JONNA LAINE
INTEGRATING BUSINESS INTELLIGENCE SERVICES TO
INSURANCE POLICY MANAGEMENT SYSTEM

Master of Science Thesis

ABSTRACT

JONNA LAINE: Integrating business intelligence services to insurance policy management system
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Business Intelligence (BI) is a way for companies to get information out of a big data mass. With the help of BI right decisions can be made; more effectively, more reliably and faster. Still a few years ago BI tools were used mostly by biggest companies that had resources and desire to invest for their business. Nowadays there are a variety of BI tools also for small and middle sized companies.

This thesis outlines the study that was made of BI tools in the market. Methods of study are presented first, then accomplishment of study is described and BI tools chosen for the study are introduced. Finally the results of study are unveiled.

The purpose of this study was to find best possible BI tool for Profit Software. BI tool had to include features that make it possible to integrate reports to Profit Software's current applications. Highest ranked BI tool from evaluation phase is introduced and conclusions about how to proceed with the BI tool issue are presented.

In addition to evaluation of BI tools a demo application was developed. The demo application included integrations of reports from the BI tool that won the evaluation. Integration of reports was also tested with the Profit Software's current applications. Prior applications are introduced with pictures and code samples.

TIIVISTELMÄ

Business Intelligence (BI) on yrityksille tapa saada informaatio esiin isoista datamassoista. Sen avulla saadaan tehtyä oikeat ratkaisut; tehokkaammin, luotettavammin ja nopeammin. Vielä jokunen vuosi sitten BI-työkaluja käyttivät lähinnä isoimmat yritykset, joilla oli varaa ja halua kehittää liiketoimintaansa isolla rahalla. Nykypäivänä löytyy paljon BI-työkaluja myös pienille ja keskisuurille yrityksille.

Tämä diplomityö esittelee arvioinnin, joka tehtiin markkinoilla olevista BI-työkaluista. Arvioinnin metodit esitellään ensin, sitten kerrotaan arvioinnin etenemisestä ja mukaan otetuista BI-työkaluista. Lopuksi käydään läpi arvioinnin tulokset.

Arvioinnin tarkoitus oli löytää Profit Softwarelle paras mahdollinen BI-työkalu, jonka tuottamia raportteja voisi integroida Profit Softwaren nykyisiin sovelluksiin. Työssä esitellään tarkemmin arvioinnissa voittajaksi selvinnyt BI-toimittaja ja kerrotaan miten Profit Softwaren kannattaisi toimia jatkossa BI-työkalun suhteen.

Arvioimisen lisäksi kehitettiin uusi demosovellus, johon integroitiin arvioinnissa voittajaksi selvinneellä BI-työkalulla tehtyjä raportteja. BI-raporttien integroimista testattiin myös Profit Softwaren nykyisiin sovelluksiin. Sovellukset esitellään kuvina ja koodipalasina.

PREFACE

This journey has been rough but thought one of the best things in my life. Doing this Master of Science degree and thesis was an opportunity that changed my career towards the dream I've had for a long time.

Creating an evaluation of BI tools was proposed by Profit Software and carried out as a Master of Science Thesis for Tampere University of Technology in Pori.

I give the biggest thanks' to my beloved family that has withstood my panic, bustle and pressure times and supported me in so many ways.

Thanks' for Profit Software's Kai Vainio, Pasi Lahti, Teppo Eeva and Tuukka Tiainen for this great opportunity and from the support I have had.

I also want to thank Professor Hannu Jaakkola and University Lecturer Pekka Ruusuvuori for the guidance on my path.

Pori, October 2015

Jonna Laine

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FIGURE CATALOG

TABLE CATALOG

DEFINITIONS

API	Application Programming Interface
BI	Business Intelligence
CSS	Cascading Stylesheets
EIS	Executive information systems
EMA	Enterprise management associates
ETL	Extraction, transformation, loading
GUI	Graphical User Interface
HTML	Hypertext Markup Language
IPMS	Insurance policy management system
JSON	JavaScript Object Notation
PLP	Profit Life and Pension
REST	Representational State Transfer
SQL	Structured Query Language
SWOT	Strengths, weaknesses, opportunities, threats

1. INTRODUCTION

This section introduces the main areas of the thesis. Problems of thesis are introduced and methods that are used to get the problems solved are presented. Facts about the company which ordered the project are shown and company's reasons to start the project are described. Structure of thesis is presented.

"What gets measured, gets managed" – Peter Drucker

The wisdom that lies behind this quote started a project for finding best integrated Business Intelligence (BI) solutions in the market. Progress of this project is documented in this Master of Science thesis. Project included evaluation of BI tools and implementation of integration tests. This thesis describes the evaluation and implementation phases of the project. Project was ordered by Profit Software at April 2015 and it shaped its scope until the end of evaluation phase.

Amount of data in organizations is increasing rapidly. Data can include webpages, text files, log files, pictures, database rows and program files and so on. From this data it is needed to collect right combinations for many kinds of reports. Without proper tools this collection is really hard or even impossible to do. Data warehouses and BI are an effective combination to create proper reporting environment for organizations. According to BI literature (Hovi A., Hervonen H., Koistinen H. 2009, p. 11) data warehouse term was established in 1988 by Devlin and Murphy in their article "An architecture for business and information system". In the article (Devlin, Murphy 1988) data warehouse term is used from "repository of all required business information". Still today that description is accurate. Data warehouses are needed because data is widely spread in different locations and to different data types. With data warehouse the data is collected to one place where it can be used by resources that needs it. It is said in BI literature (Hovi A., Hervonen H., Koistinen H. 2009, p. 11) that term BI started to use later with the term data warehouse. According to book term BI can sometimes be used for the whole solution of using and analyzing data. Data warehouses and BI tools are then only technical tools inside the BI. In this thesis term BI means the area of collecting information from the data that can be in data warehouses, databases, files or web-pages.

Who wouldn't be interested to get deeper understanding of their own business area and to get a certainty that their decisions are correct? This is a main target when starting to lighten your business with better information. BI solutions are a way for companies and organizations to access the information that describes their business. This information helps them to make more enlightened decisions and to guide business to right direction.

At the best scenario the BI is the way to lift important but hiding information up from the messy data.

BI technology has come a long way from the state it was still ten years ago. Earlier it was meant only for big companies with lots of money to spend. Evolution of BI technology has brought the solutions nearer to regular user and the pricing has come down. Nowadays BI solutions are affordable also for small and middle sized companies.

There are several good reasons for every company to start using BI solutions in their products. According to BI literature (Hovi A., Hervonen H., Koistinen H. 2009) following reasons are common for many organizations. *Endless increase of data* makes it more and more complex to get information from it. Good BI solution gives wanted information easily and automatically. *The time to make decisions* is vice versa going down, key facts needs to be delivered to decision makers in no time. With automatic BI reports you can get them instantly. Information needs to be collected from *many different sources*. Manually doing all the collection is really a big work. Proper BI solution is a way to get everything easily collected and printed as wished. *Laws and regulations* and their specific and complex reporting specifications for authorities are also reasons to get wanted information reported quickly and reliably.

This thesis focuses on the BI side of gathering information from data. Data warehouses are not wielded here. The problems that this thesis tries to find solutions for are:

"What kind of BI tools there are in the market?"

"Which BI tool should be used while creating BI integrations?"

"Should Profit Software invest to BI tool?"

Methods that are used while trying to find the answers for the problems are evaluation of BI tools and creation of integration tests with one BI tool. Evaluation includes preliminary study, selection phase and evaluation phase. Integrations tests include implementing a new demo application that uses integrated BI reports and implementation of integration tests for existing applications.

Profit Software is a software company that offers solutions for insurance business. It was established in 1992 and its flagship product, Profit Life&Pension (PLP), was first launched in 1993. PLP is a web-based solution for life and pension insurers to cover all key processes in insurance industry. Solution covers product development, sales, service and claims management processes. Its goal is to make them as automated as possible. Solutions this type can be called as insurance policy management systems (IPMS). Profit Software has about 90 employees in three different locations. People at headquarters Espoo and at side offices in Pori and Tallinn make it possible to be the market leader in Finland and in Baltic countries.

IPMS have come to an era where they need to give more information out about underlying data. Giving out this information can be done by creating views and reports of BI. Profit Software has not yet implemented BI to its IPMS. There is a known need for adding BI to Profit Software's IPMS. Adding of BI has been discussed many times before and even some testing has been done with possible BI tools. Gartner the company that is the world's leader in information technology research and advisor, has also highlighted the lack of BI as a downside in Profit Software's products. This study was first requested by Profit Software's VP Product Management Tuukka Tiainen who has previously worked in one of Profit Software's customers. Adding BI somehow to our IPMS and advertising that as a new feature gives Profit Software without a question a great benefit in marketing. There are already many BI solution tools at the market so there is no need for doing everything from the beginning. Profit Software needs to study what kind of possibilities there are to integrate BI to its IPMS. Need for BI and a good timing of my need to write my Master's thesis came together and this project was started. *Goal of this thesis* is to find a proper BI solution for Profit Software. Goal can be reached by answering to the thesis problems mentioned earlier. *First section* introduces the main areas of the thesis. Problems of thesis are introduced and methods that are used to get the problems solved are presented. Facts about the company which ordered the project are shown and company's reasons to start the project are described. Structure of thesis is presented. *Second section* introduces the theory of BI like it is told in BI literature. Section gives a clip from BI's history and a description of what BI is. Future method "BI in the cloud" is opened at the end of this section. *Third section* presents evaluation methods that are used in this thesis. Preliminary study, selection phase and evaluation phase methods are introduced. Preliminary study was used to choose 19 BI tools from hundreds of tools to selection phase. Selection phase was used to choose four BI tools to evaluation phase. Evaluation phase helped to choose a BI tool for Profit Software. *Fourth section* explains the performing of evaluation. Results of preliminary study, selection phase and evaluation phase are given. BI tools which participated to evaluation are presented. *Fifth section* introduces the highest ranked BI tool of evaluation. Usage of BIME's BI tool is presented. Some example reports are shown, comparing of BIME desktop and BIME DB is done, security specifications are given and partnership-program is introduced. *Sixth section* presents the demo application made with the highest ranked BI solution and some example integrations made to existing Profit Software applications. Demo application and integration tests are presented with help of pictures, code snippets and documentation. *Seventh section* reports conclusions from everything that was studied and came across while doing this thesis. Answers that this thesis gives concerning the thesis problems are given. Estimation about viability of BI solution investment for Profit Software is given. Section also includes thoughts about Profit Software's opportunities and threats for investing to chosen BI tool.

2. BUSINESS INTELLIGENCE

This section introduces the theory of BI like it is told in BI literature. Section gives a clip from BI's history and a description of what BI is. Future method *"BI in the cloud"* is opened at the end of this section.

According to book *"Tietovarastot ja business intelligence"* (Hovi A., Hervonen H., Koistinen H. 2009) the history of BI begun when the term was started to use with data warehouses. Usage of term BI would have been after the year of 1988 when according to Hovi A., Hervonen H. and Koistinen H. (2009) the term data warehouses was established. On the other hand webpage betterbuys (2015) claims the business intelligence term was first used by Richard Millar Devens in his year 1865 work "Cyclopedia of Commercial and Business Anecdotes". Betterbuys writes that Devens uses the term to describe the way that a banker, Sir Henry Furnese, succeeded. Usage of term was in the next sentence: *"Throughout Holland, Flanders, France, and Germany, he maintained a complete and perfect train of business intelligence"*. From these previous information it can be combined that term BI is really old but it started to use more widely in the nineteens. Source of BI history that the next description is using is a book called Financial Business Intelligence: Trends, Technology, Software Selection, and Implementation" (Rasmussen, Goldy, Solli, 2002). The book describes that BI first started to use in 1970s and 1980s by analytical software packages. In the 1980s software's like Lotus 1-2-3 and Excel spreadsheets made it possible for users to create their own models of business analysis data. At the end of 1980s and early 1990s executive information systems (EIS) was launched. EIS promised to key information on the desktop of executives. The reason why EIS didn't get more popular was the fact that it was too complex tool. At the end of 1990s and first decade of 2000 usage of SQL databases, data warehouse technologies, extraction, transformation, loading (ETL) tools and new end user analytical software made it possible to BI tools to grow its usage. Spreadsheets are still used today and probably many years to future, but effective usage of BI is now and in the future done with help of BI solutions that work web based.

Power of BI is nowadays used by most companies and there are a strong trend of developing the BI tools to automatically show information about different kind of sources. There are a list of limitations and issues in the book (Rasmussen, Goldy, Solli, 2002) that are already solved today. List contains information overload, lack of information, no interactivity and lack of unified cross database analysis tools. BI tools today have properties that takes care of all these issues by wisely combining, analyzing and filtering the data that are given out as BI reports. Book examines some issues of problems that could be faced in BI projects.

Issues are over planning, waiting too long, leaving project to IT and feature creep. These issues can effectively be taken care of by iterative planning and programming. Also heavy impact from project management is sometimes needed.

BI today includes operation in the cloud. It is said in the Klipfolio's webpage (Klipfolio 2015) that history of cloud computing started in the 1950s. It was first used with development of microchip and the mainframe computer. Pioneers like Google, Amazon and Salesforce made the cloud business as big as it is today. InformationWeek (2015) writes that BI in the cloud service started right after the first wave of application's cloud usage but many of the BI in the cloud pioneers did not survive. For example LucidEra, Oco and PivotLink fell for fears about putting data in the cloud. Today when also mission critical apps and sensitive corporate data are moving online, it makes cloud based analytics and BI also more trusted among customers. BI and cloud computing are a perfect match, writes Klipfolio in their webpage. BI is delivering the right information to the right people at the right time and cloud computing provides a light and easy way to access BI applications. InformationWeek said to proof with their BI, and Information Management Survey that data is moving in the cloud with applications. In the survey it is shown that cloud based data warehousing services gets the biggest gains in adoption of any information management category. It is raised to 34% adoption among respondents when it was 24% in 2014. Enterprise management associates (EMA) end user research report (Myers J., 2015) claims that three biggest reasons for moving to cloud based BI are minimized hardware and infrastructure cost, reduced implementation cost and reduced administrative cost. According to report most important factor in cloud based BI is security. Security issues are also the issues blocking the large diffusion of cloud usage in BI. Amount of information that is transported from source systems to cloud makes security a much bigger issue than it is in the traditional applications. Users need to be able to fully trust that their information is safe and in is not lost. Nowadays when security issues are solved and under good understanding the operation for BI in the cloud is crowing massively. Organizations image about the cloud based strategies is really important. For organizations that appreciates cloud based approaches, there are many opportunities to expand their processing, storage, and distribution options. For those that do not appreciate cloud based strategies, there are lot less options. Results of EMA's end user research tells that all industry areas are now starting to use cloud as their BI platform. When industry segments of retail, utilities and public services goes ahead for the cloud, segments of industrial, manufacturing, health care and finance will follow.

3. EVALUATION METHODS

Section presents evaluation methods that are used in this thesis. Preliminary study, selection phase and evaluation phase methods are introduced. The phases of evaluation are shown in Figure 1. Preliminary study was used to choose 19 BI vendors from hundreds of vendors to selection phase. Selection phase was used to choose four BI tools to evaluation phase. Evaluation phase helped to choose a BI tool for Profit Software.
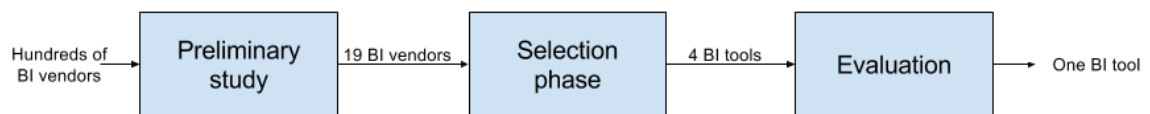

Figure 1. *Evaluation phases in a graph*

Preliminary study was done by collecting information from the internet. Starting from web searches and going throw hundreds of webpages formed a picture of proper BI tools in the market. Selection of 19 BI vendors was done by information that can be found from vendor's web pages, blog writings and related news. At this point most important aspect was appealing structure of webpage and easily found information about vendor's BI tool. Blog writings and news were used to check other that vendor's own information about the vendor's capability as a player in the BI market.

Four tools where chosen with the help of *selection phase*. Selection phase included score table that was filled for every tool. Tested subjects were overview of the webpages (*webpage*), good availability and simplicity of instructions (*instructions materials*), easily found demo-version of a BI tool (*demo*), eagerness of vendor's staff and support to service (*support*), visibility of integration possibilities (*integration preview*) and advertisement of possible representational state transfer (REST) support for importing data (*REST data upload*).

Weight coefficient values in the score-table varied from 1-3. Webpages had a weight coefficient of 1. Webpage-subject had a smallest weight coefficient value because webpage quality doesn't directly effect on the end product. It just gives an opportunity to doubt vendor's skills in web application business. Instruction materials and support subjects had a weight coefficient of 2. Those were an important part of getting to know-phase when doing something totally new. Most important thing in this getting to know-phase was possibility to use demo version of software. It was impossible to get to know the tool if demo wasn't available. The existence of demo was there for weighted with weight coefficient value of 3. Integration preview means that possibility of reports' integration was somehow mentioned in vendor's webpage. Integration preview's weight

coefficient was 2 because the main target of this study was to get to know integrated BI tools. Weight coefficient value was not 3 because answer was given by webpage information and not by a fact. All the facts about integration were not received because answers were not received from all the 19 vendors. REST import is really nice feature to have so it was valued with a weight coefficient of 3. The REST import is the easiest and the fastest way to start using BI tool if there is a ready REST Application Programming Interface (API). Weight coefficient values used are shown in Table 1.

