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# A Proposal for Business Intelligence Solution Based on Systems Integration and Enhanced Reporting Functionality

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When I started to plan for going back to school over two years ago, I could not even imagine it being such a challenging but very rewarding journey. After one year with entry exams, the first assignment handed to me during the summer even before the first day at school, enjoyable class sessions with lively conversations and tough assignments, Thesis planning and finally making of it, it feels strange that it is over now. Time flies by when having fun, they say. In this case, it may not have been so unilateral due to having a day job simultaneously, but I still enjoyed every second of it, adversities and all.

I would like to thank my boss and colleagues for making this journey possible for me. The constant support and understanding when I was not present at the office were precious. I was given the time and space to have this defining moment in life and I am ever grateful.

I would also like to thank my instructor, Dr. Thomas Rohweder, for his trust and support even though I admit being too independent when it comes to seeking guidance. He was there when I needed a nudge to the right direction and for that I am thankful. I wish to thank Dr. Satu Teerikangas for her ever-positive attitude, it was truly inspirational. In fact, the positivity was shared with all of the faculty members and it was clearly demonstrated during the classes and team assignments. Well done all, thank you for the memories.

One of the greatest things about this journey was, of course, the classmates. You guys and girls are something else, every one of you is a personality. It was so much fun and educational at the same time, and it does not end here.

Finally, I would like to thank my closest and dearest friends and family members who endured this process with me. Your support and understanding were not unnoticed, even though the year was very challenging in many aspects. Some bridges were damaged, some got renewed, but we all carry on with higher hopes and as better persons, of that I am sure.

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<p>This study builds up a proposal for a Business Intelligence Solution for the case company. The company has an existing solution that could be used for this purpose but it is used only for the external customers. The internal customers claim that the existing solution may not be the right tool for the Business Intelligence reporting so it was necessary to research the current situation and find possible alternative solutions. Furthermore, the operational infrastructure that is creating the data to be used by the Business Intelligence Solution is under integration development which is greatly affecting the outcome of the proposal. The objective of this study is to build a proposal to choose between the existing solution and an alternative solution.</p> <p>Action research was the chosen method for this study. The business challenge was identified with the company stakeholders and the current state of the reporting, operational infrastructure and their developability was analyzed and summarized. The data for the analysis was gathered from the stakeholder interviews and company's documentation. The literature summary for the proposal was studied through Business Intelligence overview and best practices alongside with infrastructure requirements for them. The current state analysis and the literature summary was the basis for the proposal after the testing phase was completed. Testing was done with the existing solution and two alternative solutions that were selected based on the company requirements and best practices. Testing of the solutions was done with the stakeholders and the summary of the solutions was used to select the alternative solution to compete against the existing solution. The initial proposal was then built and reviewed by the company and adjusted to better reflect the company needs and to reduce risks.</p> <p>The outcome of this Thesis was a final proposal for the company to choose between the existing solution and an alternative solution. The proposal included details from both solutions about pricing, implementation cost, support and maintenance functions, usability, overall performance and potential according to company needs.</p>	
Keywords	Business Intelligence, Business Management, Reporting Solution, Data Centralization, Operational Infrastructure

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## 1 Introduction

As business environment grows in a company, the leadership and managers are usually struggling to identify how the business is faring in real-time. This occurs when the infrastructure of used systems and reporting of financial and operational stakeholders are not developed simultaneously. Amidst the building of a company, certain areas like Operations and Services and Sales and Marketing might have been developed to serve their own purpose, hence having their own environment with tools and processes with the output of data like Actual Order Lead Time ( $OLT_{Actual}$ ) and Cost of Sales (CoS). Individually the areas offer the data that is needed, but to have them visible in one place is causing additional manual work if they are not integrated to do so. It might be that the interaction between these areas has been neglected to be developed, which is usually justified by not having enough time or resources. This comes at a cost when the business starts to grow and the scalability of the internal environments are lacking.

In order to tackle the above circumstances within a growing company, the integration or development of the environments is necessary to cut down the costs, avoid misinformation, gain overall visibility, reduce manual work and get rid of the silos that withhold information entities. Integration can happen through various methods, most popular ones being whole new environments with Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) tools which offer visibility to most of the business functions that are needed. The integration can also happen by exporting the information from the various systems that have been taken into use over the years and place it on a single platform that can merge and blend this data. It is called Data Warehousing (DW). There are well-known DW providers out there, but you can also build and mimic one on your own by setting up export functions from the various independent systems into a server which can be enabled for example with a Structured Query Language (SQL). This SQL database can then be read by different kind of visualization tools like Business Intelligence (BI) solutions. BI can be shortly described as a visual projection of business operations that includes the historical, current and forecastable views.

The data from the systems can be reprocessed in the server by scripts or manual work before being read into the SQL. In SQL you can again process the data prior to the visualization process in order to make it more structured for the visualization queries by the BI-solution. For the queries of the data from SQL, companies can select from a variety of BI-solutions. They vary from being a single dashboard provider to a full-blown

analytical solution with human resources behind them. Selecting the right one for the company is of high importance; commonly considered factors are cost, usability, efficiency, benefit, support and maintenance of the possible solution.

All of this is aimed towards the company needs in terms of “how the business is faring”. The starting point for this Thesis was an SQL test database built from different independent systems data within the case company which is introduced in the next chapter.

### 1.1 Case Company Background

The case company is a middle-sized data analytics company in Finland and it has a global customer base. Turnover was 9.2 million euros in 2014 and the company has shown growth in 2015. The company is still somewhat in the start-up mode even after 10 years in the business. It is gradually maturing to become a serious global player and is currently going through change management processes.

The company has a strong customer base in one major segment and is a global market leader in its core business. This has helped the company to grow significantly in the past years. However, this segment has saturated and new products and offerings are not being ordered that much anymore. The recurring revenue from this segment is providing the company the leverage to invest in other major segments in order to maintain the global market lead. This will potentially lead to a significant growth in customer base and company size.

### 1.2 Business Challenge of this Thesis

Even though the case company has data analytics as its core business, it has done all the data deliveries from beginning to the end. This means that it has a delivery organization that handles the projects which install the hardware and software in order to collect the data. The delivery organization is under-developed with tools and processes and the internal delivery costs have never been recognized until lately. If the potential business growth happens, it also scales up the current way of doing things in the delivery organization. This Thesis is part of the chosen company strategy to help the delivery organization and senior management to have visibility on the projects and company-wide progress in order to make the operations more scalable through pin-pointed development, thus aligned with the growth.

The business challenge of this Thesis is to find a suitable BI-solution that serves and supports the currently unhappy internal customers of the company in the future. Currently, the company is utilizing several independent software solutions for example for project management, inventory management and accounting. The major setback of this setup is that the systems are not integrated together yet, they are not talking to each other in an efficient way. At the same time, the visual reporting from these systems is lacking and almost non-existent. These cause a lot of manual work through double inputs into the systems and in using external tools such as Excel. The company does possess a BI-solution with the potential to integrate the reporting of the systems but it is currently used only for the external customers.

### 1.3 Objective of this Thesis

Based on the current state of the operational infrastructure and reporting style and theoretical best practices, this Thesis builds a proposal to choose between the existing BI-solution and an ideal external BI-solution in order to cover the visibility and reporting needs of the different stakeholders within the company.

### 1.4 Output of this Thesis

The output of this Thesis is a Business Intelligence Solution proposal for the company; to either rely on the existing BI-solution or an ideal alternative BI-solution.

## 2 Method and Material

This section clarifies the methodology of the research in this Thesis and defines how the data is collected and analyzed.

### 2.1 Research Approach

The research approach for this Thesis is action research, based on the practical elements that the whole process, from setting the objective and finalizing the proposal, is facing. A normal case study approach usually begins with having a preliminary interest from the researching parties towards some area of knowledge or phenomenon. Action research differs from that approach by having practical difficulties or issues which need to be addressed (Blichfeldt and Andersen 2006:4). Both approaches are diverse in theory and practice. They also provide the researcher a deep understanding of the particular phenomena in terms of reality (Blichfeldt and Andersen 2006:3), which is also a necessity for the case company and this Thesis.

In organizations, action research is conducted in order to improve processes, individual practices on any area and interactional results between managers and staff. It is a combination of taking improvement action and research around it. This consists of collecting data, gathering theories and best practices about the area of improvement in order to become self-reflective between the organization and the research. (Melrose 2001)

Action research is usually defined as cyclical, participative, qualitative and reflective. The cyclical process happens when similar steps and sequences take place within the whole research. The participation of the informants and testers is binding the research to reality which is a common characteristic of the action research. The feedback and information from the participants are gathered in a qualitative way to ensure responsiveness between them and the researcher. Critical reflection is a fundamental aspect of the whole action research; researcher and the participants increase the mutual understanding of what has happened in order to plan the next steps. (Dick 2000)

### 2.2 Research Design

This Thesis is built with the five-stage action research cycle as described by Calhoun (1994) in Figure 1. The first stage states the objective and context and sets the limitations of the research (Sections 1 and 2). The second stage collects the data from the current state in the case company (Section 3). Third stage reviews best practices from the

literature regarding Business Intelligence (Section 4). The fourth stage is about analyzing and interpreting the data through testing of the BI-solutions and receiving the feedback from them. The feedback is then reflected by stages 2-3 and an initial proposal for the company is produced (Section 5). The fifth and final stage evaluates the proposal, improves it based on the company feedback and clarifies the practicalities and possible next steps around the objective and the end result (Section 6 and 7).

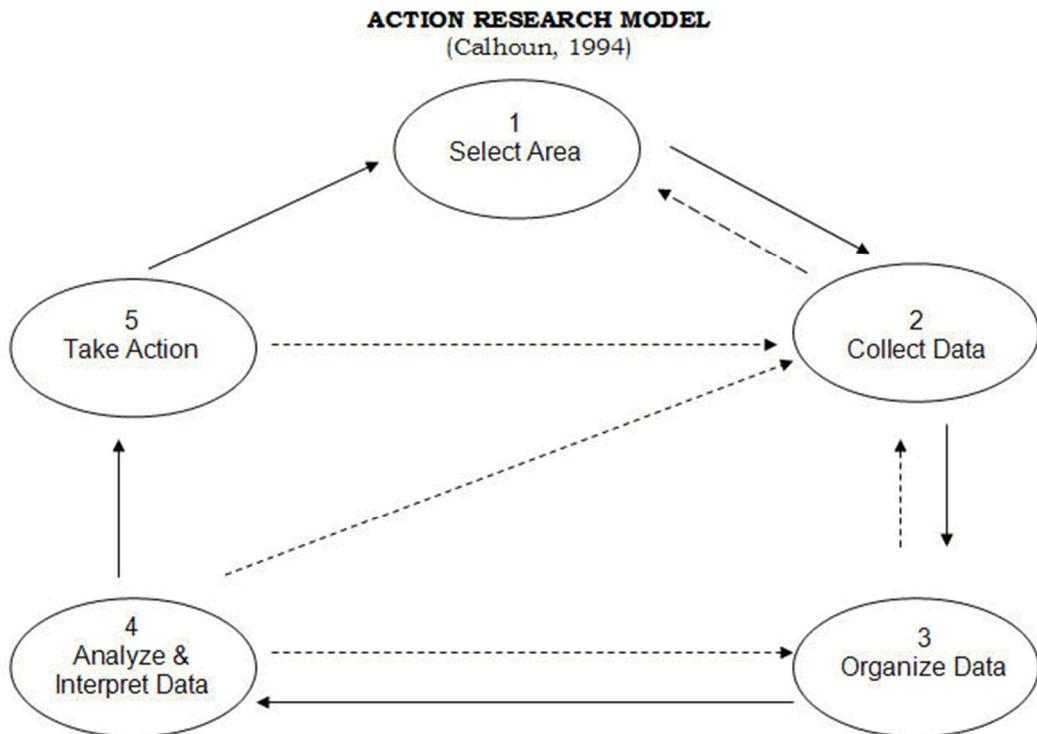


Figure 1. Five stages of the action research in this Thesis

The structure of the research design for this Thesis is summarized in Figure 2. It withholds the order of each stage, the content in them and the outputs. The data collection points and their contents are shown on the right side by the stage content. The definition of the objective is followed by the Current State Analysis (CSA), which produces an output of Summary of Current State. It shows what the stakeholders have and what they need and the current operational infrastructure of the company. This is followed by the literature review of Business Intelligence which produces an output of Conceptual Framework (CFW). Building the initial proposal includes the testing phase and the summary of the initial proposal solutions. One alternative solution is picked to compete with the existing solution, which is also tested with the same method as the others. The initial proposal is reviewed by the stakeholders and improved according to the feedback. The

final proposal is submitted to the case company with a validity and reliability check as well as the next steps with practical implications.

