Flexible Reports in Ericsson MSDP

Master of Science Thesis in Computer Science and Engineering, Interaction Design

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ABSTRACT

Report Viewer in the Ericsson MSDP is in its current form not being used as intended. Customers of the system only extract data from it to then use in their favorite data visualization tool. Additionally, a lot of users who would benefit from using Report Viewer avoid it thinking it is too hard to use. The task of this project is to evaluate other existing reporting systems and choose one to build a working prototype from. This prototype should allow users to both view and create their own reports and should accommodate the current users of the system, but also users who have no previous experience from using Report Viewer.

During evaluation both commercial and free reporting systems were looked at and in the end four were considered for use in the final prototype, BIRT being the one eventually chosen. Designing and prototyping was done in iterations in order to exclude as many usability problems as possible and each iteration was tested on a set of test users. In the end a web based prototype built on the BIRT report engine was implemented and tested.

TERMINOLOGY

Ericsson SA SD&P	The name of the division of Ericsson that is responsible for the MSDP.
MSDP	Mobile Service Delivery Platform A system for mobile content delivery.
jQuery	A JavaScript library www.jquery.com
jQuery UI	An extension to the jQuery library www.jqueryui.com
SQL	Structured Query Language The language used for managing data in a relational database.
JSP	Java Server Pages Java technology that allows for dynamically generated web pages.
Microsoft Expression Blend	User interface design tool http://www.microsoft.com/expression/products/blend_overview.aspx

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1 INTRODUCTION

Today’s mobile phone market is more competitive than ever and operators are fighting over every last user available. This is in many cases done by offering the best and newest phones or the cheapest subscription. But it can also be done by offering new services and marketplaces for users to take advantage of. In order to evaluate whether or not these investments have been successful the operators need a way to collect and analyze user statistics.

With the amount of customers operators have this is not possible to do by hand but has to be handled by a type of software systems called Business Intelligence (BI) Tools. They are designed to gather information from a system, analyze the data and finally present the result to the user.

The presentation is one of its more crucial parts, since if the user is unable to comprehend or draw meaningful conclusions from the information presented, the data is useless. There are a couple of ways this data can be presented, first of which is long tables, which quickly become difficult to read. The more useful way is to display the data as graphs and diagrams in which patterns and trends are much easier to spot.

1.1 ERICSSON AND MSDP

Ericsson is a world leading provider of telecommunication equipment with almost half of all mobile calls passing through an Ericsson designed system. Though this is the area where Ericsson is the most prominent they have many things in their portfolio. The most well known to most people is their joint venture in consumer electronics with Sony in making mobile phones.

Among their products focused at the media industry is the Ericsson Mobile Service Delivery Platform (MSDP). The MSDP was originally developed by Drutt Corporation which Ericsson bought in 2007. Drutt was converted into Ericsson SA SD&P and they are still developing the MSDP.

The Ericsson MSDP is a part of Ericsson Service Delivery Platform which is a solution for service providers to be able to act quickly to changing markets. MSDP is a product that out of the box supports all essential aspects of running a mobile service marketplace. Through it, any type of mobile offers can be marketed, sold and delivered to a consumer. It allows operators to deliver any type of content to any type of mobile device over any type of network.

1.2 BUSINESS INTELLIGENCE AND REPORT SYSTEMS

The concept of report systems is a part of what is called Business Intelligence. Business Intelligence is not a new term; it was used by an IBM researcher in an article in 1958 defining intelligence as "the ability to apprehend the interrelationships of presented facts in such a way as to guide action towards a desired goal. (Luhn, 1958). Howard Dresner proposed Business Intelligence as a term to cover "concepts and methods to improve business decision making by using fact-based support systems." (Power, 2007) This meaning did not become widespread until the late 1990s.

Today the term Business Intelligence encompasses a wide range of concepts, including business methods and different technologies, e.g. Online Analytical Processing (OLAP) which is typically used in marketing, budgeting and financial reporting. This has lead to BI systems that are very large and complex in order to handle all these aspects.

Business intelligence consisted for a long time of only data access tools; the rest was up to the user to figure out. In recent years more and more providers of BI systems have moved towards an ad hoc approach. This means allowing for freer exploring of data and the creation of unique and time specific reports as opposed to the more conventional static report. An example of an ad hoc reporting system would be TIBCO Spotfire (Bus10).

The current MSDP report viewer only offers a set number of static reports where the only options available are date and time. Ericsson wishes to move away from this static approach to a more dynamic, or ad hoc, solution that enables the end users to create their own reports when they actually need them.

Since Ericsson only wants to replace the MSDP report viewer most current BI systems are too large and complex and the companies providing BI solutions usually do not offer a single component. Another argument against a complete BI suite is that the MSDP report viewer is part of the MSDP system which they ship to their customers. Should they purchase a BI system it would either mean that their customers has to pay more for the MSDP or Ericsson would have to pay license fees for each copy sold.

Report systems focus on gathering data, doing calculations on it and presenting it to the user either as text or as charts and graphs. It enables humans to read and comprehend large amounts of information at once. Such a system can provide the user with either detailed information about a certain aspect, e.g. day-to-day sales, or a number of different aspects at once, i.e. a dashboard system such as TIBCO Spotfire.

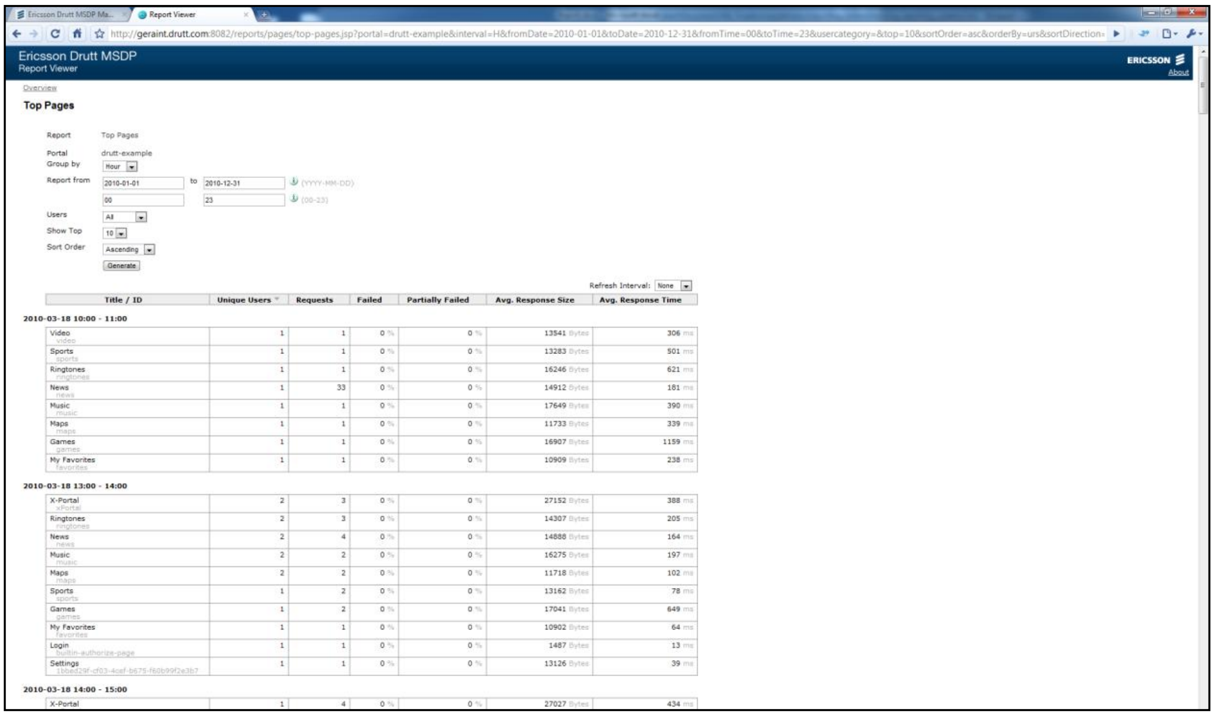
Report systems focus on gathering data, doing calculations on it and presenting it to the user either as text or as charts and graphs. It enables humans to read and comprehend large amounts of information at once. The system can have one of two major styles to it; the traditional style of having a system where all data is available and details is the focus, and the newer dashboard style system. The dashboard style can be like looking at a map of an area compared to a satellite image. The map does not show you the exact details of things but is on the other hand very easy to glance at and receive all the information you need for setting a strategy to get you somewhere.

Much like a dashboard in a car, a dashboard collects information from many different systems and presents them in a single place and in a cohesive format or as defined by Stephen Few (Few, 2006): “A dashboard is a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance.”

1.3 MSDP REPORT VIEWER

The current report viewer in MSDP is not so much a presenter of data as it is an access point to the data in the report. As can be seen in Figure 1 it is divided into two parts, parameter settings at the top and data presentation at the bottom. The parameter settings allow the user to select for which time span she wants to see the data, how it should be sorted and the time resolution, e.g. hours or months.

The bottom part is where the data is shown in a table. Depending on the parameter settings and what report the user has selected this table can be of varying length. Once the table becomes too long or divided into too many sections (seen in the figure as bold text between the grids) it becomes almost impossible to read.



http://geraint.drutt.com:8082/reports/pages/top-pages.jsp?portal=drutt-example&interval=H&fromDate=2010-01-01&toDate=2010-12-31&fromTime=00&toTime=23&usercategory=&top=10&sortOrder=asc&orderBy=urs&sortDirection=

Ericsson Drutt MSDP
Report Viewer

Overview

Top Pages

Report	Top Pages
Portal	drutt-example
Group by	Hour
Report from	2010-01-01 to 2010-12-31 (YYYY-MM-DD)
	00 23 (00-23)
Users	All
Show Top	10
Sort Order	Ascending

Generate

Refresh Interval: None

Title / ID	Unique Users	Requests	Failed	Partially Failed	Avg. Response Size	Avg. Response Time
2010-03-18 10:00 - 11:00						
Video video	1	1	0 %	0 %	13541 Bytes	306 ms
Sports sports	1	1	0 %	0 %	13283 Bytes	501 ms
Ringtones ringtones	1	1	0 %	0 %	16246 Bytes	621 ms
News news	1	33	0 %	0 %	14912 Bytes	181 ms
Music music	1	1	0 %	0 %	17649 Bytes	390 ms
Maps maps	1	1	0 %	0 %	11733 Bytes	339 ms
Games games	1	1	0 %	0 %	16907 Bytes	1159 ms
My Favorites favorites	1	1	0 %	0 %	10909 Bytes	238 ms
2010-03-18 13:00 - 14:00						
X-Portal xPortal	2	3	0 %	0 %	27152 Bytes	388 ms
Ringtones ringtones	2	3	0 %	0 %	14307 Bytes	205 ms
News news	2	4	0 %	0 %	14888 Bytes	164 ms
Music music	2	2	0 %	0 %	16275 Bytes	197 ms
Maps maps	2	2	0 %	0 %	11718 Bytes	102 ms
Sports sports	1	2	0 %	0 %	13162 Bytes	78 ms
Games games	1	2	0 %	0 %	17041 Bytes	649 ms
My Favorites favorites	1	1	0 %	0 %	10902 Bytes	64 ms
Login builtin-authorize-page	1	1	0 %	0 %	1487 Bytes	13 ms
Settings 1bbed29f-cf03-4oef-b675-f60b99f2e3b7	1	1	0 %	0 %	13126 Bytes	39 ms
2010-03-18 14:00 - 15:00						
X-Portal	1	4	0 %	0 %	27027 Bytes	434 ms

Figure 1. The current MSDP Report Viewer showing the top 10 pages over the year 2010.

