.

Sensitivity analysis can be described as a set of techniques that are used to examine the level of uncertainty involved in a cost-benefit analysis, and how that affects the final result. In general, the most common sensitivity analysis types are: partial, best and worst scenarios, break-even, and Monte Carlo analysis.

The sensitivity analysis performed in this section is focused only on partial analysis and best-worst case analysis scenarios to evaluate return on investment depending on cost-benefit information.

In order to perform cost-benefit analysis, it is necessary building up assumptions and utilize the estimates to finally calculate the expected costs and benefits of the integration between Verkkopalkka and Ubisecure. In case the assumptions and estimates contain mislead information, sensitivity analysis will show how the results would be influenced by some specific changes.

The main purpose of this analysis is measuring the impact of changes in costs and benefit over the return on investment related to the integration. It is relevant to notice that the impact is a key element that may be difficult to translate in terms of money without a proper methodology. In order to calculate properly the impact, a well-defined method is explained in further sections.

4.6.1. Context

The definition of sensitivity analysis stands as a methodology focused on determining how some independent variable values will influence or impact a specific dependent variable considering some research assumptions. In other words, Sensitivity analysis is a calculation procedure that predicts the effects of changes of input data.

This methodology is used within Verkkopalkka integration investment and focused on some input variables, such as the effect of costs and return. Investment decisions are always connected to uncertainty and risk, and sensitivity analysis enhances examination of the project costs and investment.

The main purpose of using sensitivity analysis within Verkkopalkka and Ubisecure integration is attempting to determine the impact of the project costs and return under different scenarios, such as expected, worst and best cases. In these scenarios, the analyst will determine how changes in costs and benefits will impact the return on investment.

On the other hand, it is important pointing out that this analysis is useful to estimate the potential effects on investment returns. Therefore, the real benefit of this kind of analysis regarding the investment decision is mainly focused on evaluating the risks that the integration with Ubisecure platform would bring in different use case scenarios.

There are also some disadvantages related to sensitivity analysis for investments decisions. Those disadvantages come more evident when investments are complex and their evaluation have strong dependencies with several factors. The sensitivity analysis of Verkkopalkka-Ubisecure integration does not have strong dependencies with either external or internal factors because the analysis is only based on changes regarding two variables: cost and benefit.

4.6.2. Method

In order to get proper sensitivity analysis results, it is important providing a reliable method that defines a set of steps including all the necessary elements to

carry out a detailed integration investment analysis. This method is composed of the next five steps:

1. Define a set of relevant input variables: Evaluating return on investments depending on variables changes require that these two input variables are costs and benefit.

   These variables are going to be evaluated separately to see the return on investment variations under the perspective of two different variables changes.

2. Determine the values range for the input variables: Costs and benefit are variables that move over the SEK currency domain. This domain will include values that are calculated by either increasing or decreasing percentages of the real cost and benefit values described in section 5.5.

3. Identify which are the minimum and maximum cost and benefit values for the investment to be in the profitable range: These values are going to depend on negative and positive percentages when calculating the results.

4. Identify a criteria to evaluate the investment success: In this step, it is relevant mentioning that the criteria must be quantitative to ensure a correct analysis of results.

   The criteria to evaluate Verkkopalkka-Ubisecure integration investment is based on partial sensitivity analysis and best-worst case scenarios, and is focused on evaluating return on investment results depending on changes in two different variables.

5. Analyse and interpret the results: The results are analysed in the next section. They provide a detailed description of main findings and how changes in costs and benefit range affect the return on investment.

   This analysis focuses on providing a clear and simple overview of the investment under different conditions.

4.6.3. Analysis and Results

This section shows the sensitivity analysis and results related to return on investment depending on total cost of ownership and benefit in two separate subsections. This analysis follows the method explained in the previous section and it is focused on partial analysis and best-worst case scenarios.

4.6.3.1 Partial analysis by total cost of ownership changes

In order to ensure a complete overview of the results, it is relevant performing a partial analysis of the return on investment when it is affected by total cost of ownership. This overview will provide relevant information to analyze and extract different kind of conclusions.

Table 3 shows an overview of different variations related to return on investment depending on changes in costs. These changes are expressed in cost percentages variations having as reference point the real expected value.

