

2014•2015
FACULTY OF BUSINESS ECONOMICS
Master of Management

Master's thesis

The Comparison of QlikView and Tableau: A Theoretical Approach Combined
with Practical Experiences

Promotor :
Prof. dr. Koenraad VANHOOF

Xiang Li

*Thesis presented in fulfillment of the requirements for the degree of Master of
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Abstract

QlikView and Tableau are BI (Business Intelligence) software which both are used to transform raw data into meaningful and useful information for business analysis purposes. QlikView and Tableau facilitate users to create intuitive graphics, dashboard and reports in a simple and fast way with drag-and-drop techniques. Their innovative technology and ease-of-use feature have made them very successful on the competitive BI market. They are considered as competitors to each other especially regarding their data visualization platforms. There are considerable similarities regarding capabilities/functionality between them. However, they are fundamentally different from each other regarding key technologies, the power of analytics, user experiences, enterprise scalability and pricing models etcetera. This paper intends to make a comparison of QlikView and Tableau with a theoretical approach combined with practical experiences and derive relevant insights from the in-depth comparison. The purpose is to contribute useful knowledge to people who are interested in BI software and to provide important insights for buyers selecting suitable BI software to meet their business needs.

Keywords: Business Intelligence (BI), Business Intelligence Systems, QlikView, Tableau, Data Visualization, In-Memory Technology, Self-Service BI, Associative Technology, Graphical User Interface

TABLE OF CONTENTS

CHAPTER 1 BUSINESS INTELLIGENCE	3
SECTION 1.1 BRIEF INTRODUCTIONS OF BI.....	3
SECTION 1.2 BI ENABLED DECISION MAKING PROCESS	5
SECTION 1.3 BI SYSTEM ADVANCEMENT.....	6
SECTION 1.4 MAIN BI FEATURES.....	7
SECTION 1.5 BI MARKET LANDSCAPE.....	9
<i>SUBSECTION 1.5.1 QLIKVIEW AND TABLEAU'S MARKET POSITION</i>	10
SECTION 1.6 RESEARCH OBJECTIVES.....	13
SECTION 1.7 RESEARCH METHODOLOGY	13
CHAPTER 2 QLIKVIEW AND TABLEAU INTRODUCTION	15
SECTION 2.1 QLIK COMPANY	15
SECTION 2.2 QLIK PRODUCT SUITE.....	16
SECTION 2.3 TABLEAU COMPANY	18
SECTION 2.4 TABLEAU PRODUCT SUITE.....	19
SECTION 2.5 QLIK AND TABLEAU COMPANY OVERVIEW.....	20
SECTION 2.6 QLIKVIEW AND TABLEAU PRODUCT SUITE OVERVIEW	20
CHAPTER 3 COMPARISONS BETWEEN QLIKVIEW AND TABLEAU	23
SECTION 3.1 THE STRUCTURE OF QLIKVIEW AND TABLEAU PRODUCT SUITE	23
SECTION 3.2 DATA INTEGRATION.....	23
SECTION 3.3 DATA INTEGRATION CAPABILITIES OF QLIKVIEW AND TABLEAU.....	25
SECTION 3.4 HARDWARE SPECIFICATION OF TABLEAU AND QLIKVIEW	25
SECTION 3.5 COMPARING THE BI TECHNOLOGY OF TABLEAU AND QLIKVIEW	27
<i>SUBSECTION 3.5.1 DISK-BASED BI OF TABLEAU</i>	28
<i>SUBSECTION 3.5.2 THE IN-MEMORY ASSOCIATIVE TECHNOLOGY OF QLIKVIEW</i>	28
<i>SUBSECTION 3.5.3 WHICH TECHNOLOGY SHOULD BE PREFERRED?</i>	29
SECTION 3.6 OPERATION OF THE SOFTWARE.....	30
<i>SUBSECTION 3.6.1 DOCUMENTATION</i>	30
<i>SUBSECTION 3.6.2 IMPORTING AND LOADING DATA</i>	31
<i>SUBSECTION 3.6.3 GRAPHICAL USER INTEREACE</i>	33
<i>SUBSECTION 3.6.4 VISUALIZATION TOOLS: TABLES AND CHARTS</i>	35
<i>SUBSECTION 3.6.5 MAPPING</i>	36
<i>SUBSECTION 3.6.6 TREND LINES, STATISTICS AND FORECASTING</i>	37
<i>SUBSECTION 3.6.7 DASHBOARDS</i>	38
<i>SUBSECTION 3.6.8 PUBLISHING AND SHARING</i>	40
<i>SUBSECTION 3.6.9 ACQUISITION, MAINTENANCE AND SUPPORT COSTS</i>	41
CHAPTER 4 CONCLUSION	49
REFERENCES	53

The Comparison of QlikView and Tableau: A Theoretical Approach Combined With Practical Experiences

Chapter 1 Business Intelligence (BI)

1.1 Brief Introductions of BI

The first appearance of the term Business intelligence can be traced back to 1865, when Richard Millar Devens used the very first term business intelligence in his work “Cyclopedia of Commercial and Business Anecdotes”. In this work, he described how a banker named Sir Henry Furnese gained profit by collecting information and applying it to business action prior to his competitors. Even nowadays, the ability of collecting information and responding on it is still the essentiality of business intelligence.

Although the term of business intelligence was introduced so early, the technology has not been advanced that far to couple with the concept of business intelligence until 1958 Hans Peter Luhn, a scientist at IBM officially established the theory of business intelligence by a paper titled *A Business Intelligence System*. In this article he employed the definition of intelligence from Webster’s dictionary: “the ability to apprehend the interrelationships of presented facts in such a way as to guide action towards a desired goal.”¹ He described a business intelligence system as “an automatic system... developed to disseminate information to the various sections of any industrial, scientific, or government organization (Heinze, 2014). He also addressed in the article the objective of the system as “to supply suitable information to support specific activities carried out by individual, groups, departments, divisions, or even larger units.” (Grimes, 2008) As he introduced the core concept of business intelligence and envisioned the business intelligence system even before business operation was computerized, he is regarded as the father of business intelligence.

The modern definition of business intelligence was introduced in late 1980’s. In 1989, Gartner analyst Harwad Dresner proposed business intelligence as an umbrella term “concepts and methods to improve business decision making by using fact-based support systems.”² The usage of this concept of BI has not been widely spread until the late 1990’s.

There are various explanations or definitions regarding BI either in the literature world or in the business domain. BI is referred to as an organized and systematic process by which organizations acquire, analyze, and disseminate information from both internal and external information

¹ http://en.wikipedia.org/wiki/Business_intelligence

² http://en.wikipedia.org/wiki/Business_intelligence

sources significant for their business activities and for decision making (Lönqvist & Pirttimäki, 2006). The BI term has also been regarded as a specific purpose for data-driven decision support system (DSS). A business intelligence system is a data-driven DSS that mainly supports querying of a historical database and production of periodic summary report (Power, 2008). By improving the company's capacity to structure a large volume of information and making it accessible, BI systems have the potential to maximize the use of information, therefore creating competitive advantage (Davenport, 2006). BI was also considered as a process by which data from both internal and external sources was gathered and analyzed in order to generate relevant information (Lucevich & Misner, 2002).

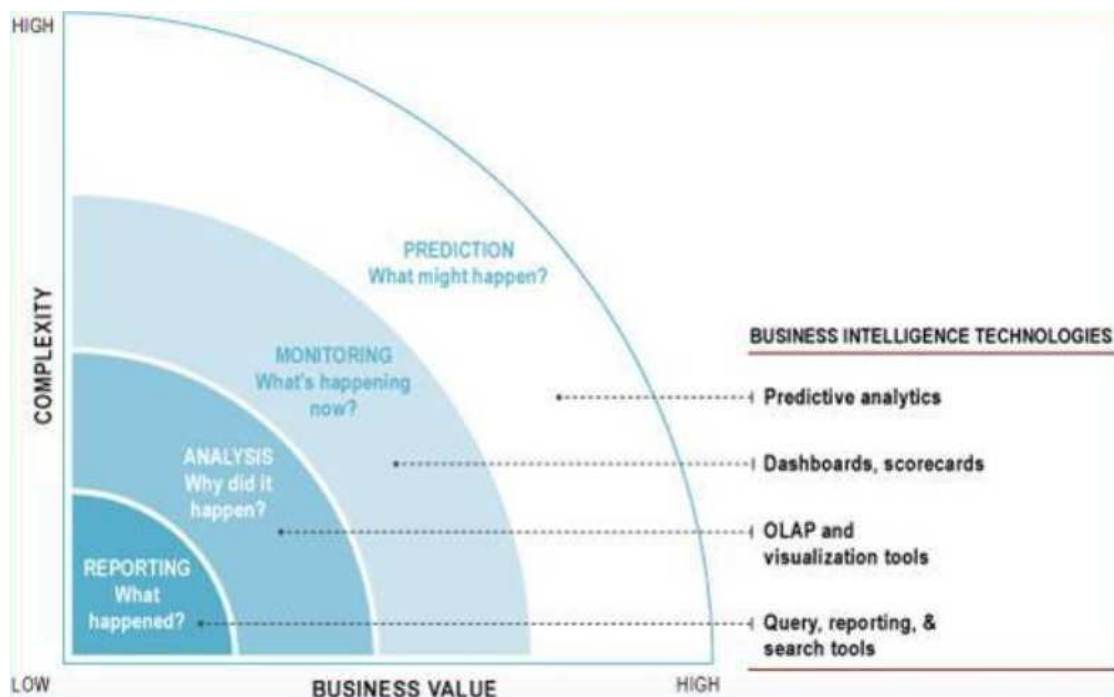
Although there are various versions of BI definition laying eyes on different perspectives in literature field, the core of BI is fundamentally the same. BI is assumed to be set of tools or technologies that transform raw data into information or knowledge, as a result it helps managers to identify, develop or create new strategic business opportunities. Forrester Research defined BI as "A set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic, tactical, and operational insights and decision-making." According to Gartner Group, BI is an umbrella term that includes the applications, infrastructure and tools, and best practices that enable access to and analysis of information to improve and optimize decisions and performance³.

Nowadays, BI is widely acknowledged that it provides direct access to business users with insightful information generated from data in real-time so that competitive advantage can be created if insights are being used appropriately. The purpose of BI is to give business decision makers well-informed information over organization's operations, for example, trends in the market place, sales performance, product distribution, geographical consumers' behavior, relationships between various factors, correlations etcetera. The benefits derived from BI are multi-faceted such as identify profitable customers, discover the best-sold product, which service is mostly profitable, what type of customer is least loyal, detect deceiving behavior and forecast the market trends etcetera (Ranjan, 2005). All in all, the value of BI to business is supposed to be positive if being used appropriately.

Another way to look at BI is the questions being asked and answered. See the model below:

Figure1. BI Derived Different Level of Business Value

³ http://en.wikipedia.org/wiki/Business_intelligence



Source: *Practicalanalytics.com* (April 24, 2011)

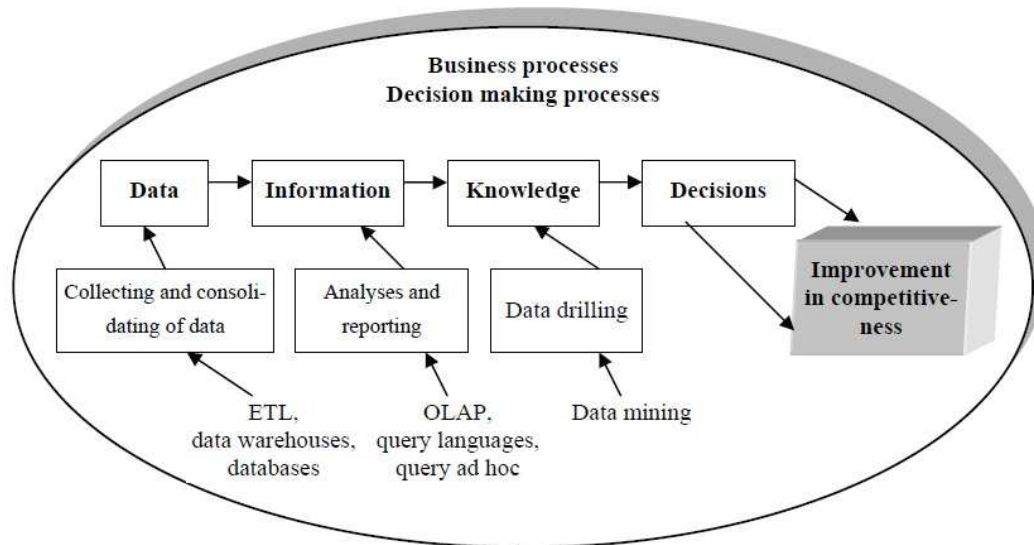
This model indicates that BI tools enable higher level of business value by providing advanced analytics: predictive analytics⁴. The modern organizations have realized that knowing the past and present insights and trend information is not enough to stay competitive on the market. They would like to be able to predict the future trends, patterns and customers' behavior beforehand so that they could make even better business decisions. To meet with this demand, many BI vendors have developed and incorporated predictive analytics tools into their BI solutions, for example, SAS and IBM. Tableau and QlikView are also one of the BI vendors who offer the capability of predictive analytics, which will be discussed later in more details.

1.2 BI Enabled Decision Making Process

BI systems are assumed to be a set of tools that are used for transforming data into information and knowledge and by which an environment is created for making effective, tactic and strategic decisions. BI systems provide a complete view of business operations by analyzing historical and current data and making prediction. Common functions like reporting, online analytical processing, analytics, data mining, process mining, complex event processing, business performance management, benchmarking, text mining, predictive analytics and prescriptive analytics are usually included in BI technologies.

⁴ Predictive analytics: Predictive analytics is a form of business intelligence (BI) that uncovers relationships and patterns within large volumes of data that can be used to predict future behavior and events. (Eckerson, 2014)

Figure2. BI enabled decision making processes



Source: (Olszak & Ziemia, 2007)

This figure shows the roadmap of BI enabled decision making process. It indicates that some essential components for BI software such as ETL⁵, Data Warehouse, OLAP⁶ and Data Mining should be embedded in the BI system in order to manipulate the datasets and to transform data into useful knowledge. One thing worth to know that not all BI solutions incorporate ETL and OLAP tools into their BI systems.