1.4 PURPOSE

The purpose of this project is to analyze the current reporting tool present in the Ericsson MSDP product and to investigate other existing reporting systems. This together with input from Ericsson's MSDP customers will serve as the basis for creating a new reporting tool to help customers with analyzing large amounts of mobile user statistics.

It will be designed to empower the users and allow them to create their own reports instead of having to go through Ericsson. This will in turn help to ease the work load on the developers, allowing them to work on more important tasks. Also, by improving the usability from the current version it is hoped that it will extend the user base and allow more people to access the information directly.

1.5 SCOPE

Due to the amount of data in the current Report Viewer this master thesis is only focusing on reports covering normal mobile portal usage, e.g. what pages have been accessed the most and which service was most popular. However, steps should be taken in the prototype to not obstruct any future development in other areas.

The scope focuses on creating a reporting system to incorporate into Ericsson's product instead of just finding an existing BI system. The reasoning for this is Ericsson's desire to preserve the completeness of the MSDP as a standalone product and to ship it without incurring additional licensing fees.

It was also necessary to develop a new database schema to hold the report data. However, since this was not the focus of the thesis little time was spent on it and aspects such as efficiency and space requirements was not taken into account.

2 DESIGN METHODOLOGY

This chapter concerns methods applied during the project and the reason behind using them. Methods for gathering information about the current system and user feedback were applied to provide a base to launch the design and implementation processes from.

2.1 PRESTUDY

During the past couple of years a number of usability studies and usability work shops have been performed with various companies that have purchased the Ericsson MSDP. A lot of the focus has been on the portal composer and designer applications which are more widely used out at the operators. The information regarding the Report Viewer has been used as the base feedback for the thesis since it involves several companies and has some real world users' thoughts and needs.

2.2 USER BASE

In order to complement the already existing information, new and more focused user feedback was needed. The user base for the Ericsson MSDP administrative tools is currently very small, on average one or two users per operator. These people do almost all work on the MSDP, i.e. creating and managing portals, adding content and extracting reports. They have learned the application over a long period of time and have a large amount of computer experience which according to Faulkner means they can be considered expert users. (Faulkner, et al., 2005)

These users are normally the only ones working directly with the system; others are only using the results from it. They are therefore faster at recognizing new needs and requirements than others and will in most cases be the ones benefiting from satisfying those needs. Von Hippel calls these users 'Lead Users' and together with Herstatt (Herstatt, et al., 1992) they recognized that 'users who have real-world experience with a need can provide the most accurate data regarding it' and have most likely experimented with solutions to those needs. Since the MSDP is a software system it is highly unlikely that the end-users have created anything to ease their problems in using it. However, the fact remains that they are most likely to provide accurate and beneficial information about the system.

Even though expert users may provide the most information about a system Faulkner and Wick discusses that having both novice and expert users will gather information otherwise not found when only having one user group. However, for the prestudy for this project it was determined that involving novice users to gather feedback on the current system would prove too time-consuming for two main reasons:

1. The novice users have either never used the system or only used it a couple of times which means they won't know what they need.
2. The novice users are employees that Ericsson rarely has any contact with making it difficult to arrange anything within a reasonable time span.

2.3 USER FEEDBACK

Karlsson talks in her paper about question based methods for information gathering; interviews, phone interviews, focus groups and questionnaire (Karlsson, 2009). While interviews provides the most flexible method for information gathering it also assumes the interviewer and interviewee has the time and possibility to assemble at one location.

Questionnaire on the other hand, is very rigid, there is no possibility for probing, but it is very flexible in that the interviewer and interviewee do not have to be at the same place and the interviewee can do the questionnaire when it suits her. Karlsson also talks about questionnaires (or phone interviews) being of great value for gathering information about the attitudes of the user base and its repeatability.

Due to the geographical spread of the customers a questionnaire was deemed the easiest and most efficient method for gathering user feedback. In addition, a questionnaire can be sent to an Ericsson representative at the customer who can then distribute it to the right people. This will minimize the administrative effort of all parties involved, as there will be no back-and-forth communication taking time.

2.4 HEURISTIC EVALUATION

Heuristic evaluation (Nielsen, et al., 1990) is a method for finding existing usability problems in an interface design. It involves having a few evaluators study the interface design and check how well it complies with a set of heuristics (See 2.4.1). The evaluator performs the inspection alone and only talks to the other evaluators once done and the results are to be collected into a set for further analysis. This is to ensure that the evaluators do not influence each other.

Evaluation is done in several passes of the interface; the first one focusing on getting a feel for how the interface works as a whole while the following passes goes into more detail. Although this is the recommended approach, evaluators can choose their own way of conducting it.

Some evaluations are done on interfaces which are either not completed or operate something very complex. For such evaluations it is useful using a technique where an observer that is familiar with the system is present. This is to help out with problems due to lack of domain expertise and take notes when the evaluator is using the system and commenting on how it is built. Similarly, it is possible to evaluate systems that still only exist on paper with this method since the evaluators are not really using the system to accomplish something, but inspecting how it works.

The analysis results depend, as with many types of analysis, on the evaluators. Having too few will result in not finding enough of the problems existing in the interface. Having too many is often unnecessary, finding the same faults multiple times instead of finding new ones. Like so many other things it will likely come down to cost, both time and money. Nielsen (Nielsen, et al., 1990) did some research into his own projects and derived the proportion of usability problems found compared to how many evaluators that were used. His results were that five evaluators are reasonable and you should use at least three. (See Figure 2) He also emphasises that if the use of the evaluated system is mission critical, you should use more evaluators to catch as many faults as possible.

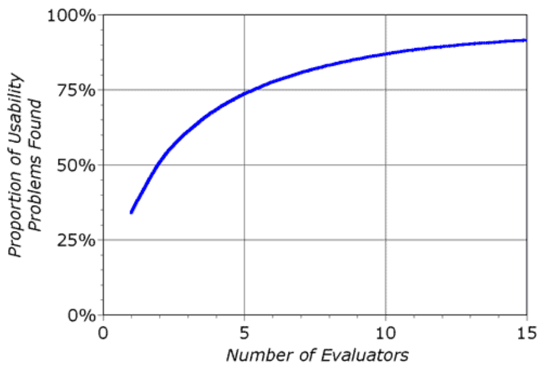


Figure 2. Diagram from Jakob Nielsen showing the Proportion of Usability Problems Found in relation to the number of evaluators.

An add-on to the standard heuristic evaluation is to grade each violation with a severity rating on a scale of 0 to 4. This is done by all evaluators on the violations found. A 0 indicate that there is probably no usability problem at all and a 4 indicates a catastrophe. When grading each violation the following criteria are taken into account; frequency, impact, persistence and market impact.

The purpose of using heuristic evaluation as opposed to any other usability method is to quickly identify shortcomings in the current user interface. This enables the project to quickly move into, and through, an iterative design process without sacrificing usability along the way. It is also a very flexible method with regard to the size and complexity of the interface or interface element being evaluated. Heuristic evaluation can be used on individual interface elements such as dialog windows, e.g. a settings window. This makes it possible to use the method throughout the development process.

The usability heuristics used in the analysis of this thesis project was the ones Jakob Nielsen developed together with Rolf Molich and last revised for maximum explanatory power in 1994. (Nielsen, et al., 1994)

2.4.1 USABILITY HEURISTICS

Visibility of system status

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

Match between system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

User control and freedom

Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialog. Support undo and redo.

Consistency and standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Error prevention

Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

Recognition rather than recall

Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialog to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Flexibility and efficiency of use

Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

Aesthetic and minimalist design

Dialogs should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialog competes with the relevant units of information and diminishes their relative visibility.

Help users recognize, diagnose, and recover from errors

Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

Help and documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

2.5 DESIGN AND IMPLEMENTATION

The design and implementation phases were divided into two parts, one that dealt with the database and one with the actual prototype.

2.5.1 THE DATABASE

Since the design and development of the database was not a prioritized task for the project, there was no time to create multiple designs or to revise the implementation once completed. This process was therefore very straightforward, following a waterfall model-like approach (Figure 3), with one design phase and one implementation phase followed by augmentation if necessary.

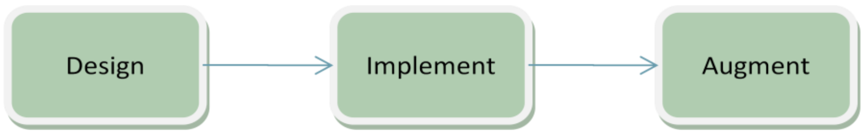


Figure 3. The workflow for the database construction.

2.5.2 THE REPORT VIEWER

The design and implementation of the report viewer was done iteratively and separately. This means the initial design together with prototyping was iterated over until a satisfactory prototype had been produced (Figure 4). This was not done with a new interface each iteration but rather focused on individual interface controls or elements. The advantage of this was that a great number of versions could be produced in a short amount of time. The complete prototype was then tested with users (see chapter 6.3 and 7.4) and changes made according to the given feedback.

Once the prototype had been properly modified it was used as the basis for the implementation. Each interface element was implemented separately just as in the design stage. They were also informally evaluated with respect to the ten usability heuristics (Nielsen, et al., 1994). If any element or control did not work as intended after implementation it was redesigned one or several times before being implemented again and reevaluated. Again, this allowed for several redesigns in a short period of time.

Once the implementation was complete it was subjected to user testing to get feedback on the function and form of the elements and controls and also how the different elements interacted with each other in a context.