These cost calculations take as reference value the total cost of ownership for the Ubisecure integration in 2015, the percentages are distributed from -5% to 110,39% to analyze the behavior of the return on investment. This analysis follows the methodology steps mentioned in the previous section.

	-5 %	0 %	5 %	10 %	20 %	50 %	110,39 %
TCO	3 797 544 SEK	3 997 415 SEK	4 197 286 SEK	4 397 157 SEK	4 796 898 SEK	5 996 123 SEK	8 410 161 SEK
Benefit	8 410 500 SEK	8 410 500 SEK	8 410 500 SEK	8 410 500 SEK	8 410 500 SEK	8 410 500 SEK	8 410 500 SEK
ROI (%)	121,4720737	110,40	100,38	91,27	75,33	40,27	0,00

Table 3.) Return on Investment by costs changes

The evaluation criteria is based on partial analysis. Regarding the partial analysis, the selected variable is costs, its value has changed while benefit variable keeps constant, and return on investment has change accordingly in response to the effect of cost changes.

The effect of changes in costs shows that 5 percent reduction in cost would lead into a 121,4 percent of return on investment, 5 percent increase would result in 100,38 percent of return, 10 percent increase would bring 91,27 percent, 20 percent would result into 75,33 percent, 50 percent into 40,27 percent, and 110,39 increase in cost would result in 0 percent of return which means no profit.

In figure 7, it is possible to see how the return on investment decreases rapidly when the cost percentage increases. In the selected range of values when the total cost of ownership percentage moves towards negative values the return on investment brings positive profit. When the cost increases over 110, 39 percent, therefore there is not profit anymore and return on investment moves towards negative values.