Table 1. *Weight coefficient values and score sets used in selection phase.*

SUBJECT	Webpage	Instruction materials	Demo	Support	Integration preview	REST data upload
Score set	0-5	0-5	0/1	0-5	0/1	0/1
Weight coefficient	1	2	3	2	2	3

Score values in the score table have two different sets. Score set is 0/1 based on subject's existence or 0-5 based on overview of the subject. Score sets used are shown in Table 1.

Evaluation phase was done the same way with all four chosen tools. Decision of the most appropriate BI tool for Profit Software was made by using the score-table and SWOT-analysis. Scores given by the evaluator were based on the BI tool experiences. Evaluation of every BI tool started from contacting the vendor. Vendor's ability to support was the first factor that affected the score. Installing of demo version and needed tools were evaluated next. Then test continued to the phase where evaluator was getting started with the BI tool. Existence of good instruction materials played a big role in this stage. Videos seemed to be the best way to learn the BI tool basics and clear and well-structured manuals supported the learning curve nicely. All previous factors were scored under the score table's subject *getting started*. Offered data sources that can be used and easiness to connect to them through BI tool were scored under the score table subject *data import*. Simplicity of making a report from a data source was one score subject, *reporting tools*. Every tools suitability for Profit Software's BI tool was scored under the subject *suitability*.

Table 2. *Score sets used in evaluation phase.*

SUBJECT	Getting started	Data import	Reporting tools	Suitability
Score set	0-5	0-5	0-5	0-5

This time the score table subjects all had the same weight coefficient. Score table subjects all got score values from 0-5. Score-sets used are shown in Table 2.

4. EVALUATION

This section explains the conducting of evaluation. Results of preliminary study, selection phase and evaluation phase are given. BI vendors which participated to evaluation are presented.

4.1 Preliminary study and selection phase

Preliminary study of this thesis was started at the beginning of June, 2015. The first step was to get a quick look of BI solution providers in the market. Hundreds of webpages were viewed for firsthand information about BI solution providers. Webpages that were viewed were mainly vendors' own pages, but also information found from blog-writings like Quora (2015) and news-pages like Louhia (2015) were read to get a good overview of BI market. Vendors that were finally chosen for the selection phase can be seen from Table 3.

Table 3. *BI solution vendors that were chosen for the first selection phase*

Vendor	Webpage
Attido	http://www.attido.com/palvelut-ja-ratkaisut/teknologiat/qlikview/
Aureolis	http://www.aureolis.com/pages/fi/bi-ratkaisut/tietovarastointi-business-intelligence.php
Bime	https://www.bimeanalytics.com/index.html
Birst	https://www.birst.com/
Fujitsu	https://www.fujitsu.com/fi/services/application-services/informationmanagement/bi/?gclid=Cj0KEQjwvuuqBRDG95yR6tmfg9oBEiQAjE3RQC9QgwcJGXayM2OFmqiZn-IZc-inH2d69060G83rhZ4aAj-p8P8HAQ
IBM	http://www-01.ibm.com/software/fi/business-intelligence/
JasperSoft	http://www.jaspersoft.com/reporting-and-analytics-inside-your-application
Oracle	http://www.oracle.com/us/solutions/business-analytics/business-intelligence/overview/index.html
Pentaho	http://www.pentaho.com/
Power	https://powerbi.microsoft.com/
SAP	https://www.sap.com/finland/solution/sme/software/analytics/edge-medium-bi/index.html
Sas	http://www.sas.com/fi_fi/software/business-intelligence.html
Sisense	http://www.sisense.com/
Tableau	https://www.tableau.com/products/online
Timextender	http://www.timextender.com/solutions/for-your-erp/business-intelligence-for-other-systems/
Trackerbird	http://www.trackerbird.com/
YellowFin	http://www.yellowfinbi.com/YFWebsite-Embedded-Business-Intelligence-and-Cloud-Analytics-77979
Yurbi	https://www.yurbi.com/
Zoho	https://www.zoho.com/reports/moving-data-from-in-house-database.html

In this section the scores of the *selection phase* are presented. Scores of webpages were given by vision of style and structure of webpages. For example the webpage of one vendor is quite amateur-like and another does not have real information about the products at all. That is why they got so poor score at webpage column. Professional webpages, fast usage and good structure of products and instructions gave the score of 5. Some vendors got 0 points for instruction materials because those couldn't be found at all. Score of support was 3 if no contacting with support was done and lower if there were something negative at their support. One vendor got support score of 2 because their support was really slow with their answers and they really didn't seem to be interested of Profit Software as a customer. One vendor got score of 2 because they never answered to questions sent but managed though to add us to their email marketing list. Better score than 3 was given if support answered to questions and 5 were given for a really good support. BIME and Sisense both had a really fast and kind support and they were eager to help even though it was a student project. Total score of every vendor was calculated with the weight coefficient value. Equation that was used in every row to calculate total score:

$$\sum_{i=1}^{n} x_i * W_i, n = 6 \tag{1}$$

Variable x means subject's score, i means column number and W means weight coefficient. Variable n is number of subjects in the test. Scores of selection phase were calculated with Excel and results are shown in Table 4.

Table 4. *Scores of selection phase*

	Webpage (0-5)	Instruction materials	Demo (0/1)	Support (0-5)	Integration preview	REST data upload (0/1)	
Weight coefficient	1	2	3	2	2	3	Total score
BIME	5	5	1	5	0	1	31
JasperSoft	5	5	1	4	1	0	28
Sisense	5	4	1	5	0	0	26
Pentaho	5	4	1	2	1	0	22
Tableau	5	4	1	3	0	0	22
IBM	4	3	1	4	0	0	21
YellowFin	4	4	1	2	1	0	21
Yurbi	4	3	1	3	0	0	19
Birst	4	4	0	3	0	0	18
Fujitsu	3	3	0	3	0	0	15
Oracle	3	3	0	3	0	0	15
Power	3	3	0	3	0	0	15
SAP	3	3	0	3	0	0	15
Sas	3	3	0	3	0	0	15
Timextender	3	3	0	3	0	0	15
Trackerbird	3	3	0	3	0	0	15
Zoho	3	3	0	3	0	0	15
Attido	2	0	0	3	0	0	8
Aureolis	1	0	0	3	0	0	7

Scores were added in to an Excel bar chart (Figure 2) to make result more visual. There was couple of tools not matching the selection criteria which got really low scores. The fact that demo didn't exist made it impossible to evaluate a tool and also their webpages were amateur like. Low scores came from that. All 11 lowest scores mainly come from the lack of demo. The competition of four highest places took place between 8 vendors. Tableau, Pentaho, Sisense, JasperSoft and BIME got the highest scores for good combination of factors in their BI solutions.
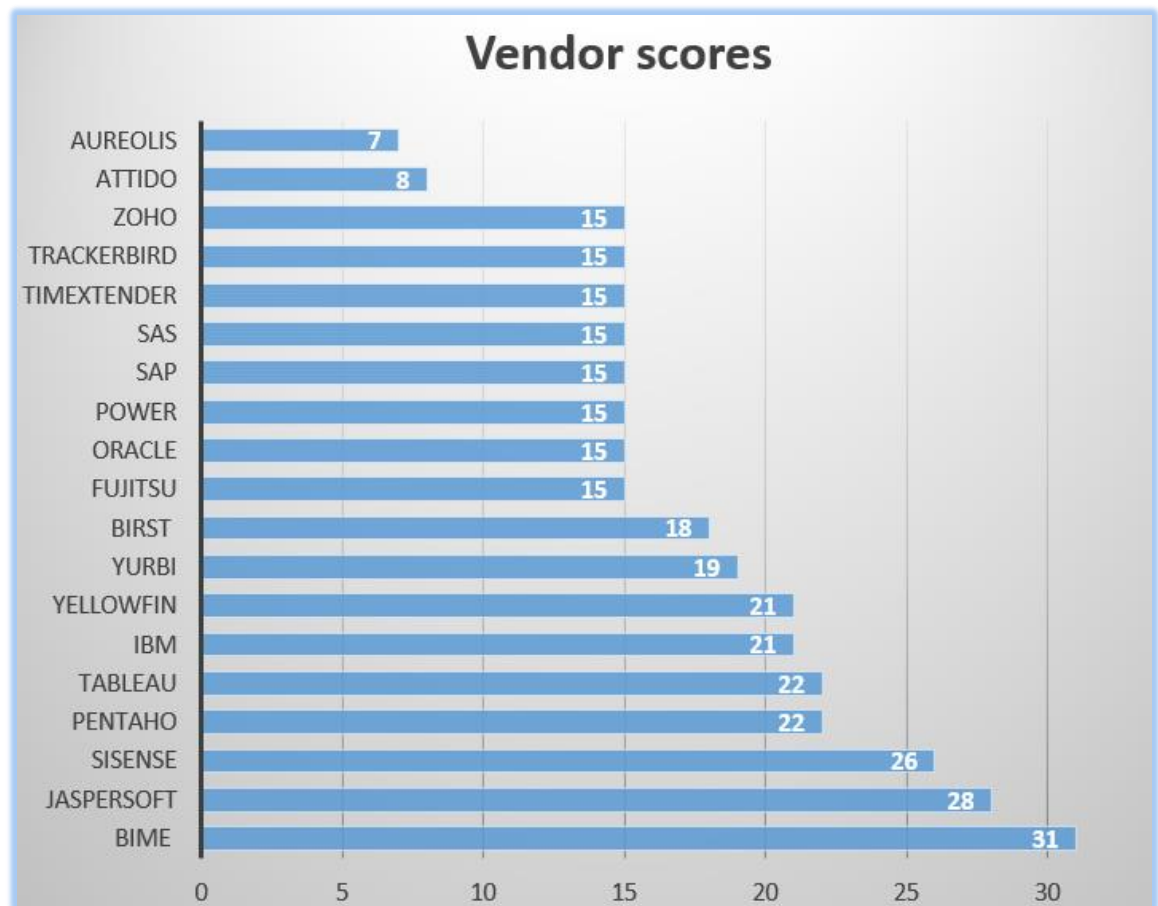
Figure 2. Total scores in bar chart

Results of this selection phase showed three clear winners by total score. Sisense, JasperSoft and BIME can any of them be a really good solution for a BI tool. Those three BI solution vendors were chosen for a deeper look up to final evaluation phase. Pentaho got a bit lower score because of lack of support.

4.2 Evaluation phase

Four more thoroughly evaluated tools all had the same basic usage pattern in their BI tool. Also all the important data sources were found from every tool. The basic usage and data sources of all four BI tools is there for described commonly in the common section.

Basic information, observations discovered during evaluation periods and visualization examples from every tool is given in their own sections. In the result section the results of evaluation are presented and reasons for final decision of one tool is shown.

4.2.1 Common

Usage pattern of all four BI tools starts from connecting to wanted data source. Then data sources are adjusted or combined to other data sources if needed. Next phase is creation of queries to data sources and finally queries are added to dashboards. Queries can be done with Structured Query Language (SQL) in all the BI tools. Dashboards can be shared with other users. All four tools have data source import options for DB2, Oracle, comma-separated values (CSV) files and Excel files that are important for Profit Software's point of view. Every BI tool was tested with large amount of data and all worked fast enough without any significant slowness.

4.2.2 Pentaho

Pentaho's LinkedIn page (Pentaho LinkedIn, 2015) reveals that Pentaho is part of Hitachi Data Systems that locates in USA, Orlando. Pentaho was founded in 2004 and it employs over 400 people worldwide. Pentaho has over 15000 product deployments and 1500 customers today including ABN-AMRO Clearing, EMC, Landmark Halliburton, Moody's, NASDAQ, RichRelevance, and Staples.

Pentaho advertises in their webpage (Pentaho, 2015a) to be the market leader of BI industry. They use slogans like "any analytics, any data, simplified" and "solutions for every business". Doing this study showed that it is not entirely true. While contacting with Pentaho's sales or support it felt from the beginning that Profit Software is not important enough for them. Pentaho answered to emails lazily and they dodged many questions totally. They also asked many times that: - When is the real phase of the project starting?

Pentaho promises to address the barriers that block your organization's ability to get value from all your data. Their platform is said to simplify preparing and blending any data and includes lots of tools to easily analyze, visualize, explore and predict. While doing a demo version's evaluation it was anyway found to be quite complex package to install and use. Many install packages needs to be installed and there is many different tools in Pentaho that needs to be started separately.

Pentaho offers free webinars which are good start before learning to create reports by yourself. Pentaho visualizations look really good as can be seen from Figures 3 and 4. Many kinds of reports can be done with it and it has good data mining engine. Pentaho describes their data mining and predictive analysis to include powerful algorithms such as classification, clustering and association.
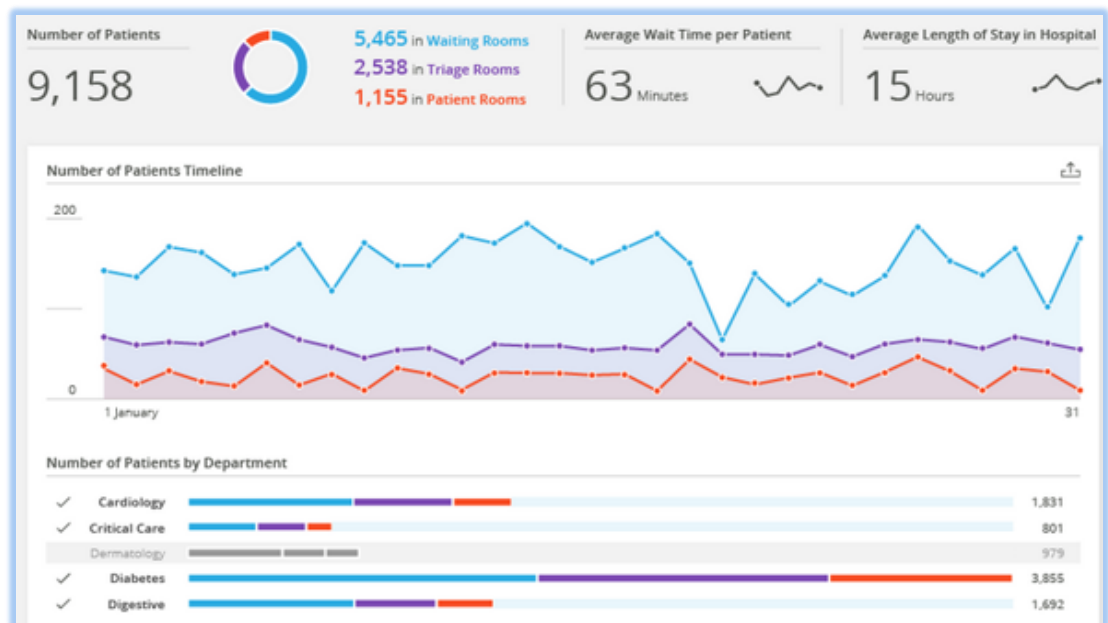
Figure 3. *Pentaho dashboard a (Pentaho, 2015a).*

Figure 4. *Pentaho dashboard b (Pentaho, 2015a).*

Pentaho includes data integration, visual analytics and predictive analytics tools which can be seen at Figure 5. Application package had five different tools to start. It was quite difficult at the beginning to remember which tool does what.
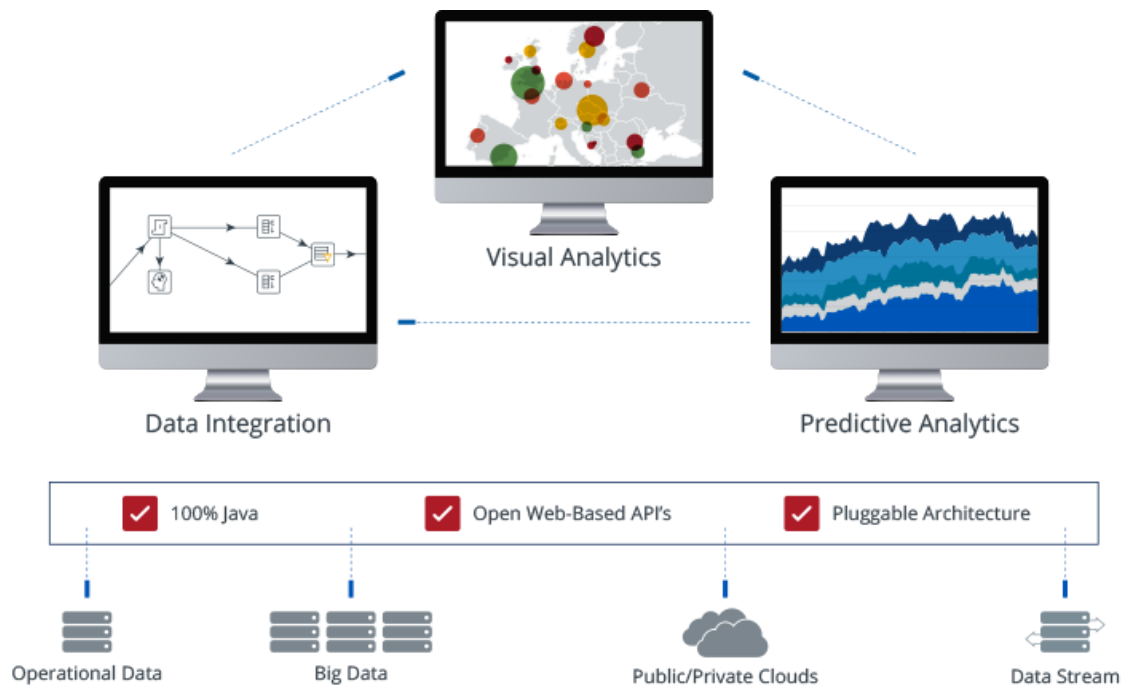

Figure 5. *Pentaho tools (Pentaho, 2015a).*

Pentaho's support falsely said the tool to have a REST-support also for importing data but in the evaluation phase it appeared to be just REST API's for exporting their reports. Pentaho's evaluation stopped before I got everything tested because they were not willing to resume the trial period. Actually Pentaho's support totally ignored the request by answering that they will ask from superiors and never gave the answer, even I asked it again three times.