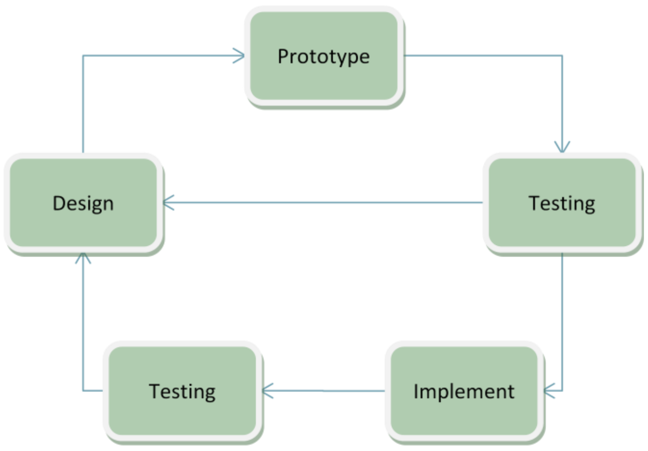


Figure 4. Rough workflow of the design and implementation of the report viewer.

2.6 EVALUATION

As discussed in the previous section evaluation was done continuously throughout the design and implementation phases in order to catch usability problems as early as possible. The method for doing this was an informal approach to heuristic evaluation (see 2.4 Heuristic Evaluation).

It is not as rigid as a normal heuristic evaluation where the evaluator checks if the application conforms to all usability heuristics (Nielsen, et al., 1994). As the developer designs or implements a new functionality, element or control she should always have the heuristics in mind and make sure that they to some extent conforms to them. In many cases this can be considered to applying common sense to the process but it serves as a reminder that there are certain aspects that has to be considered. For example, documentation is something that is in many cases lacking in larger projects but if the designers and developers has the heuristics in mind they should know that documentation is a vital part of any application.

2.7 USER TESTING

The method used throughout the project for user testing was the Think-aloud protocol (TAP) introduced in (Lewis, 1982) and later described further together in (Rieman, 1993). Using this method involves having the user perform a set of tasks while commenting on his or her thoughts and actions while doing so. The upside of this is that you hopefully get a picture of what goes on in the users' mind but it is also heavily dependent on the user taking time to describe what she is thinking as she is doing it.

During these tests there were two observers present, one for helping the user and closely observing his or her actions and one for taking more detailed notes of the user's comments. All users were given the same tasks for each of the tests in order to have a way to compare the feedback between users with different skill sets.

A possibility that was not explored in the project was to record audio or video of the test session to later analyze it. The reason for not doing so was that it was enough with two observers for getting the majority of user feedback, both visual and verbal. Recording for later review would have doubled the time spent gathering the information before the analysis could start. Had it only been one person carrying out the test, recording would have been beneficial allowing the test conductor to concentrate on interacting with the tester when needed.

The reason for using TAP as opposed to a simple observatory method is that it adds another layer of feedback in the form of user thoughts and comments. Just observing does not give access to what the user thinks will happen when an action is performed; it only shows what the user does next. Did the user open up a menu expecting to find something she was looking for or was she just exploring to know what the menu contains for future reference? These scenarios are indistinguishable if you are just observing.

While TAP will give you more information than just observing, all that information might not be valid. Maier did a study where subjects were supposed to solve a difficult problem and "accidentally" inserted a subtle hint into the problem in the middle of the subjects trying to solve it (Maier, 1931). The data showed that this greatly increased the chances of a subject succeeding, but when Maier asked the subjects how they solved the problem they did not say it was because of the hint. Looking at the statistics of who got the hint and who solved the problem, Maier knew that it was because of the hint a large majority of the subjects succeeded but the subjects themselves did not know that this was the case. The information gained with using Think-aloud could very well suffer from the same problem; the user might not know precisely why she completed a task, they might even state the wrong reason.

3 PRELIMINARY USER STUDY

Since the customer base of the Ericsson MSDP is quite large and spread across the world it was difficult to arrange contact with only local companies. This meant some of the user feedback had to come from overseas locations which made direct contact more difficult. Due to the reasons stated in 2.3 a questionnaire was created.

In order to minimize the time needed to complete it, it was designed in an unstructured manner (Karlsson, 2009), i.e. not to gather detailed information about the user experience but rather get an idea of the extent they used it, how they used it and whether or not they would benefit from incorporating other features into it. Given the assumed expertise of the user base it was possible to create a more open form of questions as well, asking the users to discuss their problems and if they could propose suggestions as to what could be done to help them overcome them.

The finished questionnaire was sent to three different operator companies in three countries, spreading the users over different cultures and corporate environments. Even though the questionnaire was designed to take no more than 15 minutes to answer and contained no questions that could be deemed sensitive, only one user answered.

This posed a problem since many of the answers were intended for developing personas that would have needs and experiences similar to those who had received the questionnaire. It was also not a good base to stand on when redesigning the report viewer since the user needs and requirements should be the main source of information and having this come from real as opposed to imagined users.

Two personas were still crafted while answers were still being waited for with the information from the answer that came in, together with internal documents. These internal documents had been researched by people wit hin Ericsson for feedback or were documents detailing customer demands to base development on.

As the personas still could not be properly fleshed out without more answers fromthe questionnaires they had to be scrapped in favor of just reading the internal documents.

4 REPORTING SYSTEM EVALUATION

This chapter details the evaluation of existing reporting systems for use in the prototype.

4.1 GATHERING REPORTING SYSTEMS

To find the best reporting system for the thesis internet search engines were used to find products related to business intelligence. Listing sites devoted to business intelligence and through them finding popular systems generated many results combined with searching for companies producing business intelligence products. It was clear from the beginning that there were some market leaders that had a more widespread community.

This is a list of the Business Intelligence systems found.

- Ab Initio
- ActiveReports
- Actuate
- Adobe Flex
- BIRT
- COA Solutions Ltd
- Comarch
- Crystal Reports
- CyberQuery
- Data Applied
- Decision Support Panel
- Dimensional Insight
- HP Neoview
- Tableau
- Informatica
- Information builders
- InfoZoom
- Izenda
- JasperReports
- Jreport
- Logi Report
- LogiXML
- LucidEra
- Microsoft Office PerformancePoint Server
- Microstrategy reporting suite
- ProClarity
- M-power
- Hyperion Solutions
- OLAP
- Oracle BI tools
- Panorama Software
- Pentaho
- Pervasive Software
- Prelytis livedashboard
- Spotfire
- Ventraq

Many of these systems are either licensed, bought by other companies and merged or discontinued, have a big lack of information on their website or on any website, or are just a BI program with no ability for customization or use of its back-end for developing your own interface.

To make the process of removing options from the list of potential candidates for a deeper examination smoother a criteria system was used. If a system passed a criterion the next criterion was evaluated and as soon as the system failed at one it was discarded. The following criterion was used:

1. Does the website, or something else, describe the product well enough to get an adequate picture of what it does?
2. Is there documentation for the system that describes things from getting started to customization?
3. Is there some sort of community around the product? E.g. is there a forum on the product website were users can discuss problems and help each other?
4. Does the product exist in a version that you can get easy access to? E.g. is there a trial or limited free version?

Using these criteria on the products in the list the systems started to fall off one by one, quickly winding them down to a manageable few. Further evaluation, being stricter according to the criteria, removed a few more until there were only four left.

4.2 COMPARISON OF FINAL FOUR

Having four different and large reporting systems to do a big comparison between seemed like a daunting task that would take a lot of time. Conveniently, one of the systems' report builders (Logi Report) was very unstable and kept crashing when trying to create new report projects rendering it impossible to have any real evaluation done on it. Considering that the developers have not made their main program stable, the one most of their customers will try, confidence in their entire system is hurt. This meant only three systems remained; Actuate BIRT, Jaspersoft JasperReports and SAP Crystal Reports.

The following sections detail the areas deemed important for the development process in that they should make the process quicker and easier. Thereby allowing focus on design rather than technical hurdles.

4.2.1 PROVIDED SOFTWARE

All three systems have a report builder and viewer available from their developers. However, there are some differences in implementation.

BIRT, being a part of the Eclipse Foundation, uses the Eclipse IDE as its base. Eclipse uses a Perspective system that accommodates many different developing environments. BIRT simply adds itself as a new Perspective and operates from there. Because of this the basic functionality and look and feel are the same as the tried and tested Eclipse IDE and should ease learning in the beginning, especially if the user is familiar with the Eclipse IDE.

JasperReports is using NetBeans as its base when creating reports and as BIRT and Eclipse, Jasper and NetBeans provide a familiarity when starting to use JasperReports' builder iReport if you have already used NetBeans before. However, iReport is a standalone application which means you have to have both iReport and NetBeans open if you are going to use both.

Crystal Reports has two versions of its report builder. One is a plug-in to Eclipse IDE that creates a new Perspective within Eclipse that you build your reports in. This is similar to how BIRT uses Eclipse and as with BIRT, if the user is familiar with Eclipse IDE, it might help when starting out. In addition to the Eclipse plug-in, SAP also has a few report builders available for purchase. They provide a 30 day trial on Crystal Reports 2008 that can be evaluated. The program instantly feels like a part of the Office Suite or Visual Studio when you first start it up. Of these, the Office Suite is a program that has likely been used by a large majority of the intended user base of this project. You instantly connect the look of this program to the experience you have had with Microsoft Word and Excel and would probably break through many adoption barriers.

Generally, all the different report builders the developers provide use very similar structure in how the report is built. Moving between them, it is more a question of where different settings and tools are located rather than having to learn a whole new way of working. You could say that report building follows its own standard way of working much like word processors have their way and share a lot of properties. The differences lie in the execution, how you select tables from the database, how you write functions, the flow of how the wizard build functions and so on.

4.2.2 API

The Jasper and BIRT systems have complete APIs to enable developers to create their own viewers and report designers. Crystal Reports' API suggests that you cannot build a report builder from scratch but you can instead make a program to modify existing reports. Their viewer API, however, is comparable to the others.

Being open source, both Jasper and BIRT has spawned projects outside the main project. For Jasper, one of these is Dynamic Jasper. It is a free, open source library that claims to hide the complexity of Jasper Reports and help developers to save time when designing simple to medium complexity reports.

Crystal Reports has a clear disadvantage in this category as it only has an API for the viewer component of the system and no support for creating a builder.

4.2.3 DOCUMENTATION AND SUPPORT

The documentation for BIRT is extensive in some areas while lacking in others. The quality is varying as well with seemingly several different authors writing part of the documentation on their own.

JasperReports' help within its builder goes as far as helping you connect to a database but not further. There is nothing about how you create or view reports. There are some tutorials on JasperReports' website but nothing comprehensive. There are, however, buyable documents that tout that they are complete tutorials that get you going in creating reports. There are also first and third party courses to take, all which cost a hefty sum to partake in.

Documentation is hard to find for Crystal Reports, there are none to be found on their website. A big downside here is that Crystal Reports share homepage with the rest of SAP's products and there does not seem to be that much focus on Crystal Reports. In SAP Community Network it is the same. Crystal Reports is not the only analytics tool that SAP has, their effort seems spread out and information is hard to find.