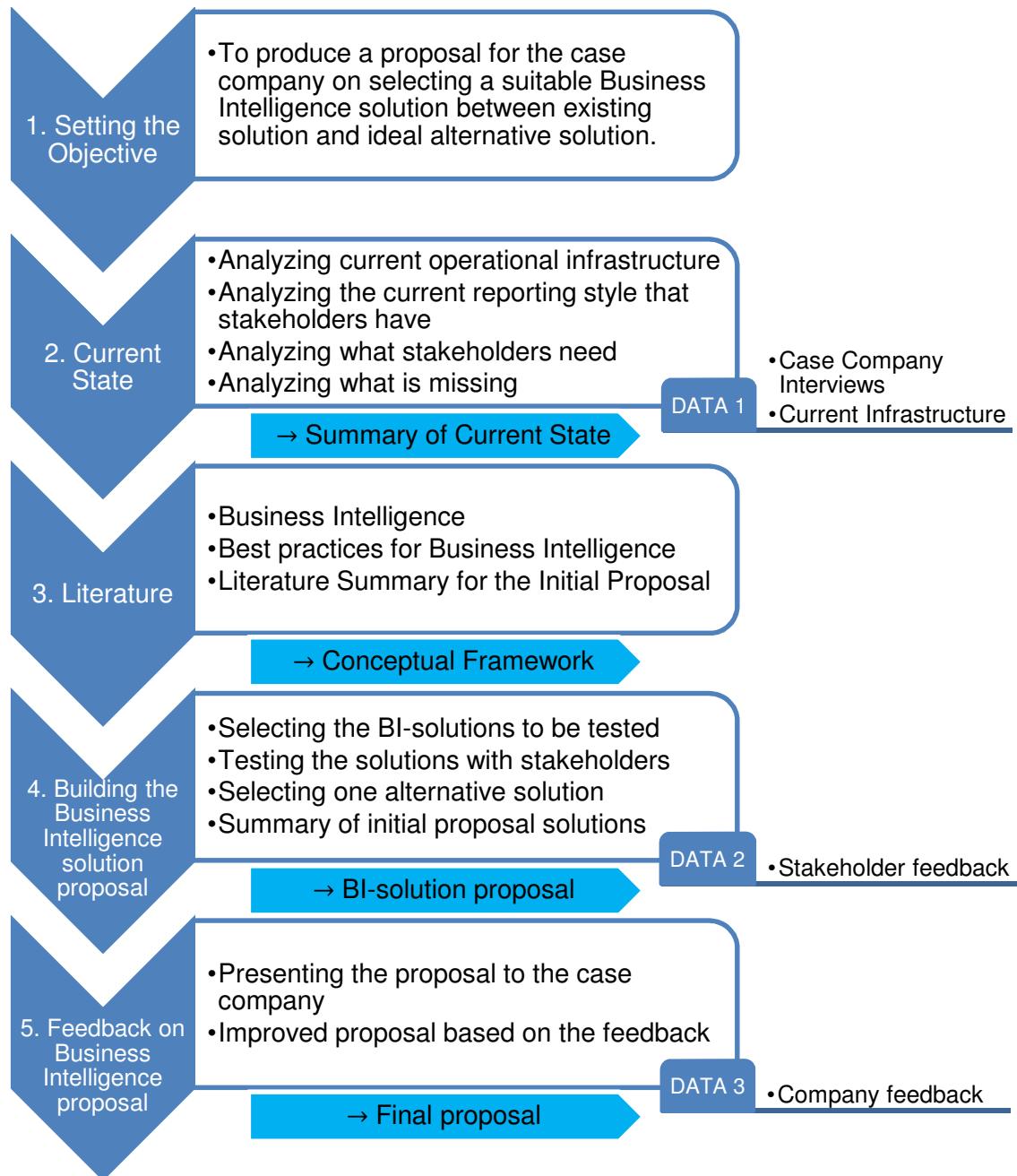


Figure 2. Research design stages and data collection points in this Thesis

### 2.3 Data Collection

As described in Figure 2 above, the data is collected in three stages. The first data collection happens when assessing the current state of the company regarding the reporting

and the needs for it. Stakeholders are interviewed and the reporting infrastructure is studied. The second data collection occurs when the initial proposal is being built. The BI-solutions are summarized and the feedback from the tests by the stakeholders is gathered. The third data collection is after the initial proposal has been reviewed by the company stakeholders and feedback from them is acquired. The data collection structure can be seen in the below table.

Table 1. Data Collection 1-3

	<b>Data Collection purpose</b>	<b>Data content</b>	<b>Documented as</b>
<b>DATA 1</b>	Current State Analysis	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Field notes</li> <li>• Company data</li> </ul>
<b>DATA 2</b>	Initial Proposal	<ul style="list-style-type: none"> <li>• Test selection process criteria</li> <li>• Tested Solutions</li> <li>• Stakeholder feedback</li> <li>• Existing Solution versus Ideal Alternative Solution</li> </ul>	<ul style="list-style-type: none"> <li>• Field notes</li> <li>• Tables</li> </ul>
<b>DATA 3</b>	Final Proposal	<ul style="list-style-type: none"> <li>• Company feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Field notes</li> </ul>

### 2.3.1 Data Collection 1

Data Collection 1 is the Current State Analysis, which is formalized through interviews with the relevant stakeholders within the company. The infrastructure of the company is also investigated and analyzed from the existing company data, the overview of it is explained in Section 3.1. The data is documented as field notes and company data. The interviews are analyzed based on the current way of doing things and the ongoing infrastructure development which enables the reporting needs to be evaluated against possibilities. This is represented as a Summary of gaps and Developability in current reporting versus needs. The data collection 1 is shown in Table 2.

Table 2. Data Collection 1

DATA 1	Current status of	Needs Definition of	Output
<b>Current State Analysis</b>	<ul style="list-style-type: none"> <li>• Infrastructure</li> <li>• Reporting</li> </ul>	<ul style="list-style-type: none"> <li>• Reporting</li> </ul>	<ul style="list-style-type: none"> <li>• Summary of Current State           <ul style="list-style-type: none"> <li>- Current Reporting versus need and Developability of them</li> </ul> </li> </ul>

### 2.3.2 Data Collection 2

Data Collection 2 is about building up the proposal for the company. This included the selection process for the solution testing phase, stakeholder feedback from the tested solutions and the Initial Proposal with Existing Solution versus Ideal Alternative Solution. The selection process is based on business and infrastructure requirements of the company and suitability for the development of the reporting environment. The stakeholder feedback is analyzed based on the same criteria and documented as field notes and tables, these can be found in Chapter 5. The output of Data Collection 2 is the Initial Proposal for the company to rely on existing or alternative BI-Solution. The Data 2 is presented in Table 3 below.

Table 3. Data Collection 2

DATA 2	Selection for testing process	Tested solutions	Stakeholder feedback	Output
<b>Initial Proposal</b>	<ul style="list-style-type: none"> <li>• Business requirements</li> <li>• Infrastructure requirements</li> <li>• Support and Pricing</li> </ul>	<ul style="list-style-type: none"> <li>• Existing Solution</li> <li>• Solution A</li> <li>• Solution B</li> </ul>	<ul style="list-style-type: none"> <li>• Usability</li> <li>• Attractiveness</li> <li>• Intuitivity</li> <li>• Potential</li> <li>• Workload</li> </ul>	<ul style="list-style-type: none"> <li>• Initial Proposal of this Thesis</li> </ul>

### 2.3.3 Data Collection 3

Data Collection 3 is the adjusting of the proposal into a Final Proposal. The company is presented with the Initial Proposal and based on the feedback from the company, final adjustments are done. The adjustments are analyzed on the location with the company stakeholders that are participating in the Final Proposal, the details can be found from Section 6. The adjustments are documented as field notes. The output of the Data Collection 3 is the Final Proposal for the company to rely on existing or alternative BI-solution. The Data 3 is presented in Table 4 below.

Table 4. Data Collection 3

<b>DATA 3</b>	<b>Feedback from company stakeholders</b>	<b>Output</b>
<b>Final Proposal</b>	<ul style="list-style-type: none"> <li>• Adjustments to Final Proposal</li> </ul>	<ul style="list-style-type: none"> <li>• Final Proposal of this Thesis</li> </ul>

### 2.4 Validity and Reliability Plan

Common concepts in scientific research are internal validity, external validity and construct validity. Internal validity explains how composed the research was, especially whether it avoids having more than one possible cause acting at the same time. This is referred as confounding, where a confounding variable is the one that changes with an independent variable. If changing an independent variable alters a dependent variable, one cannot be sure on whether it was the independent or the confounded variable that produced the change (IUB 2016).

External validity explains how well the collected data and the theories reviewed about it fits together. Construct validity relates to the degree to which the research can be generalized or conceptualized. In other words, it is an assessment of how well the theories and ideas are translatable into practicalities and realities (IUB 2016, Trochim 2002).

To make sure that the overall validity of this Thesis is based on the above definitions, the business challenge, objective and the outcome are clearly defined in the planning phase. Also, the staged structure of the research design is accurately followed to set the limitation of the whole Thesis according to the plan. Similarly, the gathered information from CSA, CFW, proposal building and the feedback from the proposal are the backbone of the action research in this Thesis.

The analysis and outputs of this Thesis are depending on the CSA and the best practice literature regarding Business Intelligence. A practical approach is taken with the stakeholders who will participate in the testing phase of the BI-solutions, thus providing an iterative and qualitative action research.

The reliability of this Thesis is based on systematic data collection and documentation of it from the stakeholders and literature. This alone diminishes the amount of misinformation or misinterpretation due to having the data for future reference. The references have been checked from multiple sources for integrity and alignment of them. Cyclical approach with the feedbacks and interviews are contributing to the interaction between the stakeholders and the research. Therefore, the reliability is increased simultaneously. The solidness and the process of the whole Thesis are observed and commented by the peer-group of the fellow thesis workers and instructors.

### 3 Current State Analysis

This section clarifies the current state of the reporting and the infrastructure in the case company. The information was gathered from company data and interviews with the stakeholders. The interview questions are in Appendix 1.

#### 3.1 Infrastructure to build reporting on

The company's operational infrastructure is currently being developed and is still in the early stages of implementation for the first development items. As stated in the Introduction, there are multiple different systems that are being used and referred to by the different stakeholders. The reporting from these systems is gathered and composed individually. The main systems that are in the first development items are Accounting, Project Management and Time Tracking and their main data transfer protocol with export is comma separated value (CSV). This means that the data is stored from exported excel files into a plain text file where the data entities are separated by a comma. Other non-integrated systems are for Partner Interface, Documentation, Customer Management and Inventory Management. The data from these systems is to be gathered into a single database in SQL-server which is then easily integrable with a suitable BI-solution. The overview of the development map is presented in Figure 3 where the green arrows show the current data transfers between systems and the server.

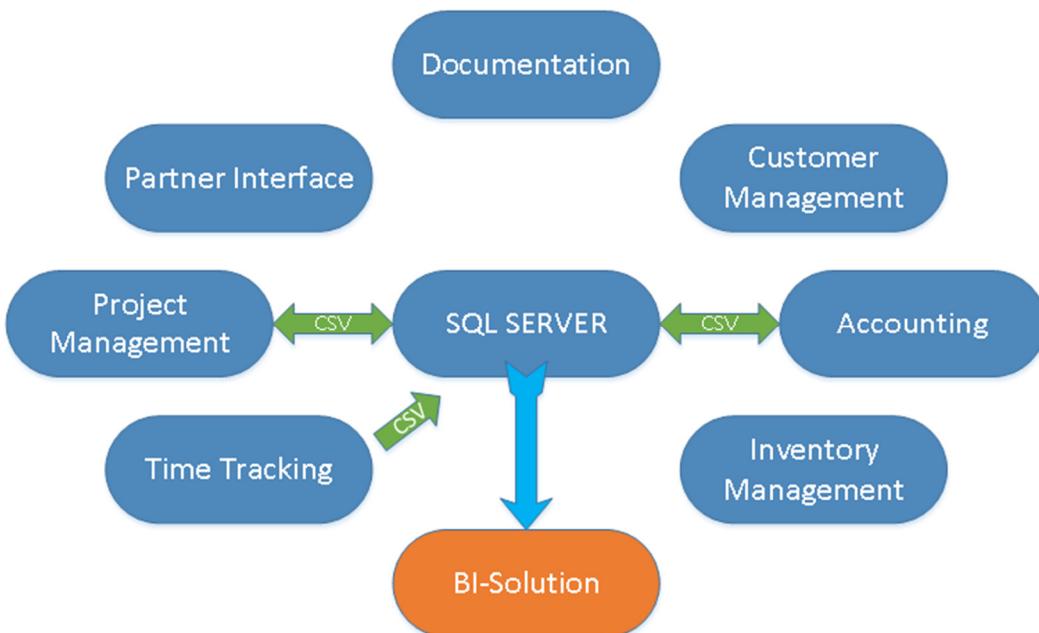


Figure 3. Operational Systems Overview and Current Developed Data Transfers (in green arrows)

### 3.2 Current reporting by stakeholders

The company has a bottom-up approach with the operational reporting; the operational and internal figures and statuses come from the root level inputs to the different systems that were listed in Section 3.1. These are then gathered by the managers into their own reporting for the senior management and company lead. They then again merge the data to be shown to the Board of Directors. Company's external figures and reporting are done by the Financial Team who store their data in the Accounting system. The following subsections are written from the stakeholder perspective regarding their current reporting.