Pentaho is without a doubt a big player in the market and certainly all the aspects of analyzing data and showing the results are taken care of. Anyway the feeling of not being important or valuable made the support score really low in both of the scoring rounds.

4.2.3 Sisense

Sisense's LinkedIn-page (Sisense LinkedIn, 2015) imparts that Sisense locates in Israel and US. It was founded in 2004 in Tel Aviv. Company employs about 50 people. Sisense has hundreds of customers, for example Avatrade, BusinessSolver, Ignite, Profit Tools and ProMarket.

Sisense was evaluated after Pentaho and it felt really nice to have a good support with the evaluation phase. Emails were answered quickly, all questions were taken seriously and Sisense were clearly interested in Profit Software as a customer.

In their webpage (Sisense, 2015a) Sisense uses slogans like *"COMPLEX DATA. SIM-PLE ANALYTICS."* and *"DATA JUSTICE FOR ALL"*. Actually analyzing wasn't any easier than with Pentaho. Sisense's BI tool also needed large installation package to install and you needed to do lots of work before you saw your first report in the dashboard. Sisense had all tools at the same package and there for easier to use than Pentaho.

Sisense claims their BI tool to be *"The only business intelligence software that lets you easily prepare and analyze big, disparate datasets."* That is a contradictory statement because there are lots of BI tools that do just the same. Sisense also emphasizes in their support contacts the fact that they do many things better that others. As an example they said to have data analytics at the same product than BI and many others did not yet have it. They are trying to create redeeming features for their product but when saying something that is not quite true it is doing just the opposite. Sisense's example visualizations are introduced in Figures 6 and 7.

Figure 6. *Sisense dashboard a (Sisense, 2015a).*

Figure 7. *Sisense dashboard b (Sisense, 2015a).*

Sisense answered quickly to questions from REST support and minor DB2 problems. They also resumed trial period twice and at the same day of asking it. Sisense is also organizing free webinars which are a good way to get basic knowledge about the product for starters.

4.2.4 BIME

According to BIME LinkedIn page (BIME LinkedIn, 2015) company is headquartered in Montpellier France with a North American office in Kansas City, USA. BIME was built for the cloud and takes full advantage of the latest analytics and visualization technologies for the era of big data. We Are Cloud has been developing BIME's core technology since 2007 and BIME was incorporated in 2009 in Montpellier.

BIME tells in their webpage (BIME, 2015) that it was born out of a frustration that existing Business Intelligence tools were simply too hard to use and too costly to implement. Today, BIME is internationally recognized as a pioneer in the field of pure cloud BI, delivering simple but yet powerful data analysis, visualization and dash boarding as a fast, easy and low-cost service. BIME is an application that connects to a large range of on premise and online data sources. With its intuitive drag 'n' drop interface, any user can perform sophisticated analysis on almost any data source. Reports can be shared by automated emails or a unique URL.

BIME harnesses the latest cloud technologies and utilizes all the advantages of the SaaS model. BIME has about 30 employees and 300 companies with about 5000 users. Customers includes for example Greenpeace, Yahoo, Shell, Coca Cola, Lenovo, Ticketmaster, Pizza Hut.

BIME uses slogans like *"explore, understand & communicate data with style"* and *"Deliver fast, easy and powerful Business Intelligence to your organization with only a browser."* This time the slogans went hand in hand with the reality. BIME was a really nice BI tool to get to know after fighting with two BI tools that needed lots of installs and settings. It can be seen in every point that BIME really works as they say in their webpage (BIME, 2015): *"We believe that business intelligence is just too hard: too hard to use, too hard to manage, too hard to buy, and too hard to get right. So, we created BIME: an easy yet powerful service to connect to and analyze data in any organization. We are focused on delivering a simple-to-use business intelligence product based on the latest data visualization and ground-breaking cloud computing innovations."*

BIME comes from Business Intelligence Made Easy and from the beginning this tool really felt like it. Especially when comparing it to other tested BI solutions it shined with its easy usage. First report with REST data import was in the dashboard in two minutes. There was no need for installing anything. Trial usage was requested from the BIME's webpage, own account was created and you got a list of all possible data sources. REST data source was added and BIME raffled the queries to fill your dashboard. For demo purposes this is quite phenomenal function. Good looking BIME dashboards can be seen from Figures 8 and 9.
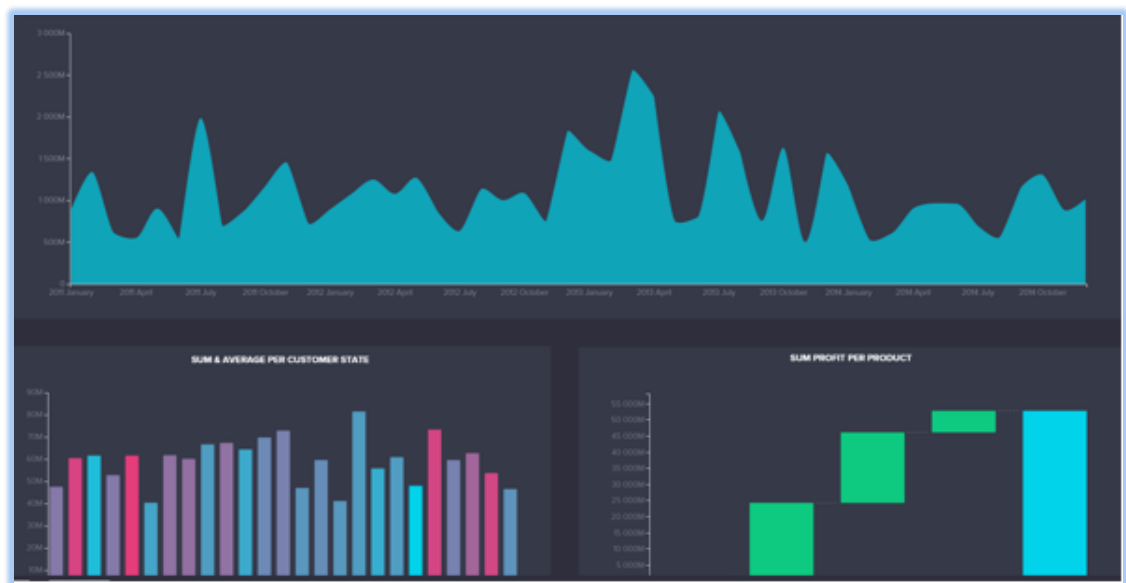

Figure 8. *BIME dashboard a (BIME, 2015).*

Figure 9. *BIME dashboard b (BIME, 2015).*

There are multiple data sources to create your reports from. BIME promises to add new data connector every week and to work in mobile devices also. BIME is not servicing any webinars but those weren't missed because of really good chat-support and free online support meeting.

4.2.5 JasperSoft

JasperSoft's development was started on 2001 by a developer who wanted to embed reporting capability in an application. Company was founded in 2004. JasperSoft's BI tool was first published in 2006. Company employs over 50 persons.

JasperSoft provides support for cloud, big data, and mobile. It is an open source software and has a community of over 250,000 registered members. JasperSoft's open source BI software has been downloaded more than 14.5 million times. JasperSoft is privately held and has locations around the world. JasperSoft has over 175000 product deployments and 14000 commercial customers today including Agiliance, Cincom, Evernote, Mosaic and SynchSource Inc.

JasperSoft's basic idea that can be found from their website: *"We empower millions of people every day to make faster decisions by bringing them timely, actionable data inside their apps and business processes through an embeddable reporting and analytics platform. Our product, unlike traditional BI tools, allows anyone to easily self-serve and get the answers they need inside their preferred app or on their favorite device. Our BI platform, unlike desktop visualization tools, scales architecturally and economically to reach everyone."*

Examples of JasperSoft dashboard reports can be seen from Figures 10 and 11.

Figure 10.   *JasperSoft dashboard a (JasperSoft, 2015)*

Figure 11.   *JasperSoft dashboard b (JasperSoft, 2015)*

Same as Pentaho and Sisense JasperSoft also have a big installation package to install with JasperReports Server, JasperReports Library, JasperSoft Studio, JasperSoft ETL and JasperSoft OLAP. It requires lots of work again to get the first report done. Integration of reports thought is advertised to be really easy in JasperSoft. That is a really big redeeming feature for JasperSoft. JasperSoft is promised to work also in tablets and mobile phones.

4.2.6 Results

Results of evaluation phase are presented in this section. Final points of score-table and SWOT-analysis are shown.

Four BI tools that were evaluated got their scores from the evaluation phase. Scores that were given can be seen from table 5. Pentaho got poor score in getting started-subject because of already mentioned lack of support. Sisense's score from the same subject was 3 because compared to JasperSoft and BIME usage was more complex to start. JasperSoft had long starting time with big installations, there for BIME got the best score from this subject. BIME got highest score from the data import-subject because they are really focusing on having plenty of possibilities for a data source and only one that has REST import in their tool. Others got score of 4 while being good enough in this subject. Reporting tools worked perfectly with all the tools so score of 5 was justified for all. Pentaho and Sisense got score only of 4 from suitability because easiness of integration was not presence in the evaluation. BIME and JasperSoft mentioned the easy integration and got the suitability score of 5 from that.

Table 5. *Scores of evaluation phase*

SUBJECT	Getting started	Data import	Reporting tools	Suitability	Total score
Score set	0-5	0-5	0-5	0-5	
Bime	5	5	5	5	20.0
JasperSoft	4	4	5	5	18.0
Pentaho	2	4	5	4	15.0
Sisense	3	4	5	4	16.0

BIME ranked highest at this score round with maximum score of 20. Pentaho ranked lowest with score of 15.

Factors in the SWOT-table are explained next. Pentaho and Sisense are both traditional BI's with massive installation package and complex usage pattern. In addition to complex traditional also means them to be more trustful than newbies. That is why both Pentaho and Sisense have *traditional BI* mentioned as strength and as weakness in the SWOT-table. BIME gave really fresh and cool experience, downside of that can show off as problems in their tool. Problems are marked as *something doesn't work* in SWOT-table. The property *new and innovative* is also mentioned as strength and as weakness for BIME. Comparison of four tools is shown in a SWOT analysis table (Table 6).

Table 6. *SWOT analysis of four evaluated vendors.*

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
BIME	Easy to use	New and innovative makes it also less trustful	Making something new and cool for our customers	Something doesn't work
	Good support			
	REST import		Easy integration to PLP	
	New and innovative			
	Works in the cloud			
JasperSoft	Easy integration	No real data analysis	Opportunity for me to learn good JavaScript-frameworks	Work is too much to handle
	Work can be mostly done by myself.	No REST support	Easy integration to PLP	
Pentaho	Traditional BI (trustful, well tested)	No REST support	Traditional and trustful tool to show for customers	Work cannot be finished, lack of support
		No integration preview		
		Lazy support		Integration cannot be done without lots of money
		Traditional BI (expensive, complex)		
Sisense	Good support	No REST support	Traditional and trustful tool to show for customers	Integration cannot be done without lots of money
	Traditional BI (trustful, well tested)	Traditional BI (expensive, complex)		

Experience about BI vendors support can be seen also in this analysis and REST-support is also mentioned. Easiness of integration is mentioned in opportunities or threats according to which side it belongs.

5. INTRODUCING THE HIGHEST RANKED BI TOOL OF EVALUATION

This section introduces the highest ranked BI tool of evaluation. Usage of BIME's BI tool is presented. Some example reports are shown, comparing of BIME desktop and BIME DB is done, security specifications are given and partnership program is introduced.

5.1 Usage of BIME

BIME can be started easily without any installations. Cloud account needs to be created and then you can start adding data sources to created account. Creation of BIME dashboard is presented with Profit Software's DB2 database. Phases of creation can be seen from Figures 12 to 18. First the data source is chosen from the list like in Figure 12.
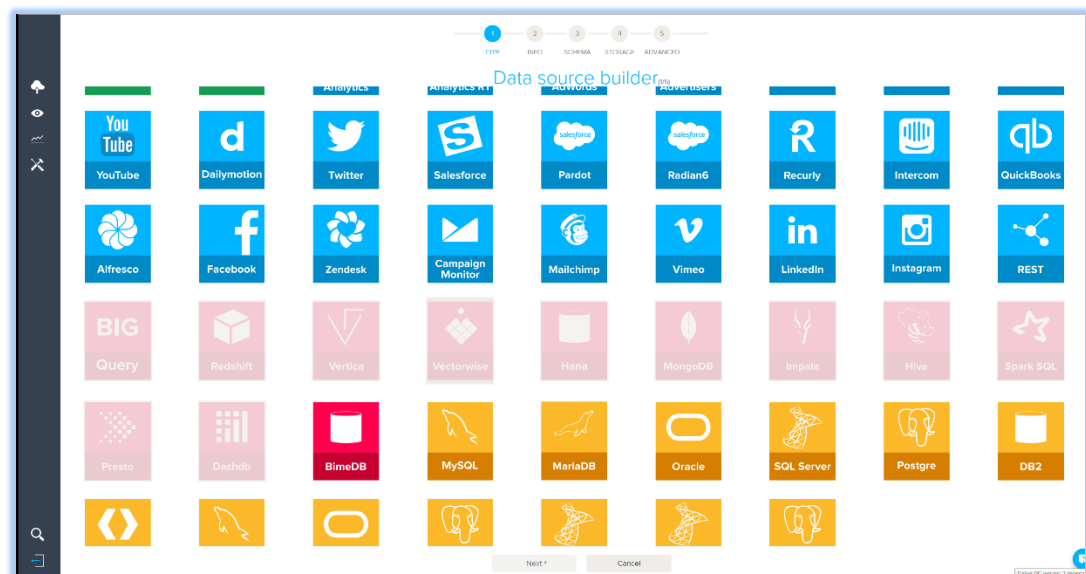
Figure 12.   *Screen 1 from BIME data source builder*

Example settings about making DB2 settings can be seen in Figure 13. Then at the table selection needed SQL-query is added like in Figure 14.

Figure 13.   *Screen 2 from BIME data source builder*

Figure 14.   *Screen 3 from BIME data source builder*

Needed qualities of the data are set to schema-tab like in Figure 15. There is two kinds of properties for the data, attribute and measure.

Measures are all quantifiable values; sales, costs, profit, unit price, quantities, etc. By default, the SUM of the chosen measure will be shown, but this can be altered. In addition, a dynamic count is added to most datasets and you can add calculated measures as well. Attributes are used to form the columns and/or rows of the chart and can be used to filter results.
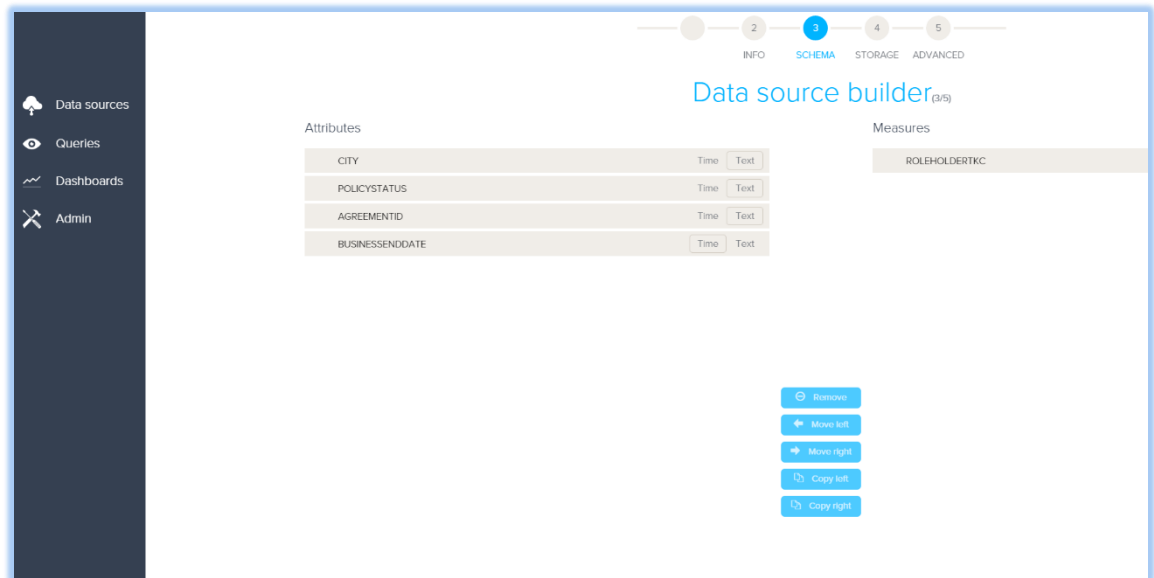
Figure 15. *Screen 4 from BIME data source builder*

Next a new query is added to created data source. If BIME is used for the first time then it asks if automatic creation of queries is wanted. When answered *"yes"* then BIME creates random reports from the data. If some other queries are needed those can be added by button *"New query"* that can be seen in Figure 16.
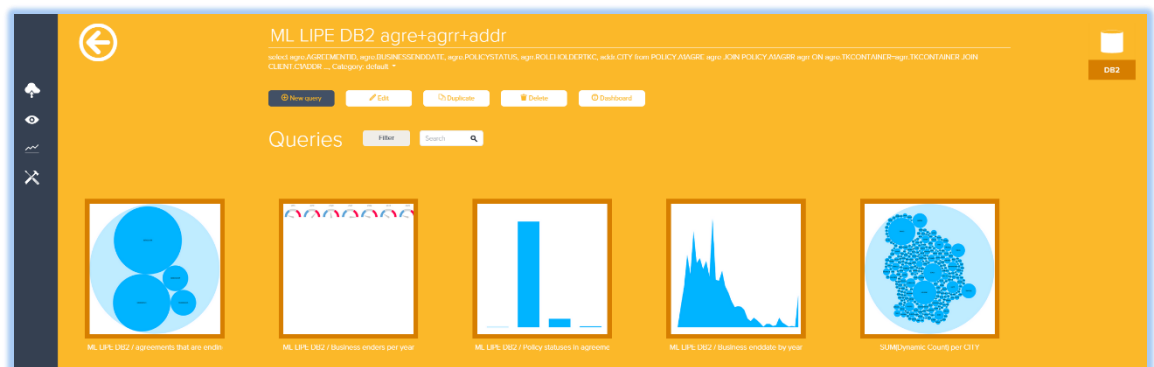
Figure 16. *New query-button in data source view*

Query is created by adding at least one measure to query view. First, view shows a dynamic count of all rows in the data source. When rows or columns are added then visualization type changes automatically to some type that fits for the chosen data.