1.3 BI Systems Advancement

In modern business context, enterprises need BI more urgent than ever with strong desire to achieve competitive advantages and outmaneuver their competitors as they face a complex and ever challenging environment (Sawka, 1996). In the late 1990's and early 2000's, dozens of BI vendors already came to the market serving for the enterprises' needs. During that period, although many BI tools provided comprehensive capabilities regarding producing and analyzing data, creating report and data visualizations, there were two issues that still remain obstacles for BI system technology. One issue is that: BI tools are such complex that only skillful IT experts could operate the system. It would take quite an intensive and long-time training for business users to grasp the skills of using BI tools. The other issue was that the ability of integrating various data source was limited. It took more time to prepare data for analysis and report. This situation has been changed in the last decade as BI vendors have strived to put the feature of "ease-of-use" into practice so that business users can operate the software without heavily relying on the aid/involvement of IT experts. As the competition in the marketplace of BI hits up and

⁵ ETL stands for "Extract, Transform and Load, which is a database procedure to read structured or unstructured data from one or more data sources, to convert the extracted data from one format or type to another, and to write the transformed data to a target database. (http://en.wikipedia.org/wiki/Extract_transform_load)

⁶ OLAP (**Online Analytical Processing**): OLAP tools enable users to analyze multidimensional data interactively from multiple perspectives. (http://en.wikipedia.org/wiki/Online_analytical_processing)

the computer hardware and software is maturing, the technology benchmark has also been lifted up to a new level. Not only the feature of ease-of-use has been addressed and put into practice, but also the time to do data integration, data analysis and reporting is significantly shortened. Furthermore, the real-time data analysis capability is also introduced into system to react to the fast changing business needs. Other technologies such as self-service BI, data visualization and cloud-based programs are also embedded in the system by some BI vendors.

1.4 Main BI Features

To empower the business decision making, BI needs to contain a set of features or technologies to fulfill the business needs. Nowadays BI vendors in the marketplace offer a wide range of solutions in all sizes and shapes with variations such as core technologies, costs and business models. Disregarding the varieties of BI products on the market, there are a few must-have features that a good BI tool should not be missing:

- Extract data from a wide range of data sources

Business dataset can come from internal and external sources, very often these data sources are in different formats. And as the new type of database is coming to the market at an increasing rate, it becomes very essential for a BI solution to provide connectivity to a wide range data sources and capability to pull data from all sorts of data sources.

Databases that modern BI software should support



- Real- time data

As businesses operate in a fast-changing environment, data sets can be quickly updated and changed. If BI software delivers old data, it could hinder users to make decision and therefore limit the advantage from BI.

- Self-service capabilities

The traditional BI systems was designed with such technical complex that only IT department controlled the reporting and BI capabilities. Nowadays, some standing-out BI

vendors offer self-service BI capabilities, which enable the end user to create their own BI applications and BI reporting without relying much on IT department.

- Mobile support

Modern BI software must be easily adapted to multiple devices such as Tablet and Smartphone. As the trends develop, more and more people use mobile devices to do their work interact with colleagues, it becomes more and more vital for BI to provide the accordingly programs to run on these multiple devices.

- Ad hoc reporting

It allows users to create and distribute reports on the fly. It enables therefore the convenience of running the reports no matter where and when they need them.

- Executive dashboards

An executive dashboards are BI applications which shows the real-time of business operation with multiple and intuitive graphs.

Figure 3. QlikView Dashboard



Source: www.qlik.com

- Interactive analysis and reporting

Interactive capability allows users to view their data in any possible way. It provides users with certain power (access to view the data, own analysis), flexibilities and ease-of-use.

- Multi-dimensional analysis (OLAP tools enables)
- Advanced analytics

It refers to data mining, forecasting or making predictions. This helps users to make tactical and strategic decisions.

1.5 BI Market Landscape

BI market has experienced an explosive growth in the past decades, not only the number of products but also the services offered. The facts such as proliferation of data both from internal and external, e-business growth, declining cost for acquiring large amount of data, query logs for websites etcetera contribute to this rapid growth. Companies that have deployed Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM) and other application are having tons of data stored to be analyzed. In addition, as more and more enterprises realize the importance of making targeted, data-driven business decision, the growing trend of BI will continue.

According to Gartner report, the software market for BI, analytics and corporate performance management grew by 16.4% in 2011 to 12.2 billion in 2012 and 14.1 in 2013 (Gartner, 2014). The table below shows the market size of BI.

Table 1. Top 5 BI, CPM and Analytic Applications/Performance Management Vendors, Worldwide, 2011-2012 (Millions of Dollars)

Company	2012 Revenue	2012 Market Share (%)	2011 Revenue	2011-2012 Growth (%)
SAP	2,902.5	22.1	2,884.0	0.6
Oracle	1,952.1	14.9	1,913.5	2.0
IBM	1,625.6	12.4	1,478.8	9.9
SAS	1,599.7	12.2	1,542.9	3.7
Microsoft	1,189.3	9.1	1,059.9	12.2
Others	3,861.90	29.3	3,416.00	13.0
Total	13,131.1	100.0	12,295.1	6.8

Source: Gartner (June 2013)

According to Gartner, SAP, Oracle, IBM, SAS and Microsoft are the major BI vendors on the market. There are also many other BI vendors which together account for about 30% of the market share. Other BI vendors such as Birst, Board, Epicor, Domo, Infor, IQMS, Pentaho, QlikView, Sisense, Tableau, WebFORCUS and Yellowfin etcetera are also competing against each other.

BI market is quite competitive and dynamic as well. A good percentage of emerging BI vendors have seen the great potentials of data visionary and business discovery meeting the need of demanding business users and entered the market in recent years, for example, Panorama software and Alteryx. The large number of BI vendors is earning a place on a niche market with specialized strength against the domination of the largest vendors (Gartner 2014).

In recent years, data visualization tools and analytic applications are receiving more and more attentions and proliferating in business units. In-memory and Mobile BI are fast-growing categories for BI solutions. BI vendors are improving and developing their products and services continuously in order to stand out on the market, which as a result will benefit the business users with more capabilities and advanced functionalities becoming available.

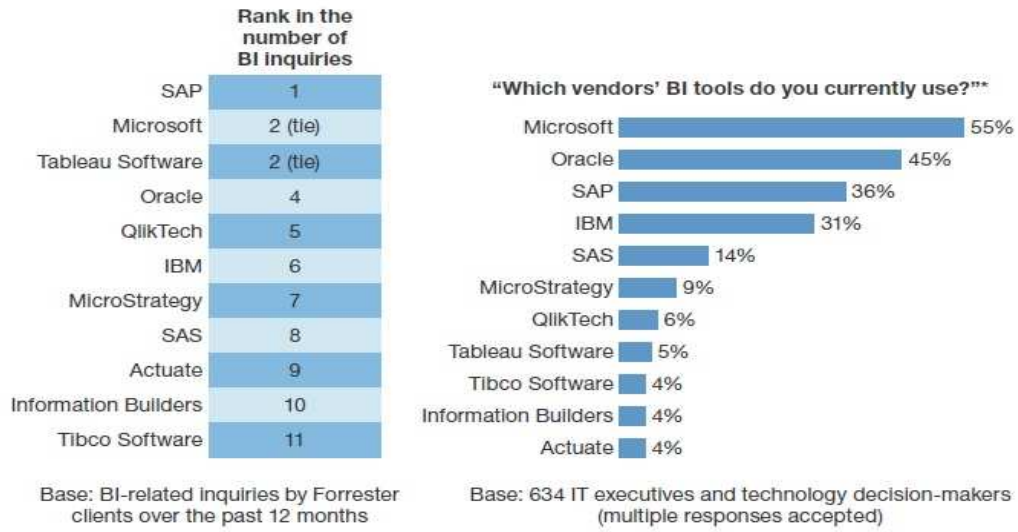
The survey of Gartner has showed that data discovery platform and ease of use are the major purchasing criterion for BI solutions. Gartner's survey also suggests that companies would like to scale up the BI deployment which is featured with data discovery capability. Although Qlik, Tableau and Tibco have the data discovery platform in place, they lack the enterprise features associated with governance, administration and scalability. QlikView's new release (QlikSense) in the second half of 2014 is said to be enterprise-ready version of its platform. In the meantime, Tableau and Tibco (Spotfire) continue to focus on business users and are also adding incrementally enterprise features with each new release.

BI market is still in the middle of significant shift. New vendors are entering the market; buyers' concerns are also on the change, given these dynamics it is suggested that buyers should not assume that only BI leaders have the ability to deliver successful BI solutions. They should take other factors into account such as the visions of BI vendor, the ability of execute when evaluating vendors as a long-term consideration.

1.5.1 QlikView and Tableau's Market Position

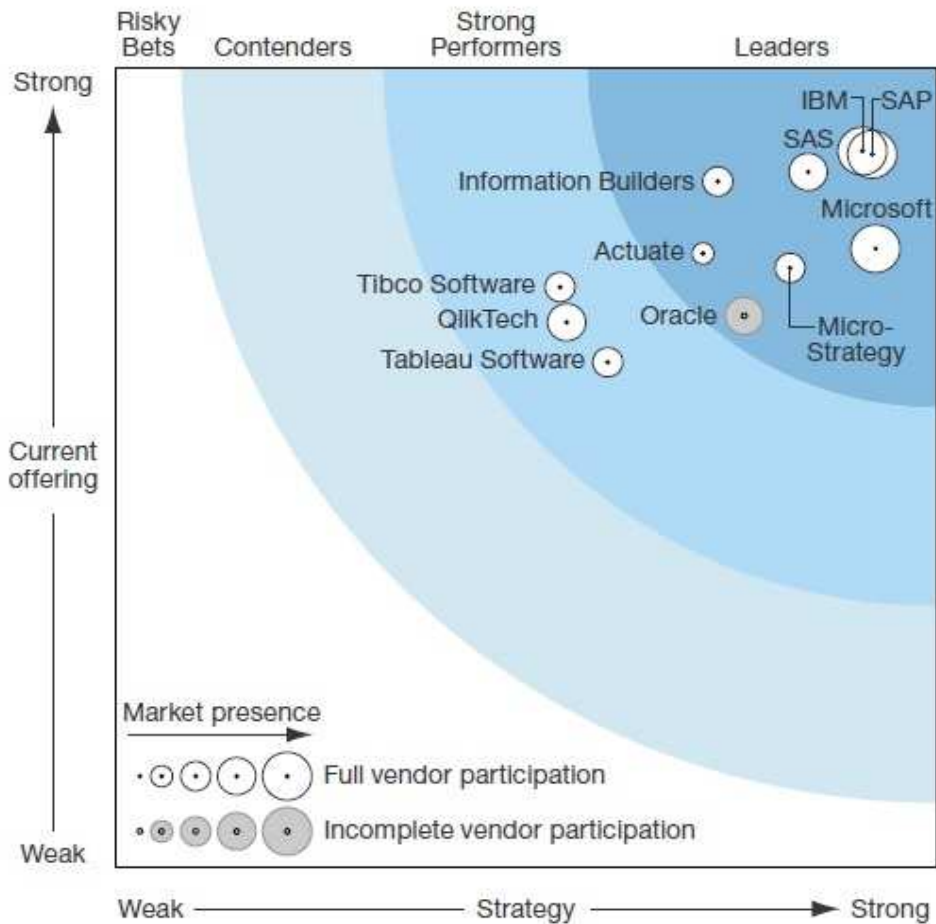
QlikView and Tableau's are riding the wave of trend, providing solutions that include the most appealing technologies which contribute to their fast and tremendous growth in recent years. Their self-service, highly intuitive features are oriented towards business users, providing significant improvement of ease of use, are therefore becoming appreciated by more and more users. Both of them offer above-average graphic manipulation and interactive analysis tools (Gartner 2014). However, their products are differentiated from each other regarding some criteria such as the key technologies, scalability, system requirement, costs etcetera which will be discussed later in this paper in more details. As Forrester research shows, QlikView and Tableau rank among the top five vendors mentioned in the BI-related inquiries that Forrester fielded in 2013. See the figures below.

Figure 4. How organizations use and inquire about leading BI vendors



Source: Forrester Research 2012

Figure 5. Enterprise Business Intelligence Platforms Q4 2013



Source: Forrester Research 2013

Garner has conducted BI related survey and evaluated the major BI vendors based on two criteria: the ability to execute⁷ and the completeness of vision⁸. See the **figure 6** below.

Figure 6. Magic Quadrant for Business Intelligence and Analytics Platforms



Source: Gartner 2014

⁷ The ability to execute criteria are: **Product/Service** (How competitive and successful are the goods and services offered by the vendor in this market, and how extensively are they used?); **Overall Viability** (What is the likelihood of the vendor continuing to invest in products and services for its customers?); **Sales Execution/Pricing** (Does the vendor provide cost-effective licensing and maintenance options?); **Market Responsiveness and Track Record** (Can the vendor respond to changes in market direction as customer requirements evolve?); **Customer Experience** (How well does the vendor support its customers? How trouble-free is the software?)

⁸ Regarding the completeness of vision, vendors are rated on their understanding of how market forces can be exploited to create value for customers and opportunity for themselves.

Seeing from the Gartner's research result, Tableau and Qlik were positioned at the top of the quadrant in terms of criteria of ability to execute and completeness of vision. Although they are not market leader at this moment, their innovative approaches surely gain customers' attentions. Because of their incredible growth and innovative BI technologies, both of them are considered to be BI leaders and meanwhile competitors to each other on the market by major research organizations.

1.6 Research Objectives

As we have known from the research result of Forrester Research and Gartner, Tableau and QlikView are both strong performers among many other vendors on the quite competitive market. Customers' interests in them are considerably high comparing to other BI vendors, as they are among a few BI vendors who provide data discovery platforms and great ease-of-use features, which fall into the categories of business users' demands. Both of them are on the rise according to Gartner report and it also suggests that in the coming years more organizations are intending to deploy QlikView or Tableau. Despite some similarities in general sense regarding data visualization, interactive analytics, self-service, extensive graphic choices, quick applications making and ease-of-use capabilities, QlikView and Tableau do differ from each other fundamentally and they are unique on some approaches and suitable for different types of applications.

What contributes to the great success of Tableau and QlikView on this very competitive market? What are the key technologies by both of them? How are they differentiated from each other? What does each of them excel in? This paper tried to answer these questions by evaluating and comparing QlikView and Tableau regarding multi-criteria. The research findings of this paper can help buyers who are interested in QlikView and Tableau to gain more knowledge/insights and consequently help buyers to find suitable and appropriate BI solution to meet their specific business needs.

1.7 Research Methodology

This paper compares QlikView and Tableau with theoretical approaches and some empirical experiences. The theoretical knowledge is based mostly on published books (please see the reference list) and white papers published by Qlik and Tableau. Empirical knowledge is gained by using QlikView and Tableau software. Due to the time limitation, it is impossible to make a comparison of all aspects. In addition, becoming a master of QlikView and Tableau requires years-long practices and extensive IT skills (especially for QlikView). Despite these obstacles, I have made in-depth comparisons regarding the most important aspects including key BI technology, software operation, graphical user interface, data visualization capabilities, and costs etcetera. The QlikView and Tableau software discussed in this paper are respectively their latest version: QlikView 11.2 and Tableau 8.3.