#### 3.2.1 Chief Finance Officer reporting

Chief Finance Officer (CFO) states that he has all the data that is needed to run the daily business: "*We have all the parts that are needed to run accounting, but the project deliveries and their internal cost structures are not reachable with the current way of doing things.*" The total overview of the financial status of the company is reached and the reporting of it is well standardized with an Excel-based approach which also handles the customized reporting through pivot tables. A pivot is a programming tool that allows the user to reorganize and summarize selected data from Excel spreadsheets into a report. Thus, customized reports from CFO are manually adjusted after exported from the Accounting system. The external Financial Statement (FS) consists of Annual Report, Profit and Loss Statement (P&L), Balance Sheet (BS), Cash Flow Statement (CFS) and notes.

The Financial Dashboard for the company and the Board of Directors is semi-manually done by the CFO. The single view dashboard is showing the Revenue Latest Estimate (Revenue LE), Annual Recurring Revenue (ARR), Operating Expense (OPEX) versus Budget, Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA), Cash Position (CP) and Aged Receivables (AR). The standardized process for this is set up to be monthly through the Accounting system and the financial planning tool which is a separate system. This separate financial planning tool system is not in the scope of the infrastructure development yet, due to it being a vital part of running the daily business of the CFO. However, it is under subject for a change if a proper BI-solution is found.

#### 3.2.2 Chief Operations Officer reporting

Chief Operations Officer (COO) of the company has a moderate approach to reporting due to the fact that the company has an ongoing change management process and the

metrics to measure performance are being developed and implemented. Still, the Key Performance Indicators (KPI) are the most important indicators for a COO and to have them correctly is the path to leading with knowledge instead of intuition: *"In the year 2015 we introduced KPI-reporting and are slowly but steadily changing the company to a fact-base-managed company."* KPI's are results of different metrics that measure the performance of the deliveries or projects for example. Usual KPI's in deliveries and projects are Average Lead Time (ALT) and Average Cost per Delivery (ACD), where ALT is measuring the average delivery time from a certain milestone within a project to an ending milestone, and the ACD is the average cost of a project or delivery. COO is responsible for the correct reporting and gathering of all the KPI's in the company for the Chief Executive Officer (CEO). It is in the company target to have the KPI's flowing smoothly and accurately from bottom to up. Almost all of the reporting from COO to CEO happens monthly, and most of the data COO gets is reported by subordinates. COO has a role in setting the guidelines for reporting.

The current reporting of the KPI's is happening through Excel whilst the data for them is collected from systems and managers. All of the data gatherings is done semi-manually, meaning that the data is exported or viewed and then manually input and configured to Excel spreadsheet. The overall view of financial status is not a snapshot but it is turned into a progress and is visible as a trend. This makes it easier to forecast business development even though the infrastructure is not implemented yet. However, whilst the reporting is manual it enables manipulation which is a risk in data accuracy.

### 3.2.3 Head of Business Unit reporting

Head of Business Unit (HBU) is responsible for reporting to the COO and to the Senior Management (SMT). HBU categorizes reporting to routine reporting, major reporting and custom reporting, where routine reports consist of revenue recognition and KPI's whereas major reports are SMT and Customer reviews. Custom reports are needed on the spot either by the customer or internal resource. Routine reports require a lot of manual work but because it is done regularly it is not too time consuming: *"Routine reports like revenue recognition or KPI's need manual work but as they are done regularly, it does not affect daily work that much."* Major reports require a lot of thought and manual configuration which significantly affects the daily work. Custom reports are also very manual and time-consuming.

Benefits of the current reporting are the frequency and similarity they are done; the numbers are easy to find when you do the reports more often in the same way. Custom reporting gives the creator some freedom to manipulate the data for different stakeholders requesting them.

The downside of the current reporting is that all of the requested information by the COO is gathered, configured and presented manually. The data is also retrieved from multiple sources so the historical information of projects and deliveries causes laborious investigation. The custom reports were mentioned as a benefit, but they have also a downside in eating up time and resources by not having a clear enough standard format or a template. It creates a risk of having a different perspective to data and possibly not being aligned with the company targets and strategy. In other words, not all of the current reporting is proved to be good for the business.

### 3.2.4 Project Management reporting

Project Manager (PM) has monthly reporting of projects to the HBU, this is done by Word and Excel. PM keeps project statuses also locally on a personal computer for quick custom reporting. Such reporting requests come for example from sales managers when they are about to meet the customer. PM has a guideline of doing more detailed internal reporting and less detailed external reporting.

The benefits of the reporting done by PM currently is that the format is easy and fast. The easy format is also preventing the customer to raise questions that are not relevant for the projects to be completed successfully.

The downside of the current reporting is that the custom reporting that deviates from the project statuses is causing significant workload: *“Additional reporting requests add the daily workload significantly.”* The key concern for PM about the current reporting is that it takes a lot of time to create reports manually from different sources of data, even though the reports are simple. The easy and simple format is also very unattractive and unprofessional according to the PM.

### 3.2.5 Supply Chain Management reporting

Supply Chain Management (SCM) is reporting two company KPI's regularly, the Inventory (INV) and the Cost of Bad Quality – Replacement Hardware (CBQ-RHW). The compiling of the KPI's is required monthly and it takes time from 1-3 days to finish them.

Custom reports usually consist of actual numbers and costs of delivered hardware to customers, this includes also forecasting of hardware deliveries to customers for hardware supplier and manufacturers. The information for KPI's and custom reporting is held and updated by the SCM in Excel documentation: "*Since all the reporting I do is rather manual the work is time-consuming. Maintaining the raw data in order to do reports is also manual currently. It is also subject to human errors.*"

The benefit of the current system is that even though it is laborious to maintain, it is fairly accurate and SCM feels to be in control. The quality issues with hardware are tracked and is the main source of information for improving quality.

The downside of the current system is that it only provides a partial view of the supply chain and quality. The visibility of sourcing and inventory management is limited to a few stakeholders which are prone to create requests to SCM from several other stakeholders. SCM also claims that since all of the reporting and maintaining the raw data in Excel is manual, it takes a lot of time to keep everything up to date. The time consumed to maintain it all is a significant factor in the SCM routine work and is highly demotivating. Additionally, when the raw data is in Excel it is not grasped at a first glance by others than the SCM. Furthermore, the whole process is subject to human errors, especially the hardware related information from customer support. This is mostly due to new people with limited amount of training doing things in their own way. There are best practices for stakeholders responsible for information flow regarding hardware, it is a matter of training to get it right.

### 3.2.6 Summary of benefits and downsides of the current reporting

The benefits of the current reporting can be stated with two things. Current reporting is repetitive and simple, meaning that stakeholders are doing their reports frequently which has enabled them to be accustomed to the style and need of them. They are also simple enough to be more producible. However, it has not been reviewed that how much work it actually is to gather and update all the data by stakeholders.

The downsides of the current reporting were the same for all the stakeholders. The reports are laborious to gather, the manual creation of them is demotivating, the partial views and perspectives of the report creator are clouding the overall insight. This has lead into having information silos where the stakeholders know where they get the data from but are not saying it in the reports that whether they provide the full story.

### 3.3 Stakeholder reporting needs

The following sub-sections are clarifying the reporting needs of the different stakeholders that were interviewed about the reporting that they do. The needs were logged from their best case scenarios and are one fundamental part when searching for the most suitable BI-solution to be used for the reporting.

#### 3.3.1 Chief Executive Officer reporting needs

Chief Executive Officer (CEO) of the company feels that the reporting he gets from the stakeholders is lacking in quality and accuracy, but it has taken steps forward recently with the ongoing change management process. CEO claims that the stakeholders have the responsibility for their own numbers and information in a bottom-up approach: *"It is important that the stakeholders take responsibility for their own numbers. This ensures that the bottom-up reporting is functional and accurate."* CEO explained that the problem is that the stakeholders have not yet familiarized themselves with the regular reporting, which is causing a delay in recognizing the needs of the company and its strategy.

Different stakeholders have their own master files to gather data and create reports from. This guarantees that the merged data from different master files is as accurate as possible as long as the guidelines and the requirements are met when handling the data. The accessibility and visibility of the data that the stakeholders have are limited, though, which creates additional inquiries and requests from stakeholders that do not have the information at hand but would need it. CEO needs these master files to be replaced with a database where the inquiries and reports are easier to make from. The best information CEO would get from this kind of approach is the revenue forecasts, which he would like to have as frequently as possible.

CEO is not receiving the profitability of the different Business Units. This was recognized in interviews with the CFO and the COO, their needs are presented in the following sub-sections. CEO needs the profitability from different areas like from customer and product based profitability. Furthermore, the schedules of the deliveries and projects are required to get the revenue recognition forecasted accurately.

The internal cost structures and their visibility is a requirement from the CEO. This gives tools for the CEO and the SMT to recognize the needs of the company from different angles like how is the strategy being fulfilled and what is the recruitment necessity status.

### 3.3.2 CFO reporting needs

The Financial Dashboard which the CFO creates is subject to review and automatization. Figure 4 is an example of how it could be done. The key parts of the possible Dashboard are listed in section 3.2.1.

## Financial Dashboard

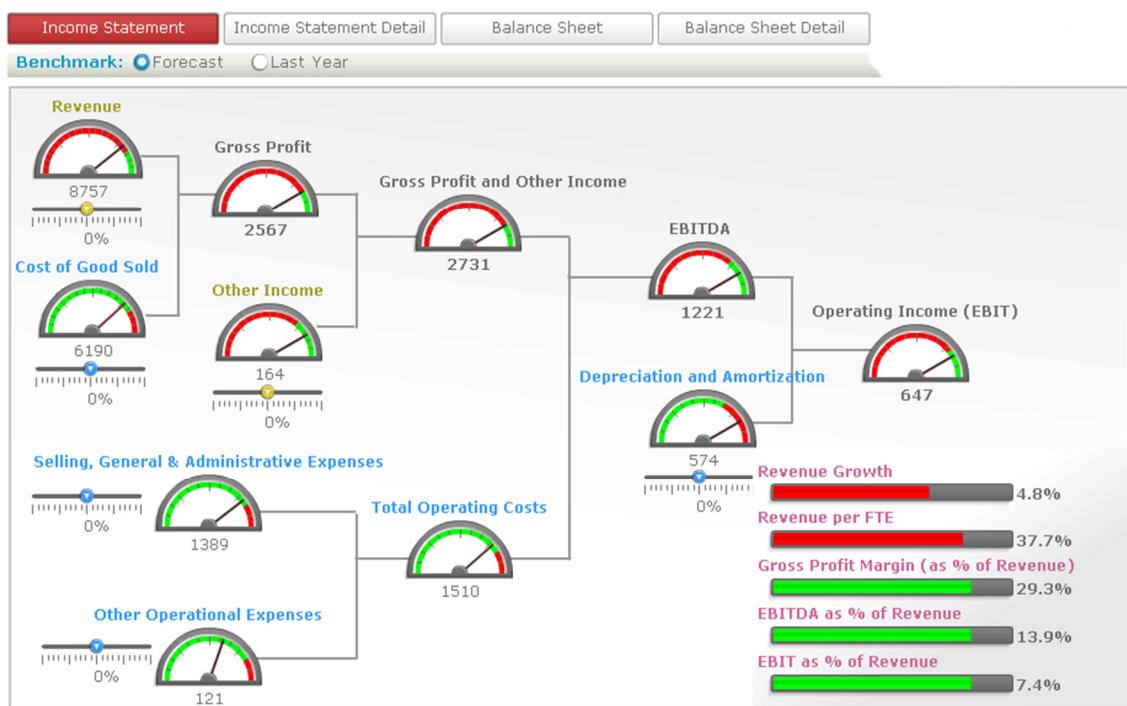


Figure 4. Financial Dashboard Example

The internal cost structures of the delivery organization are not visible to the CFO yet. The Project Management tool and the infrastructure development have just been implemented and started which are changing the situation once the reporting from them has been implemented. The scenario where the CFO does not have the visibility to the internal delivery costs is making things difficult on the reporting and forecasting side. It means that the KPI-reporting is challenging and the delivery forecasts both in cost and time are blurred by inaccurate data. The KPI's are required by the CFO in a similar dashboard than the Financial Dashboard.

The readiness of customer projects and deliveries both financially and physically is an aspect that the CFO needs in order to forecast the revenue recognition and cash flow. It is planned and requested by the CEO and CFO that the company would shift to a financial Percentage of Completion (PoC) revenue recognition, where the projects actual

costs and estimated costs are compared. This would further improve the forecasting and stabilize the revenue trend since the current revenue from customer projects are based on delivery milestones: “*PoC- revenue recognition is something we definitely want in order to better understand our business and even out the spikes in revenue flow.*”

### 3.3.3 COO reporting needs

COO is facing the same problem as the CFO; the accurate cost structures and progress of projects are not available. New KPI’s from them are necessary to run the Operations intelligently and are required to be automated as KPI Dashboards: “*We need to shift from intuition to facts.*” The progress and change in revenue in Business Units is required by the COO in a waterfall chart as shown in the example in Figure 5.