Example settings for the pie chart in Figure 17. As can be seen from the figure the settings are really simple, just one measure and one column.
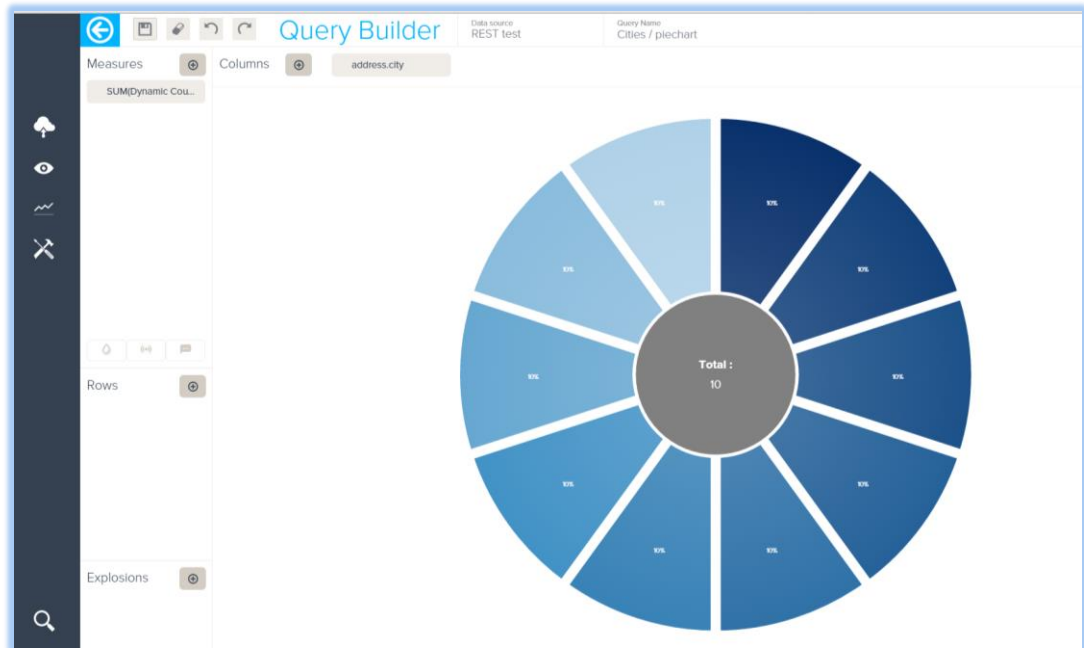

Figure 17.   *Example settings for pie chart*

Another example can be found from Figure 18. It is a table chart with annual money tracking. There is now one measure, one column and two rows. It is still quite simple.
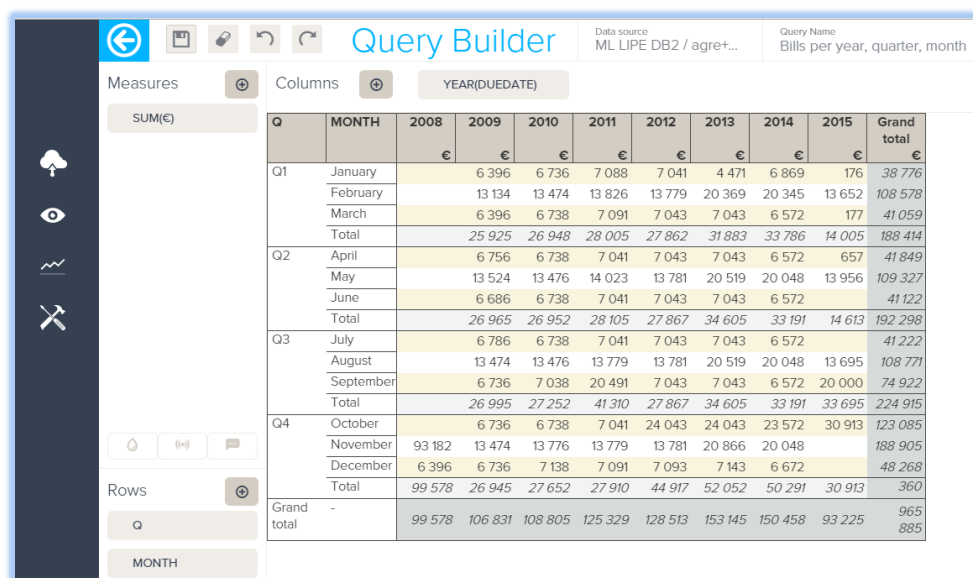

Figure 18.   *Example settings for table chart*

Large amount of different kind of reports can be done this way. In example charts the colors and labels are changed to desired look. More specific settings will not be introduced in this thesis.

When queries are made, those can be shared in many different types. Sharing can be done by choosing share from query's pop-up view (Figure 19) and then by setting public and desired type (Figure 20). URL and embed addresses can then be used as wished.
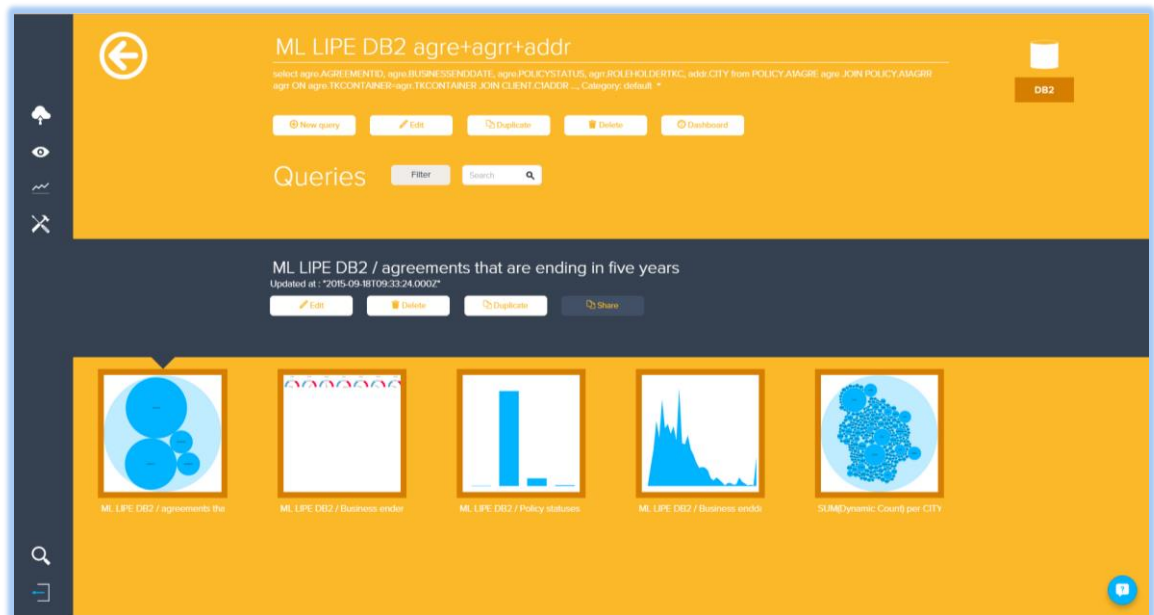
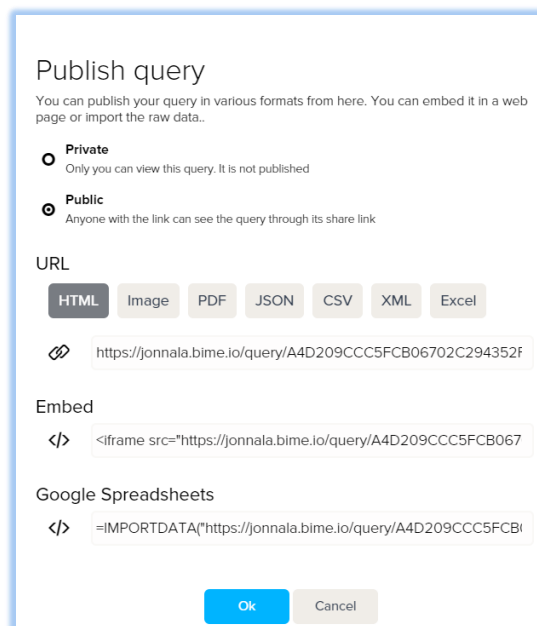

Figure 19.   *Query's pop-up view*

Figure 20.   *Query's share settings view*

Queries can also be installed to dashboards which collects desired reports under the same view. Query can be saved to chosen dashboard automatically when query is saved or it can be added to dashboard by choosing add query.

Example dashboards that are made from Profit Software's DB2 data can be seen from Figure 21 and Figure 22.
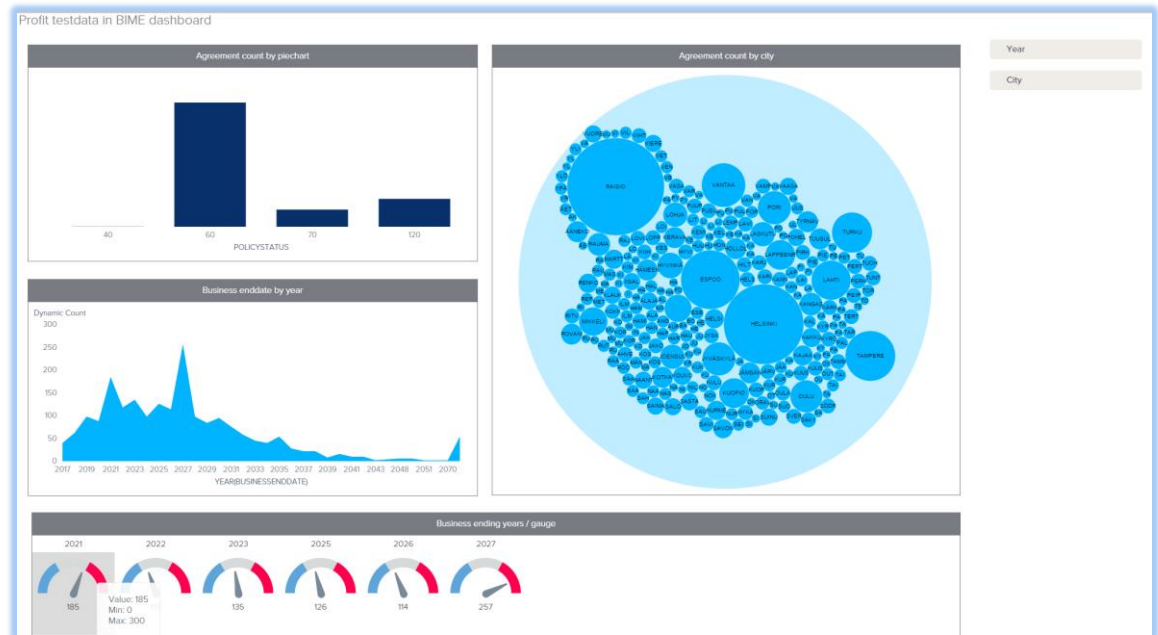

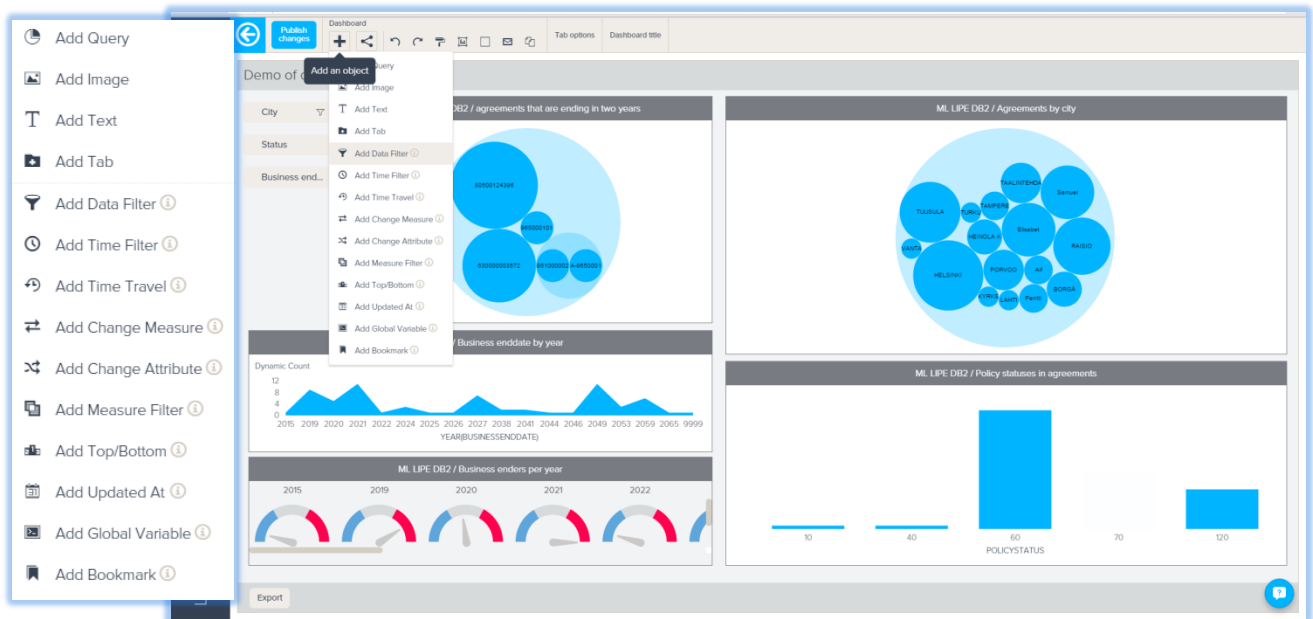***Figure 21.*** *Example dashboard 2 with graphical charts*

Figure 22. *Example dashboard with many graphical charts*

Lots of extra features can be added to dashboards. Add object-function is open in the Figure 22 and enlarged at the left of the figure.

All the tools will not be introduced here but example the data filter is really nice feature to filter whole dashboards data with the same button. All attributes that are added to dashboard can be added to filter. Filter settings that appears after choosing *"add object"* and *"add data filter"* can be seen from Figure 23.
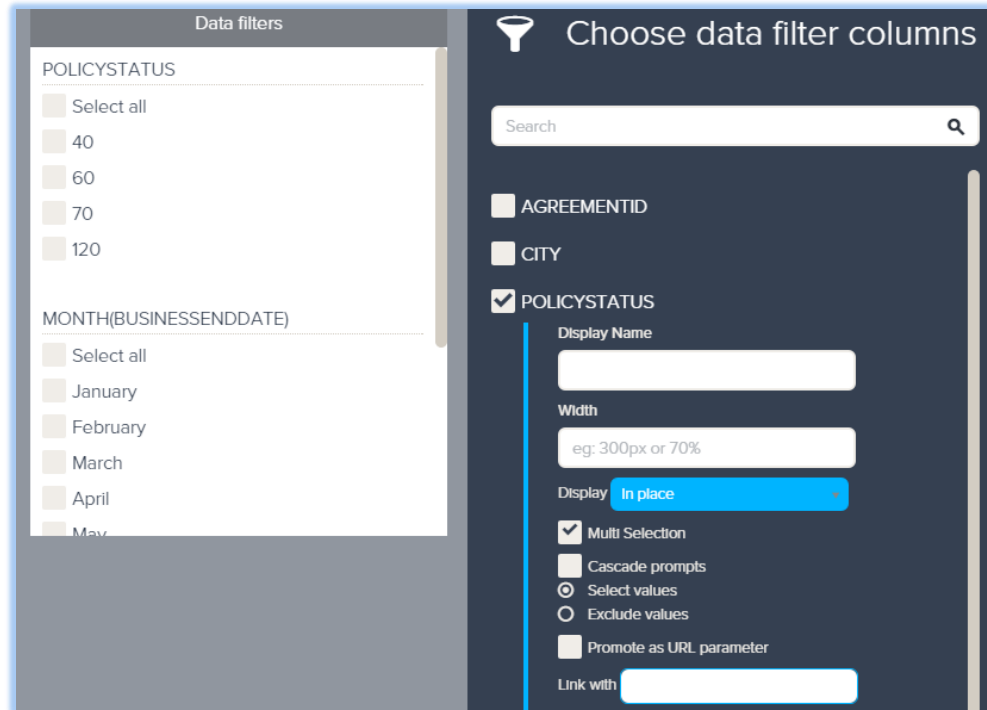

Figure 23. *Filter settings of add data filter window*

Filters can get many other properties and display type can be changed to drop box. Other features will not be introduced here. Really good feature related to this part of BIME is that you can use URL parameters with data filters. By using URL parameters the integrated queries and dashboards can be updated based on user's or application's selections. For example there could be own dynamical view of every agreement. Agreement ID would be given by URL parameter and queries or dashboards would have information about that agreement only. Implementing this kind of functionality will require quite a lot of work so it is not implemented within this thesis.