Looking at forum activity at the different websites for the systems Crystal Reports has the most activity by far. BIRT and JasperReports both have active forums, while not as active as Crystal Reports', help can be found.

4.2.4 QUALITY IMPRESSIONS

Quality impressions are a relatively subjective evaluation but without having some experience of different systems there might be some value in acknowledging an overall feeling of quality. It was to a high degree this quality aspect that fell Logi Report. The fact that it was unable to connect to the database, while the other systems connected just fine, coupled with that the report builder kept crashing sunk the perceived quality of the entire system. The report builder would probably not be used in the final results of the project, but if Logi Report cannot keep their front end stable, the single part that most end users see, you cannot be certain that the rest of the product holds a certain level of quality.

Crystal Reports, being the only one you have to pay for out of the four, gives a slight sense of security since there is a company behind it that wants it to sell, and for customers to come back and upgrade. In addition, they have a reputation to maintain and a bad product might affect the rest of their product lineup. But this might also mean that they are very protective about their product, which means they might not allow developers to create their own versions of it, especially the report builder.

In contrast, both BIRT and JasperReports are open source but with companies backing them. BIRT is a part of the Eclipse foundation's Eclipse projects. Eclipse foundation is non-profit, but supported by some major corporations including among others IBM and Oracle. The developers of BIRT are spread out among different organizations or are independent developers that volunteer their time for development. This might give a sense of that BIRT are trying to be the best it can be, but at the same time there are not as much at stake.

Jaspersoft is selling a version of JasperReports to some customers. This version includes a Professional version of the report builder, email support and a premium version of the documentation including guides on how to use their builder. Essentially it seems like Jaspersoft is making it harder for the non-paying customer to get started. If a customer looking for a reporting system starts thinking it is acceptable to pay to see how good a solution really is, the evaluation could get really expensive, really fast considering how many products that are out there.

4.2.5 QUICK SCORE

Having the three remaining reporting systems being seemingly so alike one, or possibly two, more had to be discarded. A scoring system was employed where the systems were scored according to ten different criteria in three different groups; API, Documentation and existing implementations. Scoring the systems and making a graph (Figure 5) of the result showed that Crystal Reports was never the best at anything apart from the report builder. It was either the same or worse. The Crystal Reports report builder can be considered better than the others for new users with its resemblance to the Office Suite, with otherwise similar feature set as the other systems. For more detail, see Appendix D.

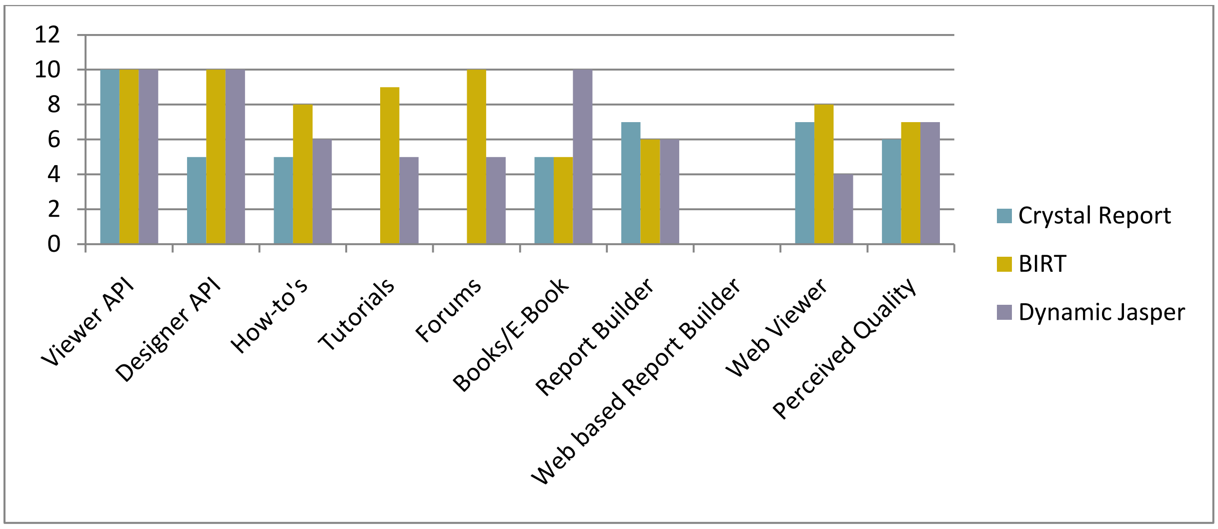


Figure 5. Quick score result graph.

Based on the quick score and the API situation Crystal Reports had to be left out of the race. The result had been the same even if the API of Crystal Reports had been comparable to the others. But considering that an API for creating the report files and their internal structure makes the entire process of creating the new Report Viewer with a Report Composer many times easier, it was the final nail in the coffin for Crystal Reports. Having an API can lighten development time from just getting things to work and will allow more concentration on the usability of the program.

4.2.6 FINAL DECISION

With having BIRT and JasperReports being almost the same the final decision could not be done objectively since they were so alike apart from having to pay for most of the help material from Jaspersoft. Due to the help material for JasperReports being quite expensive and because of BIRT's integration into Eclipse it was decided that BIRT would be the better choice for this project.

5 DATABASE DESIGN AND IMPLEMENTATION

In this chapter the database design and implementation is described along with why a new schema was needed, where the data comes from and some of the constraints.

5.1 DATABASE DESIGN

The information coming from the MSDP is organized into log files which can be accessed through a public log API. The structure of these logs was translated into a table structure. The database design was kept to a simple relational model similar to the structure of these logs.

Below (Figure 6) is a small part of the database schema in the form of an Entity-Relationship (ER) diagram (A complete diagram can be found in Appendix A). A request is received each time a user does something on the mobile portal. It contains things like what time it is and if the request failed or succeeded. In almost all cases a request is connected to a page on the mobile portal. A page has a unique identifier and a title.

They are stored in the database as tables, represented as boxes in the ER-diagram. To store the connection between a request and a page, i.e. that a request was for a certain page, a relationship table is inserted between them and connected with lines, represented as a rhombus in the diagram.

This allows a user of the database to access not only the information in the individual tables but also to join them together with the help of the relationship table and then get access to the information in both tables at the same time.

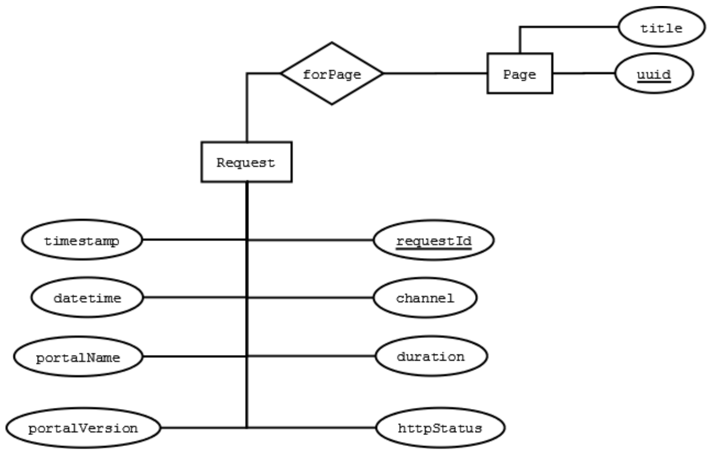


Figure 6. Example of the ER-diagram used for the database.

5.2 DATABASE IMPLEMENTATION

Implementation of the database schema was done on an Oracle 10g database system which means all communication with it had to comply with the Oracle SQL standard. Such a database was provided by Ericsson and it was outside the scope of this thesis to research other alternative databases.

In many database naming convention guides it is recommended to use descriptive names but also to use abbreviations and prefixes for organizing the tables into groups. This could obviously not be done since the end users would in some way come in contact with the database tables and attributes. That meant they had to be readable, understandable and had to, as well as possible, describe what they contained.

The datetime attribute (seen in Figure 6) was added to the database at the end of the implementation as it became clear that simply using the timestamp would mean a lot of conversion calculations. Datetime is actually an Oracle data type designed to store all information for date and time. It contains the date, time, weekday and more which makes it very powerful and it makes extraction of certain dates and times easier. It does, however, have some drawbacks, most notably the fact that in its raw form it cannot be extracted as is but has to be converted into a string of characters.

6 INTERFACE PROTOTYPING

In this chapter it is described what different prototyping tools and methods were used in the project and what design decisions were made.

Prototyping is a great tool for trying out solutions without committing time and resources to implementing an untested design. This meant that before starting to implement anything, everything was prototyped to get a feel for how things would look and to be able to discuss solutions while having the same mental model of what was being discussed. During the prestudy a few short paper sketching sessions were held to get a few ideas out there and let them incubate (Araï, 2001) while continuing with the prestudy.

Continuing with the prototyping phase more sketching was performed to find the best solutions for layout and controls. This involved focusing on one control or layout at a time and designing different solutions for it. Some of these sketches can be seen in Appendix C. The next step was to convert these sketches into a high-fidelity prototype that testers could interact with in a more real way. To do this a high-fidelity prototyping tool had to be found.

6.1 PROTOTYPING TOOLS

The choice of prototyping tool depends on how complex the prototype should be and how much time is available. There are many different tools and methods that target different levels of prototyping needs and the following sections describe the tools and methods used for creating prototypes during the project.

6.1.1 PAPER PROTOTYPING

Paper prototyping (Nielsen, 2003) is a prototyping method where the designer creates all interface elements using paper as the basic material. The prototyping method can be as extensive as making an entire functioning interface with folding paper for drop-downs, etc. or it can be less complex and only involve drawing interface elements to try out different layouts.

Paper prototyping was the go-to prototyping method of choice during the project and almost every detail of the interface has been drawn, discussed around, modified and approved on paper before doing a more high fidelity prototype or going straight into the code.

It was used because a lot of the components had to be explored more thoroughly and more rapidly. It was mostly used to explore different control layouts and designs in order to find the most intuitive and easy to use. Using paper prototyping made it possible to create several versions of the same control or layout in a short amount of time and later to integrate it into either the prototype or the implemented version once a satisfactory solution had been found.

6.1.2 MICROSOFT EXPRESSION BLEND

Microsoft Expression Blend is a tool for creating desktop and web applications without having to code the interface and its behavior. It allows the developer to create a rough prototype fairly quickly and then to build upon that until a complete application has been created. Using Blend also enabled aesthetic prototyping giving the ability to prototype the look of the application as well as the functionality.