**Horizontal Chart with subtotals example**

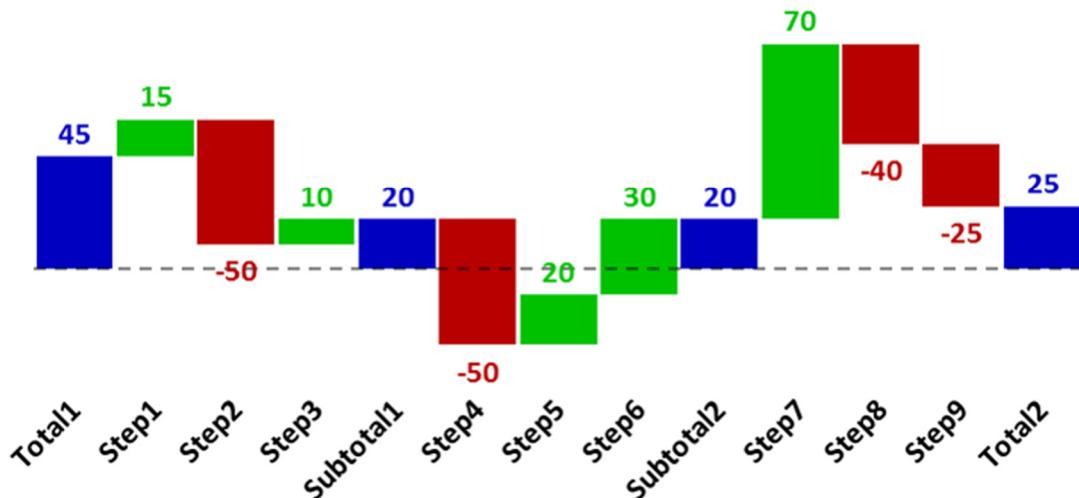


Figure 5. Waterfall visualization graph example

### 3.3.4 HBU reporting needs

Key concern according to HBU is that the reporting does not have a common tool or standardization nor a plan to achieve them. Reporting has been created from the financial point of view rather than the business and strategy point of view, which creates an atmosphere of reporting for the sake of reporting. There are no clear guidelines for the reporting, there are mainly schedules. Documentation for the reporting is lacking.

HBU would like to shift from creating reports to analyzing and receiving insight from the reports: "*It would be good to develop from just generating reports to actually analyzing and producing insight based on the reports.*" These insights would include meaningful analysis of different market segments and internal examples from dealings with a customer. Especially KPI's are needed by the HBU; currently, they can be measured but it is taking a lot of work. The data availability and automatization of those would make a lot of difference in the daily work of a Business Unit. The ownership of reporting development and a proper graphical interface is required by the HBU.

### 3.3.5 PM reporting needs

Detailed data like Percentage of Completion (PoC) of a project or delayed tasks in projects is not available. PM would also benefit from having project schedule visibility in terms of what was planned and what is the actual schedule. This is highly important for the customer according to the PM: "*Customer would be interested to see the schedule of the project once the delivery has been ordered, and to have the progress report.*" The same visibility requirement applies for the budget. These progress reports would be ideal for PM as automated reports for internal and external usage.

### 3.3.6 SCM reporting needs

SCM states that the inventory management and both of the KPI's mentioned in subsection 3.2.5 should be automatically visible somewhere after the related information is input to systems: "*The sources of raw data are scattered, so merging those to one place would ease up the whole report creating process.*" This is a required feature in order to cut down manual labor and time-consuming routine work with reports, raw data maintenance and keeping stakeholders up to date. Additionally, the replacement hardware process is to be changed after the visibility enablement and automatization of reports are done. Furthermore, when current main reporting from SCM is automatized, the possible extra reports should be reviewed and increased accordingly in order to increase monitoring and quality of daily work within SCM.

## 3.4 Summary of gaps in current reporting versus needs

CFO has three major gaps between his current reporting and the way he would like to do it. Firstly, the Financial Dashboard is collected from different systems and stakeholders semi-manually and it should be automated as far as possible. Secondly, the internal cost structures are not visible in any kind of reporting yet, even though the information

and raw data is available for a limited amount of projects as of recently. Thirdly, the lack of visibility of project progress is preventing the CFO from making the company proceed with the anticipated PoC revenue recognition.

COO has two identical gaps in current reporting versus the actual needs than the CFO, they are the internal cost structure visibility and the progress of projects visibility. Additionally, COO does not have all the metrics for all the KPI's that is needed for the successful enablement of leading the operations with knowledge. These metrics come mostly from the internal cost structures and forecasting of revenue and delivery schedules. The revenue and the progress are required to be shown in a waterfall chart for better visualization. Furthermore, COO wants the reports, KPI's and the knowledge to be automatically shared and be retrievable from a common interface.

HBU recognizes the need for a common tool to create reports, which is not currently the case. Also, the guidelines to create reports upon requests are wanted by the HBU. Automatization of the most routine type of reports is mandatory according to the HBU. Additionally, there should be someone in charge of exploring this kind of development and maintaining it.

PM is lacking the easy visibility of projects regarding schedule and progress, which are the key ingredients for successful project managing. The automatization of them being visible is of high importance to the PM.

SCM also requires automatization of the KPI reporting as well as the handling of the Inventory and cost structure of it. Further reporting metrics are also required to enhance the quality of the supply chain, this can be reviewed once the laborious routine work with the current reporting and maintenance of it has been solved by a more streamlined and faster process.

The current reporting style has another downside that derived from the interviews and was presented in the subsection 3.2.6. The information silos mentioned there are problematic for the managers and leadership when they want to form the decisions with knowledge. As a by-product of this, the managers are digging data by themselves in order to feel in control. This creates micromanagement and trust issues between stakeholders and management.

The current reporting by stakeholders, their needs and the overall development potential is presented in Table 5 as a Summary of the Current State of Reporting and its Developability. The needs of the CEO are not presented in the table since they reflect identically with the potentials and needs of the stakeholders. The development potential items are divided into two categories: to those that can be automated and to those that can be developed further to reflect the needs. The potential is based on the current operational infrastructure and the development plan of it. Green color has been used on the table to mark the ones that can be automated and the red color is used to mark the ones that can be developed further. There was a joint need for the Common Tool for Reporting and Internal Cost Structures which for they are presented only once in the development potential column.

Table 5. Summary of the Current State of Reporting and its Developability

		Current Reporting	Needs	Can Be Automated / Developed
Current State Analysis - Summary				
CFO	• Financial Dashboard	Total Financial Status Financial Statement	Internal Cost Structures KPIs	• Total Financial Status Financial Statement
	• Revenue forecast	Percentage of Completion Revenue Recognition	KPIs	• Internal Cost Structures KPIs
		Revenue forecast	Recognition	• Percentage of Completion Revenue
			Revenue forecast	
<b>Current reporting benefits:</b>				
	✓ Simple	• KPI's	Internal Cost Structures Waterfall chart New KPI's	• KPIs and New KPI's Waterfall chart
<b>Current reporting downsides:</b>				
	✗ Laborious	• Revenue recognition KPI's	Business Unit Cost Structures Business Unit Cost Structures	• Revenue recognition KPIs
	✗ Manual	• SMT and Customer Reviews	Common Tool for Reporting Insightful reporting	• Common Tool for Reporting SMT and Customer Reviews
	✗ Partial views	• Custom reports	Insightful reporting Custom reports	• Insightful reporting Custom reports
<b>PM</b>		• Monthly Project Status Custom reports	Project progress ○ Cost ○ Schedule	Monthly Project Status Custom reports Project progress ○ Cost ○ Schedule
<b>SCM</b>		• KPI's Inventory Management Custom reports	New KPI's Common Tool for Reporting Custom reports	KPIs and New KPI's Inventory Management Custom reports

## 4 Business Intelligence

This section takes a look at the Business Intelligence from a theoretical and best practice perspective. The section explains the basics of BI, then clarifies the required infrastructure for it, followed by reviewing the main principles and features when selecting a suitable BI-solution and finally defines the Conceptual Framework of this Thesis.

### 4.1 Business Intelligence in a company

Business Intelligence is considered as a series of technological processes for interpreting information and projecting it to the leadership of the companies in order to do decisions based on facts and forecasts. Benefits of having BI in a company are based on visibility, efficiency and decision making. BI is formed from a variety of different information entities within a company, like systems that withhold critical data about company statuses regarding financials, operations and customers. This information is collected into a single place and then visualized for different stakeholders in the company. The single place for the collection can be any kind of data center that is able to transform the data into the same format so it can be read unilaterally. This read, query, can be performed by a number of different applications and programs such like BI-solutions, which then presents data visualizations through reports, dashboards and analysis for operational and corporate purposes. BI-solution can either have a web-based or desktop-based approach. The web-based approach requires an internet connection to edit content whereas desktop-based is designed to be used offline with a personal computer and requires the internet connection when the content is ready for publishing.

Questions like “What happened?”, “When?”, “Who?” and “How many/much?” are answered by a basic BI environment in a company. Answering happens through different mechanisms within a BI-solution. The mechanisms include reporting with KPI’s and metrics, custom reporting, dashboards and scorecards, real-time data and automated monitoring and alerting. (Rouse 2014)

When metrics and KPI’s are reported, BI offers information on how the business is faring through different units within the company. These units usually include the measure on cost, resources, time, scope, quality and actions. The metrics are created to serve the stakeholders in the most informative way in order to keep track of the overall performance of the company. BI is, therefore, an important tool to recognize where speed can

be increased and costs decreased. This leads to proper benchmarking within the industry. Benchmarking means that the company reflects itself against the best practices of the industry which enable the comparison with the competition. Ultimately the company with BI will lead its business with better knowledge and the management of it. (Kass 2011)

#### 4.2 Infrastructure Requirements for Business Intelligence

A well-designed BI-infrastructure is the key element when trying to achieve advantages with visibility into business management. It is considered to be a multi-layered set of operational systems and BI-building stages with their own metadata which are funnelled through a process and into a structure to serve the stakeholders. Metadata is data that defines other data, for example if an apple was plucked from a tree on a certain date, then the date would be metadata for the apple. These layers have possibly tens of thousands of metadata variables such as dates, authors, costs, resources or whatever the stakeholders consider as critical information within the systems and processes in the daily operations of a company and business. Figure 6 presents the set of layers.

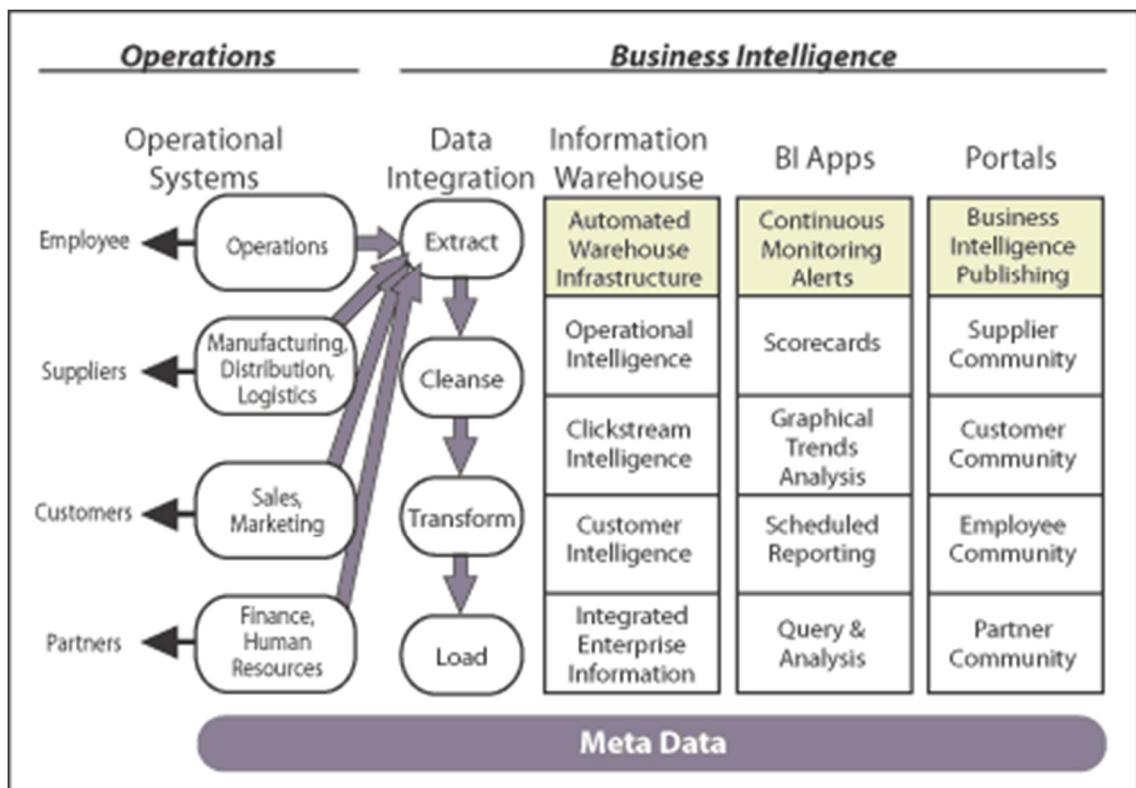


Figure 6. Business Intelligence Infrastructure (Robinson 2002)

The efficiency of the infrastructure is based on how well it operates through support, maintenance and enhancements. The standards and processes in integrations of the different set of systems allow the infrastructure to reach maximum potential. One can say that the more automatized the input and processing of the data and metadata is, the more efficient the infrastructure gets. Figure 6 shows the layer for Data Integration, where the standards and processes are highly demanded in order to avoid resourcing issues with manual work and possible human errors. Data Integration consists of Extract, Cleanse, Transform and Load (ECTL) processes. The ECTL-process can be done by manually editing the data or having automated processes through scripts. The script is a computer program which has a sequence of commands and instructions to manipulate and edit for example text files. The scripts can be scheduled and automatized to run as desired.