When city of Helsinki is chosen from the city filter then same dashboard than in Figure 21 will now look like one in Figure 24.
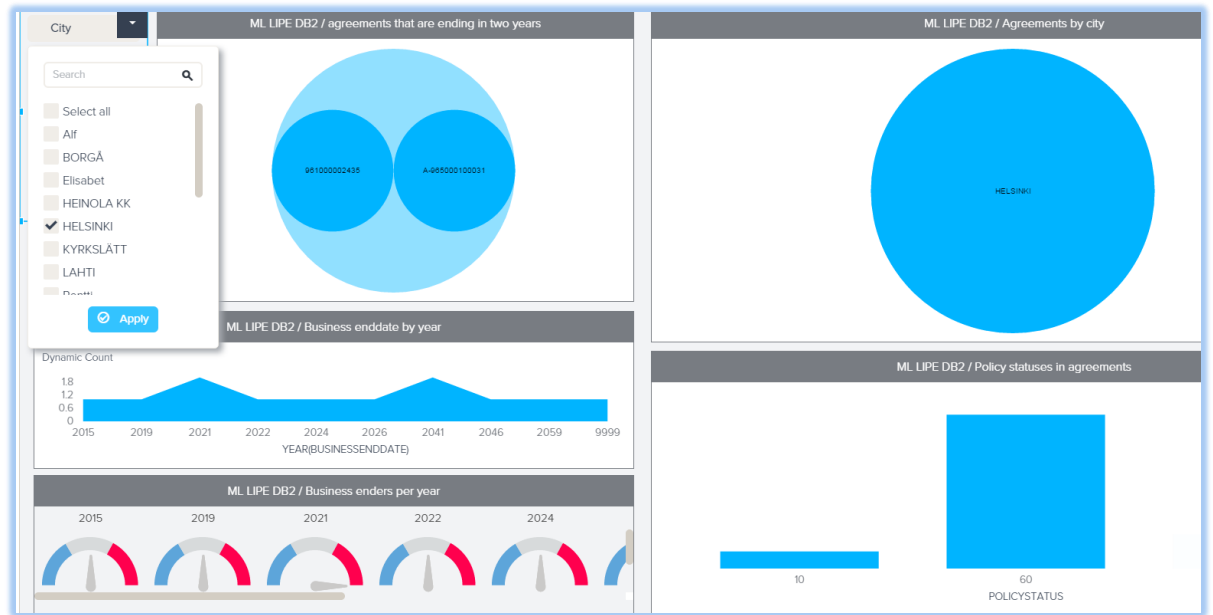

Figure 24.   *Example dashboard with many graphical charts and city filter="Helsinki"*

Filters can also be used for example to filter date specific data by year, quarter or month. This is very useful property while doing reports of company's financial areas.

5.2   Example reports

Next there are some example reports that are made from Profit Software's DB2 test data and from open REST API. Profit Software's DB2 has same structure that it has in real production database also. Open REST API means that it is public and can be used by anyone. Another example report is shown from conversions reconciliation data. Automatic reconciliation report would be really helpful report for Profit Software their self in the future.

It is possible to visualize all data from the DB2 database. Easiest way to find needed collection of database columns, is to design the data model for the report and then create a SQL-query that collects needed data.

For example when it is needed to find out number of agreements grouped by city from Profit Software's DB2 database, the data model is first designed as can be seen from Figure 25. Data model's mission is to collect together actual database columns and tables where those are located.
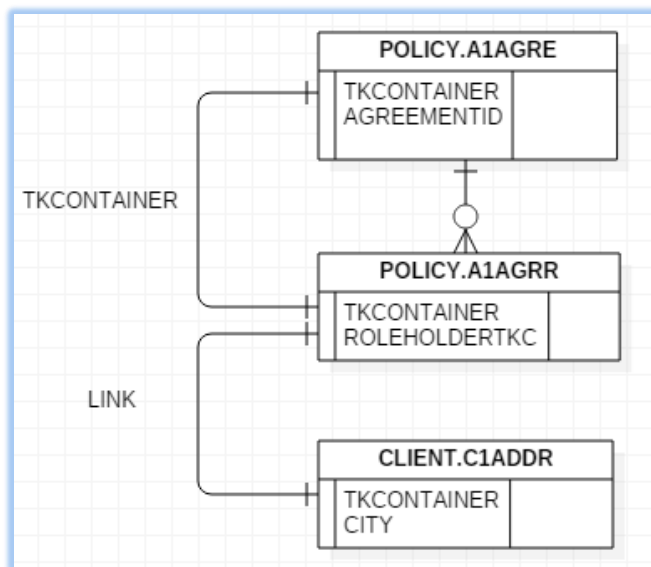

Figure 25.   *Example of data model*

Model will help to solve database table's dependencies. In the example data model can be seen that agreements (AGREEMENTID) are related to addresses (CITY) via the table POLICY.A1AGRR. Columns are related like this:

POLICY.A1AGRE.TKCONTAINER= POLICY.A1AGRR.TKCONTAINER

POLICY.A1AGRR.ROLEHOLDERTKC=CLIENT.C1ADDR.TKCONTAINER

With the help of this information it is possible to create SQL-query which fetches the wanted data. SQL-query can be for example like the query in Code 1.

```
SELECT agre.AGREEMENTID, agre.BUSINESSENDDATE, agre.POLICYSTATUS,
agrr.ROLEHOLDERTKC, addr.CITY
FROM POLICY.A1AGRE agre JOIN POLICY.A1AGRR agrr
ON agre.TKCONTAINER=agrr.TKCONTAINER
JOIN CLIENT.C1ADDR addr
ON addr.TKCONTAINER=agrr.ROLEHOLDERTKC
WHERE agre.TKVERSION=0 and agrr.ROLETYPE=20
```

Code 1.   *Example SQL -query for fetching data (©Jonna Laine)*

SQL-query selects five columns (*SELECT*) from (*FROM*) three different database tables and joins (*JOIN*) them together with given (*ON*) conditions. If many joins are needed those will be done sequentially. At the end of a query there is another query condition (*WHERE*) where can be added more data filtering.

With above query BIME fetches the wanted data from DB2 and in BIME the data looks like in Figure 26. Attributes and measures are chosen from data field list that is the same than the list in SQL-query's select command.

Figure 26. *Fetched data in BIME*

Next new report is made by choosing new query and desired report is created by choosing correct data to measures (*SUM(Dynamic Count)*) and columns (*CITY*). Nice looking report about the agreements grouped by city can be done example with bubble chart that is shown in Figure 27.
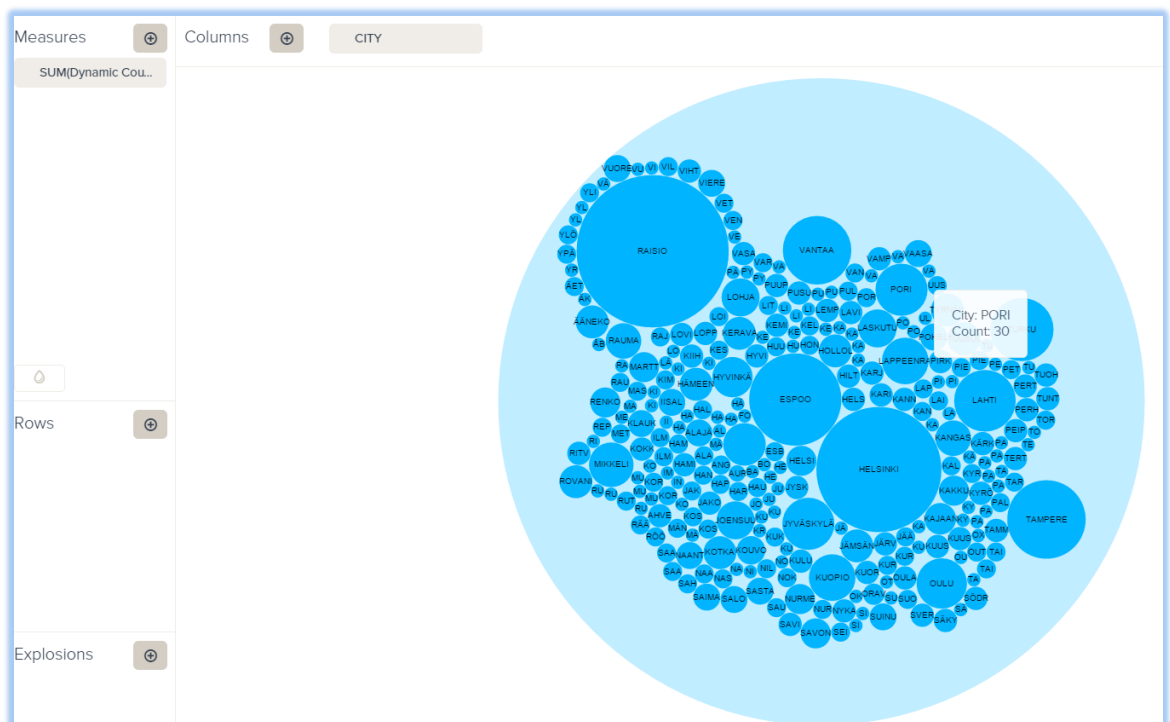

Figure 27. *Example bubble chart with agreements grouped by cities*

When mouse is hovered above the bubbles, BIME shows pop up information that can be edited as wished (in query settings). Now bubble's pop up shows name of the city and count of the agreements in that city.

Procedure of creating the REST API data import is introduced next. Import is done from the open REST API.

First REST data source is chosen from the data sources, then connector settings are changed (Figure 28). Open REST API that was used for following reports: http://jsonplaceholder.typicode.com/users

Jsonplaceholder's webpage includes dummy JavaScript Object Notation (JSON) data. According to Wikipedia (Wikipedia, 2015) JSON is an open standard format that describes data objects in human readable format and transfers data asynchronously between browser and server. Jsonplaceholder's webpage includes person data and their addresses. Next will be shown how that data can be visualized with help of BIME.

Figure 28.   *Setting for REST API import*

Many REST related features (other methods, other formats, authentication type, request parameters like oAuth and URL query parameters etc.) can be used here. Contents of REST API can be seen by pressing button "Test". Data appears to BIME table like in Figure 29.

address.street	address.suite	address.zipcode	company.bs	company.catchPhrase	company.name	email	id	name
Kulas Light	Apt. 556	92998-3874	harness real-time e-markets	Multi-layered client-server neural-net	Romaguera-Crona	Sincere@april.biz	1	Leanne Graham
Victor Plains	Suite 879	90566-7771	synergize scalable supply-chains	Proactive didactic contingency	Deckow-Crist	Shanna@melissa.tv	2	Ervin Howell
Douglas Extension	Suite 847	59590-4157	e-enable strategic applications	Face to face bifurcated interface	Romaguera-Jacobson	Nathan@yesenia.net	3	Clementine Bauch
Hoeger Mall	Apt. 692	53919-4257	transition cutting-edge web services	Multi-tiered zero tolerance productivity	Robel-Corkery	Julianne.OConner@kory.org	4	Patricia Lebsack
Skiles Walks	Suite 351	33263	revolutionize end-to-end systems	User-centric fault-tolerant solution	Keebler LLC	Lucio_Hettinger@annie.ca	5	Chelsey Dietrich
Norberto Crossing	Apt. 950	23505-1337	e-enable innovative applications	Synchronised bottom-line interface	Considine-Lockman	Karley_Dach@jasper.info	6	Mrs. Dennis Schulist
Rex Trail	Suite 280	58804-1099	generate enterprise e-tailers	Configurable multimedia task-force	Johns Group	Telly.Hoeger@billy.biz	7	Kurtis Weissnat

Figure 29.   *Preview that comes from BIME account's test link*

There is location data at the REST API above. Map reports can be created in BIME by city and postal code or latitude and longitude-components.

Example map is showed at the Figure 30. There is also dashboard in Figure 31 that is made from the data in the above REST API.

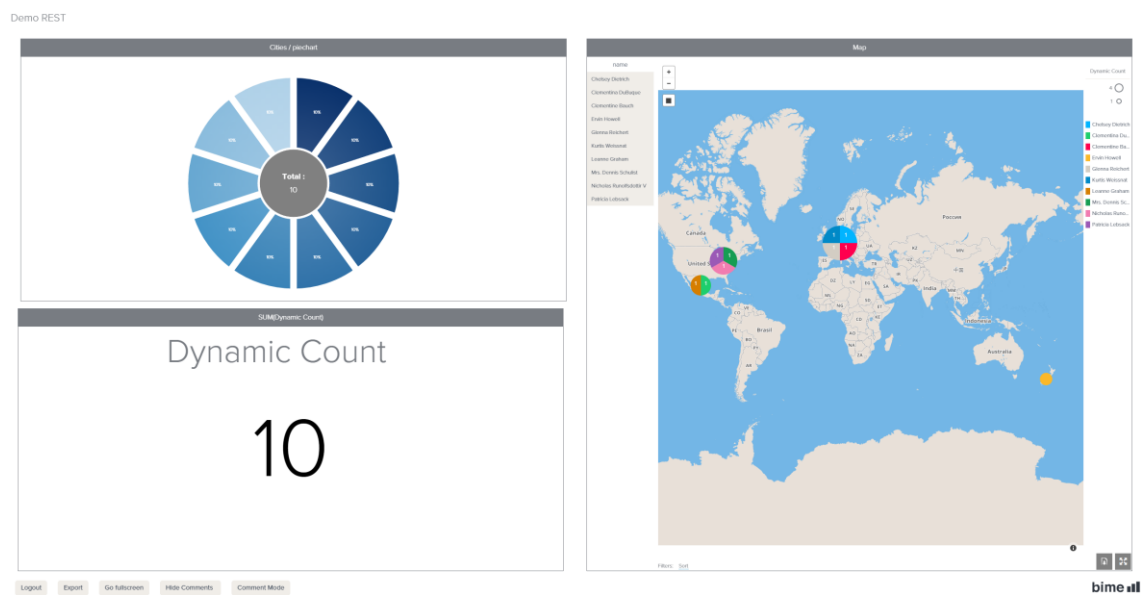*Figure 30.*   *Persons from REST API planted to map*

Figure 31.   *Figure of dashboard that is opened from the shared URL*

There are queries of map, pie chart and dynamic count in above dashboard. Pie chart is done from REST API data by choosing city as a column and dynamic count as a measure. Now there is only one person per one city so pie chart is even. Dynamic count is count of all persons in the REST API data.

When customer starts to use Profit Software's products they usually have some legacy system in use. Legacy system's data is needed to be converted to DB2 database. Conversion is done with help of CSV files. Customer gets instructions how the data needs to be exported to CSV files and then customer can make their own tests to exported data with Profit Software's conversion prevalidator. Structure of new data needs to follow Profit Software's data rules. Prevalidator finds most of the errors in the data, but it still needs to be reconciliated with the help of reconciliation queries. After conversion of data Profit Software uses reconciliation to check everything has converted correctly. Work is now done quite manually and it would be big help if BIME would be used for this reconciliation. There is an example dashboard made with BIME in Figure 32 that includes few Profit Software's reconciliation queries from two different databases. Two databases represents the data before and after the conversion.

Figure 32.   *Example of conversion reconciliation data report*

These BIME queries could also be color-coded so that example REC3 would get different color that others because in that query the reconciliation doesn't match. Color coding would make it really easy to see if some of the tens of reconciliation queries would not match.