6.2 THE PROTOTYPE

The actual prototype created in Blend was done as a series of interface screens and states that could be navigated between using the various controls available. While this will look real to the user the prototype is actually a carefully designed flow of these screens and states. If the user strays outside this she will either not get anywhere or end up in unexpected places.

Blend can be used to create more dynamic and fault tolerant prototypes but it was not explored due to the time constraints of the prototype phase. Figure 7 shows the interaction flow of the constructed prototype. Each box is an interface screen in a particular state and the lines between them denotes how the user can move from one screen state to another. As mentioned before, should the user pick an action that does not conform to the specified paths she will activate a state that does not correspond to the users' expected result.

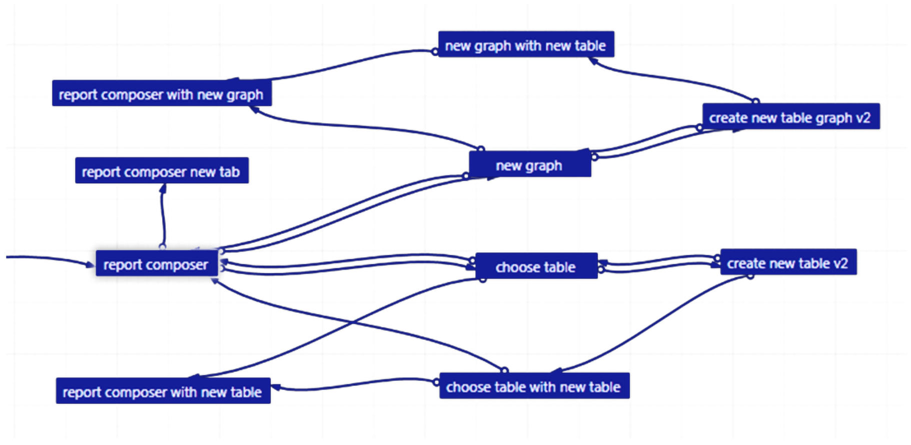

new graph with new table
report composer with new graph
create new table graph v2
report composer new tab
new graph
report composer
choose table
create new table v2
report composer with new table
choose table with new table

Figure 7. Part of an interface flow chart from Microsoft Blend.

6.2.1 REPORT CONTROLS

In order for the reports to have any value to the users it must be possible to control what it shows, for this project that means controlling over which period of time the report displays data. Apart from the standard start and end date and time, there would also have to be predefined time spans, weekday settings and the possibility to choose the time of day. An example of the design process is given below for a control for time settings (Figure 8).

Creating a control for selecting time involves many different aspects, e.g. usability, understandability and flexibility. Allowing the user full control of what time to select suggests using a simple input box where the user writes the desired time. However, the user can input nonsensical values or if a range is required the user might input an end time that is before the start time. This means the input has to be either checked continuously for user errors or made in such a way that it is impossible to do it wrong.

A compromise of the two is to present the user with a list of predefined values while still allowing for custom input. In the case of the Report viewer it was clear that complete user control of the time input was not required since there was no need to have that fine detail of the data. This meant the time values could be set to fixed time intervals, in this case 30 minutes. This also excluded a traditional input box since no custom user input would be allowed.

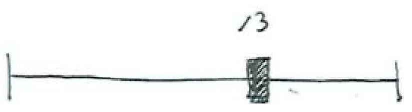


Figure 8. A slider control.

Using only a list of predefined values was also not possible since that would mean 48 rows of values which are too many, both in screen space and work required to scroll through it. A more abstract way of representing this list is as a slider control (Tidwell, 2005), a list of values laid out on a horizontal line with a movable pointer which controls the selected value.

Although this was found to be the best solution it was not included in the high-fidelity prototype because of the complexity of creating them combined with that the focus of the user tests was not on the time and date parameters but on creating reports and report elements.

6.2.2 LAYOUT

The main layout of the application was decided to be a two panel layout with the report content in the center and various parameters and tools off to the left side in a thinner column. This is a common web page layout together with having the menu at the top. Placing the menu to the left, however, frees up space vertically while using today's widescreen resolutions more efficiently.

Tabs

The main window of the application, where the report information would be, went through two major iterations during the prototyping phase. The first version placed all content on the page at once but separated into frames that could be minimized if not used and resorted to place the most wanted part at the top. An example of this can be seen in 9.

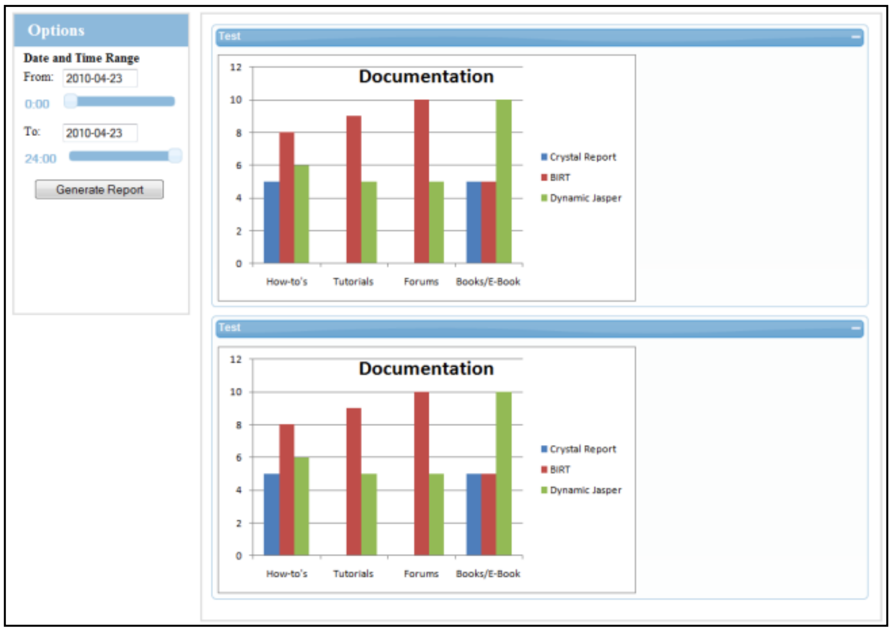


Figure 9. Prototype with minimizable frames.

However, this is not a common pattern which means users will most likely not recognize it and know what to do with it. If the report contains data tables it could also become quite unruly and if the users do not know they can minimize the table window they would have to perform a lot of work simply to reach what is below.

This lead to a redesign of the layout to a more conventional and recognized tab layout. The tabs allow the users to divide the report content into different sections, e.g. graphs in one and tables in another. This can be seen in Figure 10.

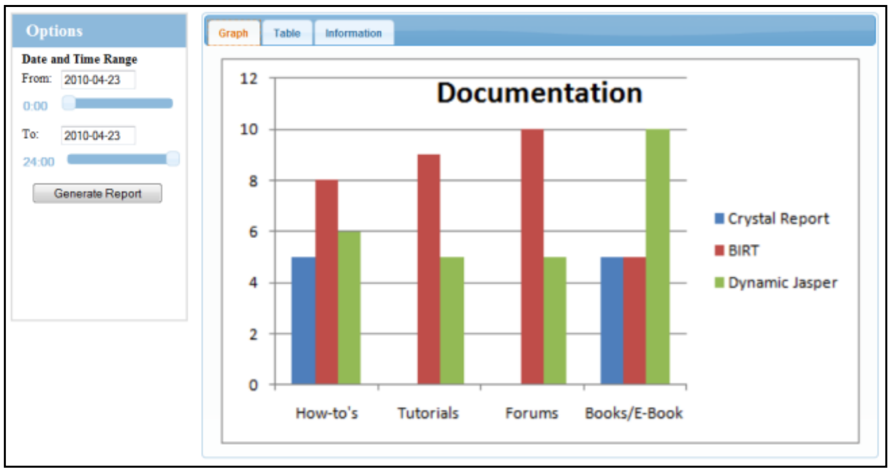


Figure 10. Prototype with tabs.

Report list

How the user navigates between the different reports is another issue which has gone through two major iterations.

Having an ever present list of reports allows the user to quickly change report without having to navigate away from the current page. However, this comes with some problems. If the number of reports in the list is great, the list will extend the page so the user has to potentially scroll very far to find the desired report. If the list is forced to a certain height which means the users can only a see a certain number of reports at once, it makes searching more difficult.

In the end the report list, along with the viewer part of the application was emitted from the high-fidelity prototype since its function is shared by the report composer. This meant it was possible to only focus on the report composer for the user testing.

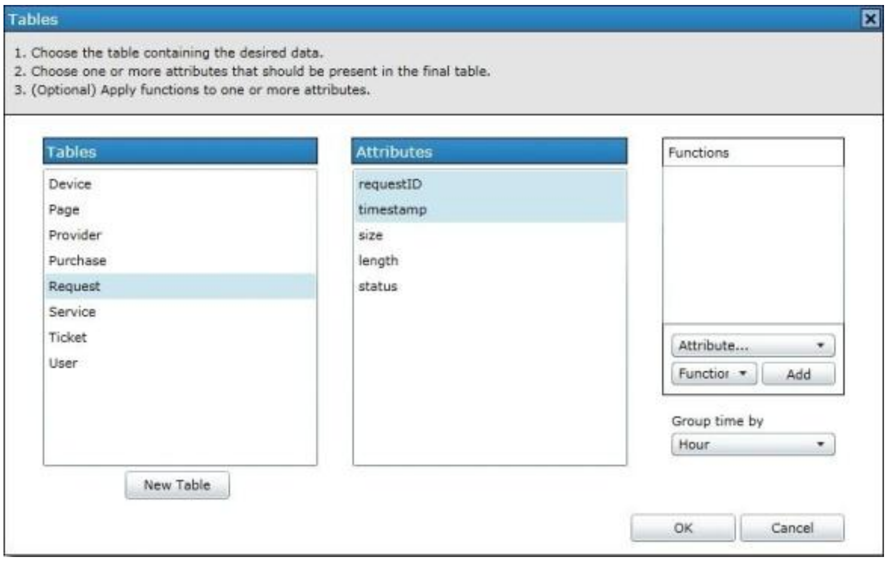
Dialogs

Dialogs are a way of grouping information and controls that are related to each other, e.g. the creation of a graph or a table. In desktop applications the use of dialogs is wide spread but they are not so common in the web environment. The decision to use dialogs is based on it being a desktop application pattern; it makes the web application feel more like a standard application which might feel more familiar to some users. The other reason is that if the user is instead taken to another page she might forget what they were doing, especially if a task takes a long time to complete.

New Table

The task of creating a new table consisted of three different sub task; pick the database table in which the data exists, choose the attributes to display in the table and possibly apply one or more functions to the selected attributes. This was placed in a dialog window that would be shown when the user chose to create a new table.