Extraction means that the data from different systems is gathered through exports or queries from them. Then the Cleansing validates and organizes the data in order to transform it into a loadable form. After that, the Transform changes the data to be more readable by external solutions in a single query. After the Extraction, Cleaning and Transforming of the data are done, the Loading of the data can happen via scripts by exporting it or by querying externally.

Information Warehouse (IW), also called DW in the Introduction of this Thesis, in Figure 6 is the layer for the ECTL-processed data. It gathers entities of data, which are also called Data Marts or Data Cubes, under one place as centralized and harmonized data. These entities can provide Operational Intelligence, Customer Intelligence and Clickstream Intelligence, where Clickstream Intelligence refers to web-based usability and presentation. This means that IW is a single organizational repository for the company width data, whereas Data Mart is a subset of the IW. These subsets contain specific data from different parts of the company, like Finance, Operations and Sales. The subset is not excluded to having data from only one source or integration, the subsets are defined by the users and stakeholders in order to create bridges between different sets of data and have them in one place. This is also called merging or blending the data. The IW and Data Marts can have either a bottom-up or top-down approach ([www.stratdata.com](http://www.stratdata.com) 2016), which means that the Data Marts can be set up correctly already within the IW or they can be queried or exported from there by external definitions. This is illustrated in Figure 7, where the process of gathering data is simplified.



Figure 7. Data Warehouse and Data Mart approaches ([www.stratdata.com](http://www.stratdata.com) 2016)

BI-Apps (BI-solutions) in Figure 6 are designed to deliver the insight and visibility from IW to stakeholders of the company. This happens through applications that are specifically projecting the information from IW Data Marts with visualizations like Scorecards, Dashboards, Monitoring Centers and analytical reports.

Portals presented in Figure 6 are a single point of access for different users and user groups and usually, BI-solutions grant these portals in their offering. The portals have different views for different users, which means that the hierachic customization enables restrictive accesses and need-to-know-basis functions for example for Senior Management. The Portals can be opened for Employees, Partners, Customers and Suppliers which increases the visibility to all parties involved in the company business. Furthermore, Portals increase the level of self-service in a business environment, which then again increase efficiency and performance of all the stakeholders.

Organizational requirements for maintaining, developing and supporting the BI-infrastructure can include BI Architect, ECTL Developer, BI Analyst, Database Administrator and Business Content Manager.

BI Architect is responsible for the whole BI-infrastructure with design and implementation of it, ECTL Developer is responsible for the Data Integration and the efficiency of it, BI Analyst is in charge of identifying the stakeholder and company needs regarding the visualization content of the IW and BI-solution, Database Administrator is responsible for the physical implementation and support of the IW and finally Business Content Manager is responsible for the delivery of needed information to the Portal community stakeholders. These responsibilities and their stakeholders are to be reviewed regularly for example with steering group for the BI in the company. Additionally, the BI-infrastructure can

have measured performance in terms of KPI's and metrics. Furthermore, the BI-responsible stakeholders can be merged with one stakeholder handling several responsibilities. This allows flexibility especially in smaller companies where there are no capabilities to recruit all of the required stakeholders. (Robinson 2002)

#### 4.3 Selecting the suitable Business Intelligence solution

Selecting the suitable BI-solution for a company is fundamental. Therefore, the process of getting one includes the gathering and prioritization of the requirements from the company and its stakeholders as well as the requirement matching for the possible BI-solution. The scope of the BI-solution acquisition is critical to research and evaluate before one can start examining the solutions and their features, especially the number of users and what kind of data from company systems is required. Furthermore, the budget that withholds implementation costs, recurring costs and the possible next features or add-ons in the future must be evaluated.

The BI-solution requirements can be divided into three categories: Must-haves, Nice-to-haves and Will-not-use. Must-haves are critical features for the company; if the BI-solution does not have this feature it is eliminated from the acquirement process. Nice-to-haves are not critical features but are usually the differentiators between BI-solutions. Will-not-use is a category for features that the company is not going to use. In addition, there are obtainability conditions for all of the features that are in the requirements. This means that if a requirement has a workload to enable it for the company to use in the BI-solution, it is subject to consideration in the acquirement process since they bring costs and additional time loss. Such workloads can be custom coding, integrations, add-on purchase from an external provider or a specific BI-solution product edition with basic or enterprise version. The following sub-sections clarify the two categories that are needed, Must-haves and Nice-to-haves, and what are the best practices when considering to acquire a BI-solution. (Sherman 2015)

##### 4.3.1 Must-have features

Must-have features are usually Data sources, Data filters and drill-down, Web-based client user interface, Independent and interconnected visualizations, Security, Report and Export and Microsoft Office Data Exchange. There are also specific Must-haves for self-service requirements like Selection of data, Data Blending and Creation of measures.

Access to multiple Data sources is necessary due to companies having different ways of storing and handling the data with multiple systems. Additionally, direct integrations with system data sources are a possibility.

Data filters and drill-down mean that the content of the BI-solution reports and dashboards can be filtered with for example drop-down lists or searches, and that the drill-down can happen between summarized and detailed data.

Web-based client user interface has become the industry best practice due to low cost and being effective in administration, support and deployment of it.

Independent and interconnected visualizations mean that the reports and dashboards within the BI-solution can have multiple styles of presenting them at the same time, meaning that they are not subject to only one visual configuration. In addition, the visualization can be presented with many chart types and the combination of them.

Security is relevant due to internal and external reasons. Internally it means having a role-based security with designated users who can create, edit, publish and administrate within the BI-solution. Externally it means that the company data is protected, especially if the BI-solution is web-based.

Report and Export are required features that increase the visibility and communication within a company and business environment. They can happen with multiple formats like text files or spreadsheets.

Microsoft Office Data Exchange is required in order to import and export data with Microsoft products, especially with Microsoft Excel.

For self-service, it is recommended to have the freedom of selecting the data for analysis. Furthermore, Data blending between different data sources is a good feature to have since it enables the user to intelligently map various sources of data that relate to each other. The ability to create formulas and calculations in order to enhance the reports and dashboards is a feature that self-service users value highly due to it enabling the creation of the KPI's. (Sherman 2015)

#### 4.3.2 Nice-to-have features

There are multiple Nice-to-have features that can make the difference in finding a suitable BI-solution. The prominent ones include Creation and publish by users, Advanced Visualizations, Collaboration and Social Interaction, Storyboarding, Mobile version, Performance Monitoring and Platform Administration.

Creation and publish by user groups is a feature that allows the users to share their findings and reports with others in the company as they will. This enables better communication and visibility as per recognized by the users.

Advanced Visualizations mean that the list of presenting the data is more evolved. It can include heat maps, maps, geographical maps, scatter-plots, bubble charts, histograms and a combination of these such as histograms of heat in areas.

Collaboration and Social Interaction means that the BI-solution has a platform for communicating and sharing of knowledge. The ability to discuss findings in forums, threads and social media is valuable to keep track of things in a timely fashion.

Storyboarding allows users to link reports, charts and dashboards as a process or a workflow. The ability to knot visualizations as a sharable storyboard can give users an idea of what has happened and why when evaluating and analyzing data.

Nowadays BI-solutions should be able to be accessed with a mobile-friendly application as well as with a web-based one. This enables a more interactive and high-performing user community within a company.

KPI's are critical to companies when they try to lead with facts and knowledge. Therefore, having a Performance Monitoring as a tailored feature in a BI-solution is highly valuable to business.

Platform Administration is beneficial for larger BI-user communities since it allows development and maintenance of the BI-solution. This gives flexibility and cost-effectiveness for the BI-deployment due to not having to rely on the solution provider support at all times. (Sherman 2015)

#### 4.4 Offering, Implementation and Pricing of a BI-solution

Gartner Inc. (2016) has evaluated and overviewed the BI-solution market and states that the growth rate of the BI and analysis segment is going to be steady at least until the year 2019. However, they claim that the buying patterns and company requirements are changing to be more executive-lead than IT-lead as it has been before. This is due to flexibility and agility needs of the different stakeholders within a business environment. IT-lead BI deployment was popular when the IT-funding was significant in the past, which lead to enterprise width implementations that cost time and money. The change has enabled the market to be offering smaller deployments with a land-and-expand business model where BI is developed from a small scale deployment to a bigger one with a suitable schedule and cost. This allows the companies to iterate and re-evaluate the process and deployment. To keep up with the ever-growing data feeds from different sources, the solution providers are constantly developing their capturing and processing of those feeds. The solution providers are developing their offering in order to penetrate the market with a tailored approach and innovations to serve the business environments and companies. The feature of having self-service which empowers the companies' stakeholders is strongly present in the solution offering. Self-service allows the stakeholders to do their own customized analysis and insight from the company data. Additionally, the geographic strategy of the provider is a factor in the support and development of the mutual commitment. Having a local support is of high value in making the communication levels and trusting relationship stronger. Furthermore, usability is measuring the flexibility and purpose of the solution. Managerial implications are required to be minimal in terms of getting the BI implementation done efficiently. The implications are one measure for the workload to reach the potential of the solution in terms of the business and company requirements.

The pricing and business model of a BI-solution provider can make the final difference in the eyes of their customers. The solution providers' capability to inform customers about their offering throughout presales to acquisition is vital in order to have efficient and transparent communication. The offering should have transparency with activities and support that include deal management, presales support, negotiation and pricing. The overall solidity of the providers offering and product strategy is the key to recognizing the match between the provider and the customer. This includes the future innovations with product roadmap (development tunnel in the future) and the ability to be flexible according to the customer need. (Gartner Inc. 2016)

#### 4.5 Conceptual Framework of This Thesis

The Conceptual Framework of this Thesis consists of three main topics: 1) Business Intelligence, 2) Infrastructure Requirements and 3) Defining the suitable BI-solution. The three steps build a consistent view on the theoretical side and best practices regarding the acquisition of a BI-solution. The Conceptual Framework is visualized below in Figure 8.

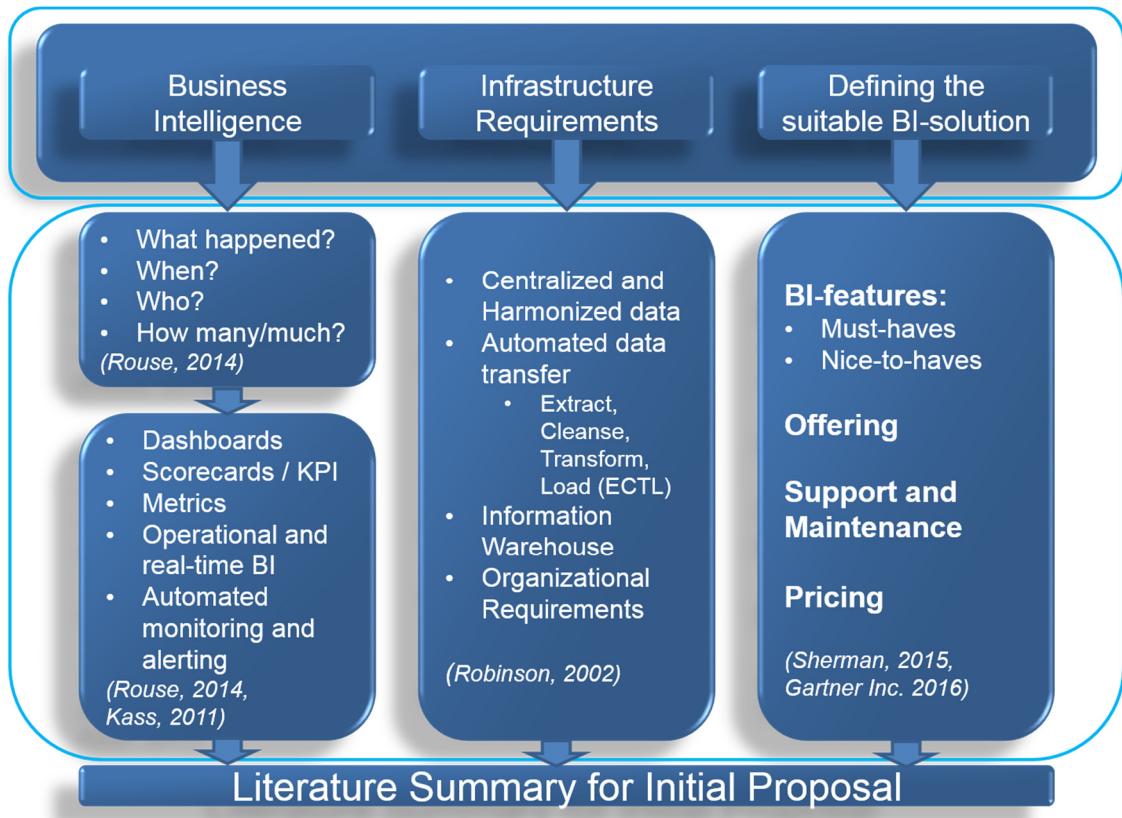


Figure 8. The Conceptual Framework of this Thesis

As shown in Figure 8, the first topic focuses on the basic functions of BI. It clarifies the specifics of BI and the ways of visualizing and monitoring it. The second topic goes through the Infrastructure Requirements for the BI. It states the best practices to get the business data feeds as BI as well as explains the resource implications to a company. The third and final topic defines the best practices in acquiring a suitable BI-solution according to the business requirements. The combination of the three topics and the Conceptual Framework are the basis for the Literature Summary for the Initial Proposal which is presented in the next sub-section.