5.3 BIME cloud or BIME desktop

There is two possible ways to use BIME with the Profit Software's or customer's DB2 database. With BIME cloud BIME-reports can be totally used in the cloud. With this option connection to database is done with SSH-tunnel. Integration architecture of this option was drawn by thesis writer and it is introduced in Figure 33. In this case it is needed to buy and build a SSH-server and create SSH-tunnels for needed databases. No other installation is needed.
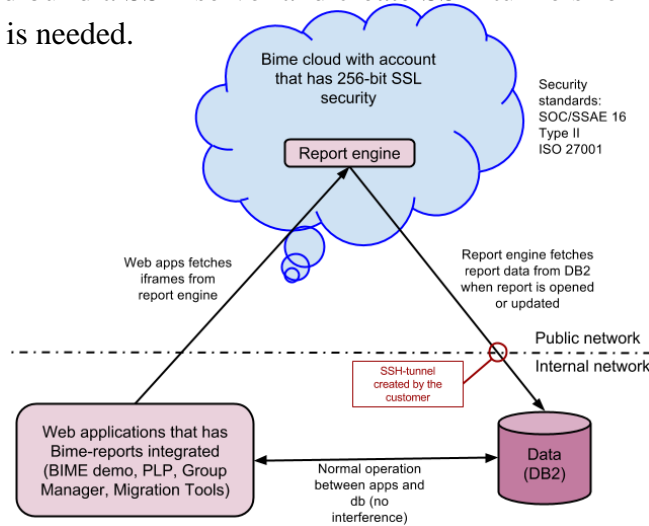
Figure 33. *Integration architecture when SSH-tunnel is used*

Other way is to use BIME reports in BIME-desktop that is installed to same network than needed databases. Integration architecture of this alternative can be found from Figure 34.
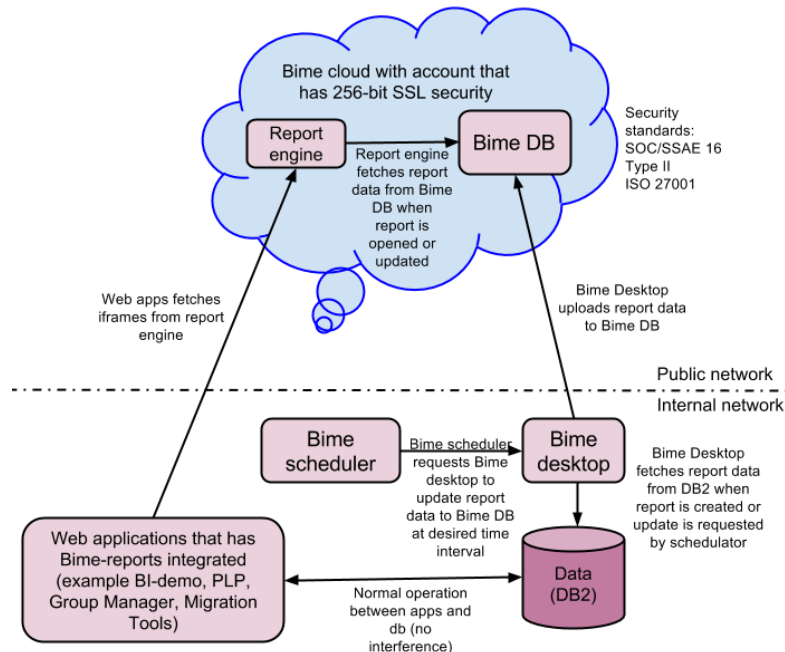
Figure 34. *Integration architecture when BIME DB is used*

BIME-desktop will copy needed data to BIME DB and Scheduler will take care of updating the data at desired time interval. In this alternative BIME desktop and BIME Scheduler installations is needed.

According to BIME, the two ways to use it are both used a lot. The best way to use BI-ME was weighted with help of SWOT analysis. SWOT analysis can be seen from Table 7.

Table 7.   *SWOT analysis about usage of BIME.*

|	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
SSH-tunnel	Security is in the hands of a customer	Customer need to have knowledge about SSH-server and creating tunnels	Live reports integrated to PLP	SSH-server cannot be installed
	Data is not transfered anywhere			SSH-tunnel cannot be established
	Reports are live	Network traffic is unscheduled		SSH-tunnels security is not handled correctly
	Profitable (-2520€ / year)			
BimeDB	Doesn't interfere with your production environment	Report data needs to be refreshed	Really fast performance	Price is too much for customers
	Is designed to be used in analytics	Security is in the hand of Bime		
	Optimal performances			Someone breaks in to BimeDB
	Allows to perform SQL operations with none SQL-based data	Expensive (+2520€/year)		

Upper row has strengths, weaknesses, opportunities and threats for usage of BIME with the SSH tunnel. Strengths in this usage style are related to security, report update and money. Security of data is in the hands of a customer because customer by their self installs the SSH server and creates the SSH tunnel. Data is not transferred anywhere in this option. In insurance business this is sometimes even regulated by law. Reports updates their data when browser is updated so data is live. SSH tunnel option is profitable option because BIME DB costs more. Weaknesses of SSH tunnel includes issues of SSH knowledge and network traffic. SSH knowledge is not often very high level so it might cause problems. Network traffic might in worst case effect on other significant network traffic if it is run in a critical moment. Really good opportunity in SSH tunnel option is to have appealing and live reports integrated to PLP. Threats of SSH tunnel option are related to SSH tunnel itself. If there is not enough knowledge about tunneling then it might cause some problems.

BIME DB option has strengths concerning product environment, analytics, performance and operations. Product environment is not interfered with BIME DB option because it works totally in the cloud, even the data is there. Possible analytic tools are professional when data is in the BIME DB. Performance is fast when all work is done in the cloud. BIME DB makes SQL tools available even to not SQL structured data. Weaknesses of BIME DB option are opposite to SSH tunnel option. Reports needs to be refreshed with separate scheduler and security of data is in the hands of BIME. Opportunity in this option is the fast performance that is really important and required property nowadays. Threats relates to price and security. Customers could refuse BIME license because of the high price. If data security would not be in high level enough then there might happen a breakage.

5.4 Security in the BIME cloud

According to BIME webpages (BIME 2015) security of BIME is as good as the online banks have. Facts of BIME security introduced:

- BIME account is password-protected. If a login / password is not enough, BIME also offers single sign on (SSO) with all the standards of the market (used by Google, Database.com, Facebook etc.), i.e. OAUTH, OPENID and SAML.
- BIME can be logged in from Google Apps account and also active directory can be used without requiring a login / password.
- BIME can also deactivate the use of login/password to delegate the identity management to a third party.
- All BIME accounts include 256-bit SSL security – the same used by online banks.
  - o Security standards: SOC/SSAE 16 Type II, ISO 27001

BIME has been developing its BI tool in the cloud for many years and with hundreds of customers so it is fairly believable that the company knows how security needs to be handled.

5.5 BIME partner program

BIME offers partnership program for companies who are interested of selling their product, or for example like Profit Software, wants to integrate their reports to own products. Terms of being a BIME partner is introduced in the BIME webpage (BIME 2015). To become a BIME partner it is just needed to activate one Base plan license that is payed once per month. If and when the first resale is done, then Profit Software would get their own BIME-license for free. Profit Software would take care of selling the BIME license for their customers and for the reselling Profit Software would get 30% of every license sold. Profit Software would get training and support for free from BIME and also get access to BIME's marketing materials.

6. APPLICATIONS

Section presents the demo application made with the highest ranked BI solution and some example integrations made to existing Profit Software applications. Demo application and integration tests are presented with help of pictures, code snippets and documentation.

6.1   Demo application with BIME

Demo-application (demo-app) was planned for Profit Software to be able to demonstrate BIME-reports for their customers. Demonstrating needs to be able to make without BIME account, that is why demo-app includes mostly pictures. With demo-app you can see pictures of many different BIME reports, BIME tools and integrated views from Profit Software's other applications. Main view of the demo-app can be seen from Figure 35.
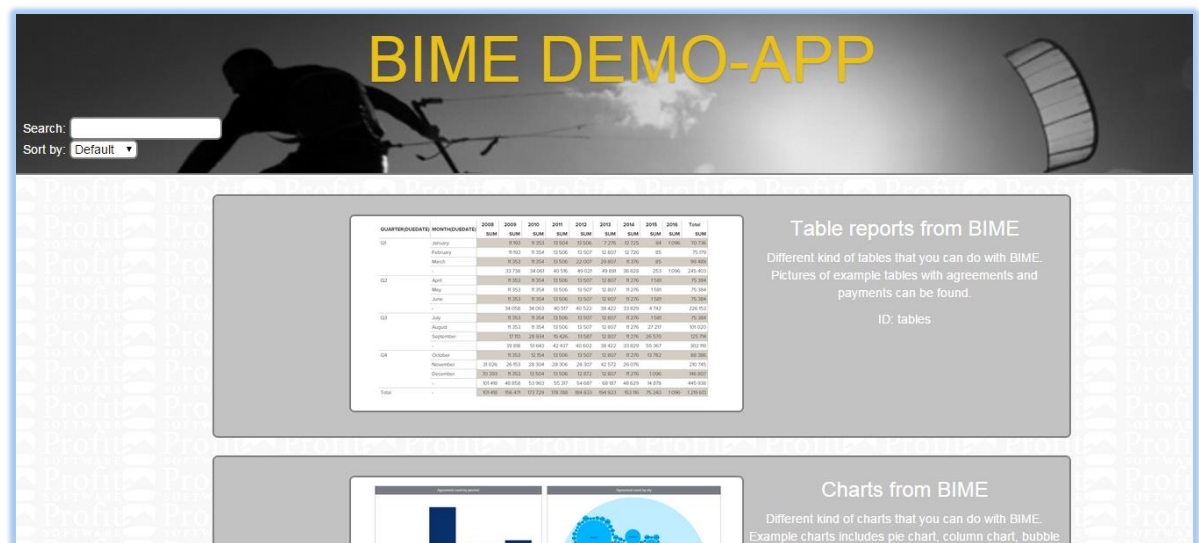

Figure 35.   *Main view of demo-app*

Demo-app was made from AngularJS template project. Usage of template is recommended by AngularJS (2015). Above left there are *"search"* and *"sort by"* fields which can be used to filter the list of pictures. Filtering with *"search"* can be done by writing characters to field next to *"search"* header and filtering with *"sort by"* can be done by choosing the filtering criteria from the drop down list that is defined beforehand. Demo-app's front page has list of pictures and info text about the type it represents. Pictures by themselves are links that opens a view specific to chosen type.

List of pictures is done by template html file (bimeReport-list.html, Code 2) that dynamically creates the webpage based on a JSON file (reports.json, Code 3).

```
<div class="container-fluid">
    <div class="header">
    <h1>BIME demo-app</h1>
    <div class="filters">
    Search: <input ng-model="query">
    <br>
    Sort by:
    <select ng-model="orderProp">
     <option value="order">Default</option>
     <option value="name">Name</option>
     <option value="id">Id</option>
    </select>
    </div>
    </div>
  <div class="thumb_area">
    <ul class="reports">
    <li ng-repeat="report in reports | filter:query | orderBy:orderProp"
      class="thumbnail report-listing">
    <a href="#/reports/{{report.id}}" class="thumb"><img ng-src="{{report.imageUrl}}"></a>
    <h3>{{report.name}}</h3>
    <p>{{report.snippet}}</p>
     <p>ID: {{report.id}}</p>
    </li>
    </ul>
    </div>
</div>
```

Code 2. Template html file, bimeReport-list.html (©Jonna Laine)

```
{
  {
    "order": 0,
    "id": "tables",
    "imageUrl": "img/reports/tables_thumb.png",
    "name": "Table reports from BIME",
    "snippet": "Different kind of tables that you can do with BIME. Pictures of example tables with
agreements and payments can be found."
  },
  {
    "order": 1,
    "id": "charts",
    "imageUrl": "img/reports/charts_thumb.png",
    "name": "Charts from BIME",
    "snippet": "Different kind of charts that you can do with BIME. Example charts includes pie chart,
column chart, bubble chart, gauges and line chart. More charts can be found until 16 chart types."
  },... }
```

Code 3.   Main JSON file, reports.json (©Jonna Laine)

Pictures are links to next html template and modification of it is done with help of picture id and id specific JSON file. Specific picture id is given in the reports.json and when picture link is clicked with mouse then browser opens a new URL created from predefined address and picture id.
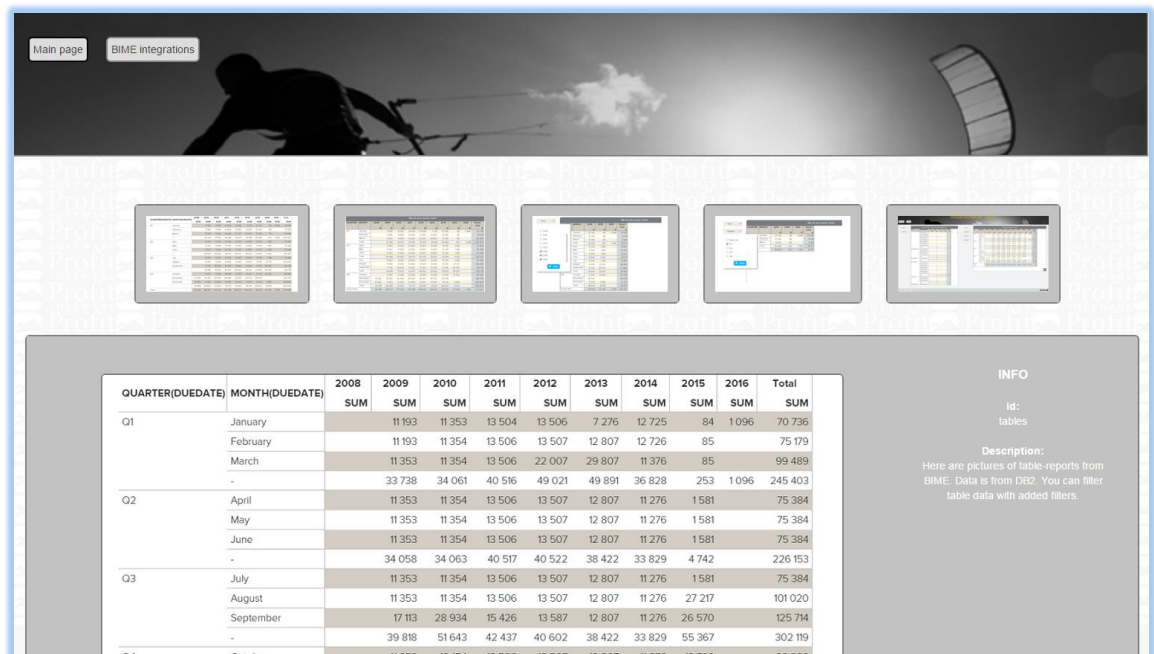
JSON file that creates this id specific view has fields of id, button content, iframeUrl, description and image file addresses. These fields creates dynamic button, description and picture thumbs for the opening view. JSON data of id specific JSON file looks like the example code-snippet in code 4.

```
{
    "id": "charts",
    "button_content":"BIME integrations",

"iframeUrl":"https://profitsoftware.bime.io/dashboard/962201D8B01EB9B1450B6AD18E822D811927F
C9EE4C56DB34F03ACF06E67F21B?access_token=****",
    "desc":"Here are pictures of different charts and also demo dashboard from Profit BIME-account. You
can filter dashboard data with added filters.",
    "images": [
        "img/reports/charts_thumb.png",
        "img/reports/charts.0.png",
        "img/reports/charts.1.png",
        "img/reports/charts.2.png",
        "img/reports/charts.3.png"
    ]
}
```

Code 4.   *Snippet from the JSON-data (©Jonna Laine)*

Dynamically created views are presented in pictures 36-40. Pictures of BIME-reports includes tables (Figure 36), different chart-types (Figure 37), presentations about BI-ME-tools (Figure 38), pictures of integration examples (Figure 39) and reconciliation data (Figure 40).