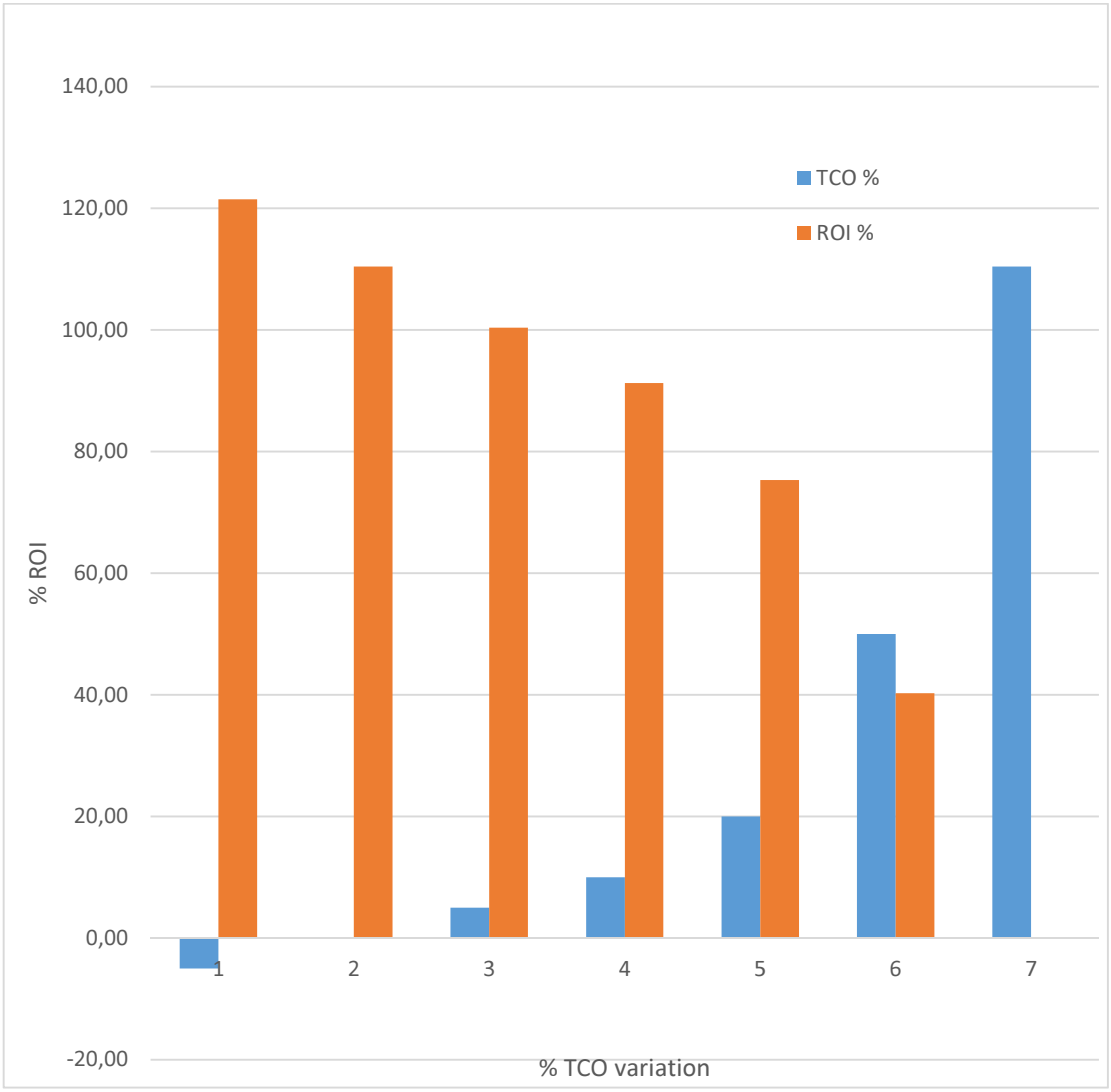

Figure 7.) Comparison % TCO variation against % ROI.

4.6.3.2 Partial analysis by benefit changes

This section focuses on providing a deeper overview of what would happen whether the benefit value changes proportionally in terms of percentage. This percentage is calculated based on real values obtained from the integration project results. The changes in the values are performed according to a range of negative and positive percentages.

Table 4 shows the results of return on investment when the benefit variable changes in terms of positive and negative percentage. The value reference point is the real expected result related to the benefit obtained from the integration. The changes in the benefit result are calculated according to a range of different percentages.

The benefit calculations take as reference value the benefit result for the Verkkopalkka-Ubisecure integration in 2015, this reference value is associated to 0 percent in table 4. The percentages are distributed from 5 percent t -52,47 percent to analyze the behavior of the return on investment. This analysis follows the methodology steps mentioned in the method section.

	5 %	0 %	-5 %	-10 %	-20 %	-50 %	-52,47 %
TCO	3 997 415 SEK	3 997 415 SEK	3 997 415 SEK	3 997 415 SEK	3 997 415 SEK	3 997 415 SEK	3 997 415 SEK
Benefit	8 830 669 SEK	8 410 161 SEK	7 989 653 SEK	7 569 145 SEK	6 728 129 SEK	4 205 081 SEK	3 997 350 SEK
ROI %	120,91	110,39	99,87	89,35	68,31	5,19	0,00

Table 4.) Return on Investment by benefit changes

The evaluation criteria is based on partial analysis and the selected variable is the benefit that the integration provides. The benefit value has changed while the total cost of ownership variable value keeps constant. The return on investment has change according to the effect of benefit changes that are calculated depending on the percentages visible in table 4.

The effect of changes in the benefit variable shows that 5 percent increase in the benefit would lead into a 120,91 percent of return on investment, 5 percent reduction would result in 99,87 percent of return, 10 percent reduction would bring

89,35 percent, 20 percent would result into 68,31 percent, 50 percent into 5,19 percent, and 52,47 reduction in benefit would result in 0 percent of return which means no profit.

In figure 8, it is possible to see how the return on investment decreases rapidly when the benefit percentage decreases. In the selected range of values when the benefit percentage moves towards positive values the return on investment brings positive profit. When the benefit decreases over -52,47 percent, therefore there is not profit anymore and return on investment moves towards negative values.