Chapter 2 QlikView and Tableau Introduction

2.1 Qlik Company

Qlik (previously known as QlikTech), was founded in Lund, Sweden in 1993 and is headquartered in Radnor, Pennsylvania in USA. QlikView is its flagship product. QlikView enables organization of any size to drive the value from their data to make well-informed decisions that in turn will improve business outcomes. Qlik's initial vision was to create a completely new kind of software, which imitates how man's brain works to make the users experiences as much intuitive as possible. The PC based desktop tool was initially named QuikView. "Quik" stood for "Quality, understanding, interaction, knowledge." In 1996, the application was renamed QlikView to emphasize its capability to supply users with extraordinarily detailed data analysis by just a single click.

Qlik has experienced a remarkable success of fast growing. The number of employees grew from 35 employees in 1999 to 1,900 in 2014. It has up to now a customer base of 33,000 companies spreading in 100 countries⁹.

QlikView was designed to generate business insights by accessing information from standard database applications such as Excel, CRM, ERP, ORACLE SAP, URL etcetera. Since 2000, Qlik has turned its focus on providing Business intelligence (BI) products, as they believed that BI technologies on the market did not match up with the business needs. Qlik decided to dedicate its technology development to business performance management and intelligence solutions for interactive data analysis with a determined focus on ease of use and deployment. This business shift has enabled Qlik a fast expansion and led to an exceptional growth in the following years. In 2004, QlikTech secured \$12.5 million in venture capital funding from Accel Partners and JVP¹⁰. Meanwhile, QlikTech took its R&D to a new level and increased exceptionally the products' functionality, usability and scalability. By 2005, QlikView evolved from a single user desktop tool to a server- and java-based Web tool. The sophisticated technology enables QlikView to conduct very quick analysis on hundreds of millions dataset. In the meantime, the incorporated beautiful charts and different colors had made it standing out from many existing BI products.

In order to harness the power of emerging multi-core and multi-processor advancements, Qlik partnered with Intel and HP. Coupled with faster and faster processors and expandable memory capabilities, QlikView can now easily handle billions of rows of data and tens of thousands of users.

With its innovative and disruptive BI technology and powerful capabilities, Qlik has gained attentions of many enterprises. Some of the best-known company such as Best Buy, Cannon, Shell, ING and Panasonic are Qlik's customers.

⁹ Qlik Company Introduction www.Qlik.com

¹⁰ Qlik Company History www.Qlik.com

2.2 Qlik's Product Suite

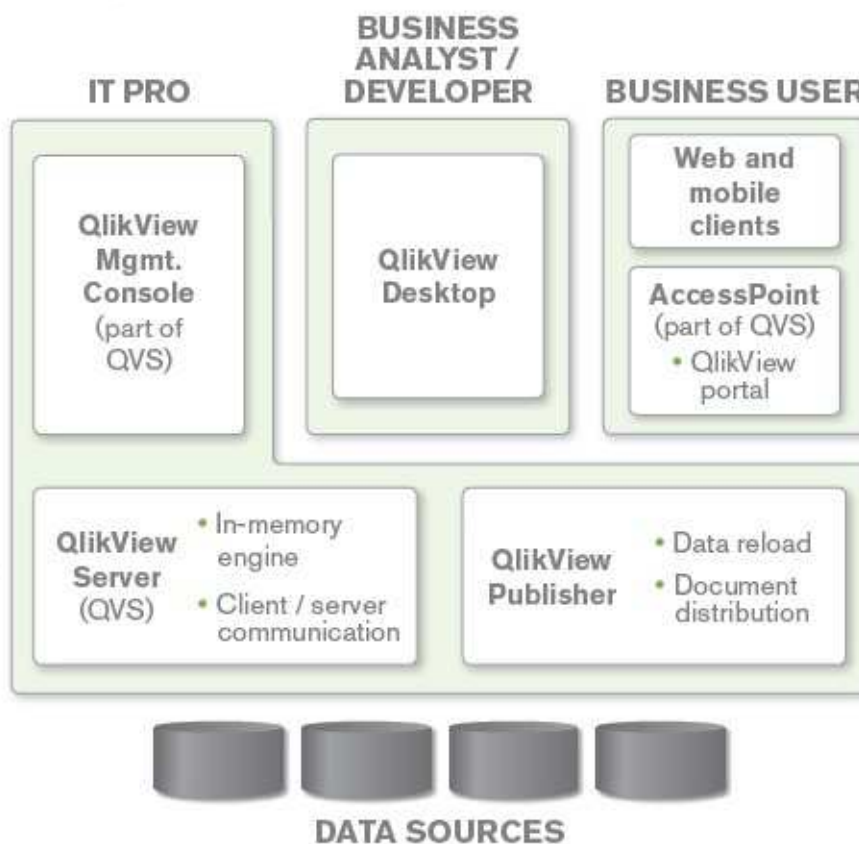
Qlik has currently two sets of platforms: QlikView and QlikSense. Under each platform, there are a series of products which serve for different level of users. QlikSense is a newly released platform in the second half of 2014. It is similar to QlikView but a little different from QlikView. It is officially an improved and extended version of QlikView.

QlikView

QlikView is a business intelligence and analytics software, with which users can quickly and efficiently create data visualizations, reports and dashboards and interact, collaborate with real-time data analysis. QlikView enables users to assemble data from multiple sources, explore data, discover insights, and to solve business problems or make informed business decisions.

QlikView is a single product with multiple components for business users in various roles: business analysts, BI application developers and IT professional. These multiple components together form a business discovery platform. The figure below shows the product family of QlikView.

Figure 7. QlikView Business Discovery Platform



Source: Qlik.com

As we can see on this platform, there are three main components: QlikView Desktop, QlikView Server and QlikView publisher. Each component plays an important role in designing, developing and implementing almost every QlikView deployment.

QlikView Desktop

The QlikView Desktop is a Windows-based desktop tool for business analysts and developers to create a data model, and to lay out the graphical user interface (GUI) for creating QlikView applications. Currently it is the business analyst/developer who facilitates connections to data sources and transforms the data so that the data is ready for analysis. QlikView Desktop enables users to make graphs and tables in a drag-and-drop fashion, which improves innovatively the degree of the ease of use to a high level. The file type created by QlikView Desktop is known as a QVW (.qvw, or QlikView file).

QlikView offers a free download Personal Edition, but it limits the connections to data sources. It allows only the data source that is developed by user himself and located in local computer. With Personal Edition, the BI applications can be created but cannot be shared. QlikView Local Client is a licensed version which has no such limitations as Personal Edition has.

QlikView Server (QVS)

QlikView Server is a server-side product which comprises of the in-memory analytics engine and deals with the communications between clients and QlikView applications. The QlikView applications are loaded in the memory engine of QlikView Server, and then the clients can interact with those applications in real time, such as calculations and new selections. It supports multiple kinds of QlikView clients to interact with applications on the server including desktop, IE plug-in, AJAX or mobile.

QlikView Server has two versions: Small Business Edition and Enterprise Edition.

QlikView Publisher

QlikView Publisher is a server-side product. It is used to load data directly from data sources via connection strings in the source QVW files. And it is also used as a distribution service to reduce the QlikView applications from source QVW files by applying certain rules on it. Certain roles are, for example, the user authorization and data access privileges. QlikView Publisher distributes the QVW files to QlikView Server or as static PDF reports through email. QlikView Publisher is designed for more complex tasks, which a large enterprise would likely require it.

QlikSense

QlikSense is a newly released software package in the second half of 2014. Comparing the major functionalities to QlikView, QlikSense is not a very different product from it. However, according to Qlik website knowledge, QlikView and QlikSense serve for different purposes. QlikView is for guided analytics, whereas QlikSense is for self-visualization analytics. QlikSense cannot be regarded as the next generation of QlikView yet, and Qlik is continuously investing on both platforms. However, Because of the ambiguity of the differences between QlikView and QlikSense, it does raise some concerns. Some users hope QlikView to integrate QlikView and QlikSense into one platform so that the structure of their products can be clearer and easier for users and buyers to understand. The confusing product structure may hinder the marketing of Qlik products. At this point, QlikSense is not yet fully completed and will not be covered in discussion of this paper.

2.3 Tableau Company

Tableau Software, INC is an American business analytics software company founded in 2003 in California and headquartered in Seattle, Washington in USA. It produces a series of data visualization products focusing on business intelligence.

The initiative of Tableau creation came from Professor Pat Hanrahan, Ph. D. student Chris Stolte and a Ph. D. candidate at computer science department of Standford University. They were researching visualization techniques for exploring and analyzing relational databases and data cubes and saw the opportunity to commercialize their solution. Together they invented a database visualization language called VizQL (Visual Query Language), which does database interaction in a visual form. VizQL is a breakthrough unification of computer graphics and databases. It changes the way of using the data and allows users to visualize data of any size at just finger tips (drag and drop).

Tableau has experienced a fast growth of period during 2010-2013, in which its revenue grew at the speed of more than 80% yearly. Tableau launched an initial public offering in 2013 on New York Stock Exchange and raised capital of more than \$250 million USD.

With the innovative technology and great ease of use, Tableau has established a big customer base of 19,000 customer accounts worldwide, covering a wide range of industries. Some of the well-known companies like Amazon, yahoo, Citigroup, Golden Sachs, Coca-Cola, Intel, American Airline etcetera are on the customer list of Tableau¹¹

¹¹ Tableau Company Introduction www.tableausoftware.com

2.4 Tableau Product Suite

Tableau has five products which together form a product platform to enable users to create Tableau files, to interact and share with other users, to read the files on the local disks or on the web and to publish the results on the internet. These five products are: Tableau desktop, Tableau Server, Tableau online, Tableau Public, and Tableau reader.

Tableau Desktop

Tableau Desktop is a data visualization tool designed to create data visualization, report and dashboard in a fast and intelligent way. To be more specific, users can connect to multiple data sources, carry out multi-dimensional data analysis, create dashboards or report, modify metadata and publish a complete workbook to Tableau server if needed. The desktop product comprises two versions: Personal Edition and Professional Edition.

- **Personal Edition:** This edition allows users to connect to limited data sources as Microsoft Access 2003 or later (Windows only), Microsoft Excel 2007 or later, Microsoft Windows Azure Marketplace DataMarket, Odata, Tableau Data Extract and Text files (Comma separated value files). It cannot connect to Tableau Server but allows users to create package files for Tableau Reader. The price is \$999 per user.
- **Professional Edition:** It connects to a wider variety of data sources including Amazon Redshift, Google Analytics, Google BigQuery, Hortonworks Hadoop, OLAP databases, and Salesforce. It enables connection to Tableau Server and creating package files for Tableau Reader. The price is \$1999 per user.

Tableau Server

Tableau Server is a data governance platform and can be either browser based or mobile based. It enables users to publish dashboards on Tableau Server so that everyone in the organization can share, collaborate and interact with them. It facilitates the integration of data in the organization

Tableau Online

Tableau Online is a hosted version of Tableau Server. It is the business analytics platform where people are able to share dashboards, interact with report and gain insights. It is hosted in the cloud so that there is no hardware, no set-up time needed.

Tableau Public

Tableau is a free tool that anyone can use to connect to data, create interactive data visualizations and publish them on the web. Since everyone has access to published data, user should be careful not to put the proprietary data on Tableau Public.

Tableau Reader

Tableau Reader is a free desktop application that users can open and interact with data visualizations which are created with Tableau Desktop. Users can filter, drill-down and view the details of the data as long as the author allows.





2.5 Qlik and Tableau Company Overview

Table 2. Qlik and Tableau Overview

	Qlikview	Tableau
The year of Establishment	1993	2003
Location of Establishment	Lund, Sweden	California, USA
Headquarter	Radnor, Pennsylvania, in USA	Seattle, Washington, in USA
Number of Employees	1,900(As of July 2014)	1,212 (As of December 2013)
Number of Customers	33,000	19,000 Customer Accounts
Revenue	\$470.5 million(2013)	\$232.44 million(2013)
	\$388.5 million(2012)	\$128 million(2012)
Traded Stockmarket	NASDAQ	NYSE





2.6 QlikView and Tableau Product Suite Overview

Table 3. QlikView Product Suite Overview

	DESKTOP		SMALL BUSINESS SERVER	ENTERPRISE SERVER	PUBLISHER
	Personal Edition	Local Client			
Features	<ul style="list-style-type: none"> - Local client for building dashboards - Full data connectivity and functionality - Not able to share documents 	<ul style="list-style-type: none"> - Local client for building dashboards - Full data connectivity and functionality - Able to share documents 	<ul style="list-style-type: none"> - Central computer to handle all reloads, RAM performance and administration - Allows users to access QlikView apps via web clients - Two license options: Named Client Access License (CAL) and Document CAL - Maximum deployment of 25 Named and 100 Document CALs - No clustered server option 	<ul style="list-style-type: none"> - Central computer to handle all reloads, RAM performance and administration - Allows users to access QlikView apps via web clients - Four license options: Named, Document, Session and Usage CALs - Unlimited users and documents - Server clustering and server-based collaboration - Integration with third-party security systems 	<ul style="list-style-type: none"> - Developed for large user environments - Central administration and management - Complete control of the distribution of QlikView apps - Automation of the data refresh process
OS					N.A.
License	Free	\$1,350	\$8,400	\$35,000	\$21,000

Source: Qlik website 2014

Table 4. Tableau Product Suite overview

	DESKTOP		READER	SERVER	PUBLIC	ONLINE
	Personal	Professional				
Features	<ul style="list-style-type: none"> - Local client for building dashboards - Limited data connectivity - Not able to connect to Tableau Server 	<ul style="list-style-type: none"> - Local client for building dashboards - Full data connectivity - Full enterprise capabilities 	<ul style="list-style-type: none"> - Local client to view and interact with local files - Unable to modify workbooks - Not able to connect to Tableau Server 	<ul style="list-style-type: none"> - Privately managed Tableau Server - Interact with dashboards via browser 	<ul style="list-style-type: none"> - Public non-commercial Tableau server - Published data is public - Free client available to create dashboards 	<ul style="list-style-type: none"> - Commercial server hosted in the cloud - No infrastructure required - Live connections only possible with Google BigQuery and Amazon Redshift
OS					N.A.	N.A.
License	\$999	\$1,999	Free	Named User or Core Licensing	Free	\$500/user per year

Source: Tableau website 2014

Chapter 3 Comparisons between QlikView and Tableau

3.1 The Structure of QlikView and Tableau Product Suite

Tableau’s product structure is quite logic and straight forwards. The layout of its structure is very easy for non IT professional to understand. On website its’ products are also displayed and explained in a very clear and logical manner. However, it took me a while to figure out the whole package of QlikView’s products as they are not all listed on the website in a visible way. QlikView’s product structure is built from the point view of the ICT architecture, and that has a hierarchic structure for different level of users (IT department, business analyst/developer and business users) in the organization. To get a holistic view of QlikView’s product structure, it requires a bit longer time.