#### 4.6 Literature summary for the Initial Proposal

The Initial Proposal of this Thesis is a selection between the Existing Solution and Alternative Solution. The selection process for a suitable BI-solution includes the reflection to the desired features (Must-haves and Nice-to-haves) and requirements and the best practices on what they are. Table 6 presents them as output from the Conceptual Framework, as Literature Summary for the Initial Proposal. The Initial Proposal is built in the next section of this Thesis.

Table 6. Literature Summary for the Initial Proposal

Feature / Evaluation Item	Infrastructure supports the feature	Must-have / Nice-to-have	Existing Solution	Alternative Solution
<b>Data sources</b>				
<b>Data filters and drill-down</b>				
<b>Web-based client user interface</b>				
<b>Independent and interconnected visualizations</b>				
<b>Security</b>				
<b>Report and Export</b>				
<b>Microsoft Office Data Exchange</b>				
<b>Selection of data</b>				
<b>Data Blending</b>				
<b>Creation of measures</b>				
<b>Creation and publish by users</b>				
<b>Advanced Visualizations</b>				
<b>Collaboration and Social Interaction</b>				
<b>Storyboarding</b>				
<b>Mobile version</b>				
<b>Performance Monitoring</b>				
<b>Platform Administration</b>				
<b>Price</b>	N/A	N/A		
<b>Implementation Cost</b>	N/A	N/A		
<b>Support and Maintenance</b>	N/A	N/A		
<b>Usability</b>	N/A	N/A		
<b>Workload to reach potential</b>	N/A	N/A		

## 5 Building the Business Intelligence proposal for the Case Company

This section merges the results of the CSA and the CFW towards the building of the proposal. It clarifies how the solutions were picked for the testing phase, what were the testing methods, what was the feedback from the testing by the stakeholders, selects the ideal alternative BI-solution to be compared with the Existing Solution and finally presents the summary of the Existing Solution and the ideal alternative solution. The summary is then adjusted to be presented as the Initial Proposal of this Thesis.

### 5.1 Selecting the alternative Business Intelligence solutions for testing

The BI-solution selection process for the testing phase was implemented with business requirements of the case company and being in contact with 17 BI-solution providers. The 17 providers were searched through internet, adverts, personal contacts and referrals by various studies and organizations such like Gartner Inc. The goal was to reach down to 3 solutions that were to be tested, one of them being the Existing Solution. The two others are referred to as Solution A and Solution B.

The stakeholder and infrastructure requirements were clarified in the CSA of this Thesis in Section 3. One requirement came from the budget of acquiring the BI-solution. The budget was setup around the Existing Solution price and implementation cost which can be seen in subsection 5.5. The budget requirement narrowed down the possibilities to nine solutions. The rest of the narrowing down happened with infrastructure requirements and the Must-haves and Nice-to-haves that were clarified in Section 3 and 4.

### 5.2 Testing method

The tests with the selected BI-solutions were done by four different stakeholders and one additional presentation was held by one provider to the COO and the CFO of the company. The stakeholders who did the practical testing were HBU, PM, SCM and Project Assistant (PA). PA was selected due to most of the reporting and automatizing of it is going to be handled by that role. This also means that feedback from PA is of critical value, but is not excluding the other feedback in any way.

The presentation that was held to the COO and CFO was from the Solution A. This was due to the local presence and that their solution was more focused on Business Management with BI than the other providers. Their tailoring approach seemed to suite the infrastructure development of the company in the long run so it was beneficial to see the

difference between basic dashboard providers and Business Management. Solution A was also lacking in training videos and manuals, so it was necessary to have them presenting their features and functionalities.

### 5.3 Test feedback from stakeholders

The next sub-sections present the feedback from the solutions by the stakeholders. The COO and the CFO were not participating in the practical testing of the solutions.

#### 5.3.1 HBU feedback from testing the Existing Solution

An existing solution of the company had good instructional videos and documentation according to the HBU. They helped in familiarizing with the solution from the start and gave a big impression with showcases. The visual feel was that it was clearly organized which supports first-time users. On the other hand, there are lots of things available which can also intimidate users. The first issue which the HBU encountered was easily solved due to having good enough manuals, although the issue caused HBU to start the testing all over again.

Business perspective benefits of the existing solution according to HBU are its extensive and elaborate ways of building reports, dashboards and the data stories. Also, the modifiability of these is of high value. There is a huge amount of features involving visualization, data and analysis. Almost all of the HBU needs can be covered by this solution if the potential can be reached.

Downsides of the existing solution from a business perspective are that it is too extensive and complex for the light usage need by the HBU. Therefore, it is not very intuitive either and it will take a lot of time to master the features of the solution. HBU states that it is clear that the solution is meant for analytics professionals rather than for managerial usage: *“The tool is meant for analytics professionals, rather than ad hoc high-level business users.”* HBU also claims that the professionals are trained to spot variances and errors within the solution outputs whereas managers and less trained users are bound to miss them. One obvious gap is that there is no clear way of doing the reports and dashboards, HBU states that the wanted outcome is to be planned well beforehand in order to have good time and effort ratio when executing it. This leads to increased workload. The overall feeling of the solution by the HBU is that it is too complex and the users will not use it.

### 5.3.2 HBU feedback from testing the Solution A

The visual look of Solution A was clear at first but as first time user, HBU quickly ran into obstacles which would have required manuals or tutorials. However, the provider had offered a demo of what could have been possible to do with the solution so HBU did not waste too much time on the learning curve.

The benefit of Solution A on business side include a tailored approach with Report Center, KPI Center and Alarm Center which are highly demanded by the HBU. Since they look clear and simple enough, HBU is convinced that the training to reach full usage is minimal: *"Does not seem to have too many features so probably relatively easy to learn to use with the training of course."* Furthermore, the solution seemed fast and responsive. Additionally, the drilling down to historical or task level information is of high value to the HBU and the solution was providing that. Usability, once learning curve had been done, was clear and did not provide any surprises.

The downside of the solution is that it is not highly intuitive so there will be trial and errors to begin with. Lack of manuals is a nuisance as well: *"Needs clear instructions before any benefits can be extracted from the solution."*

### 5.3.3 HBU feedback from testing the Solution B

Solution B had provided good manuals and tutorials which enabled HBU to test the solution fast. The navigation and instructions were well defined and the structure of them was logical, which was creating an inviting atmosphere. The solution seemed like a simple dashboard creator.

Business benefits of the solution include that it is simple, fast, and it provides dashboards from any kind of data. HBU states that it would be good enough: *"Quite simple to use, just enough features. Probably quick to ramp up."*

The downside of the solution is that it is too simple: *"Could be that basic reporting and especially ad hoc reporting needs are well met but then more in-depth/complex analysis is open."* HBU worries that the solution is not capable of creating complex reporting or drilling down to historical or task level data. The solution has too basic features.

### 5.3.4 PM feedback from testing the Existing Solution

According to the PM the Existing Solution seemed very complicated to begin with. However, the solution had very good instructional videos and tutorials so the testing could begin quite fast. The solution had Windows User Interface which helped the learning process and made it look professional.

Business benefits of the solution include that there are many possibilities to do a variety of analytics, reports and dashboards according to the PM. The multitude of features is also a positive thing if the potential can be reached. All the needs of the PM could be covered with this solution: *"The "windows" layout seems to have an abundance of possibilities and it gives out a very professional feeling."*

The downside of the solution is that it is very complex and demanding: *"It may take more time to master this solution as it is more demanding."* The numerous ways of doing things and the feature complexities are going to be very time consuming if all the business and stakeholder needs are to be covered. Furthermore, PM believes that the solution is meant for analytics professionals, not for managers.

### 5.3.5 PM feedback from testing the Solution A

Solution A seemed very simple visually by the PM but the same thing applied here than with the HBU. The lack of manuals and tutorials were hindering the beginning of the testing and made the solution a bit unreachable to the PM. However, the demo that was provided let the PM see the potential and an understanding of benefits and downsides could be formed.

The business benefit of the solution is that it is aligned with the needs of the PM and the company in general. The features match the needs and it is not a big threshold to learn to use the solution: *"Possible to produce a variety of analytics and reports (once one learns how to use it without instructions) with a variety of different visual settings."* There was a certain simplicity with the solution which can reduce the workload of the potential reachability.

The downside of the solution is that it did not give a professional feeling and sometimes the user gets lost with illogical functions within the solution: *"Even though the visual look was simple it took the time to understand where to do the actions."* The lack of manuals

and tutorials is worrying to the PM, the training needs to be well organized to tackle the inconveniency.

### 5.3.6 PM feedback from testing the Solution B

The initial look of Solution B was simple and clear. The provided manual and tutorial helped to get the testing up to speed very quickly, the engagement of the solution was strong according to the PM.

The business benefit of the solution is that it can provide good enough dashboards from many sources of data. The visual settings of the solution can make the dashboards appealing and easy to comprehend. The simplicity of the solution is very appealing to the managers: *“Very easy to understand how to make analytics and easy to produce reports.”*

The downside of the solution is that it lacks professionalism and the features are not covering all the needs of the PM or the company: *“Did not provide such a “professional” feeling in general. I would prefer the “windows” layout over this one.”*

### 5.3.7 SCM feedback from testing the Existing Solution

The initial feeling from the solution by the SCM was that it was typical and traditional; designed by engineers for the engineers. The information overflow of the solution was obvious and it felt overwhelming. The tutorials and manuals were helping to get the testing started.

The business benefit of the solution is that it has many features and it covers almost all of the needs of the SCM and the company: *“Seems to have a lot of potential for different kinds of analysis.”*

The downside of the solution is that the multitude of features is demanding a lot from the development and upkeep of the reporting. It is hard to find the correct tools and features within the solution if you are not a professional user: *“Too much information available and it is hard to find the right tools. The typical user group is Research and Development.”* The quick custom reports are not easy to create without knowing complex details about the solution. SCM worries that the solution is not easy enough for daily operational reporting.

### 5.3.8 SCM feedback from testing Solution A

First glance by the SCM showed that the Solution A was not intuitive enough to operate without manuals or tutorials. However, the demo showed SCM the potential and the things that can be done. Initially, SCM felt that the User Interface (UI) was boring and not very engaging.

According to the SCM, business benefits of the solution are that it can automate many reporting needs of the SCM and the company. Furthermore, SCM claims that the learning curve to operate the solution in the full potential seems to be quite low: *"It has useful tools once you learn how to use it, which does not look too hard. In a long run, it has all the functions the company needs."*

SCM states that the downside of the solution is the UI which does not look very professional or intuitive: *"I found it too unclear in the start which does not help when implementing a new tool."*

### 5.3.9 SCM feedback from testing Solution B

SCM felt initially that Solution B was engaging, intuitive to use, very visual and clear. The manuals and tutorials gave good insight to SCM on how to start using the solution.

SCM claims that the business benefit of the solution is that it is designed for managers and for people who do not want to waste too much time on creating custom reports: *"It is really visual and easy to learn by doing. I can spend my time with analyzing the data, not struggling to learn how the solution works."* The produced dashboards were very clear and could be automated.

According to SCM, the downside of the solution is that it does not have sophisticated features like drilling down to historical and task level data sets: *"The lack of good enough features like the browsing of history events or detailed information in entities makes the solution quite basic in my eyes."* Therefor SCM feels that it is not suitable for the SCM nor company needs.

### 5.3.10 PA feedback from testing the Existing Solution

PA was not impressed by the initial look of the Existing Solution, it was overwhelming with a high number of features and the interface was not self-explanatory and looked

outdated. The manuals and tutorials helped to gather the needed information so the testing could start.

Obvious business benefits of the solution recognized by the PA include that it is very powerful of what it does and is professional. There are many features and they cover almost all of the PA and company needs: *"It is a solution that offers a broad range of reporting functions."* Furthermore, it is widely used so the support and peer groups are of high value in the long run. Business benefits of the solution were the versatility of the features. Almost anything is possible and the global peer groups, online tutorials, YouTube-videos and blogs help when the user is in doubt.