Figure 36.   *Example pictures of BIME's table reports*

Tables have predefined columns and rows which can present for example financial data. Appearance of tables can be modified with many ways.
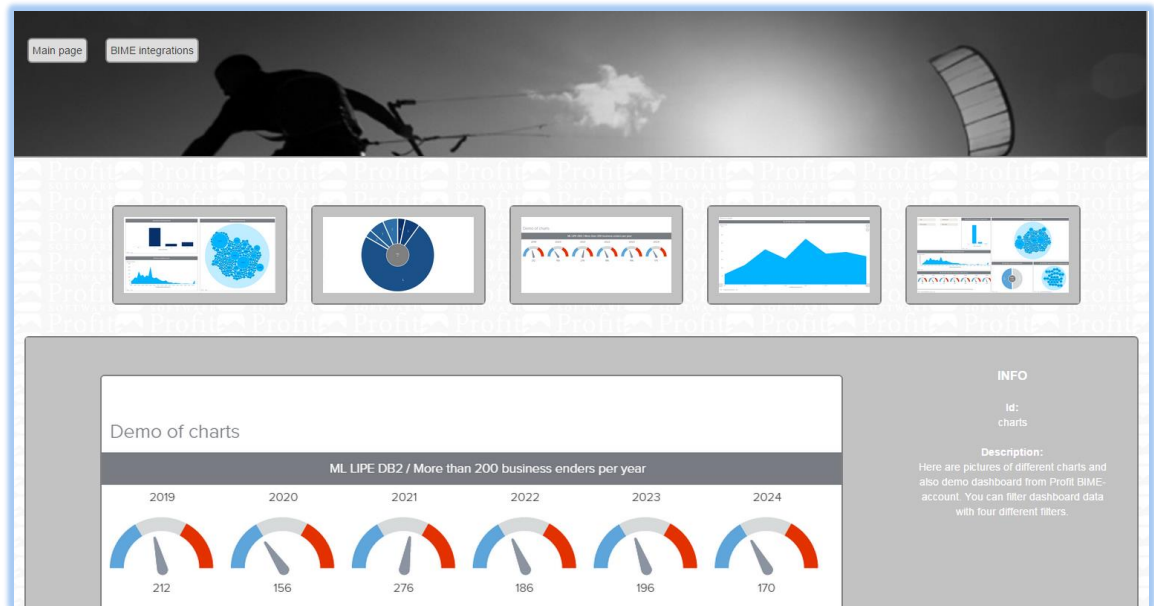
Figure 37. *Example pictures of BIME's charts*

Charts can include gauges, pie charts, bubble charts, line graphs, column charts and bar charts and so on. Appearance of charts can be changed as wished in many ways.
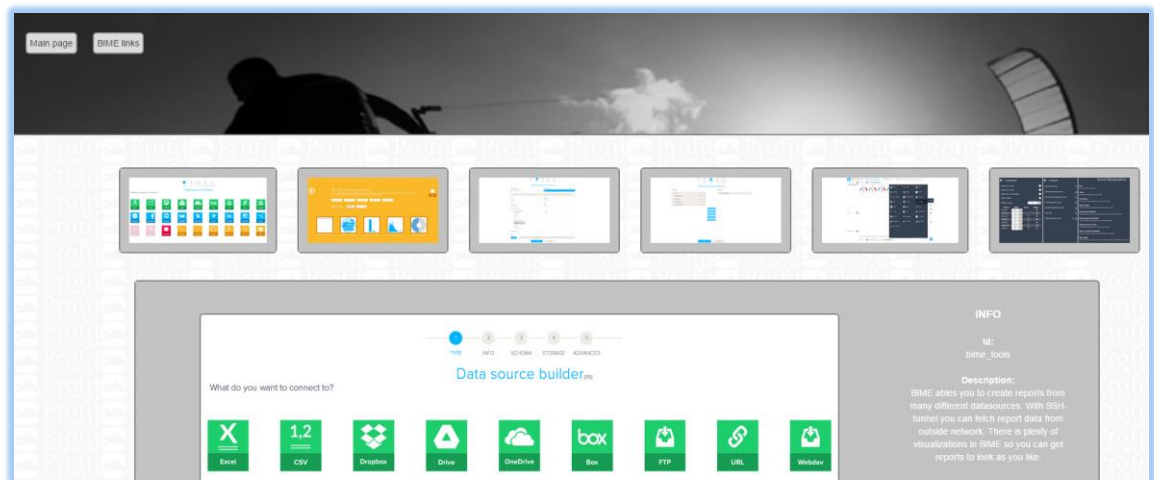
Figure 38. *View that has pictures of BIME tools*

BIME tools are presented in above view. Adding of data source, defining queries to data source and changing of appearance is shown with help of pictures.
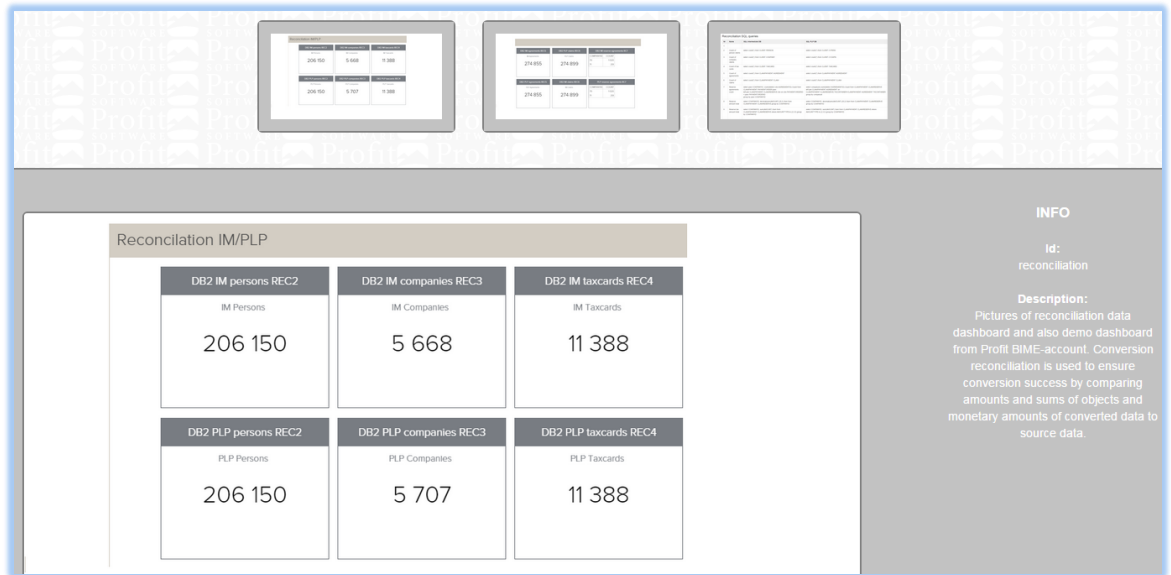
Figure 39. *View that has pictures of reconciliation data reports*

Couple of pictures from reconciliation data are shown in above view and queries from Profit Software's Confluence page is also shown. Queries from Confluence are there to make it easy to see what data does those reports represents.
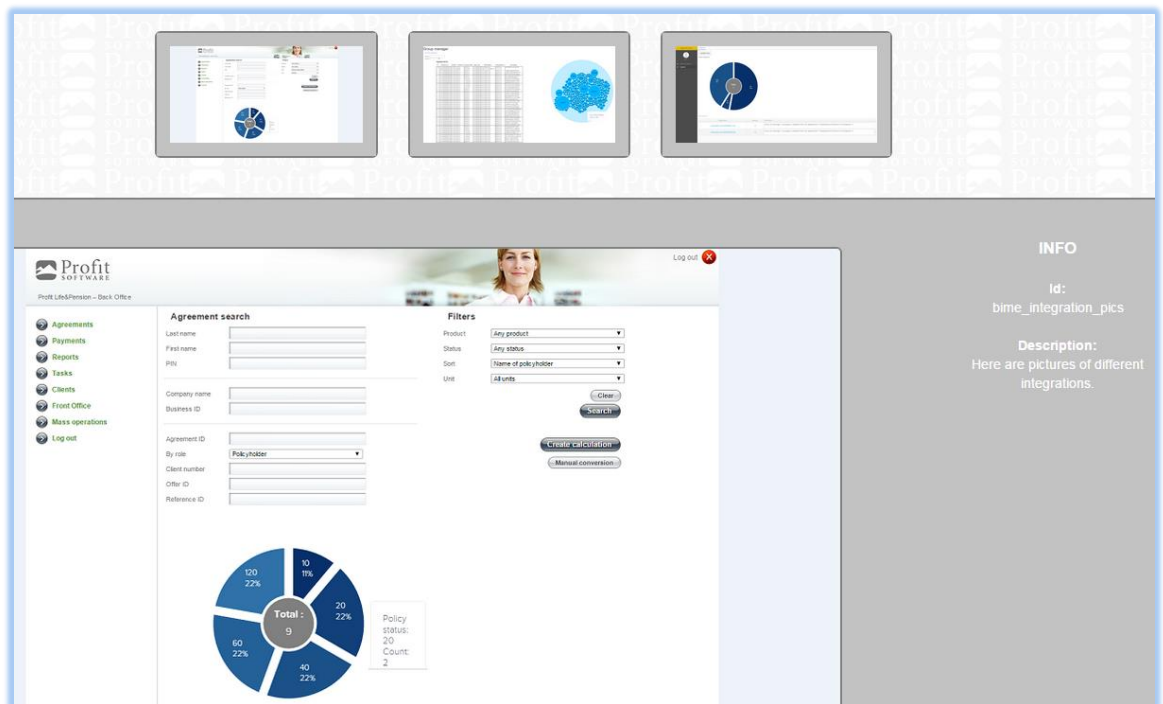
Figure 40. *View that has pictures of integration examples*

Integration examples view has pictures of integration tests that were done during this project. There are pictures from PLP, Group Manager and Migration UI. Applications are presented in the next section.

Some picture id specific views includes also button *"BIME integrations"*. Button takes user to corresponding view that has integrated BIME dashboard either from tables, charts or reconcliation data. Charts integration view presented in Figure 41.
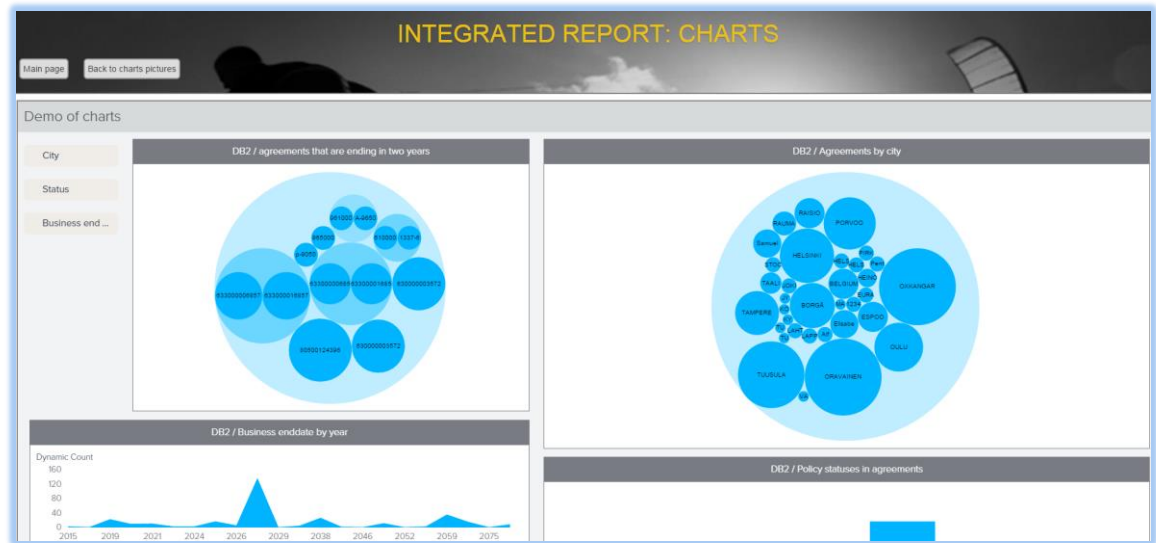
Figure 41.   *Integrated BIME dashboard in demo-app*

Integrated report is added to webpage with help of previously mentioned JSON data field *"iframeUrl"*. Field is again used in url address. In picture id views, that does not include integrated report, there is button *"BIME links"*. Button takes browser to page where are predefined webpage list from the specific view's JSON file.

6.2   BIME report integrations in Profit Software's applications

In this section BIME-report integrations are introduced. BIME-reports can be seamless-ly integrated to any of Profit Software's application. Group Manager is an AngularJS application to view group agreements. Migration UI is a Graphical User Interface (GUI) for conversion prevalidator. It is based on Vaadin framework. PLP is Profit Software's base product where many of the customer applications are based on. It is made with Java and JSP-pages. This project included the phase of testing integrations to above applications. Main idea is the same in every application. Integration style in every ap-plication is specifically introduced next.

6.2.1 Group Manager

With group manager you can browse and add new agreements. Predefined properties of agreements are shown in the applications front view. Application is still under construction and in test usage only. BIME reports are really easy to add to AngularJS-projects html files as an iframe. Styling of an iframe can be done by CSS-file. Example html code can be seen in Code 5 and CSS-code in Code 6.

…\group-manager-ui\app\partials\agreement-list-view.html:
```
 <div id="BIME_iframe">
     <iframe src="https://profitsoftware.bime.io/query/2DD43FC50E9BFB64E5A7E66CFCEF3CC8
     ?access_token=****"
         Browser doesn't support iframes!
       </iframe>
      </div>
```

Code 5.   *Html-file that has BIME report integrated as an iframe (©Jonna Laine)*

…\group-manager-ui\app\css\my-styles.css:
```
#BIME_iframe > iframe {
   padding: 0px;
   border: none;
   width:700px;
   height:550px;
   padding-left: 10%;
}
#BIME_iframe{
   float:left;
   width:50%;
 }
```

Code 6.   *CSS-file that has iframe style settings (©Jonna Laine)*

Code 5 adds the basic structure of html frame to Group Manager. Frame can be added to desired location. When structure of basic code is not known beforehand needed location can be difficult to found. Code 6 sets properties of frame as wished. *"Div id"* creates new division to html page and *"iframe src"* defines the address of BIME query. "*Access token"* is used for user identification. "*Browser doesn't support iframes!"* row is shown automatically if iframes are not supported. CSS file defines the properties of frames size and location. For example "*border:none"* is used to make the page look seamless and "*width"* is in percentage to make the frame get it size compared to browser size.

Picture of BIME bubble chart integrated to Group Manager can be found from Figure 42. Bubble chart is seamless and looks like belonging to main page.
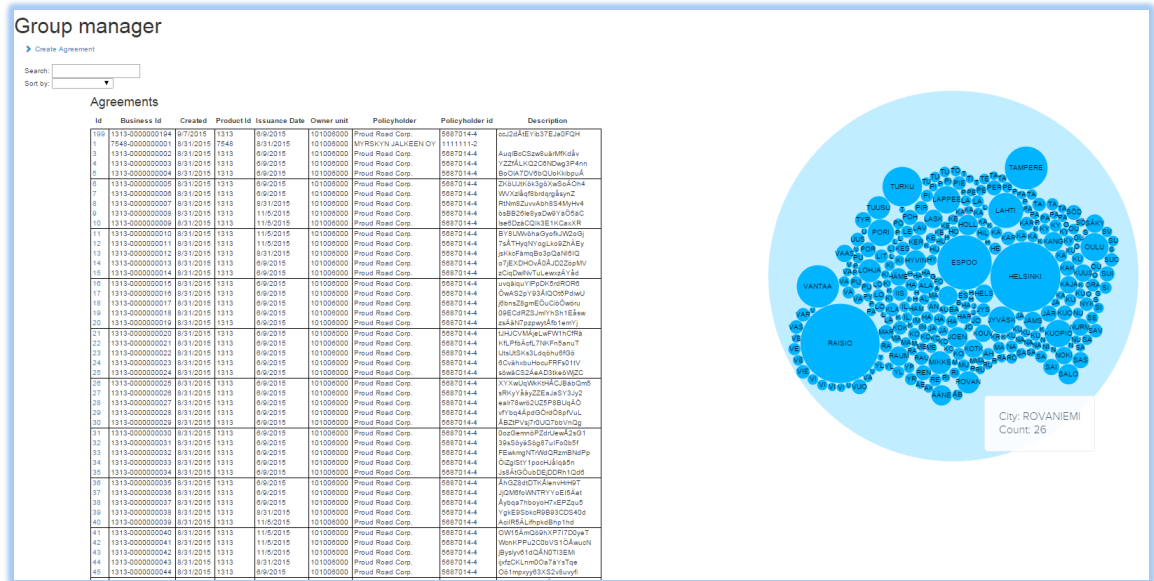

Figure 42.   *Figure of BIME integration in Group Manager*

Integration of Group Manager could have previously mentioned URL parameter in the integration URL. It would make it possible to create for example a report of active agreements this week or ending agreements this year.

6.2.2 Migration UI

Migration UI is a GUI for conversion data pre-validation tool (Prevalidator tool). Prevalidator tool is console based Java-application which have been used successfully in migration projects to validate conversion source data. Migration UI is GUI for Prevalidator tool. Purpose of Migration UI is to be easier to use and to have more attractive appearance and better support for error reporting and data analysis. It would be good idea to start using BIME reports in Migration UI. Adding of BIME reports can be done by Vaadin specific BrowserFrame. Code example can be seen from Code 7.

…\migration-ui\migration-prevalidation-
plugin\src\main\java\com\profitsoftware\migration\prevalidation\plugin\FullReportsTab.java:
```
  BrowserFrame    browser    =    new    BrowserFrame("BIME    integration",new    ExternalRe-
source("https://jonnala.bime.io/query/FAD4F9BA0A049CC92286BB2785169CE8?access_token=c9ffb4
94204f5d08"));
  browser.setWidth("700px");
  browser.setHeight("550px");
  tabLayout.addComponent(browser);
```

Code 7.   *Vaadin Java code that has iframe implementation (©Jonna Laine)*

Vaadin has its specific components which creates JavaScript to front end application. In the Code 7 there is "*BrowserFrame*" which makes html iframe.

Methods *"browser.setWidth"* and *"browser.setHeigh"* defines CSS properties of iframe. Migration UI shows errors that are found from the conversion prevalidation process. Those errors could be shown example in pie chart easily like in Figure 43.
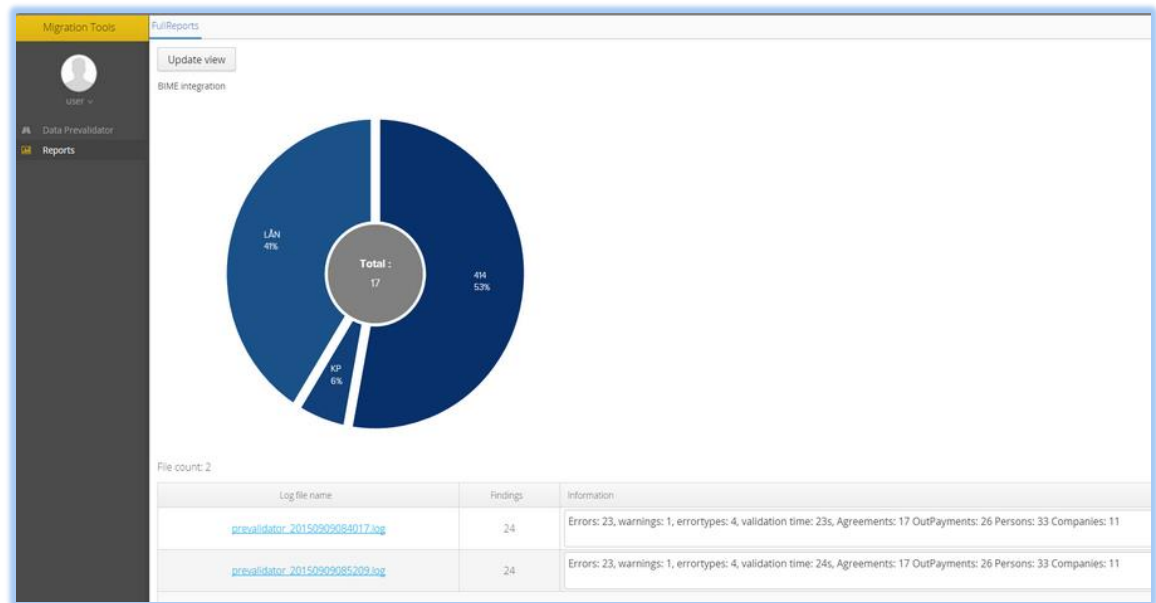
Figure 43. *Pie chart report of BIME integrated to Migration UI*

BIME would make it really easy to implement new reports to Migration UI. Now used reports are done manually by adding data to every report in the java code.