3.2 Data Integration Capabilities of Tableau and QlikView

Since business intelligence is derived from data, data is certainly conceived as a valuable asset to any enterprises. In the mean time, enterprises have usually a complicated data structure. Not only is the amount of heterogeneous data huge, but also the format is quite complicated. The data is scattered over multiple databases, text files, spreadsheets, access and public services. In order to facilitate business analysis or business discovery on data residing in different places, it is very important for good business analytical software to provide connections to various data sources. Being able to integrate multiple data sources into one platform can save lots of time and create convenience and value for users.

Tableau and QlikView both enable connections to multiple data sources. However, QlikView has built-in ETL tools which Tableau lacks. ETL¹² represents extract-transform-load which is used to migrate data from one database to another, to form data marts and data warehouses and also to convert databases from one format or type to another.

Tableau Connections to Multiple Data Sources

Tableau has native connectors to many common databases, such as Microsoft SQL Server, My SQL, Oracle, Teradata and more. There are currently thirty-three different database connectors available with each year more being added. If native connector is not available, users can access to data via ODBC (open database connectivity) that utilizes the Open Database Connectivity standard. The table below exhibits a full list of data sources which Tableau supports.

Table 5. Data Sources Tableau Supported

Tableau Data Extract	IBM DB2
Microsoft Access	IBM Netezza
Microsoft Excel	MapR Hadoop Hive
Text File	Microsoft Analysis Services
Import from Workbook	Microsoft PowerPivot

¹² http://en.wikipedia.org/wiki/Extract_transform_load

Tableau Server	OData
Actian Vectorwise	Oracle
Amazon Redshift	Oracle Essbase
Aster Database	ParAccel
Cloudera Hadoop	PostgreSQL
DataStax Enterprise	Progress OpenEdge
EMC Greenplum	Salesforce
EXASOL	SAP HANA
Firebird	SAP NetWeaver Business Warehouse
Google Analytics	SAP Sybase IQ
Google BigQuery	Teradata
Hortonworks Hadoop Hive	Windows Azure Marketplace DataMarket
HP Vertica	Other Databases (ODBC)

Source: Tableausoftware.com

QlikView

QlikView enables data extractions from multiple, heterogeneous sources such as spreadsheets, webpages and big data sources like Google BigQuery, and creates a homogeneous data set suitable for analysis and visualization. The following list shows the multiple data sources that QlikView can support.

Table 6. Data Sources QlikView Supported

Actian Vectorwise	Microsoft SharePoint
Amazon EC2	Microsoft SQL Server
Amazon Redshift	MySQL
Aster Data nCluster	OData
Cloudera Hadoop Hive	ODBC
Cloudera Impala	Oracle
CSV	Oracle Hyperion
DataStax	Oracle JD Edwards
Epicor Scala	Oracle Peoplesoft
EMC Greenplum	ParAccel
Firebird	ParStream
Google BigQuery	PostgreSQL
Hortonworks Hadoop Hive	Progress OpenEdge
HP Vertica	Sage 500
IBM DB2	Salesforce
IBM Netezza	SAP
IBM (Lotus) Notes	SAP HANA
Infor Lawson	SAP NetWeaver Business Warehouse
Intuit QuickBooks	Siebel
Informatica Powercenter	Sybase ASE
MapR	SybaseIQ
MicroStrategy	Teradata
Microsoft Access	Web pages

Microsoft Dynamics NAV (Navision)	XML
Microsoft Excel	

Source: Qlik.com

QlikView data connectivity technology

- **Files:** use QlikView’s built-in data wizard to connect to data sources such as spreadsheets, XML, and web pages.
- **Databases:** pull data using the ODBC connector or native connectors from QlikTech, database vendors, or third parties.
- **Direct database queries:** query databases using the Direct Discovery connection.
- **Custom data sources:** build your own data source connector using QVX technology.

3.3 Data Integration Capabilities of Tableau and QlikView

Both tools enable multiple data sources connections. However, QlikView has built-in ETL tools which Tableau at this moment does not have. QlikView also enables users to build data source connector via QVX technology. Tableau has no equivalent built-in technology to provide such flexibility. Therefore, blending data from certain type of data sources can be a challenge for Tableau. However, in QlikView environment, data extracting, transforming and loading is usually done and completed by developers and requires more extensive IT skills as it is more script-driven. In Tableau environment, the data integration is done via user interface (wizards). It usually requires no scripting skills. Again the focus of business model reflects here. That Tableau facilitates ease of use for any level of users; QlikView targets on different level of users with different tools. Meanwhile, Tableau is constantly busy with providing more native data connectors and improving the capability on this regard. In short, QlikView has a little stronger capability than Tableau in terms of data integrations.

3.4 Hardware Specifications of Tableau and QlikView Software

The basic system requirements for Tableau and QlikView are given in **Table 7**. As what holds for most BI products is that the system requirements do not differ a lot. The main differences are that QlikView cannot run on Mac-computers at this moment, that Tableau still supports a single core processor (Pentium 4) while QlikView supports only multiple core processors, and that QlikView requires much more RAM memory because of its in-memory technology. The first two differences are relatively unimportant, but the last difference can be crucial when setting up a server environment.

Table 7. Systems Requirements of Tableau and QlikView

	Tableau			QlikView	
	32-bit (x86)	64-bit (x64)	Mac	32-bit (x86)	64-bit (x64)
Desktop					
<i>Operating system</i>	Windows XP SP3 Windows Vista Windows 7 Windows Server 2003 Windows Server 2008	Windows XP Professional x64 SP2 Windows Vista x64 Windows 7 x64 Windows 8 x64 Windows Server 2003 x64 Windows Server 2008 x64 Windows Server 2008 R2 Windows Server 2012	iMac MacBook MacBook Pro MacBook Air Mac mini OS X 10.8.1 or later	Windows XP SP3 Windows Vista Windows 7 Windows Server 2003 Windows Server 2008	Windows XP Professional x64 SP2 Windows Vista x64 Windows 7 x64 Windows 8 x64 Windows Server 2003 x64 Windows Server 2008 x64 Windows Server 2008 R2 Windows Server 2012
<i>Processor</i>	Intel Pentium 4 AMD Opteron	Intel Pentium 4 AMD Opteron	Intel Pentium 4 AMD Opteron	Intel Core Duo	Intel Core 2 Duo
<i>Memory</i>	2 GB memory	2 GB memory	2 GB memory	1 GB minimum	2 GB minimum
<i>Disk space</i>	500 MB	500 MB	500 MB	250 MB (installation)	300 MB (installation)
Server					
<i>Operating system</i>	Windows 7 Windows 8 Windows Server 2003 Windows Server 2008	Windows 7 x64 Windows 8 x64 Windows Server 2003 x64 Windows Server 2008 x64 Windows Server 2008 R2 Windows Server 2012		Windows 7 Windows Server 2003 Windows Server 2008	Windows XP Professional x64 SP2 Windows Vista x64 Windows 7 Windows Server 2003 x64 Windows Server 2008 x64 Windows Server 2008 R2 Windows Server 2012
<i>Processor</i>	Intel Pentium 4 AMD Opteron	Intel Pentium 4 AMD Opteron	Intel Pentium 4 AMD Opteron	Intel Core Duo or higher	Multi-core x64 processors
- Small deployments (10-25 users)	4 cores, 2.0 GHz CPU	4 cores, 2.0 GHz CPU	4 cores, 2.0 GHz CPU		
- Medium deployments (25-100 users)	8 cores, 2.0 GHz CPU	8 cores, 2.0 GHz CPU	8 cores, 2.0 GHz CPU		
<i>Memory</i>	2 GB minimum	2 GB minimum	2 GB minimum	1 GB minimum	4 GB minimum
- Small deployments (10-25 users)	8 GB minimum	8 GB minimum	8 GB minimum	24 GB*	24 GB*
- Medium deployments (25-100 users)	32 GB minimum	32 GB minimum	32 GB minimum	256 GB*	256 GB*
<i>Disk space</i>	500 MB (installation)	500 MB (installation)	500 MB (installation)	450 MB (installation)	450 MB (installation)
- Small deployments (10-25 users)	5 GB	5 GB	5 GB	5 GB	5 GB
- Medium deployments (25-100 users)	50 GB	50 GB	50 GB	50 GB	50 GB

* QlikView is an in-memory product. The memory requirements depend on the quantity of data to be analyzed.

Source: Websites Tableau Software and Qlik, 2014

The memory needed for the analysis depends on various factors, among others, the amount and structure of the data, the number of concurrent users, the number of applications, and the application design (Qlik, 2011). QlikView uses data compression as well as shared memory usage to reduce memory consumption. Take the following scenario as an example. Assume that there are multiple users interacting with the same QlikView application simultaneously. When the first user opens the application, the data is loaded into the memory, and when he starts to interact with the application, the result sets from requested calculations are stored in RAM so that they can be used later on again. Additional requests from him or similar requests from other users that interact with the application are served from memory directly by returning the result sets that are already in memory. Because of compression and the shared memory feature, the RAM utilization of a certain QlikView application does not follow a simple mathematical formula. Experts of QlikView have found out through experience and simulations that the amount of RAM needed for a certain data size and expected number of users can be roughly calculated as follows (Qlik, 2011)

$$\text{RAM}(\text{total}) = \text{RAM}(\text{user}) \times N + \text{RAM}(\text{initial})$$

where

$$\text{RAM}(\text{initial}) = \text{QVW}(\text{size on disk}) \times \text{Multiplier}(\text{file size});$$

$$\text{RAM}(\text{user}) = \text{RAM}(\text{initial}) \times \text{RAM}(\text{incremental user});$$

$$\text{QVW}(\text{size on disk}) = \text{Source Data} \times (1 - \text{Compression}\%);$$

with

N: Number of concurrent users;

RAM(incremental user): ranges between 1%–10% (this is the RAM each incremental user consumes);

Multiplier(file size): range between 2–10 (this is the factor to transform the data into associations);

QVW(size on disk): this is the size on disk of a QlikView file

Compression%: range between 20%–90% (this is the factor of compression).

For companies with many QlikView users and huge datasets, an initial setup can become infeasible when databases grow in size, more applications are built, and more users interact with the applications simultaneously. Scaling up the RAM memory is possible, but relatively more expensive than increasing the disk space which it is the case for Tableau. Memory management and CPU utilization as well as optimizing the network architecture can increase the user capacity significantly, but requires highly skilled IT people and costly investments.

3.5 Comparing the BI Technologies of Tableau and QlikView

Tableau and QlikView exploit different technologies to transform large amounts of unstructured data into meaningful and useful insights for business intelligence. Tableau has adopted a traditional query-based technology that operates from disk. Such a technology requires that a database resides on a hard drive, while it is actively being queried by an application. Disk-based BI assumes that not all the data can be stored in Random Access Memory (RAM) and must therefore be located on disk in order to query the data within a reasonable amount of time. On the contrary, QlikView assumes that all databases and associations can be hold in memory where it can benefit from the fastest storage system a computer has. **Figure 8** shows the different approaches of Tableau and QlikView graphically.

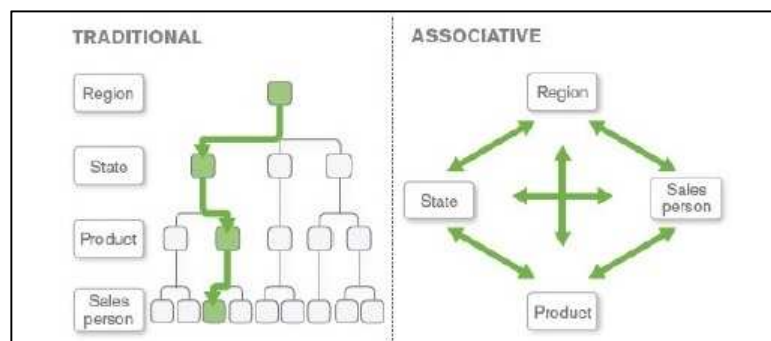


Figure 8. Query-Based Technology of Tableau (Left) and Associative In-memory Technology of QlikView (Right).

Source: Qlik, 2014

Although there are many vendors on the market providing BI tools, the technologies used by Tableau and QlikView are both powerful and distinctive from others.

3.5.1 Disk-based BI of Tableau

The BI technology of Tableau, called VizQL™, has been developed by Stanford University in 2003. The technology is a query language to create a visual representation of the data from inputs of the user. This method is different from traditional analysis which forces the user to analyze the data in rows and columns, choose a subset of them, organize these data into a table, and then create a chart from that table. VizQL™ allows people to work much faster than can be realized by conventional methods, as a result, more time is left to gain a deeper understanding of the data.

Another breakthrough was realized by the development of the Tableau's Data Engine. This data engine is a high-performing analytics database that has the speed benefits of in-memory BI tools and does not require that the data has to be fully loaded into memory. The data engine of Tableau is particularly designed to optimally exploit the current generation hardware to achieve query response of hundreds of millions of rows of data on a simple personal computer in real time.

3.5.2 The In-memory Associative Technology of QlikView

QlikView has a unique, patented in-memory associative technology for data visualization. With this technology QlikView can maintain associations among datasets in computer's memory. This is done by so-called *symbol compression*¹³. QlikView first preloads all data into memory. The data is then compressed and stored in straightforward tabular format. The compression is done such that all the fields in a column have the same length. The result of this compression is that all data are stored in nice arrays, so that the addresses of individual rows can be easily calculated.

This type of data structure makes it possible to set up associations between variables and datasets. The different states of the variables are searched through by scans using look up tables, and when fields are identical, they are associated. In this way every data field is assigned a selection state. In Figure 9 such a selection state is depicted. Since the associations among result sets are fully maintained in memory, all data points are updated in real time when the user makes changes to the selection state.

¹³ Symbol compression is also denoted by dictionary or token compression. It was introduced by Abraham Lempel and Jacob Ziv in 1977.

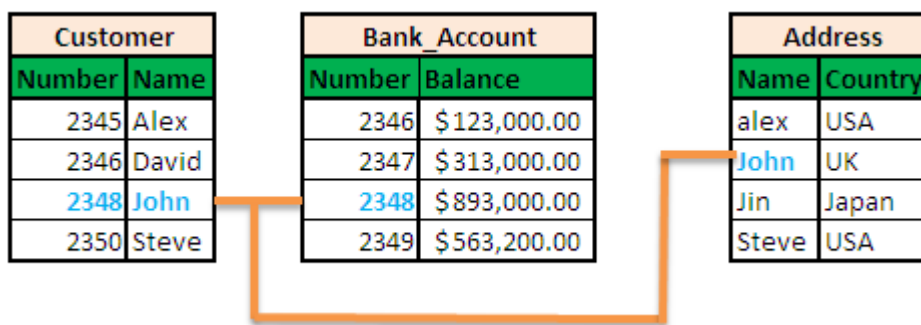


Figure9. An association between the fields in multiple tables in QlikView

Source: <http://dmbicastle.com>

The concept of in-memory business intelligence already exists for many years. However, the technology was not feasible for many companies until recently. In-memory business intelligence strongly relies on RAM which is much more expensive than storage space on hard disk and limited by 32-bit processors to at most 4 Gigabytes. Since 64-bit processors became widely available on the market a few years ago, the in-memory storage capacity of computers is no longer limited to 4 Gigabytes. Commodity computers can now even be delivered with 32 Gigabytes at a favorable price.