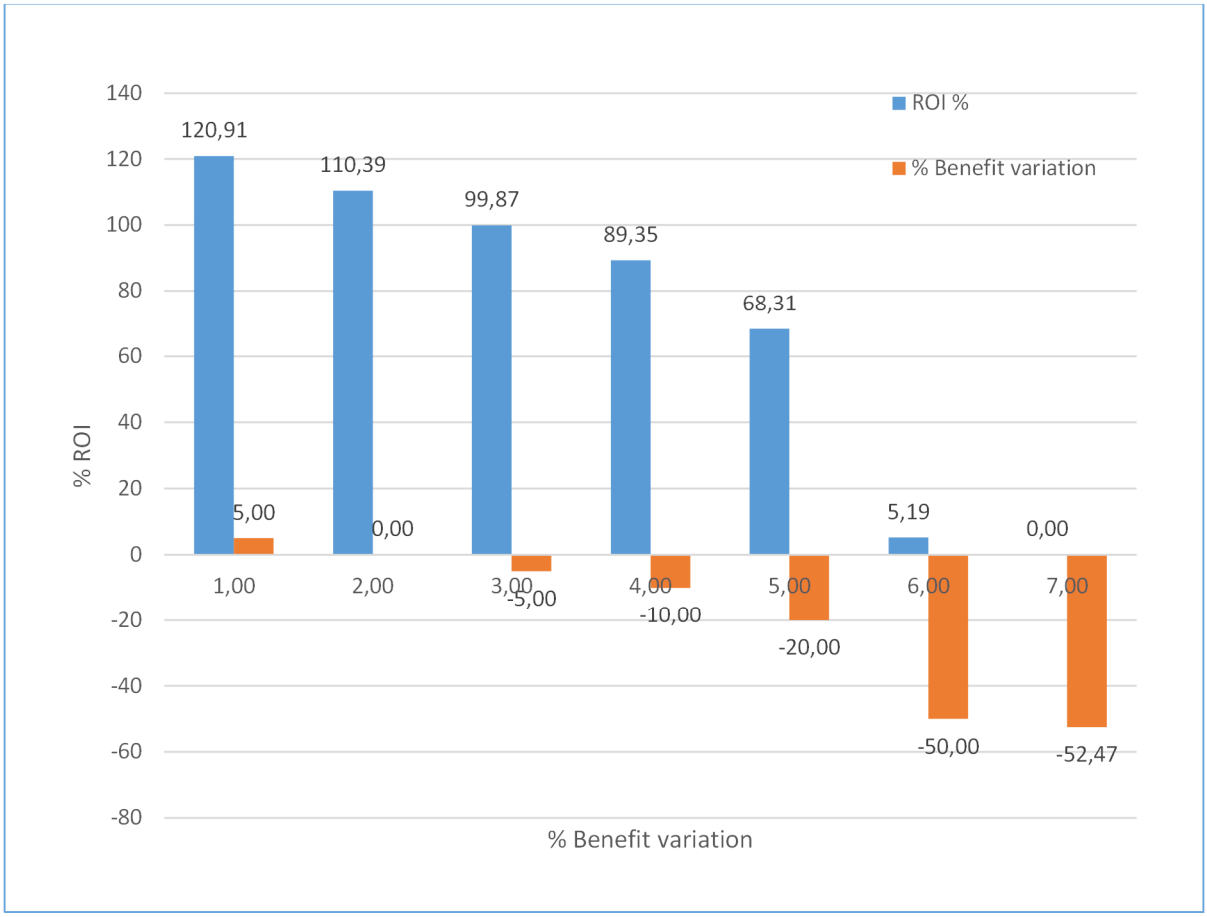

Figure 8.) Comparison % Benefit variation against % ROI.

4.6.3.3 Analysis of best and worst case scenarios

This sensitivity analysis shows how a range of possible costs and benefit outcomes affect the return on investment. These two variables outcomes take as reference point their respective expected values which were calculated in a previous chapter. Once the reference point is set up then worst and best cases are calculated according to different kind of assumptions.

In order to perform the best case scenario analysis, it is necessary using the most beneficial and favourable assumptions about the variables outcomes. Regarding the worst case scenario, the least favourable assumptions are used to perform calculation and further analysis.

Table 5 shows different return on investment results that vary based on combinations of worst, expect and best scenarios for cost and benefit variables values. Return on investment results moves between a range of negative and positive value results that depend on benefit and cost variable values for different case scenarios.

ROI results			Benefit		
			Worst	Expected	Best
			3 997 350 SEK	8 410 161 SEK	8 830 669 SEK
Cost	Worst	8 410 161 SEK	-52,46999433	0	4,999999405
	Expected	3 997 415 SEK	-0,001626051	110,3899895	120,9094878
	Best	3 797 544 SEK	5,261453192	121,4631615	132,5363182

Table 5.) ROI results for best and worst case scenarios

For the return on investment of Verkkopalkka-Ubisecure integration, the best case scenario is visible when the benefit increases 5 percent its expected value

and the cost decreases -5 percent its respective expected value. These values would bring around 132,53 percent of return on investment, which means the integration would increase the profit under assumed beneficial conditions.