According to the PA, the downsides of the solution are in the complexity and demand of professional usage. PA states that these alone will cause a significant workload for the upkeep and development of the reporting. The custom reporting is not easy enough for managerial usage. Additionally, PA says that the obvious gaps are that the solution does not have easy enough functions for dashboard creation, reporting and monitoring of statuses. PA claims that the solution does provide a wide range of reporting functions but they are not efficiently created: *"Functionalities are plentiful but not very handy to execute."*

### 5.3.11 PA feedback from testing the Solution A

PA says the demo version of Solution A was impressive and set the expectations high. Since there was no manuals or tutorials the initial usage was difficult and required many trial and errors. PA also claims that the visual look of the solution was simple and good but it was not appealing to use. The estimated workload to reach stakeholder and company needs is medium according to the PA.

PA claims that the business benefits of the solution include that it offers exactly what the PA and the company need with features and functionalities. PA continues that the monitoring features allow the users to be passive and react only when there is a need for interaction: *"The Alert Center is very useful when it comes to tracking critical KPI's and taking action when a certain value is exceeded."* PA states that the tailored approach with business management and the easy usability is a solid combination that is of high value to the company: *"I did not identify an obvious gap. The range of functionalities is broad but not overwhelming."*

The downsides of the solution recognized by the PA include that the lack of manuals and tutorials will create problematic situations when creating custom reports. The use of different features is not intuitive enough for managerial usage without sufficient training: *"My major concern is to engage the different users to actively work with the solution. This can be mitigated with proper training given to all users. Functionalities are promising, but the user needs to be equipped with the necessary know-how to be able to get the most out of it."*

### 5.3.12 PA feedback from testing the Solution B

Solution B offered a very easy approach for the testing according to the PA. The tutorials and manuals were excellent and the solution itself was inviting and intuitive to use. PA claims that the interface was clear, simple and clean.

PA recognized that the business benefits of the solution include fast reporting and that the basic needs of the stakeholders and company are met. Furthermore, PA estimated that the workload to reach potential is low: *"Functionalities are very clear and easy to execute, no extensive user training needed; usage is intuitive."*

PA claims that the downsides of the solution are that it lacks depth and has a poor cost-benefit ratio. PA clarifies that everything the solution offers can be handled with Excel but with a lower workload and that the basic features are not sophisticated enough: *"My key concern is the cost-benefit ratio. The solution offers useful insight into corporate data, but functionalities are limited. It saves the user time, but in principle, Excel can do the same at zero cost while this solution requires a monthly subscription fee."* Additionally, PA worries that the lack of drilling down to historical data is going to produce problems in the long run with analysis of the previous events in the operations.

### 5.3.13 COO and CFO feedback from Solution A

Solution A has an offering that matches well with the current and future company needs according to both the COO and the CFO. They both also claim that the gradual approach with integrations and the tailored business management alignment is appealing to the company. Local presence of the support and the enthusiasm of the owners are a significant factor according to the COO: *"I felt that these people are almost part of our company in spirit, face-to-face conversation with them is fruitful."* Furthermore, the solution provider is a young company and being in their first client base is good for the possible

relationship and support. The pricing model of the solution was at a very acceptable level according to both COO and CFO and it was also aligned with the gradual approach.

The downside of the solution provider is that they are still at the development status of future plans, as recognized by the COO and the CFO. They claim that even though the current offering is good and aligned with the company needs, can the company be sure that the support and development needs are met when the solution provider is developing new features with limited resources.

#### 5.4 Selecting the Alternative Solution

Table 7. Summary of the tested Solutions for Alternative Solution

Feature / Evaluation Item	Infrastructure supports the feature	Must-have / Nice-to-have	Solution A	Solution B
<b>Data sources</b>	Yes	Must-have		
<b>Data filters and drill-down</b>	Yes	Must-have		
<b>Web-based client user interface</b>	Yes	Nice-to-have		
<b>Independent and interconnected visualizations</b>	Yes	Nice-to-have		
<b>Security</b>	Yes	Must-have		
<b>Report and Export</b>	Yes	Must-have		
<b>Microsoft Office Data Exchange</b>	Yes	Must-have		
<b>Selection of data</b>	Yes	Must-have		
<b>Data Blending</b>	Yes	Must-have		
<b>Creation of measures</b>	Yes	Must-have		
<b>Creation and publish by users</b>	Yes	Nice-to-have		
<b>Advanced Visualizations</b>	Yes	Nice-to-have		
<b>Collaboration and Social Interaction</b>	Yes	Nice-to-have		
<b>Storyboarding</b>	Yes	Nice-to-have		
<b>Mobile version</b>	Yes	Nice-to-have		
<b>Performance Monitoring</b>	Yes	Nice-to-have		
<b>Platform Administration</b>	Yes	Nice-to-have		
<b>Price</b>	N/A	N/A	1620€/a	5200€/a
<b>Implementation Cost</b>	N/A	N/A	3500€/Data Mart+2000€	0€
<b>Support and Maintenance</b>	N/A	N/A		
<b>Usability</b>	N/A	N/A	Medium	
<b>Workload to reach potential</b>	N/A	N/A	Medium	

The Literature Summary for the Initial Proposal from Section 4 is used to visualize the difference between Solution A and Solution B in Table 7. The feedback from the testing

is included in the evaluation of the features and items. The color coding means that green is available/acceptable, yellow is for medium significance/being developed and red is unavailable/high significance. Feature requirements are based on the CSA.

The main difference that can be seen from Table 7 is with the Must-have feature of Data filters and drill-down and the Microsoft Data Exchange, which are marked as yellow. This means that the feature is in their product roadmap but is not available yet. For a quick ramp-up of the BI deployment, this proves to be a challenge. However, it is still not excluding either solution entirely due to a promised implementation of it in the year 2016. The lack of drill-down feature is affecting on the other Solution B's Nice-to-have features like Storyboarding and Advanced Visualizations, as proved in the CFW and the feedback from the testing. The lack of Performance Monitoring from Solution B is a big difference when reflected against the CSA and the ongoing change management in the case company. The KPI's are a must-have for the company and that alone is hindering Solution B significantly in the comparison. The price of the Solution B is also a major setback when compared to the Solution A. These differences and the feedback results combined, Solution A is the logical selection for the Alternative Solution.

## 5.5 Existing Solution and Alternative Solution comparison

The comparison between the Existing Solution and the Alternative Solution is visualized in Table 8. The feedback from the testing is included in the evaluation of the features and items. The color coding means that green is available/acceptable, yellow is for medium significance/being developed and red is unavailable/high significance.

The main differences with them are in the Price, Implementation Cost, Usability and Workload to reach potential. Also, the Must-have-feature of Microsoft Office Data Exchange is a noticeable difference, there is no export function for excel files in the Alternative Solution. The data exchange can be done manually via the infrastructure of the company from the SQL-server and can be used until the feature is implemented in the year 2016 by the Alternative Solution provider.

The biggest benefit of the Alternative solution was its tailored approach which suited extremely well for the company requirements. The Report Center, KPI Center and the Alarm Center are all required features of the company based on the CSA.

Usability of the Existing Solution was deemed very demanding by all the stakeholders whereas the Alternative Solution had medium Usability. In addition, the Alternative Solution was estimated to have a quick learning curve based on the demo version of it.

Table 8. Existing Solution and Alternative Solution comparison

Feature / Evaluation Item	Infrastructure supports the feature	Must-have / Nice-to-have	Existing Solution	Alternative Solution
<b>Data sources</b>	Yes	Must-have		
<b>Data filters and drill-down</b>	Yes	Must-have		
<b>Web-based client user interface</b>	Yes	Nice-to-have		
<b>Independent and interconnected visualizations</b>	Yes	Nice-to-have		
<b>Security</b>	Yes	Must-have		
<b>Report and Export</b>	Yes	Must-have		
<b>Microsoft Office Data Exchange</b>	Yes	Must-have		Yellow
<b>Selection of data</b>	Yes	Must-have		
<b>Data Blending</b>	Yes	Must-have		
<b>Creation of measures</b>	Yes	Must-have		
<b>Creation and publish by users</b>	Yes	Nice-to-have		
<b>Advanced Visualizations</b>	Yes	Nice-to-have		Red
<b>Collaboration and Social Interaction</b>	Yes	Nice-to-have	Red	
<b>Storyboarding</b>	Yes	Nice-to-have		
<b>Mobile version</b>	Yes	Nice-to-have		
<b>Performance Monitoring</b>	Yes	Nice-to-have		
<b>Platform Administration</b>	Yes	Nice-to-have		Red
<b>Price</b>	N/A	N/A	5500€/a	1620€/a
<b>Implementation Cost</b>	N/A	N/A	High	3500€/Data Mart+2000€
<b>Support and Maintenance</b>	N/A	N/A	Medium	
<b>Usability</b>	N/A	N/A	Heavy	Medium
<b>Workload to reach potential</b>	N/A	N/A	High	Medium

The Price of the Existing Solution is significantly higher and affects the comparison accordingly. In addition, the Implementation Cost of it was estimated high by the testers and peer groups, since the internal use of the Existing Solution has not been negotiated in the current contract. This alone brings extra costs that cannot be estimated until new negotiations have taken place with the Existing Solution provider. In comparison, the Implementation Cost for the Alternative solution has been fixed and the provider offers a gradual approach to reach maximum potential based on the company and business requirements. Additionally, Workload to reach potential was estimated to be very high for the Existing Solution. The solution is meant for advanced users and the managerial implications would be severe with intense training and the hardship of creating customized

reports. The maintenance of such a demanding environment is bound to cause daily workload according to the stakeholders.

## 5.6 Initial Proposal of this Thesis

The comparison process was done with the stakeholders and the Initial Proposal was confirmed based on the CSA, CFW and the test feedback. The Initial Proposal that was done to the case company can be seen in Figure 9 below.

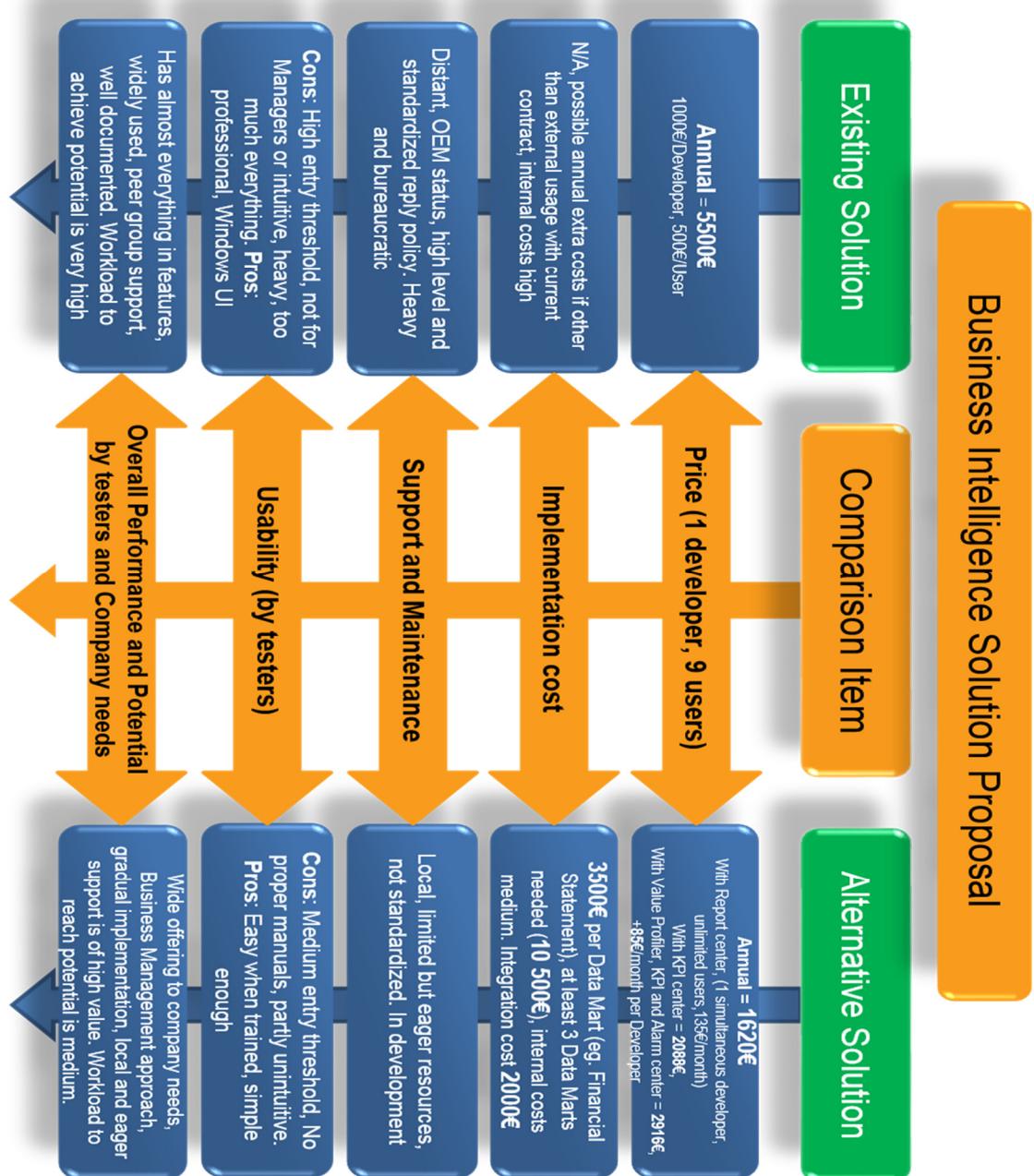


Figure 9. Initial Proposal of this Thesis

## 6 Validation of the Proposal

The Initial Proposal was done to the case company based on CSA, CFW, test feedback and comparisons between solutions. The outcome of this section is a Final Proposal which has been adjusted from the Initial Proposal based on the company feedback.