Because of 64-bit computing, QlikView can now also manage **gigabytes-scale databases**. According to QlikView its software can “comfortably handle databases with 10-20 gigabytes of compressed data, at whatever product of record count and record length you like”¹⁴. This market development allows QlikView to maintain all data associations in the data engine and to make visualizations in real time. Therefore, QlikView has become a strong competitor to many other BI vendors.

Another feature of QlikView is ETL. This functionality of QlikView is missing in Tableau. Therefore, Tableau requires a separate ETL tool which has to be purchased from a vendor and increases the total costs of the software solution.

3.5.3 Which Technology Should Be Preferred: Disk-based or In-memory BI?

Both technologies do the job. But how should we choose between one of these BI tools? In order to evaluate the BI technologies of Tableau and QlikView, the following aspects should at least be evaluated: performance, scalability, and data discovery.

Performance

In-memory BI tools like QlikView avoid the querying problem by loading the entire dataset into RAM. In this way a substantial speed advantage is gained when the data is analyzed and visualized as scanning data

¹⁴ <http://www.dbms2.com/2010/06/12/the-underlying-technology-of-QlikView/>

in RAM is a few orders of magnitude faster than reading it from hard drive. However, it can take a considerable time for QlikView to load a massive database into memory and to establish all the associations between the data fields. Performance can also become an issue when multiple, intensive RAM-using programs run at the same time and RAM is limited. In practice, the speed gain of QlikView over Tableau is hardly notable by a single user that works with a stand-alone product as both BI tools operate in real time when RAM is not a limiting factor.

Scalability

Scalability can be defined as the ability to retain the same level of performance when new data, users, and applications are added to the server system. There are a number of factors to be considered in the scalability of a BI solution, among others, the hardware specifications, the network architecture, the software configuration, the software usage and the data volumes handled. In a survey of Tableau many of these factors are taken into account to determine to which extent the Tableau software is scalable (Tableau Website, 2013). The results of this survey show that Tableau Server 8 can be considered as a nearly linearly scalable system with respect to various types of workloads and deployment topologies. These results give a good indication that Tableau Server works for large enterprises as well. On the other hand, QlikView heavily relies on the available memory resources. It is important to know that QlikView also scales linearly as long as there is sufficient CPU capacity and RAM (Qlik, 2011). Since the vast majority of enterprises will never produce more data than it can handle, scalability is only an issue with respect to hardware costs as RAM memory is more expensive than storage capacity.

Data discovery

The technologies that are used by Tableau and QlikView are both powerful in data discovery. They provide graphic manipulations and interactive analytics in real time, though QlikView is faster due to its in-memory calculations. Moreover, QlikView can carry out segmented group analysis quickly due to its associative technology. To perform segmented group analysis in Tableau, the input data has to be manipulated or new variables have to be constructed by means of the functions “Create Calculated Field” or “Create group”.

3. 6 Operation of the Software

To evaluate the functionalities of the two software products different aspects will be taken into account. Next, we discuss the ease of use of Tableau and QlikView, the analysis capabilities of the software products, and the quality of the output.

3.6.1 Documentation

An important aspect in the acceptance and effective use of a software product is its documentation. High-quality software cannot come without a good user manual. Such documentation is needed to find

out the basic working of the software, to understand its possibilities and features, and to have a reference. It requires that the descriptions in the documentation are clear and concise, the structure is task-oriented, and it has to include an index, headers and footnotes.

The documentation of the Tableau Software turns out to be quite good. Tableau provides different ways to help the user in understanding and operating the software. Examples of documentation for Tableau Desktop are an online help manual for people that have an internet connection, an offline help manual for those without an internet connection, a PDF manual, and a quick start guide. However, the PDF manual does not include a table of contents and an index (but it contains a glossary). Besides, there are many Tableau books on the market to learn how to make a dashboard in Tableau (Murray, 2013; Peck, 2013; Nandeshwar, 2013), valuable instruction videos are posted on YouTube, and answers to specific question can be found on the website of the Tableau Support Community. It is even possible to get training by following Tableau courses¹⁵.

QlikView has fewer documentation sources. The main documentation consists of a digital reference manual of 942 pages (Qlik, 2013). There are also several QlikView books available on the market, but it looks like that QlikView currently has less published guide books Tableau. Other documentations and supports can be found on the Qlik Community, blogs and YouTube. Like Tableau, QlikView also provides training courses.

3.6.2 Importing and Loading Data

Importing data into Tableau is quite intuitive. On the starting page of Tableau you can go directly to 'Connect to Data' under Data or the Data menu. In the next window you can select your data source type and data source file name. Once the data is imported you are given the option to correct the data types of the variables (in case that not all data is imported with the right data type) and rename them. Moreover, by means of selecting an SQL clause (i.e., inner join, left join, and right join) records from two or more tables in a database can be combined together. The last step is to make the data import complete by clicking on 'Go to Worksheet'. The data are then imported into Tableau as dimensions and measures.

QlikView can read data from files representing a table and databases. There are two ways to load data in a file table into QlikView. Both methods use the QlikView script editor. This script editor can be found in the file menu and is called 'Edit Script'. Clicking on it opens a script window with basic information.

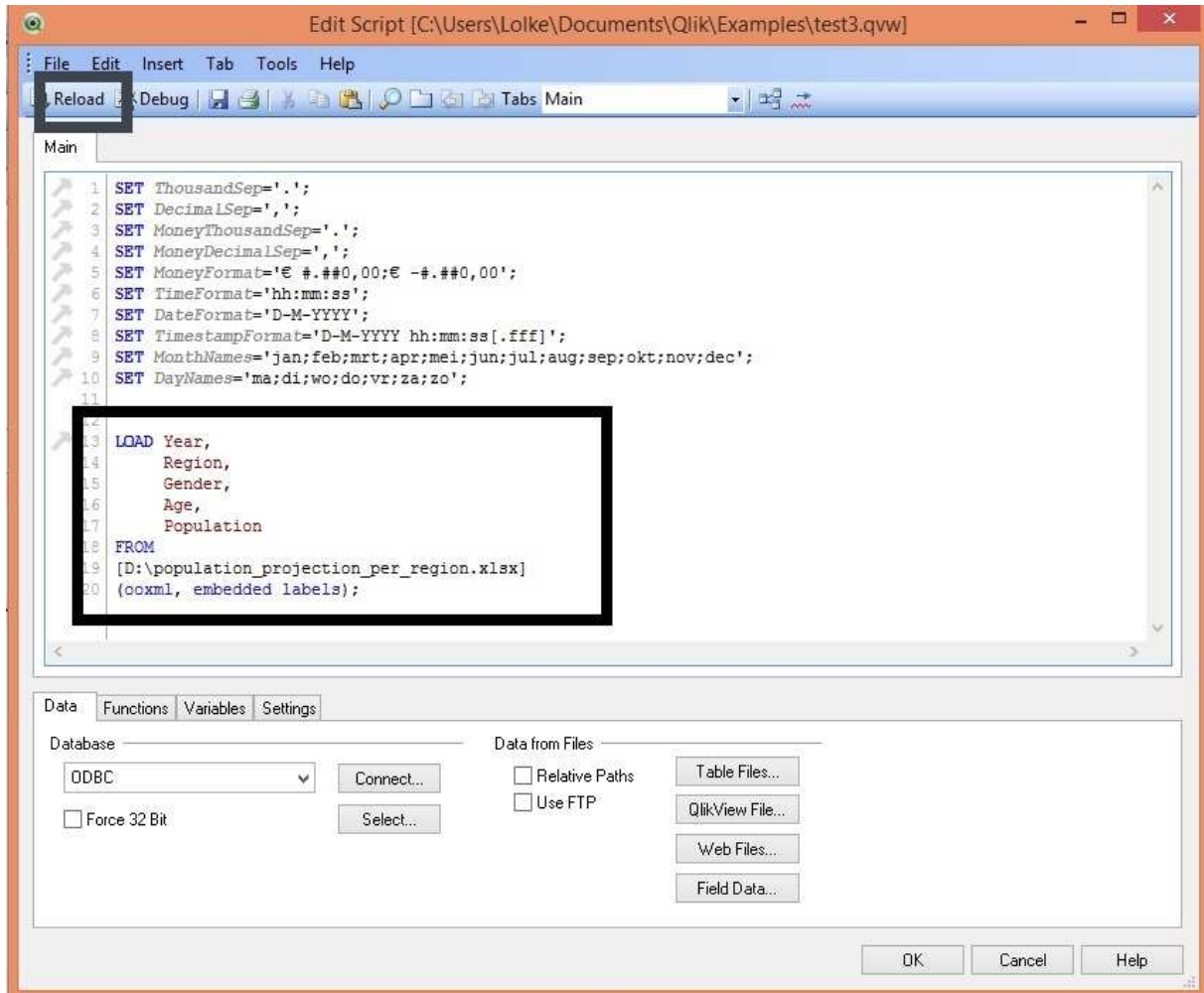
Loading Data from a Table File

The first method to load the data is to append the script with statements of the variables to be loaded, where the file is located, and what type of it is. Once complete, the data can be loaded into QlikView by

¹⁵ <http://www.tableausoftware.com/support/training>

selecting the 'Reload'-button on top of the window. **Figure 10** gives an example of loading data from an Excel file.

Figure10. A Script File Example to Load Excel Data into QlikView



The second method is to use the file wizard in the script editor. This wizard can be found at the bottom right of the script editor and is called 'Table Files'. It requires to fill in and adjust some default settings such as file type, table type, column separators, data types of the variables, and whether or not the first row in the table constitute headers.

Loading Data from a Database

To load the data from a database one first has to configure the database as an ODBC data source. After that, you can establish a connection with this database by clicking on the 'Connect' button, which is found at the bottom of the script editor. After that, you click on the 'Select' button to choose the variables and tables to be loaded.

To summarize, the Tableau method of importing data is more intuitive and easier to operate than the data load features in QlikView. The QlikView script editor misses a logical structure since the wizards to load

data can be found at the bottom instead of at the top of the script editor. However, reloading data or adjusting the data to be loaded is more effective by QlikView due to the scripting possibility. It depends on the type of user whether the user has relevant scripting or IT skills.

3.6.3 Graphical User Interface

The next aspect to be evaluated is the ease of use of the graphical user interface (GUI).

Tableau has a very thoughtful and intuitive GUI. First, it groups the variables by dimensions and measures. If a variable is wrongly categorized as a measure or a dimension, it is very easy to recover the mistake by right-clicking on this variable and convert it. Moreover, by right-clicking on this variable the data type can be easily changed as well. Second, Tableau has strong capabilities in performing multidimensional analysis because of its clean and simple operating interface. By dragging and dropping variables across dimensions and filters useful information and relationships between two or more variables can be discovered. It also includes a page filter to control and fix the axis range across a variety of dimension choices, which is very useful when performing comparative analysis. Third, two kinds of sheets are available in Tableau, namely worksheets and dashboards. A worksheet can be used to design an interactive table, chart or map. The dashboard sheet is meant for combining dashboard objects together. By selecting sheets and moving them to the dashboard, it is very easy to make insightful and interactive dashboards. Since filters and selections can be assigned to a single object on the dashboard, this gives a great flexibility to the developer to show the data from different perspectives.

QlikView has an associative interface for data visualization, which is possible due to its in-memory associative technology. After loading all the data in the QlikView application, all associations are kept in memory and can be accessed in real time by its innovative selection filter. Once tables and charts have been constructed, it is quite easy to find relationships between variables and data fields by means of this instantaneous selection filter. When a user clicks on some data fields of a variable, the user's selections are highlighted in green. The datasets that remain valid are highlighted in white. Unrelated data is highlighted in gray. **Figure 11** shows the instantaneous selection filter of QlikView graphically.



Figure 11. QlikView Selection Filter with Highlighted Selections, Associated Data, and Unrelated Data

Source: *www.QlikView.com (Qlik, 2010)*

So when users click on same data field, they can immediately see how these selected data is related to the other sets. By clicking on the data fields of the appropriate data sets and adjusting them, it is also straightforward to see how the analytic dataset responds and charts and table change. With QlikView, any or all aggregated statistics can be calculated in real time, regardless of the selections chosen. The number of clicks needed to obtain the desired information is also orders of magnitude less comparing to Tableau. In Tableau you have to deselect the chose selections first, which can require many clicks, and then you have to make new selections.

Despite of its innovative selection filter, it is quite complicated to set up tables and charts in QlikView. It requires expert knowledge to create effective dashboard objects. The reason for this main limitation of QlikView is that the menus lack an intuitive structure, that the submenus have too many tabs, and that these tabs have illogical names and a messy interface. The visual outputs also require time-intensive formatting. Part of the limitations can be tackled by scripting, but scripting requires users to have programming knowledge.

Another limitation of QlikView is that the active selection holds for all dashboard objects and worksheets. It is not possible to use different selection filters in a dashboard application. Moreover, QlikView does not distinguish between worksheets and dashboards like Tableau does. As a consequence, building dashboards in QlikView requires that the objects on the dashboard are associated with each other. Data discovery should therefore be led by perspective (e.g., regional analysis, time analysis, and market analysis) and different features of the chosen perspective should come together in one sheet.

It looks like the graphical user interface of QlikView is not thoroughly developed yet. However, its associative and instantaneous selection filter is one of the strongest features of QlikView. Therefore

QlikView is more suitable for IT people who know about SQL and programming and know how to set up charts and tables that can be analyzed by other departments and business users. Tableau does not require IT people to build dashboards. It can be easily be operated by any level of users such as data scientists, business analysts, managers and so on.

3.6.4 Visualization Tools: Tables and Charts

When comparing the visualization capabilities of Tableau and QlikView, I see that both software products have many tools for visualization. Straight and pivot tables and standard charts (bar chart, line chart, pie chart, area chart, and scatter plot) are all available in Tableau and QlikView. Tableau includes also other chart options such as histograms, box-and-whisker plots, filled maps, packed bubble charts and word clouds which are not available in QlikView. On the other hand, QlikView gives the possibility to make gauge charts, funnel charts, grid charts, and Mekko chart. **Figure 12** shows the visualization tools of Tableau and QlikView in a packed bubble chart.

Altogether, Tableau has more visualization capabilities than QlikView. Features such as “word clouds” or “bubble maps” are magnificent tools to enrich your dashboards. And filled maps can be used to compare regions across some metric by coloring. Moreover, Tableau supports multidimensional analysis by allowing the designer to build multidimensional tables and charts. To my knowledge, this feature is not yet mature or not yet intuitive in QlikView. On the other hand, QlikView provides 3D charts, an assortment of gauges, and faded bar charts. The gauge charts can be useful in designing a KPI¹⁶ dashboard, but I do not think that the formatting options of charts in QlikView create added value to business.