The worst case would happen when the benefit value is reduced -52,47 percent from its expected value and the cost value is increased 110,39 percent from its respective expected value. These values would lead into around -52,46 percent of return on investment, which means the integration would bring excessively negative profit.

5. CONCLUSIONS

Technology management and strategy are powerful concepts that require good knowledge of latest technologies and business models in order to make proper investment decisions that improve existing software solutions. Verkkopalkka and Ubisecure integration solution is mainly designed to fulfill business requirements that focus on increasing profit, reducing internal processes overhead and providing better and more flexible identity management and administration functionalities to existing and new customers.

In 2015, ROI is higher and TCO is lower for Ubisecure integration compared to custom. This result shows the integration has been a proper choice for the benefit of the business. Regarding 2016, ROI is slightly higher and TCO is relatively lower for Ubisecure integration compared to custom. The integration choice is still going to bring profit during that year. According to the results for 2015 and 2016, return on investment is more beneficial for the business with Ubisecure integration rather than the Custom solution which turned to be more expensive.

Number of payslips processed in VP is growing every year which means more revenue. This is a good indicator to see the Verkkopalkka-Ubisecure integration is bringing new customers. On the other hand, the big costs come from development and bank fees. This is something that affect a percentage of the total costs and need to be reviewed to improve the business conditions of Verkkopalkka solution.

Sensitivity analysis shows different kind of possible situations to understand better how some dependent variables values affect the behaviour of return on investment results. According to the sensitivity analysis the best case scenario would happen when the costs are reduced and benefit increased. The worst case scenario would happen when the costs increase substantially and the benefit decreases substantially as well.

The outcome of this work could be used as a generic approach applicable to similar situations where it is important evaluating whether specific technology investments are profitable in the long and short term. In order to reuse the result of this work within different IT projects that involve technology integrations between different platforms, it is necessary following the methodology explained in previous chapters to evaluate the return on investment results, considering what would happen under different project investment decisions.

A generic reusable methodology would include two main steps: (1) evaluation and comparison of return on investment and total cost of ownership for at least two different investment decisions and periods, and (2) sensitivity analysis that would provide a better and deeper understanding of the results regarding the investment decision from the cost and benefit angles.

The first step requires as input the benefit obtained from the integration project for at least two years, as well as, the costs associated to each of those years. These input data will be used to calculated return on investment and total cost of ownership over the selected years. A separate comparison of the benefit and cost per year is relevant to identify the differences between possible decisions to either

choose the most adequate for the interest of the company or provide an overview of how profitable and beneficial was the actual investment decision.

The second step focuses on the effect of separate changes in two input variables: benefit and cost. Once these two variables are defined as the input for the sensitivity analysis, the following actions are related to: determine the values range for the input variables, identify which are the minimum and maximum values for the investment to be in the profitable range, identify a criteria to evaluate the investment success and analyse and interpret the results.

The results are analysed in two separate contexts that provide a detailed description of the findings and how separate changes in costs and benefit affect the return on investment. These two contexts are focused on partial analysis and best-worst case scenarios. This analysis should provide enough information to have a clear and simple overview of the investment under different conditions that affect the final result.

Finally, it is possible to conclude that this approach is very simple to follow and applicable to different scenarios and companies where it is necessary evaluating technology investments that are meant to increase the profit of a certain business. The profitability of a certain business is a key factor to keep alive products within their respective markets and a very important measurement to see in how good or bad shape the business is at the moment.

Technology investments are one the most relevant elements that companies use to improve existing products. This kind of expenses have to be well understood

by managers who should be able to evaluate correctly the impact and mechanisms to justify and carry out technology improvements that potential would end up in providing more profitability to the company.

In order to increase profitability of specific products, it is usually necessary making a proper technology investment, particularly in situations where the software product is outdated or carry technology weaknesses that the market does not tolerate. Technology investments are often difficult to make because there are many internal and external factors that influence the decision. Making a product more profitable is a process that has to consider different technologies and solutions comparable across the time, short-long term costs and return on investment.

New and better technologies offer solutions to make existing business easier and reduce overhead in certain areas. The integration between Verkkopalkka and Ubisecure is a good example of a proper investment decision that brings benefit to the company and customers reducing overhead and optimizing some processes. It is important to mention that technology investments have to be validated against approaches as the described in this work.

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