As seen in Figure 11 the dialog consisted of three lists, the left containing database table names. The middle list contains the attributes belonging to the selected database table in the left list. The right list shows the functions that have been applied to the selected attributes. The button below the table list opens another dialog that allows the user to create their own data table by joining two or more tables together.



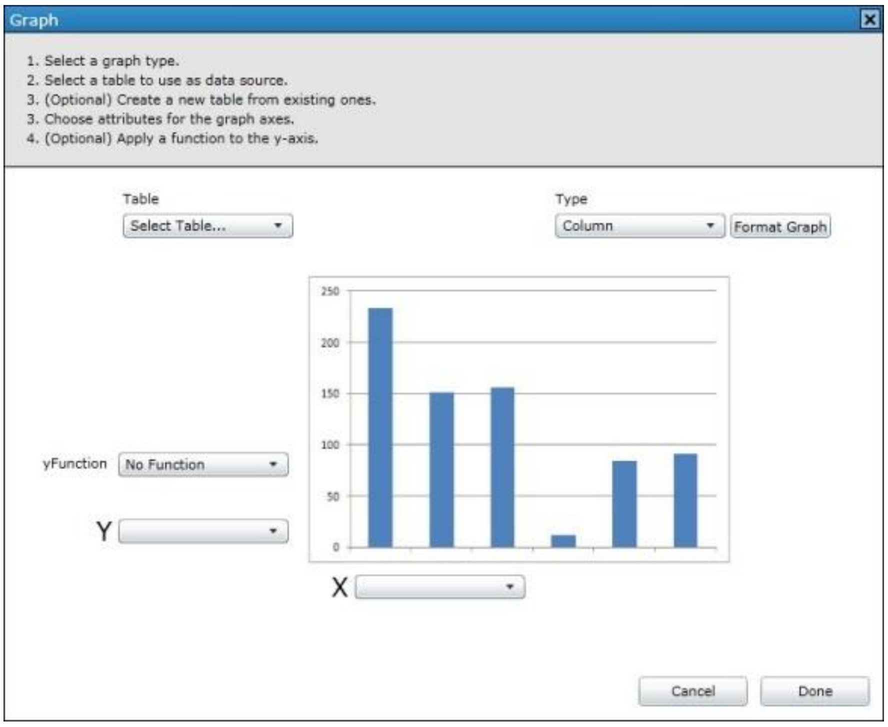
Tables

1. Choose the table containing the desired data.
2. Choose one or more attributes that should be present in the final table.
3. (Optional) Apply functions to one or more attributes.

Figure 11. The 'New Table' dialog.

New Graph

Creating a new graph was designed quite differently from the new table dialog. Since a graph, in general, only has two axes there was no need to have a visible list of tables or attributes. The selection of those was therefore designed as drop-downs. Figure 12 shows the table selection drop-down in the top left corner, the placement indicates that this is the first action to do. The selection of attributes has been placed in relation to its respective graph axis, drawing upon visual cues instead of interface linearity (Tidwell, 2005). The big graph in the middle of the dialog is the preview graph which changes depending on user selections.



Graph

1. Select a graph type.
2. Select a table to use as data source.
3. (Optional) Create a new table from existing ones.
3. Choose attributes for the graph axes.
4. (Optional) Apply a function to the y-axis.

Figure 12. The 'New Graph' dialog.

6.3 USER TEST 1

The first user test was designed to test the design and capabilities of the high-fidelity prototype report builder. It used the Talk Aloud Protocol described in 2.7. Two hypotheses were formulated with regard to the users' knowledge and experience and were tested by having the users performing two separate tasks.

6.3.1 HYPOTHESIS

1. Users with previous knowledge in databases and SQL will be less confused about the interface than those without previous knowledge.
2. Users with previous knowledge in databases and SQL will perform the tasks faster than those without previous knowledge.

6.3.2 PROCESS

From the information gathered about the existing and potential users of the MSDP report viewer four types of test subjects were identified. These test subjects are all Ericsson employees or consultants because it was not possible to involve real MSDP users. They are listed below as what knowledge they possess.

Tester 1.	SQL and MSDP
Tester 2.	SQL
Tester 3.	MSDP
Tester 4.	None of the above

The bare minimum of test subjects for this test was two, since then it would be possible to cover the two extremes above, i.e. number 1 and 4. However, to get a better understanding of potential problem areas, especially those dealing with database terms and concepts, a larger group was needed. It was therefore decided that all four types of users should be represented which meant a test group of four persons. This number could be increased after the first four should the received feedback not garner sufficient material to move on.

Each test subject was given two specific tasks to perform, the second of which would not be given until the first one was completed to avoid confusing the user with too much information. The two tasks are listed below.

1. Create a graph showing the number of unique users per page.
2. Create a table showing the total number of requests per page for the last month.

6.3.3 ANALYZIS AND CONCLUSION

This first user test provided more information and insight than was predicted which may be interpreted as it was enough with four test subjects. A lot of the received feedback dealt with more mundane, but not less important, things such as positioning of buttons, background color and symbols. This, combined with the general consensus from all four subjects that the interface was neatly designed, meant there were just minor redesigns that had to be done and it was possible to move on.

While hypothesis 1 turned out to be plausible, it was not enough of a difference between the testers to call this one confirmed. Testers that had SQL knowledge surely recognized many terms such as Table, Attribute and Join, but the interface and the names of the used terms explained enough of this not to give them a much greater understanding than testers without SQL knowledge of what was going on. The testers that knew SQL could probably guess what was happening behind the scenes but that was irrelevant for the tasks performed.

The difference between tester 3 and 4 also shows this hypothesis to be hard to confirm. One tester without SQL experience, but with some product experience, had a small learning curve in the start, when she realized what the tables actually was she had no further complications. This could be because she could then connect her mental model of the prototype interface with her mental model of Microsoft Excel and follow roughly the same work flow.

Hypothesis 2 cannot be confirmed either. The testers with SQL experience were faster at choosing the right things but at the same time were hesitating to confirm their choices as they knew that *join* can be a complicated thing and wanted to be sure of what they did. The tasks the testers were asked to perform was not that complex so the ones with less SQL experience chose the things that seemed logical and tried it out. They took longer in selecting what they needed but they worked at a steadier pace with less pauses.

The time taken by each tester was between 27 and 40 minutes with the ones having SQL experience being slower on average. They did not, however, spend much more time on the tasks. Instead, they commented more during the process. This could likely be because they were both developers and had experience with creating an interface and some of the thought that goes into that.

6.3.4 OUTCOME

This section describes the result of the user testing and what changes were made to the prototype.

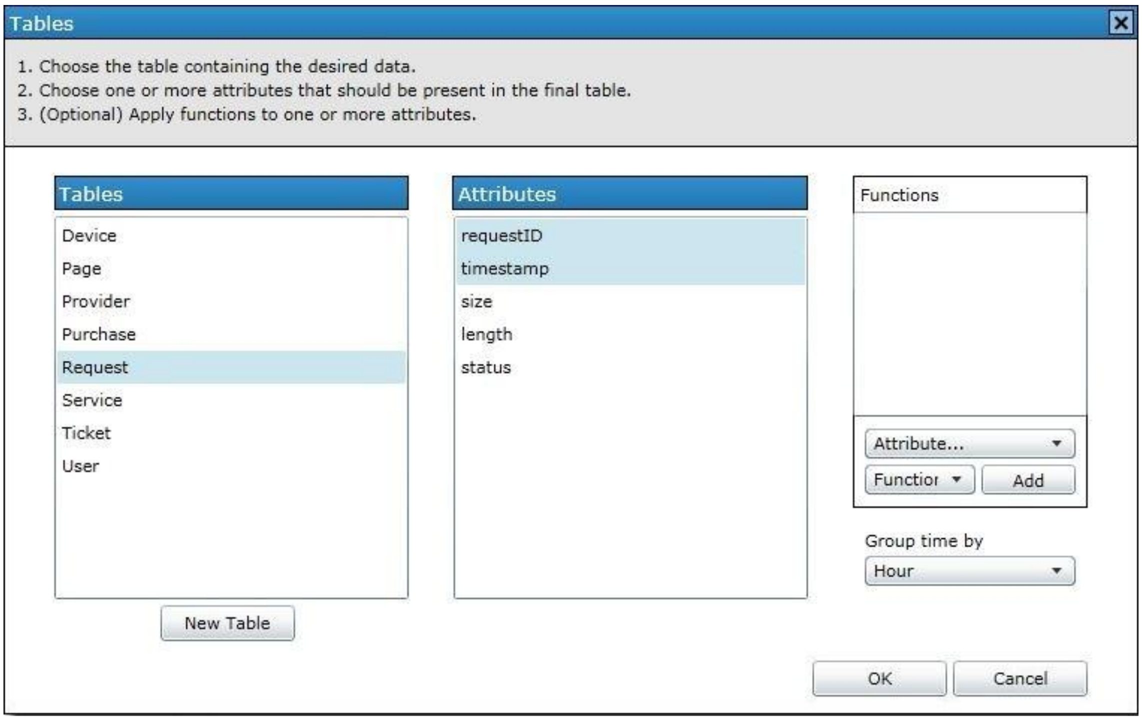
6.3.4.1 TABLE

In the 'Add table' window (Figure 13) there was a problem with the user not being sure about what attributes was chosen from the attribute list. It did not make sense to have the same selection indication as in the list of tables as only one table can be selected in contrast to the limitless amount of attributes that is selectable.

The blue row markers were removed in favor of a system with checkboxes to make it totally clear which attributes are selected (see Figure 14). As with the blue row markers the selection of attributes are cleared when selecting a different table. While it would be a faster process if the checks are kept in memory and rechecked when a table is chosen again after having had some of its attributes checked, it would likely lead to confusion as to if the attributes are still selected when a different table is selected. If you do not know that you can only select from a single table, it would seem as if they are always selected after you check them.

The 'Add table' window also got a preview of the resulting table in the same vein as its graph counterpart. This preview will show a subset of the data source and display a preview of selected attributes and their modifications according to what functions have been applied. It is placed below the flow of creating the table to not have it interfere in the process if the user does not want to see it as well as to give it room to expand its width. The width is prioritized over height because if there always is width to include all the attributes you want there will never be any need to scroll sideways. There will almost always be a need to scroll up or down, and having to scroll in two dimensions just to get an overview only adds additional load on the user.