¹⁶ Key Performance Indicator

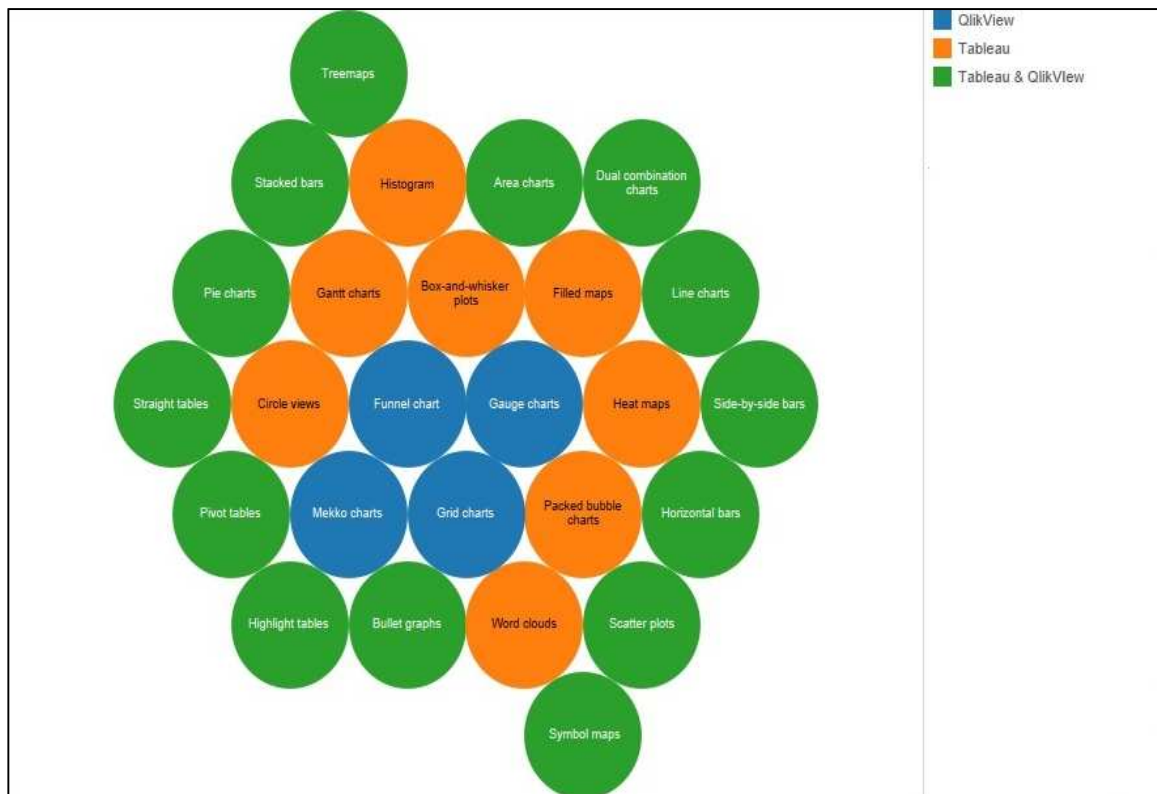


Figure 12. The Visualization Capabilities of Tableau and QlikView Shown by a Packed Bubble Chart

3.6.5 Mapping

Mapping is one of the strongest features in Tableau. It is fully integrated in the software and does not require additional license costs. Tableau automatically assigns geographic roles to variables that contain geographical data such as Country, Province, City, and ZIP Code. These geographic roles use longitude and latitude coordinates that can be plotted on the in-built Tableau maps. Since Tableau is a US company, its support for US maps is extensive. For other continents there are fewer maps available. Tableau maintains a repository for non-US and customized maps¹⁷. From this repository maps can be downloaded and opened in Tableau. It is also possible to import polygon files in Tableau for customized purposes. At this moment, Tableau does not support standard shapefiles¹⁸ from third party GIS platforms, so shapefiles have to be first converted into polygon files before they can be used in Tableau. This conversion can only be done by other (mostly commercial) software.

Mapping is not standardly integrated in QlikView. To visualize data on a map it requires you to purchase an additional extension such as GeoQlik. GeoQlik is commonly used for creating symbol maps, filled area

¹⁷ <http://tableaumapping.bi/repository/>

¹⁸ The shapefile format is a geospatial vector data format that is commonly used in geographic information system (GIS) software. The shapefile format defines land, boundaries, water wells, river and lakes by vector elements: points, lines, and polygons.

maps and flow maps; it does not provide clean filled maps. However, it supports many normalized GIS formats¹⁹ including shapefiles. This suggests that QlikView has also powerful mapping features. I have tried to use the extension (GeoQlik trial version), but the operation is not very intuitive.

3.6.6 Trend Lines, Statistics and Forecasting

A comprehensive BI tool should also include methods for statistical analysis, trend analysis and forecasting²⁰. We have evaluated Tableau and QlikView to find out whether they can be included in their dashboards.

Tableau turns out to have many features for data analysis with respect to estimating and visualizing trend lines (e.g., linear regression, logarithmic regression, and exponential regression), visualizations like histograms and boxplots and the ability to attach statistical output of a statistical model to dashboard objects (e.g., correlation coefficient, linear regression model, p-value/significance, and analysis of variance).

Tableau also contains different models to forecast time-series data. In fact, it uses exponential smoothing to forecast data, which is a technique that assigns more weight to recent observations than to older observations. Since there are various exponential smoothing models that capture trends or seasonal patterns in the data, Tableau automatically selects the best out of eight models²¹ on the basis of the goodness of fit.

QlikView has no extensive feature set available for performing statistical analysis and to attach statistical output to dashboard objects. It only includes a Statistics Box to select statistical quantities from a data set (e.g., Min, Max and Median), the Chi2-Test, One-sample T test, Paired Samples T Test, and Independent Samples T Test (using the Statistic Chart Wizard from the Tools menu) and a box plot (using the Box Plot Wizard from the Tools menu) (Qlik, 2013)

It is however possible to connect QlikView with the R project using the QlikView R Connector. The R project is an open source project to develop a language and environment for statistical computing and graphics²². It provides many statistical and graphical techniques (e.g., linear and nonlinear modeling, classical statistical tests, time-series analysis, clustering, forecasting). The Qlikview R Connector allows the QlikView user to communicate with the R software. By giving commands, statistical calculations are performed in R, and when completed, the result sets are returned to QlikView. It requires some IT skills to install the connector and to let it work with QlikView requires R language knowledge. This statistical package is specially meant for data scientists that have a strong background in statistics.

¹⁹ <http://www.geoqlik.com>

²⁰ Forecasting is a technique to extrapolate trends in the future on the basis of regular patterns in historical data.

²¹ <http://www.tableausoftware.com/support>

²² <http://www.r-project.org/>

To summarize, Tableau has already built-in a complete suite for statistical analysis and predictive modeling. QlikView does not have this feature yet, but it can connect with R which allows the user to perform advanced statistical analytics and forecasting. Installation of the connector requires some IT knowledge and to be able to work with the R project requires expert knowledge of statistics and the programming code R.

3.6.7 Dashboards

While high-quality business information is still important in reports, the presentation of the information receives more attention nowadays. Ad-hoc and interactive, self-service dashboards become the standard now. The appearance of the dashboards in Tableau and QlikView should therefore also be discussed in the comparison.

To start the discussion, we first give some examples of a dashboard in Tableau and QlikView. The dashboards are obtained from the websites of both companies (see **Figure13 (a) & Figure13 (b)**). In general, Tableau dashboards look better than QlikView dashboards with respect to resolution, fonts, colors, text size, margins and other formatting features. The default settings of the visualizations of QlikView are certainly not optimal, and it requires quite some time to improve the appearance of dashboard objects. Since the tabs are messy and difficult to understand, it takes quite a time to learn how tables, charts and other dashboard objects can be formatted in QlikView.

A non-data scientist would probably find it easier to build a dashboard in Tableau. Tableau provides more visualization possibilities and is very intuitive in operation. These characteristics make it easier to build effective and attractive dashboard. To make a dashboard with the same quality in QlikView requires more knowledge and creativity because of the limited visualization possibilities.

Figure 13(a) shows that traditional filters on a dashboard can be effective. The Tableau dashboard has three filters: 'year', 'region', and 'category'. The filter 'year' is modeled by a slider, the filter 'region' is modeled by a select menu, and the filter 'category' by a checkbox. This filter structure together with some visual enhancements (symbol map, different circle sizes, and colors for profits) gives you great analysis opportunities without the need to execute many clicks.

The selection filter of the QlikView dashboard gives you the opportunity to discover your sales and sales margin by year, quarter, month, channel, country, product category, product subcategory, and any combination of it. The dashboard includes a lot of information and gives many options to discover your unprofitable and most profitable markets. However, without having prior knowledge or expectation of the performance of your markets, it will be a little cumbersome to discover business value because of the large number of possible crossing category combinations. A Tableau dashboard with a few filters and filter

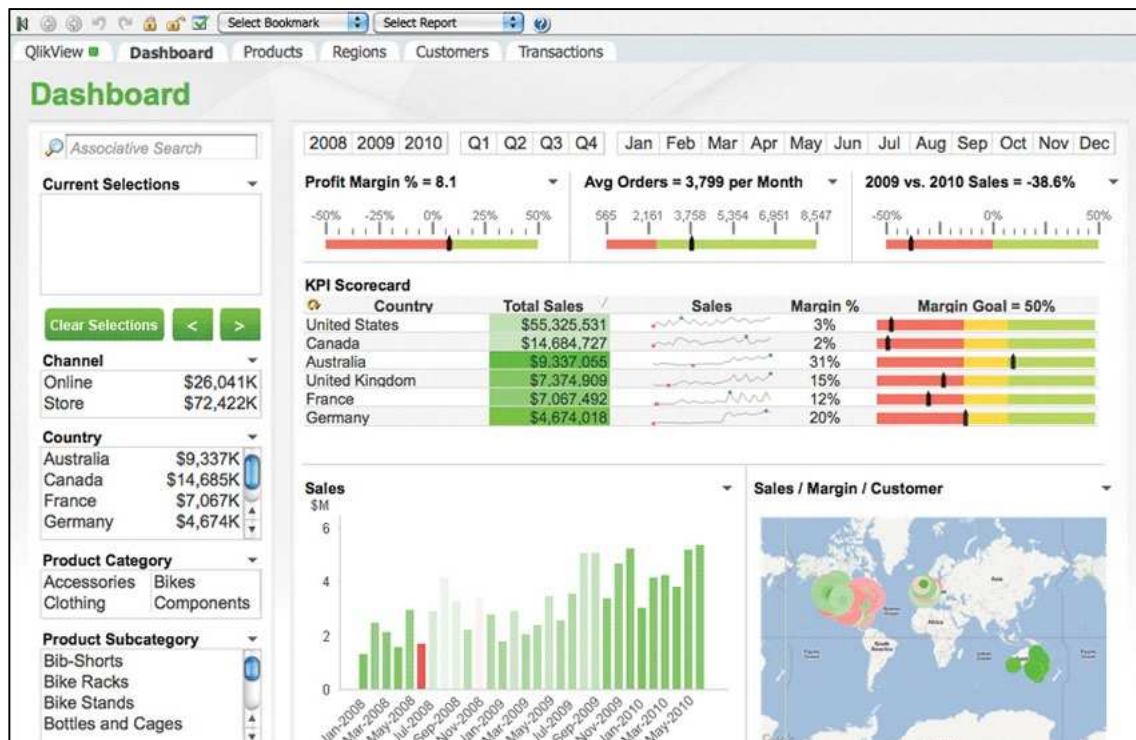
options can also be as effective as a QlikView dashboard where the data is analyzed along all the dimensions, only it takes a bit longer time than by QlikView.

Figure 13(a). Example of a Tableau Dashboard



Source: Tableau Website

Figure 13(b) Example of a QlikView Dashboard



Source: QlikView Website

It is clear that with both Tableau and QlikView effective and attractive dashboards can be designed, though the visual attractiveness of a QlikView dashboard is lower and it has fewer charts available for visualization. It depends merely on the skills of the user, the data, and the goal of the dashboard which software product should be preferred. QlikView seems to be suitable for IT people and data scientists, while Tableau is a self-service data visualization product which can be used by any kind of user. Some data can be analyzed best in Tableau, while other data analysis is more suitable by QlikView. When the data has to be analyzed along various dimensions with numerous categories, QlikView probably has better performance with respect to data discovery than Tableau.

3.6.8 Publishing and Sharing

There are several ways to publish and share your dashboard in both Tableau and QlikView. Next, we discuss the possibilities briefly.

In Tableau you can publish your dashboard as a Tableau Workbook to Tableau Server or Tableau Online. Instead of saving it to an internal or private cloud server, you can also save your workbooks to Tableau Public. In the latter case, everyone is allowed to view or interact with your workbook, and is able to retrieve all data from it. In case you do not have Tableau Server or you want to share your dashboard with someone without Tableau Server, you need to save your work as a packed workbook. A packaged workbook is a workbook which also contains the used file-based data sources (i.e., background images,

custom geocoding, custom shapes, local cube files, Microsoft Access files, Microsoft Excel files, and text files) and the non-file-based data sources (i.e., Tableau data extract files for SQL queries).

It is also possible to save or export work in Tableau. Tableau allows to save a document as a workbook (saves all open worksheets), a packaged workbook (saves the workbook with the file based and non-file-based data) or bookmarks (saves the active worksheet). The export function in Tableau provides the possibility to export data to an Excel worksheet or an Access database. It is also possible to make an image file from a worksheet or dashboard for use in another application. The print function can be used to publish to a PDF file.

In QlikView you can publish your documents through QlikView Server either with QlikView as a client or web client. QlikView Server provides a platform for hosting and sharing QlikView documents over the Internet and Intranet. It is also possible to send your document to someone who does not have QlikView Server, but that person needs to have a licensed version of QlikView desktop instead. An advantage is that a QlikView document (.qvw) contains all the information to reproduce the dashboard; there is no additional file-based and non-file-based local data needed as all the information is included in the QlikView document.

It is also possible to save or export work in QlikView. QlikView allows user to save their work as a QlikView document on local disk. Exporting tables, figures, and dashboards can only be realized by one of the following image files: Portable Network Graphics (.png), Joint Photographic Experts Group (.jpeg), Bitmap (.bmp), and Graphics Interchange Format (.gif). The print functions can be used to save dashboards and dashboard objects to a PDF file. The quality of an image or PDF file is however low; the output is stored with low resolution, which is a limitation of QlikView.

When the publishing and sharing features of Tableau and QlikView are compared, it turns out that there are only few differences: QlikView provides no possibility to realize applications sharing/interaction with someone who has no licensed version of QlikView, while Tableau provides free tool Tableau Reader for document sharing/interaction; a Tableau document that is sent to someone without Tableau Server has to be stored as a packed workbook and unpacked later on; and the exporting function of QlikView delivers inferior output.