### 6.1 Feedback from presenting the proposal to the case company

The company feedback was given by the COO and the CFO. The initial response was a clear understanding that the Existing Solution was inferior in the critical parts of the comparison. For COO and the CFO the critical parts were the Price, Implementation Cost, Usability and Support and Maintenance. The Price being almost four times higher is a significant difference even though the Existing Solution can bring powerful features into use. Furthermore, the fixed Implementation Cost was attractive to both of them. Usability issues with the Existing Solution bring too many managerial implications and Organizational Requirements according to the feedback received. Additionally, the local Support and Maintenance of the Alternative Solution provider is very attractive and can affect many things in the deployment and development of the BI environment.

The downside of the Alternative Solution was that it is a young company with lots of development work to be done. The COO and CFO were concerned that whether the product roadmap and development of the solution can serve the company needs efficiently. The positive side with that is that the provider does not have a big client base so being one of the first can be fruitful in terms of relationship.

Overall, there was no dispute over which solution should the company proceed with. The only adjustment that was done was with the Data Marts and their gradual implementation. The Data Marts cost 3500€ each within the Alternative Solution so the company wants to be sure that the money goes to the right place and wants experience with the implementation of the first Data Mart. Therefore, the Final Proposal will be with a single Data Mart instead of the estimated three Data Marts.

### 6.2 Final Proposal

The Final Proposal was adjusted with one alteration in the previous sub-section. The single Data Mart adjustment was decided due to not taking a risk in the launch of the Alternative Solution. The Data Mart that was picked is the Internal Cost Structures of the

Operations, which was highly demanded according to the CSA of this Thesis. The Final Proposal can be seen in Figure 10 below.

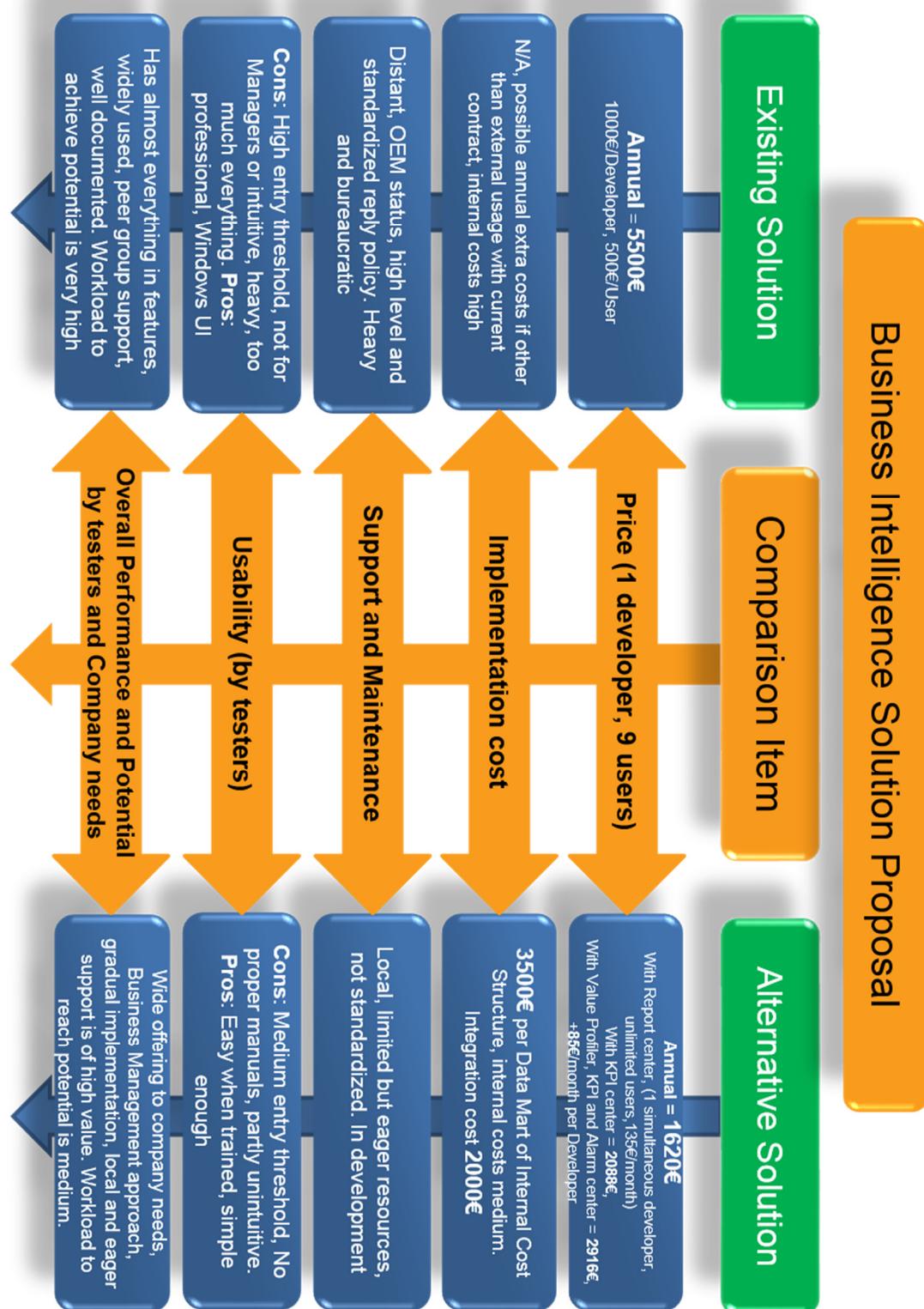


Figure 10. Final Proposal of this Thesis

## 7 Discussion and Conclusions

This section concludes the Thesis by summarizing the findings, identifying practical and managerial implications and evaluating the outcome and validity of it.

### 7.1 Summary

The Thesis concentrated on building a BI-solution proposal for the case company in order for it to tackle visibility, performance and knowledge issues, especially within its Operations. The internal efficiencies and cost structures are unknown to the company and the ongoing change management process is slowly implementing the operational infrastructure in order to centralize and harmonize the data feeds from various sources within operational systems. This created a basis for researching the way to visualize the data and this Thesis proposed a solution.

The research approach of this Thesis is action research. It defined the case company background, the business challenge and the objective the Thesis. Thesis assessed the current state of the company in terms of stakeholders' current way of reporting their work, their actual needs in order to do it and the infrastructure that they work with. The assessment was done with interviews with the stakeholders and investigating the infrastructure of the operational systems. The conceptual framework of this Thesis was built around the BI best practices, required infrastructure in order to manage BI and the definition of a BI-solution in general.

The CSA of this Thesis showed that the current way of doing reporting was highly inefficient and was not building confidence among the stakeholders. It also showed that the operational infrastructure was being developed towards a more centralized approach with the operational data. This enables the use of a proper BI-solution.

By combining the CSA and the CFW, this Thesis built a testing phase for different BI-solutions and made comparisons with the Existing Solution. The result was an Initial Proposal for the case company to select between the Existing Solution and the Alternative Solution. The Initial Proposal was presented to the company and minor adjustments were done. The outcome of this Thesis was the Final Proposal which clarified the differences between the solutions and their implications in meaningful areas like cost, usage, workload, performance and support.

## 7.2 Managerial Implications

This Thesis presented a Final Proposal which was reviewed by the case company. The proposal was presented and a decision to choose the Alternative Solution was done immediately after. The managerial implications are of importance when the BI-solution is being acquired. The organizational requirements clarified in the CFW of this Thesis explained that a proper BI environment is not running by itself. The training, processes and even recruitment become a reality if the workload of maintaining the environment is meant to be stable and scalable.

The gradual approach suggested by stakeholders, company executives and even the Alternative Solution provider helps the acquiring process with iteration and development purposes. Proper tracking and implementation of the BI deployment is the key to avoiding back-tracking and extra costs. It is not only the money and time that are at stake, it is also about the stakeholder motivation and trust. The operational infrastructure is still being developed in the company and it is gradually producing more Data Marts to be taken in use by the BI environment. The creation, implementation, training and process awareness within the company are imminent every time a new Data Mart is taken into use. Simultaneously, the maintenance of the environment gets more workload.

## 7.3 Evaluation of the Thesis

The final section evaluates the Thesis by comparing the outcome to the original objective and by reviewing the reliability and validity of the Thesis.

### 7.3.1 Outcome vs Objective of the Thesis

The objective of this Thesis was to build a proposal to choose between the existing BI-solution in the case company and an ideal external BI-solution. The outcome was a proposal to choose between the Existing Solution and the Alternative Solution. The Thesis was well structured in the beginning which helped to follow the framework and the logical path. The CSA gave a baseline for the CFW material which was guiding the rest of the proposal building. The merging of the CSA and CFW in order to build the proposal was the most challenging part of the Thesis but the structure was still clear in order to make the right conclusions. Another challenging aspect of the proposal building is the recent development speed of the BI solutions, and especially the providers offering and business models. In reflection to that, the Thesis managed to search for recent enough ma-

terial with best practices as well as relying on older but more experienced literature content. The Initial Proposal was successfully built when compared to the adjustments that were needed after the presentation of it. This alone proves that the framework and logic of the Thesis are consistent. Therefor, one can say that the objective of this Thesis is in line with the outcome.

### 7.3.2 Reliability and Validity

This Thesis depended on the reliability and validity plan which was explained in Section 2.4. The internal validity of this Thesis relied on the data collection points and in an iterative review of those. The data was gathered through interviews, test feedback, company feedback, via various coffee talks and from the case company data.

The external validity of this Thesis relied on the recent literature and articles regarding BI environments and solutions and their merging in the CSA results. The conclusions and comparisons with BI solutions were reflected from the external perspective while having the internal knowledge.

The business challenge, objective and the outcome were clearly structured when Thesis was being planned. The plan was built with a well-thought research design, accurate and meaningful CSA definition, CFW building against the actual environment that was found with the CSA and a purposeful testing phase which revealed the benefits and downsides of the tested BI-solutions.

Iterative and qualitative action research was taken place efficiently by reviewing the CSA, CFW and proposals with the stakeholders before moving to the next stage. The qualitative approach with the action research is important and this Thesis managed to collect the data from the stakeholders with a clear and accurate manner. The reliability of this Thesis depends on the data collection from the stakeholders and on recent enough best practices regarding BI deployment in a company.

### 7.3.3 Closing words

In conclusion, selecting a suitable BI-solution for a company that is just beginning its journey can be a fruitful experience. This Thesis revealed the importance of having a BI environment. The overall benefits of having one, when compared to a non-scalable reporting and visibility functions, are significant. The process to build a proposal in this Thesis helped the case company to recognize many flaws in their operational environment but at the same time, the path to take the infrastructure development was proven as a right decision.

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## Research Interview – Current reporting and needs

	Topic(s) of the interview	QUESTIONS	FIELD NOTES
1	Overall view	<p><b><i>What is your view of the current reporting you're doing to different stakeholders?</i></b></p> <p><b><i>How do reporting requests affect your daily work?</i></b></p> <p><b><i>Please give an example of how you receive a report request and how you fulfill it?</i></b></p>	
2	Identify strengths/problems	<p><b><i>What are the benefits of the current reporting?</i></b></p> <p><b><i>What are the downsides of the current reporting?</i></b></p>	
3	Key concerns	<b><i>What are your key concerns regarding current reporting?</i></b>	
3	Best practice	<b><i>Do you have some guidelines to do reporting for different stakeholders?</i></b>	
4	Analysis and needs	<p><b><i>In which areas do you think there is space for improvement in your reporting?</i></b></p> <p><b><i>In what way?</i></b></p> <p><b><i>How could that be done?</i></b></p>	
5	Development needs	<b><i>What do you need to improve your reporting?</i></b>	

## Feedback from Testing – Business Intelligence proposal

	Topic(s) of the interview	QUESTIONS	FIELD NOTES
1	Overall view	<p><b><i>What do/did you expect from the solution?</i></b></p> <p><b><i>How was the initial visual look of the solution?</i></b></p> <p><b><i>Did you feel that you were engaged by the solution?</i></b></p> <p><b><i>Please tell the first problem that you encountered with the solution and how long did it take to solve.</i></b></p>	
2	Identify strengths/problems	<p><b><i>What overall benefits/good things you noticed about the solution?</i></b></p> <p><b><i>What about the overall downsides?</i></b></p> <p><b><i>In terms of usability, what were the pros and cons?</i></b></p>	
3	Key concerns	<b><i>What are your key concerns regarding the solution?</i></b>	
3	Best practice	<b><i>How would you like to do reporting/dashboards, and to what extent did the solution provide it?</i></b>	
4	Analysis and needs	<p><b><i>In which areas of reporting do you think the solution might work?</i></b></p> <p><b><i>What are the obvious gaps?</i></b></p>	
5	Additional comments	<b><i>Please share your gut feeling on the solution and provide possible additional information</i></b>	