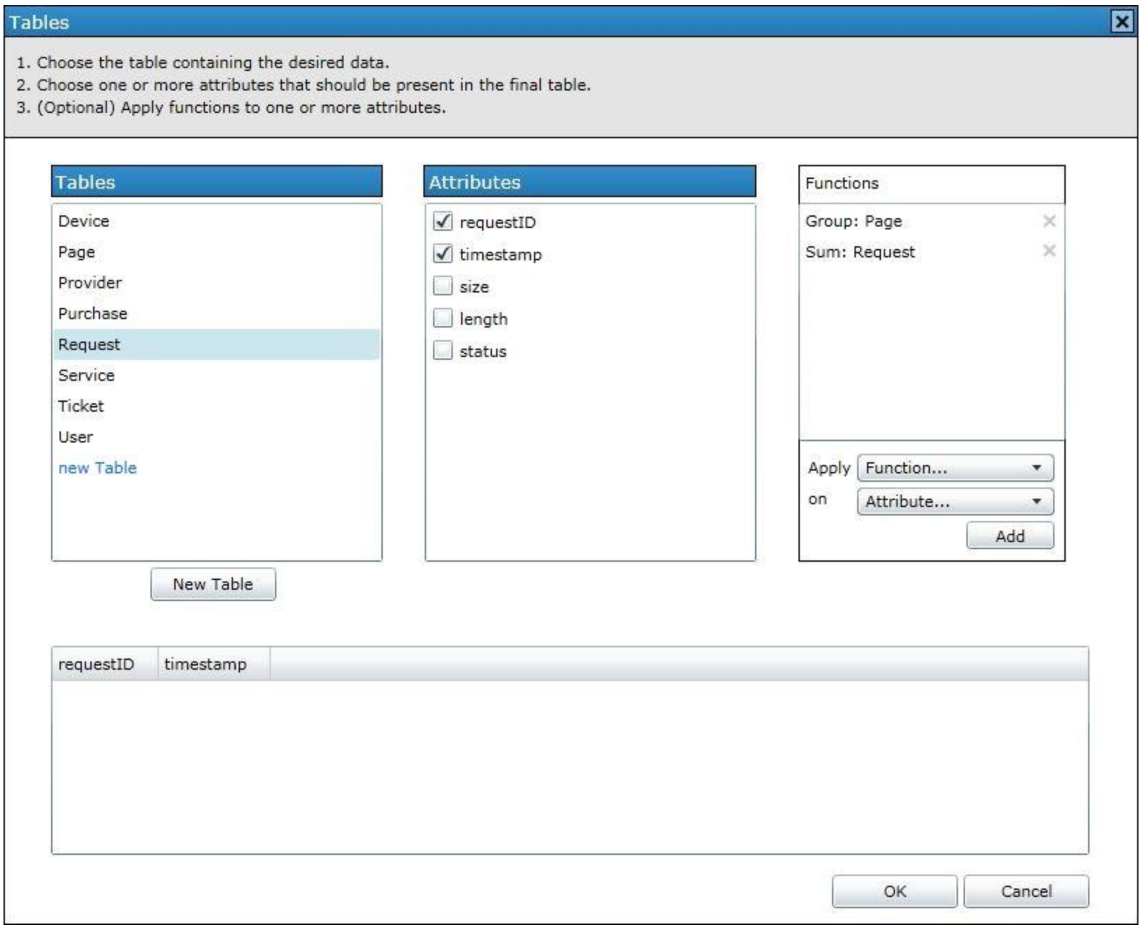
During testing the 'Functions' element was not clear to the tester what it did. On the other hand if they knew what it was supposed to do, they did not know how to do it. To alleviate this one simple change was done by adding a word in front of each drop-down to make the two extra words and the drop-downs form a sentence (Nielsen, et al., 1994). This makes it initially easier to understand and shows that it is separate from the other parts of this window. In addition, the 'Add' button is now grayed out and disabled if nothing has been selected from the two required drop-downs. Each applied function in the list also got an 'x' next to it for individual removal of each function.



1. Choose the table containing the desired data.
2. Choose one or more attributes that should be present in the final table.
3. (Optional) Apply functions to one or more attributes.

Tables	Attributes
Device	requestID
Page	timestamp
Provider	size
Purchase	length
Request	status
Service	
Ticket	
User	

Figure 13. The Add table window before the user feedback changes.



1. Choose the table containing the desired data.
2. Choose one or more attributes that should be present in the final table.
3. (Optional) Apply functions to one or more attributes.

Tables	Attributes
Device	✓ requestID
Page	✓ timestamp
Provider	☐ size
Purchase	☐ length
Request	☐ status
Service	
Ticket	
User	
new Table	

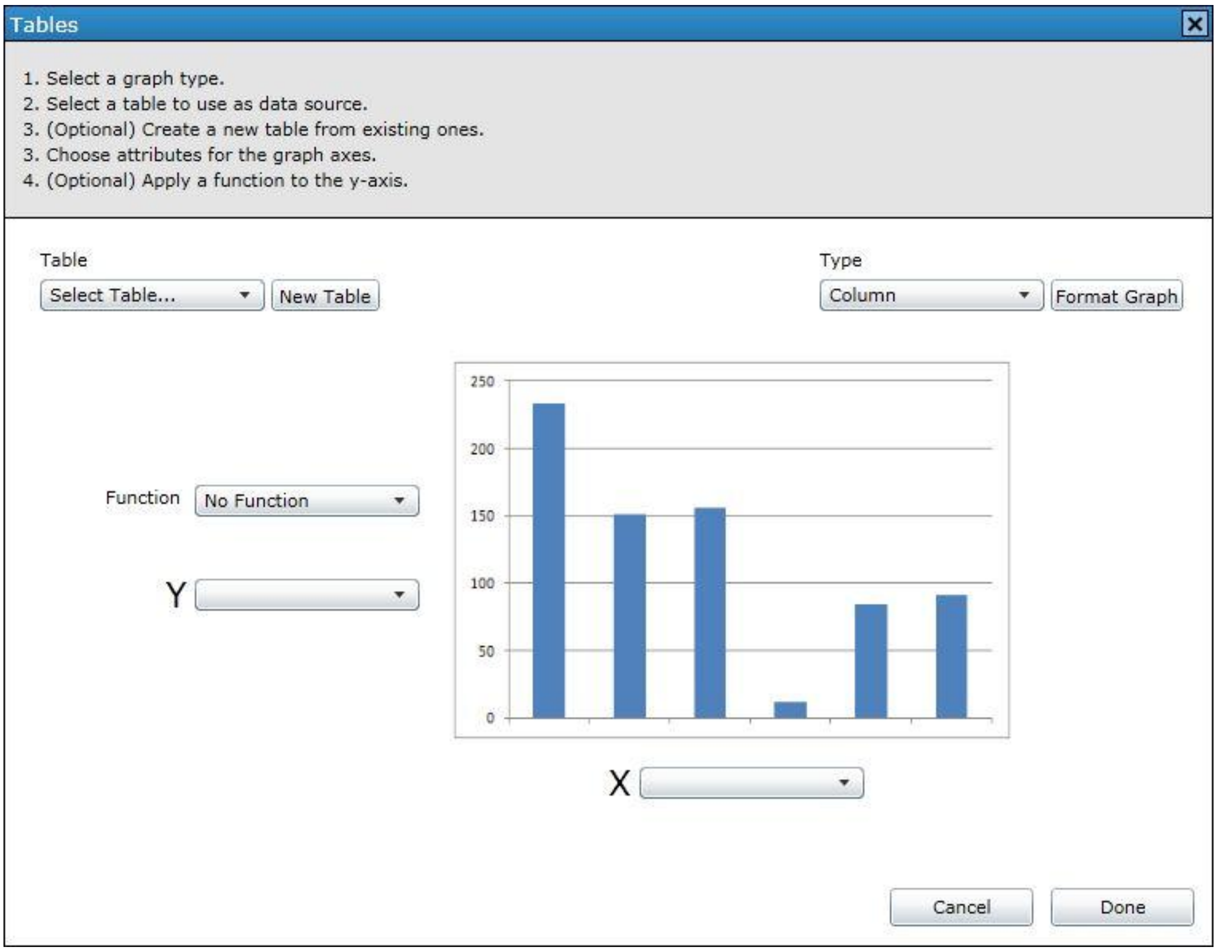
Functions:
- Group: Page
- Sum: Request

requestID	timestamp

Figure 14. The Add table window after the user feedback changes.