3.6.9 Acquisition, Maintenance and Support Costs of Tableau and QlikView Software.

A good comparison between the acquisition costs of Tableau and QlikView is difficult to make. This is because the companies have adopted different license pricing models, the price specifications are often changing, and they are also not very transparent and clear to its potential buyers (which probably indicates that price negotiations are possible). Moreover, the acquisition costs depend on the IT architecture of the

company as well as the number of users and whether or not they should build or have access to dashboard applications. Finally, one should also keep in mind that the acquisition costs of a software product are usually much lower than the amount of money spent after the initial deployment (Sisense, 2014)

In order to make a straightforward comparison between the two software solutions, the next discussion only covers the acquisition costs and the costs for maintenance and support for internal use of the software. In **Tables 8 and 9** the acquisition and maintenance and support costs are given for Tableau and QlikView respectively. For convenience, all prices are converted into USD.

Table 8. The acquisition and maintenance and support costs of Tableau solutions

Tableau product suite	Costs/user	Remarks
<i>Tableau local versions (Desktop)</i>		
- Tableau Reader	Free	View and interact with local files
- Tableau Desktop Personal	\$999	Building dashboards, but with limited data connectivity
- Tableau Desktop Professional	\$1,999	Building dashboards with full data connectivity
<i>Tableau server products</i>		
- Tableau Server	Free	Minimum configuration: 1 Desktop Professional & 10 Web clients
- Tableau Desktop Professional	\$1,999	Building dashboards with full data connectivity
- Web Client Interactor	\$999	Viewing and interacting with dashboards
- Tableau Public	Free	Public non-commercial Tableau server
- Tableau Online	\$500	Private version of Tableau Public (no infrastructure needed)
<i>Maintenance and support</i>	25%	From second year onwards

Source: Website Tableau (2014)

Table 9. The acquisition and maintenance and support costs of QlikView solutions

QlikView Product Suite	Costs/user	Comment
<i>QlikView local versions (Desktop)</i>		
- Personal Edition	Free	Individual use only
- Local Client	\$1,350	One named user or machine identity has unlimited rights
<i>QlikView Server</i>		
- Small Business Edition Server	\$8,400	Up to 25 named users licenses and 100 document licenses
- Enterprise Edition Server	\$35,000	More than 25 named users or 100 document licenses
- Named User License	\$1,350	One named user or machine identity has unlimited rights
- Document License	\$350	License is associated with one document and one user
- Concurrent License	\$15,000	Allows one arbitrary user to have access to one document
<i>Maintenance and support</i>	20%	From second year onwards

Source: Website Qlik (2014)

The total cost of ownership depends on several factors such as the number of users, the proportion of designers and viewers/interactors, the type of business intelligence (many different dashboard applications or a few dashboard applications that are spread among many users throughout the whole company), the predictability of which users should have access to the dashboard applications and whether or not a cloud-based server solutions should be adopted.

The pricing model of Tableau is simple and transparent. It is merely based on the number of users, the user types, and whether or not a private cloud is used for viewing and interacting with the dashboards. In fact, the cost of ownership increases linearly with the number of users, so the only decisions to be made are related to how many users should design dashboard applications, how many users should have access to the dashboard applications for viewing or interacting with them, and whether or not for a hosted cloud solution should be chosen.

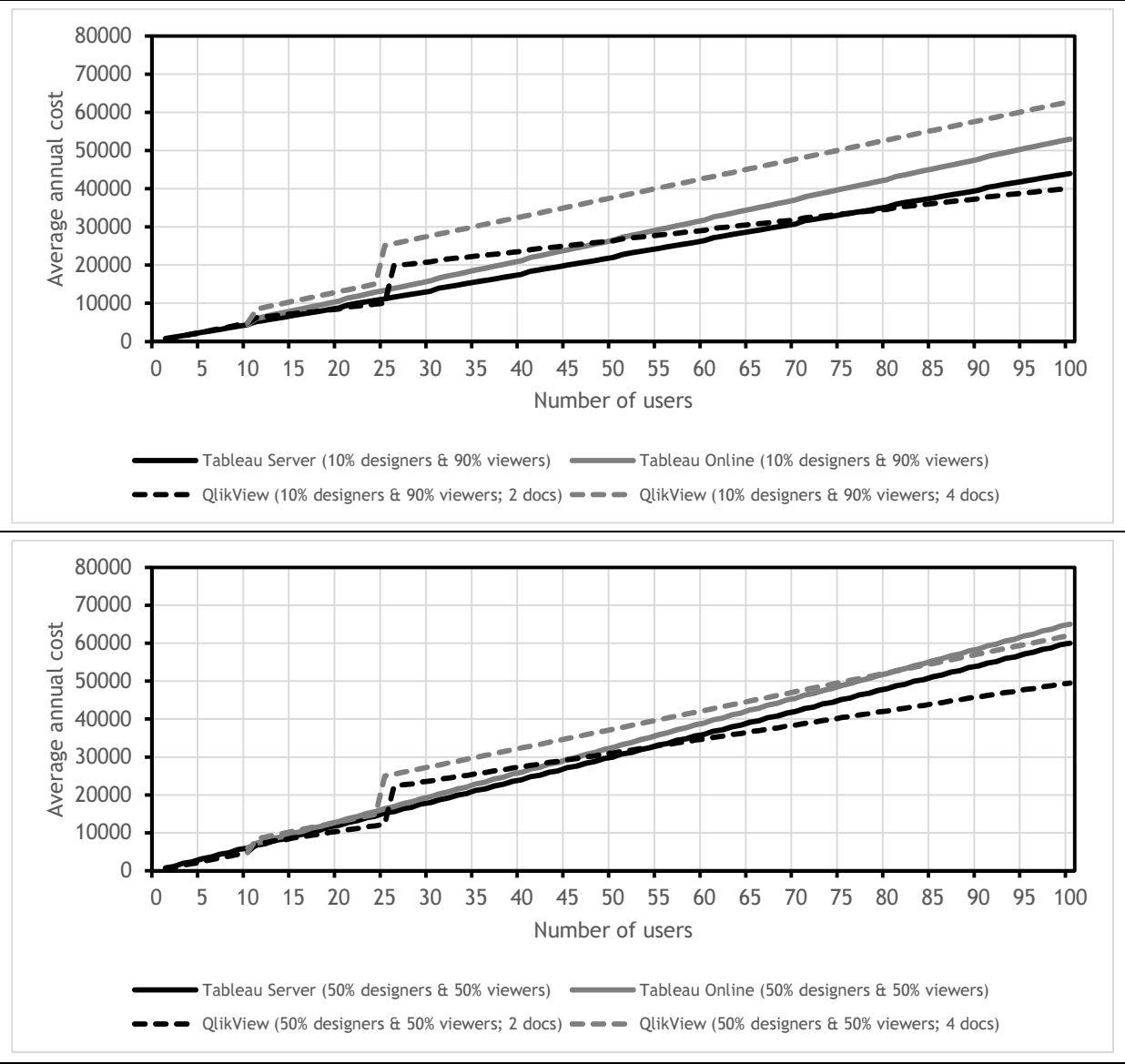
The pricing model of QlikView is more complex because of the additional costs associated with the acquisition of the Small Business Edition Server or Enterprise Edition Server and the document license costs for viewing or interacting with one particular document. In addition, for infrequent users in the company they also have included the option of a concurrent license.

In order to understand the differences between the pricing models of Tableau and QlikView, I have set up 12 instances to find out which criteria are relevant in the acquiring process. The costs will be compared up to 100 users and for a five-year period. The first year costs are equal to the acquisition costs; the costs from the second year onwards are equal to the costs for maintenance and support, which account for respectively 20% of the acquisition cost for QlikView and 25% of the acquisition cost for Tableau. The following 12 instances will be considered in the analysis:

- Tableau Server (10% designers and 90% viewers/interactors)
- Tableau Server (50% designers and 50% viewers/interactors)
- Tableau Server (90% designers and 10% viewers/interactors)
- Tableau Online (10% designers and 90% viewers/interactors)
- Tableau Online (50% designers and 50% viewers/interactors)
- Tableau Online (90% designers and 10% viewers/interactors)
- QlikView Server (10% designers and 90% viewers/interactors; 2 document licenses each)
- QlikView Server (50% designers and 50% viewers/interactors; 2 document licenses each)
- QlikView Server (90% designers and 10% viewers/interactors; 2 document licenses each)
- QlikView Server (10% designers and 90% viewers/interactors; 4 document licenses each)
- QlikView Server (50% designers and 50% viewers/interactors; 4 document licenses each)
- QlikView Server (90% designers and 10% viewers/interactors; 4 document licenses each)

In **Figures 14 and 15** the average cost per year and the average cost per year per user are shown up to 100 users for the above-mentioned instances. Each subfigure considers one particular ratio of designers to viewers for each of the four software solutions.

Figure 14. Average Annual Acquisition, Maintenance and Support costs of Tableau and QlikView for a 5-year Period



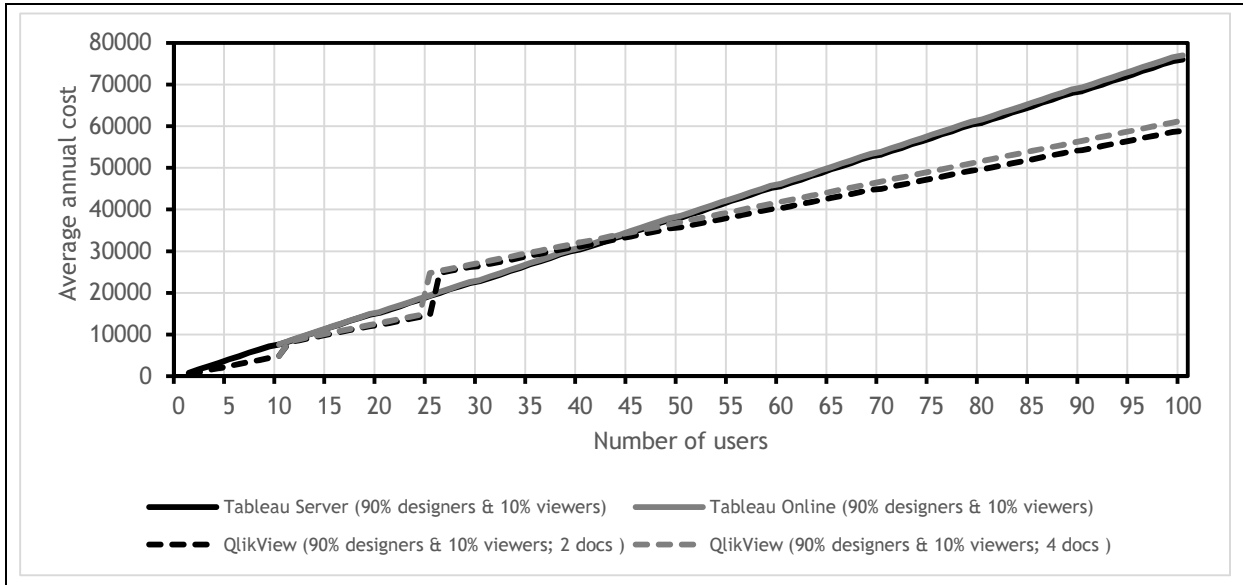
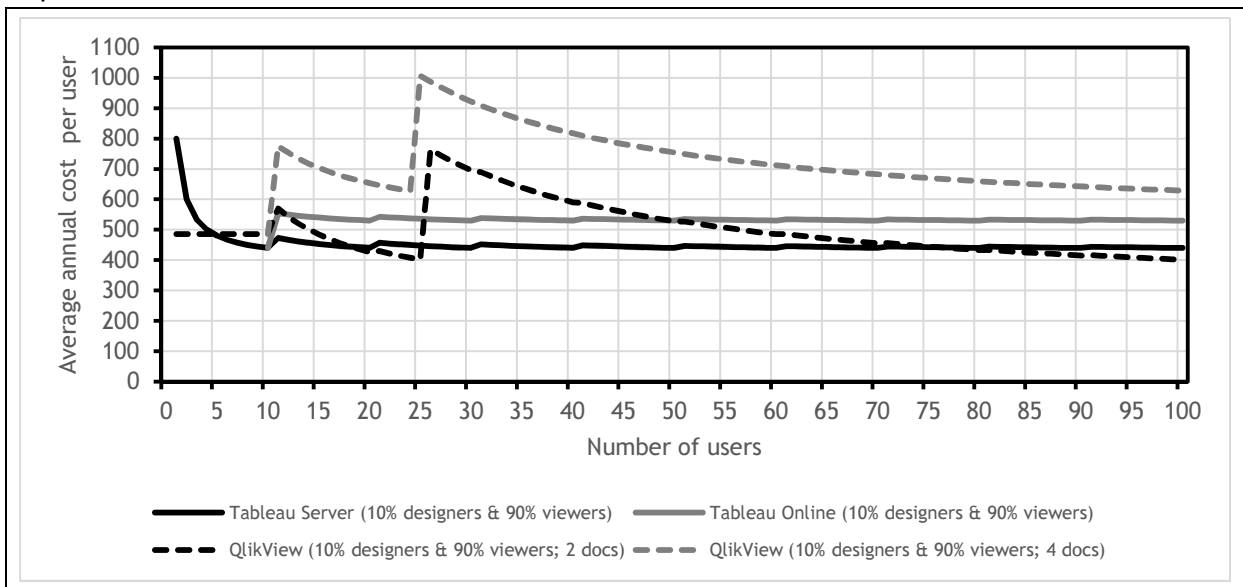
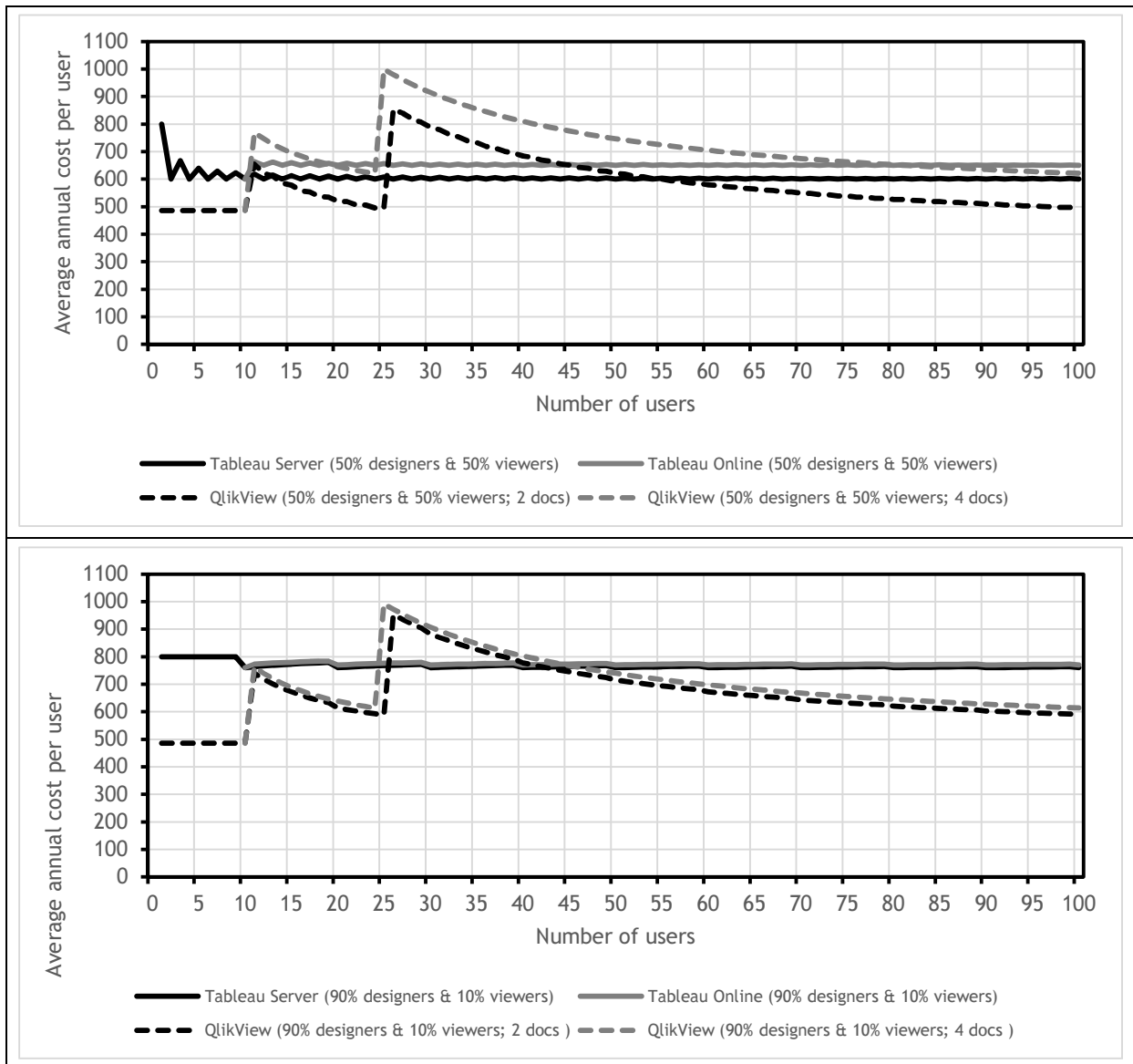