6.2.3 PLP

PLP is a base product for many Profit Software's products. PLP includes policy based insurance agreements in front and back office view, clients and batches. One BIME-report was integrated inside the PLP's back office view. Iframe-tag was added to file AgreementSearch.jsp. Code-example can be found from Code 8.

...\lbo-life-back-office-app\ProfitLifeBackOfficeWeb\src\main\webapp\searchmodule\jsp\AgreementSearch.jsp

```
<div id="BIME_iframe">
    <iframe
    src="https://jonnala.bime.io/query/76699DBF97D2D325DB010A87C0A32027
?access_token=****"
    width="450" height="350" frameborder=0>
    <p>Your browser does not support iframes.</p>
    </iframe></div>
```

Code 8. *Snippet from the code where iframe is added to PLP's view*

Code is similar to the one in Group Manager except the CSS settings are inside the html element. CSS values can be given in URL as parameters.

PLP is a program that would benefit a great deal from BIME kind of reports. Example customer, agreement and payments base can be viewed by pie charts, column charts, bubble charts, time line craft etc. Graphical reports would make it lot easier to see wanted information quickly. Example of iframe element can be found from Figure 44. In the pie chart there is amount of agreements grouped by policy status.
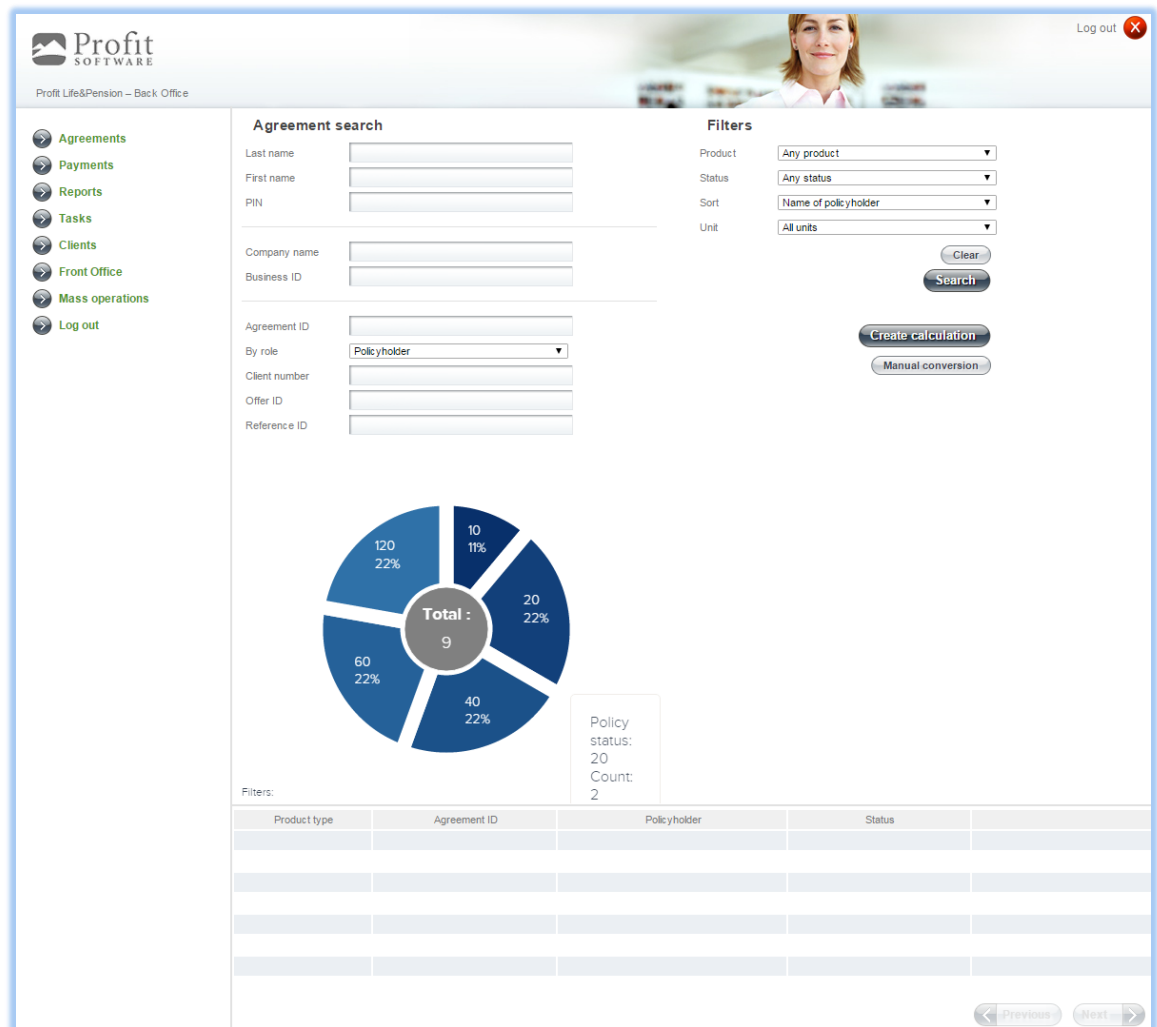

Figure 44. *Example view of PLP that has BIME report integrated to it*

Also in PLP URL parameters would be excellent way to implement integrated reports. Graphs could be shown by selected agreement or client. Also graphs of the week, month, quarter or year would be great to have.

7. CONCLUSIONS

This section reports conclusions from everything that was studied and came across while doing this thesis. Answers that this thesis gives concerning the thesis problems are given. Estimation about viability of BI solution investment for Profit Software is given. Section also includes thoughts about Profit Software's opportunities and threats for investing to chosen BI tool.

The main purpose of this thesis was to get solutions for the thesis problems:

"*What kind of BI tools there are in the market?*"

"*Which BI tool should be used while creating BI integrations?*"

"*Should Profit Software invest to BI tool?*"

First problem was resolved by preliminary study. Study got throw tens of BI tools which are working in the field of BI integration. Phase was executed by searching information from the internet. *Second problem* was resolved by evaluation of BI tools. Evaluation included preliminary study and selection phase for narrowing the number of tools for the actual evaluation phase. Actual evaluation was done with four BI tools. Combined results from the scores that were given during the evaluation are shown in Figure 45.
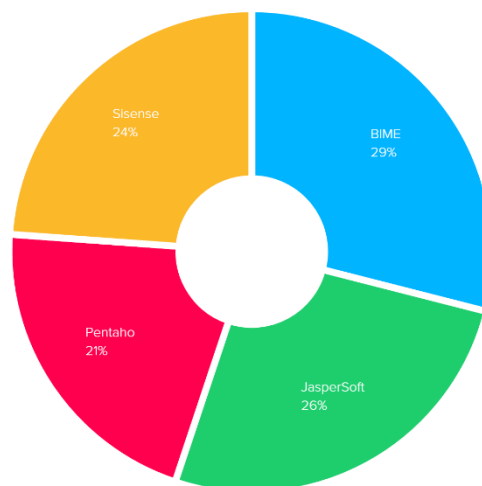

Figure 45. *Grand total of four highest ranked BI tools*

Pie chart is made by combining the scores of four highest ranked BI tools. Scores were first normalized and then added to BIME as an Excel sheet. Pie chart shows that BIME got share of 29% from all the scores.

Highest ranked BI tool was introduced in general and in code level concerning demo application and integration tests. This phase answered the *thesis problem number three.* Introduction phase showed what can be done with BIME and how it helps to make current Profit Software's applications more attractive to customers.

There are two options now concerning proceed of this project. Profit Software can terminate BIME license and continue as before or start as a BIME partner and take advantage of everything BIME has to offer. These two options are valued in SWOT analysis at Table 8.

Table 8.   *SWOT analysis of BIME or noBIME*

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
BIME	Profit can tell Gartner that BI is now added to their product	Profit consumes money until customer who buys BIME is found	More appealing product for customers	Profit cannot get customers to buy BIME
	Profit can use BIME to view data (really useful in migration)	Profit needs to prepare for work related to customers BIME usage	Profit make money by selling BIME licenses (30% of every BIME license)	BIME requires too much workload from Profit
	Profit can show cool new feature to customers			
noBIME	Profit won't spend money	No BI still to Profit products	No investments needed	Profit will totally get off from this trendy train of BI
		All reports made will disappear		
		Profit will miss a good business opportunity		
		All work done in Profit and in BIME has been pointless		

Proceeding with BIME has strengths related to Profit Software's image and internal BIME usage. If BIME was taken for a standard BI tool, it could be presented to Gartner and advertised to customers. By using BIME internally Profit Software would get better view for databases in general and in reconciliation. Weaknesses and threats of proceeding with BIME are related to costs and workload. Profit would pay monthly license until first resale is done. Workload of getting the customers to use BIME is one thing that needs to be taken account.

As there is no certainty about the first resale then it is a threat of being a bigger expense than expected, in license payments and unnecessary work resource. Opportunities in future BIME usage would be more appealing product for customers and profit that is gotten from the resale of BIME licenses.

Termination of BIME license has strengths and opportunities concerning money. If license is terminated, money is saved. Weaknesses of not proceeding with BIME is related the work that is done and loss of good business opportunity. If BIME license is terminated, all reports that are in Profit Software's BIME account will disappear. Also all work that is done to this project has been in vain. Biggest weakness and threat in terminating BIME is missing the good business opportunity and leaving off from this trendy train of BI that is travelling really fast right now.

This project showed that BIME would be a really good partner for Profit Software. If one license could be sold to Profit Software's customers then own license would be free. Profit Software would benefit a lot from BIME reports by itself while doing reconciliation for conversion data and while being able to add BIME reports to its products.

 I strongly recommend Profit Software to start as BIME's partner.

REFERENCES

Affecto (2015), Analytiikka, [www], accessed at: 2.6.2015, available at: http://www.affecto.fi/Ratkaisut/Analytiikka?gclid=Cj0KEQjwvuuqBRDG95yR6 tmfg9oBEiQAjE3RQGvbV5_eHnPdJaq6ms_DXNia0U1sjWLPGl33SZxAH98a AndT8P8HAQ

AngularJS (2015), AngularJS by Google, [www], accessed at: 9.10.2015, available at: https://angularjs.org/

Attido (2015), QlikView - BI työkalujen aatelia, [www], accessed at: 2.6.2015, available at: http://www.attido.com/palvelut-ja-ratkaisut/teknologiat/qlikview/

Aureolis (2015), Tietovarastointi, Business Intelligence, [www], accessed at: 2.6.2015, available at: http://www.aureolis.com/pages/fi/bi-ratkaisut/tietovarastointi-business-intelligence.php

BIME (2015), [www], accessed at: 2.6.2015, available at: https://www.bimeanalytics.com/index.html

BIME LinkedIn (2015), [www], accessed at: 20.9.2015, available at: https://www.linkedin.com/company/bimeanalytics

Devlin, Murphy (1988), an architecture for a business and information system, 1988, p. 80, available at: http://altaplana.com/ibmsj2701G.pdf

Chint (2015), [www], accessed at: 5.10.2015, available at: http://forums.bsdinsight.com/threads/edo-interactive.7273/

Hovi A., Hervonen H., Koistinen H. (2009), Tietovarastot ja business intelligence, Docendo, p. 196

IBM (2015), IBM Cognos Business Intelligence, [www], accessed at: 4.6.2015, available at: http://www-01.ibm.com/software/fi/business-intelligence/

InformationWeek (2015), 10 Cloud Analytics & BI Platforms for Business, [www], accessed at: 19.10.2015, available at: http://www.informationweek.com/cloud/software-as-a-service/10-cloud-analytics-and-bi-platforms-for-business/d/d-id/1318724

JasperSoft (2015a), REPORTING AND ANALYTICS INSIDE YOUR APPLI-
CATION, [www], accessed at: 4.6.2015, available at:
http://www.jaspersoft.com/reporting-and-analytics-inside-your-application

JasperSoft LinkedIn (2015), [www], accessed at: 20.9.2015, available at:
https://www.linkedin.com/company/jaspersoft

Klipfolio (2015), [www], accessed at: 5.10.2015, available at:
http://www.klipfolio.com/resources/articles/what-is-cloud-business-intelligence

Louhia (2015), Ennuste vuodelle 2015: mitä tapahtuu analytiikan ja tietovaraston
saralla, [www], accessed at: 4.6.2015, available at:
http://www.louhia.fi/2015/01/08/ennuste-vuodelle-2015-mita-tapahtuu-
analytiikan-ja-tietovaraston-saralla/

Myers J. (2015), Analytics in the Cloud, An ENTERPRISE MANAGEMENT
ASSOCIATES® (EMA™) End-User Research Report, accessed at: 19.10.2015,
available at: http://research.enterprisemanagement.com/rs/ema/images/EMA-
CloudAnalytics-2015-RR.pdf

Nathanhoeft (2015), Business Intelligence and Other Things I've Learned,
[www], accessed at: 4.6.2015, available at:
http://www.nathanhoeft.com/2012/03/24/couchdb-and-pentaho-data-integration/

Nenit (2015), Understanding Star and Snowflake Schemas, [www], accessed at:
4.6.2015, available at: http://www.nenit.net/articles/sql-server/schemas

Oracle (2015), Oracle BI - Business Intelligence, [www], accessed at: 8.6.2015,
available at: http://www.oracle.com/us/solutions/business-analytics/business-
intelligence/overview/index.html

Pentaho (2015a), A Comprehensive Data Integration and Business Analytics
Platform, [www], accessed at: 8.6.2015, available at: http://www.pentaho.com/

Pentaho (2015b), Pentaho Developer Center, [www], accessed at: 8.6.2015,
available at: https://help.pentaho.com/Documentation/5.4/0R0

Pentaho (2015c), Getting Started, [www], accessed at: 10.6.2015, available at:
http://wiki.pentaho.com/display/EAI/Getting+Started

Pentaho (2015d), Getting Started with PDI, [www], accessed at: 10.6.2015,
available at: http://help.pentaho.com/Documentation/5.4/0J0/0C0

Pentaho LinkedIn (2015), [www], accessed at: 20.9.2015, available at:
https://www.linkedin.com/company/pentaho

Power (2015), [www], accessed at: 10.6.2015, available at:
https://powerbi.microsoft.com/

Quora (2015), How do Jasper and Pentaho compare as business intelligence solutions, [www], accessed at: 10.6.2015, available at: http://www.quora.com/How-do-Jasper-and-Pentaho-compare-as-business-intelligence-solutions

Rasmussen, Goldy, Solli (2002), Financial Business Intelligence: Trends, Technology, Software Selection, and Implementation, p. 283, available at:
http://library.books24x7.com.libproxy.tut.fi/toc.aspx?bookid=3766

SAP   (2015), [www], accessed at: 11.6.2015, available at:
https://www.sap.com/finland/solution/sme/software/analytics/edge-medium-bi/index.html

Sas   (2015), [www], accessed at: 11.6.2015, available at:
http://www.sas.com/fi_fi/software/business-intelligence.html

Sisense (2015a), Sisense-product-overview, [www], accessed at: 11.6.2015, available at: http://www.sisense.com/

Sisense (2015b), 4 Steps to Successfully Evaluating Business Analytics Software, [www], accessed at: 11.6.2015, available at: http://www.sisense.com/

Sisense LinkedIn (2015), [www], accessed at: 20.9.2015, available at:
https://www.linkedin.com/company/sisense

Tableau   (2015), [www], accessed at: 16.6.2015, available at:
https://www.tableau.com/products/online

Trackerbird (2015), [www], accessed at: 16.6.2015, available at:
http://www.trackerbird.com/

Visma (2015), Liiketoimintatiedon ja BI:n hyödyntäminen pk-yrityksissä, [www], accessed at: 16.6.2015, available at: http://www.visma.fi/Tietopankki/opas/liiketoimintatiedon-ja-bin-hyodyntaminen-pk-yrityksissa/?gclid=Cj0KEQjwvuuqBRDG95yR6tmfg9oBEiQAjE3RQDQbdlrtUQrs2RKTTGGleWwopqkaWaUNC7lSFpm0tCEaAuOP8P8HAQ

Wikipedia (2015), JSON, [www], accessed at: 8.10.2015, available at:
https://en.wikipedia.org/wiki/JSON

YellowFin   (2015), [www], accessed at: 16.6.2015, available at: http://www.yellowfinbi.com/YFWebsite-Embedded-Business-Intelligence-and-Cloud-Analytics-77979

Yurbi (2015), [www], accessed at: 17.6.2015, available at: https://www.yurbi.com/

Zoho (2015), [www], accessed at: 17.6.2015, available at: https://www.zoho.com/reports/moving-data-from-in-house-database.html