Figure 15. Average Annual Acquisition, Maintenance and Support Costs per User of Tableau and QlikView for a 5-year Period





The main findings of the costs comparison are the following:

- The annual costs of Tableau and QlikView increase linearly with the number of users.
- The higher the share of dashboard designers, the higher the annual costs.
- The cost difference between Tableau Server and Tableau Online decreases when the share of dashboard designers increases, and becomes zero when it reaches 100%. Then, the maintenance costs of Tableau Desktop Professional equal the costs of Tableau Online due to the fact that maintenance and support costs of Tableau Desktop Professional are 25% of the acquisition costs.
- High acquisition costs and maintenance and support costs are associated with QlikView when the number of named users exceeds 25 and/or more than 100 document licenses are needed. The jump in costs is due to the fact that purchasing QlikView Enterprise Edition Server costs 35,000 USD. This makes QlikView quite expensive compared to Tableau when the number of dashboard designers is higher than 25 and lower than 50.

- The pricing model of QlikView is competitive with Tableau as long as the number of document licenses per user is small (1 or 2) and the total number of document licenses is limited to less than 100. In case that every QlikView interactor has 4 document licenses, the annual costs of QlikView are usually much higher than those of Tableau.
- When there are many infrequent users, QlikView provides a concurrent license to reduce costs. However, one should not forget that 11 named user licenses cost exactly the same as 1 concurrent license. Thus, a concurrent license is only beneficial in the situation where there are many infrequent users whose identity is not known before using the software.
- QlikView software is less scalable than Tableau software because of the high costs involved in acquiring the Enterprise Edition Server when the number of named user licenses or document license has to be increased.
- When there are many large dashboard applications to be developed and used in the company, QlikView requires a lot of server memory to handle all the data volumes. Since RAM is much more expensive than storage capacity on hard disk, these costs should also be incorporated in the total cost of ownership.

Chapter 4 Conclusion

This paper has described and applied a methodology to compare the BI tools for data visualization. The BI tools that have been evaluated in the study are Tableau (version 8.3) and QlikView (version 11.2). The following aspects are discussed in my research study:

- Hardware specifications
- Data connectivity
- BI technology
- Operation of the software
- Acquisition, maintenance, and support costs.

In this chapter, I only report the main conclusions of the comparison.

I did not find major differences between the hardware specifications and the data connectivity of the two software applications. In some aspects Tableau has a better performance; in other aspects QlikView. First, QlikView does not support OS X, the operating system of Apple, so business people cannot install and use QlikView on an Apple computer or laptop. People that are loyal to Apple will therefore not consider QlikView as a desktop solution for their business. Second, for enterprises with huge and numerous databases as well as a large number of regular and infrequent users, QlikView is also less attractive as it requires more challenges to set up an effective network architecture and more memory management efforts of the IT department. However, Qlikview has more data connectivity possibilities than Tableau and has built-in ETL to connect to unstructured data, but since Tableau can connect also to all common data sources in the market, this asset of QlikView is non-essential.

Tableau and QlikView use divergent technologies for data discovery and data visualization. Tableau uses a disk- and query-based technology, while QlikView utilizes an in-memory associative technology. The in-memory technology of QlikView heavily relies on RAM memory. The QlikView technology allows users to experience instantaneous responses on selections, while data analytics in Tableau take a little longer to process the query. However, QlikView needs to reload the application data every time the source data is updated, which is not the case for Tableau.

The operation of the software is more distinctive. Tableau has a very intuitive graphical user interface with drag-and-drop technology. It is possible to create brilliant charts, tables and other visualizations with just a few mouse clicks in short time. The arsenal of charts for data analysis of Tableau is also impressive and Tableau outperforms QlikView with respect to multidimensional analysis. Moreover, Tableau requires no additional packages for mapping and statistics as these features are built-in in the software.

With respect to ease of operation and visualization capabilities it seems that QlikView is not yet fully mature. The menu structure and tabs of the submenus are illogical and sloppy, and the features for visualization are limited compared to Tableau. It is possible to extend the software features by extensions (such as GeoQlik for mapping) and connections to other software packages like the statistical R project, but it requires additional costs and IT challenges for users. The quality of the exported files by QlikView

is also disappointing. Tableau provides visualizations with much higher granularity than QlikView. The main two strengths of QlikView are the scripting editor, which gives the developer a lot of freedom to create effective dashboards, and the instantaneous selection filter, which allows the data analyst to search through the data along all dimensions in real time and makes real data discoveries possible.

It depends on the user which of the two software programs should be preferred. When the goal is to build beautiful, rich, powerful dashboards to create business value, Tableau can be a better choice. Tableau is also user-friendly, and can be operated by all kinds of people such as data scientists, data analysts, business analysts, and managers. When the goal is to discover useful information from large data sets, QlikView is probably better. However, it requires more skills from its users such as SQL, programming, statistics, and IT skills. Therefore, I think that QlikView is more ideal for academic researchers or data scientists, or enterprises which have a skillful IT department and data scientists to rely upon.

The total cost of ownership is also relevant in the decision-process of acquiring new software. In my study I have sketched many scenarios in order to compare the pricing model of Tableau and QlikView. From the evaluation it turns out that both software products come with free versions (Tableau Public and QlikView Personal Edition), but that these products are not suitable for small and medium business and enterprises. In order to compare the costs of Tableau and QlikView one has to consider the costs of local clients in a non-server environment and local clients operated in a server environment.

Both Tableau and QlikView are competitive with respect to the costs of purchasing a local client. Tableau Desktop Personal costs \$999, but has limited data connectivity. Tableau Desktop Professional costs \$1,999 and comes with full data connectivity. The local client of QlikView has a cost of \$1,350 and has full data connectivity as well.

In a server setting, the pricing models are different. The annual costs of both Tableau and QlikView increase linearly with the number of users, but while Tableau has adopted a simple licensing structure (developer and viewer/interactor), Qlikview employs licenses with some certain limitations that are also difficult to be understood by its (potential) customers, i.e., one or multiple document license and a concurrent license.

The total cost of ownership of Tableau and QlikView does not only depend on the number of users only, but also on the distribution of the license types among them. The pricing model of QlikView is competitive with Tableau as long as the number of document licenses per user is at most 2 and the total number of document licenses is less than 100. In that scenario, no expensive Enterprise Edition Server is needed. If QlikView users purchase more document licenses, the annual costs of QlikView are usually higher than the annual costs of Tableau. In situations where an enterprise has many infrequent users or users that only need to interact with a single document, the concurrent and document licenses of QlikView give some additional control of keeping the acquisition costs low. Another finding is that QlikView is less scalable than Tableau because of the high costs involved in upgrading from the Small Business Edition Server to the Enterprise Edition Server when the number of named user and document licenses must be increased. And because of its in-memory technology, an upgrade of QlikView can result in more memory requirements for the server and higher hardware costs.

The differences between Tableau and QlikView are summarized in **Table 10**.

Table 10. Summary of the differences between Tableau and QlikView

	Tableau	QlikView
Hardware specifications		
- Operating systems	Windows and Mac computers	Only Windows computers
- Processor	Single- and multiple-core processors	Only multiple-core processors
- Memory	Low RAM requirements	High RAM requirements
Data connectivity		
- Data sources	Connects to 33 data sources	Connects to 49 data sources
- ETL	No ETL	Built-in ETL
BI technology		
- Used technology	Disk-based operation	In-memory operation
	VizQL™	Symbol compression
	Powerful data engine	Associative technology
Operation of the software		
- Documentation	Many documentation sources available.	Many documentation sources available; less than Tableau.
- Importing and loading data	Intuitive wizard	Wizard and script-editor, not intuitive
- Graphical User Interface	Thoughtful and intuitive GUI	Non-intuitive interface; illogical submenus
	Drag and drop	Associative interface
	Real time visualizations	Instantaneous responses
- Visualization tools	Standard tables and charts available, and several other useful charts	Standard tables and charts available. Less useful 3D and faded charts.
- Mapping	Integrated in the software. Custom maps can only be made via polygon files. No support for shapefiles.	Mapping requires an extension (e.g., GeoQlik). No clean filled maps. Support for shapefiles. Mapping feature not so intuitive.
- Trend Lines, Statistics and Forecasting	Built-in in the software. Easy to use.	No built-in statistical package. Connection with R-project. Requires expert knowledge of statistics and R.
- Dashboards	Many types of filters available (e.g., sliders, select menu and checkbox). Special worksheet for dashboard. Good visual output.	Only selection filters. No special worksheet for dashboard. Visualization objects lack a good presentation.
- Publishing and sharing	Many ways to publish and share your workbook. Disk-based technology requires saving a dashboard as packaged workbook to share it. Tableau Reader allows viewing dashboard for free. High-quality output.	Many ways to publish and share your QVW files. No free reader available. Exporting to PDF and saving images give inferior output (low resolution).
Target group	Any kind of user.	IT expert, data scientist, and programmer. Meant for hierarchical organizations.

Acquisition, maintenance, and support	Simple pricing model. Fixed price per user. Easy to scale.	Competitive pricing model. Upgrading licenses can be expensive. Cost can be managed by document and concurrent license. RAM requirements may increase IT cost.
----------------------------------------------	---------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------

Altogether, it is not straightforward to choose one of the software programs over the other. QlikView seems to be more suitable for large enterprises with a hierarchical structure in which a skillful IT department, and/or data scientists are in place to make effective dashboards for other departments business users. On the contrary, Tableau is suitable for any kind of user, ranging from data scientist to manager. Also the type of end user and the purposes matter when choosing between Tableau and QlikView. It is important to know who is going to use the dashboard applications and the purpose of the usage. Do they have an analytical or IT background, or are they just interested in information presented in a simple way? Are the dashboards meant for internal use or for external use? And what are the requirements for the quality of the visualizations shown on a dashboard? And should the analysis focus only on data discovery? Once all these questions are answered one can then take the acquisition, maintenance and support costs into the evaluation. All in all, there is no straight answer to the question of which BI platform one organization should choose. One must take multiple factors into account before making purchasing decision.

References

- Davenport, T. H. (2006) 'Competing on Analytics', Harvard Business Review January 2006.
- Eckerson, W. (2014) 'Myths of Predictive Analytics', www.bi-bestpractices.com 2014.
- Forrester Research (2013) 'The Forrester Wave™: Enterprise Business Intelligence Platforms' Q4 2013.
- Gartner (2014) 'Magic Quadrant for Business Intelligence and Analytics Platform', February 2014.
- Grimes, S. (2008) 'BI at 50 Turns Back to the Future' (2008 www.informationweek.com).
- Heinze, J. (2014) 'History of Business Intelligence', (September, 2014 www.Bisoftwareinsight.com).
- Lukevich, M., Vitt, & Misner, S. (2002) 'Business Intelligence', Microsoft Press.
- Murray D. G. (2013) 'Tableau Your Data! Fast and Easy Visual Analysis with Tableau Software', Published by John Wiley & Sons, INC November 2013.
- Nandeshwar, A. 'Tableau Data Visualization Cookbook', Published by Packt Enterprise 2013.
- Olszak, C. M. & Ziemba E. (2007) 'Approach to Building and Implementing Business Intelligence Systems', Interdisciplinary Journal of Information, Knowledge and Management Vol 2, 2007.
- Peck G. 'Tableau 8: The Official Guide', Published by McGraw-Hill Education 2014
- Power, D. J. (2008) 'Understanding Data-Driven Decision Support Systems', Information System Management 25:149-154.
- Qlik (2010) 'The Associative Experience: QlikView's Overwhelming Advantage', A QlikView Technology White Paper, October 2010.
- Qlik (2011) 'QlikView Scalability Overview', A QlikView White Paper, April 2011.
- Qlik (2013) 'QlikView Reference Manual'.
- Tableau Website (2013) 'Tableau Server Scalability Explained', A Tableau White Paper, July 2013.
- Tableau (2014) 'User guide for Tableau Desktop Version 8.3', November 2014.
- Ranjan, J (2005) 'Business Intelligence: Concepts, Components, Techniques and Benefits', Journal of Theoretical and Applied Information Technology Vol 9, 2005.
- Sawka, K. A. (1996) 'Demystifying Business Intelligence', Management Review October 1996.
- Sisense (2014) 'Cutting the Cost of Business Analytics', A Sisense White Paper, October, 2014.

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Datum: **19/01/2015**