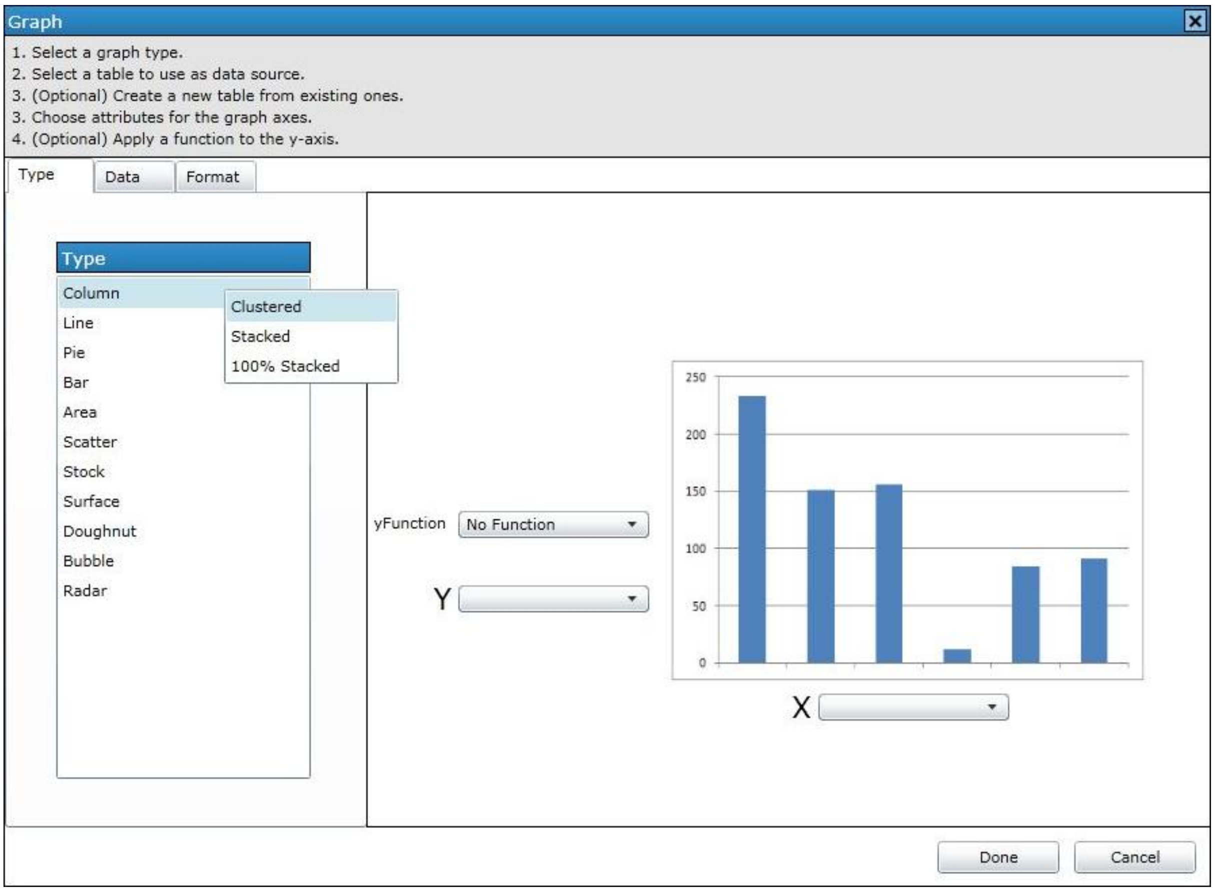
6.3.4.2 GRAPH

The biggest change for the 'Add graph' (Figure 15) window is the addition of a tabbed section with different tools in each tab (Figure 16). This allows for less cluttering of the interface and lets the interface present one of the three parts of creating a graph in more detail. The first one contains a list of different graph types the user can select from and this tab replaces the drop-down above the graph preview in the previous version. This allows for a tree structure of graph types as well and hovering over each type reveals further graph types choices. The 'Data' tab has a list of available database tables that the user can choose from when creating the graph and when hovering over each one a tooltip describes what attributes the table has. By selecting tables in this list the contents of the X and Y drop-downs changes. These drop-downs have been moved closer together to emphasize their connection to each other while still maintaining their separate connection to the X- and Y-axes. The button 'Format graph' has been converted to a tab instead of a pop up window toolbox. Format graph contains tools for customizing the look of the graph, i.e. colors, labels, etc.


Tables

1. Select a graph type.
2. Select a table to use as data source.
3. (Optional) Create a new table from existing ones.
3. Choose attributes for the graph axes.
4. (Optional) Apply a function to the y-axis.

Figure 15. The Add graph window before the user feedback changes.


Graph

1. Select a graph type.
2. Select a table to use as data source.
3. (Optional) Create a new table from existing ones.
3. Choose attributes for the graph axes.
4. (Optional) Apply a function to the y-axis.

Figure 16. The Add graph window after the user feedback changes.

6.3.4.3 GENERAL

The button to enter the 'New table' window has been renamed to 'Join tables' to better reflect what it actually does and give new users a hint of what to do when the data they want is in two different tables.

An attempt to differentiate user created tables from the raw data in the database has been added by coloring the font of the user created tables in all lists (Figure 14). Some users did not see that a new table was created and this change might alleviate this.

The buttons for 'Cancel' and 'OK' had inadvertently been placed in an UNIX fashion with the dialogs "ending" with the 'OK' button, i.e. Cancel on the left and OK on the right. There are arguments both for and against both configurations but as Nielsen (Nielsen, 2008) argues, "Do what the platform owner tells you to do" and "inconsistency costs more time than it saves", the interface now has OK on the left and Cancel on the right as it is the Microsoft Windows standard. Nielsen also suggests that giving a more descriptive word than OK on the button can help the user as just-in-time help. The window that has a button to apply the things you have done in the window has the word OK on it. In the windows with all actions done and confirmed by tools within the window, the word ‘Done’ is used instead to close the window, while keeping the ordering of Done and Cancel the same as OK and Cancel.

7 IMPLEMENTATION

This chapter describes the implementation part of this project, what parts were involved in it and which different technologies were used.

7.1 TECHNOLOGY

Bellow follows a description of some of the technologies used in this project and why they were used.

7.1.1 JSP

JSP is best described as a tag library for HTML that enables the use of Java inside regular HTML tags. It is executed on the server and is a tool for software developers which allows them to generate content before presenting it to the user. For this project it was used for generating the report layout from the report configuration files and for handling information requests by the interface.

7.1.2 JQUERY

JQuery is a JavaScript library designed to speed up the development process by simplifying certain tasks such as document traversal and manipulation. It also contains complete 'widgets', controls, which can be used on an existing web page.

Both jQuery and regular JavaScript have been used extensively throughout the implementation phase of this project since they provide a way of handling events and user interaction on the client side, greatly reducing the need for page refresh.

7.1.3 XML

Due to the design decision to use a tabulated layout, the structure and contents of those tabs needed to be saved somewhere. Likewise, time and date settings as well as tabs and their content made in the composer had to be saved so that when bringing up the report in the viewer they were still the same. XML provided a structured way of saving data in a file and was used extensively in this project.

7.1.4 JSON

JSON is a lightweight data-interchange format that is both easy to read for humans and easy to parse and generate with another programming language. For this project it was used to handle communication and data transfers between the client and server, allowing for data updates without reloading the page.

7.2 SERVER

Since most of the content in the application has to be generated from a set of report files and configuration files when requested by the user it was necessary to use a more powerful tool than HTML, in this case JSP. When the user requests a page the server compiles the JSP files into ordinary HTML and relays that to the user, meaning the user does not know it is a JSP file. However, this also means that the JSP code is only run once, at request, and the information it produces will not be updated on the page until the user requests the page again.

The server side of the application is divided into several smaller chunks each of which handles a specific task. These tasks are initiated through user actions and relayed to the server using the JSON data-interchange format. Each JSON request to the server targets a specific JSP file that only does one thing and once done it sends a JSON response to the client, either confirming the completion of the task or providing a set of result data. This allows updates of certain parts of the interface without reloading the page.

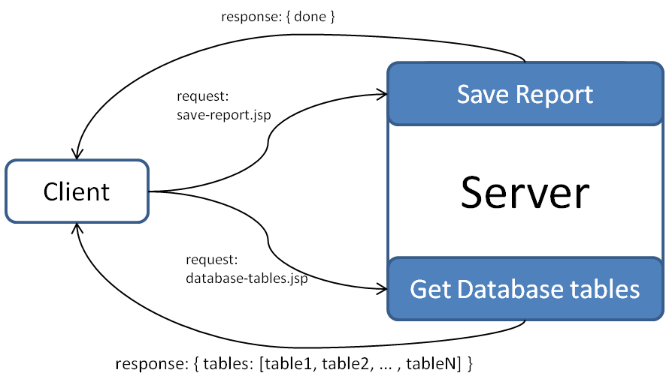


Figure 17. Example of the client-server communication used in the Report Viewer.

The biggest task of the server, however, is to maintain the report files and the user generated report structure. Each table and graph that BIRT generates is stored in an XML formatted file called rptdesign file. And because a user created report can contain several of these elements another XML file is needed to maintain the structure of the user report, i.e. what goes into what tab. This configuration file also holds all time and date information specified at report creation. This means that a lot of the work on the server comes down to file handling; reading, writing and moving.

Most of the database communication is handled internally by the BIRT Report Engine but some information has to be retrieved manually such as database tables and their corresponding attributes. This is needed to populate the lists of tables and attributes that the user can then choose from when creating his or her report. Because these are simple lists of information this information can be retrieved through the JSON communication described earlier meaning the table and attribute lists can be updated on the fly without page reload.

7.3 CLIENT

The client is the part of the Report Viewer system that the end user interacts with, i.e. the interface. It was constructed as a web application using HTML and CSS for layout and style. All events, user or application generated are handled by JavaScript and by jQuery, a JavaScript library. This meant that most things could be done and updated without actually refreshing the page the user is on, making it feel more like a desktop application. However, once a new report element is created, i.e. a BIRT report file, the page has to be updated since the population of the interface can only be done by the server.

7.3.1 VIEWER

The Viewer application is composed of two parts; the first is the report selection screen and the second is the report viewer itself.

Report selection screen

The reason behind having a separate report selection screen is that some of the feedback received from customers detailed which reports they had or were interested in. This feedback showed that they had a potentially very large number of reports. Placing a large number of items in a list will only force the user to search the list and the longer it is, the harder it gets and the more time it takes.

A solution for this was to move all the reports to a dedicated selection screen where there were more space to work with. The final result is shown in Figure 18. In all cases where the customers detailed their reports they never had any logical division of their reports, it was always one long list.

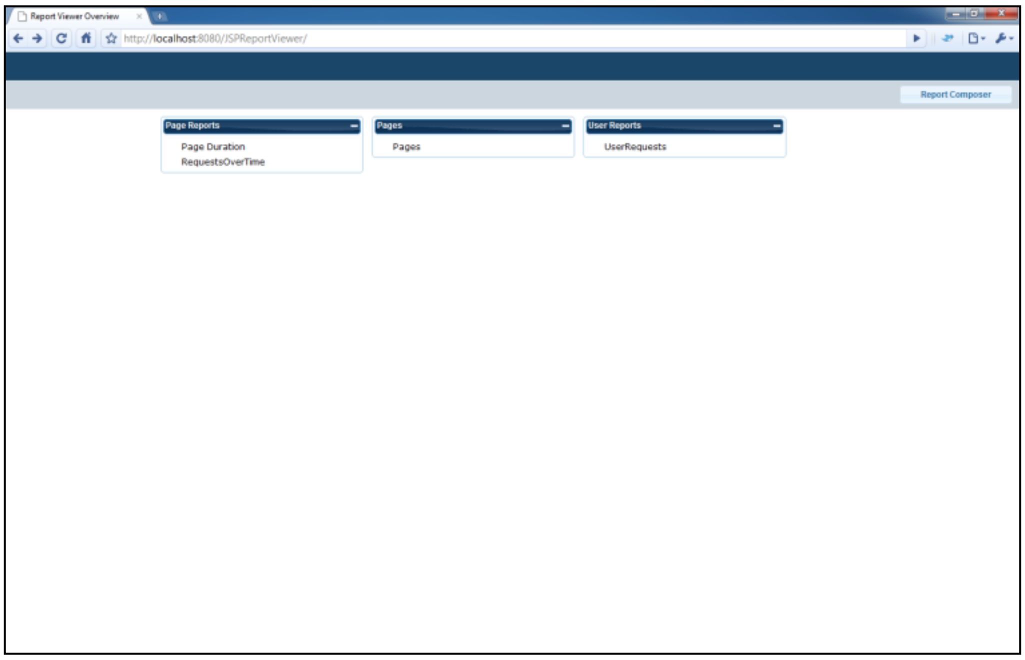


Figure 18. The report selction screen.

This resulted in the idea of dividing the reports into separate categories where the reports belonging to the same category had something in common. An example could be that all reports detailing user purchases and transactions is put in a category called *Commerce*. These categories can be created from within the report viewer when saving a report.

In Figure 18 the categories are seen as almost separate windows, each with a blue header with the category name. Inside them they contain a list of all reports belonging to that category and clicking on one report opens that report on another page. As can be seen in Figure 18 they are divided into three columns and the windows are called *Portlets* which is a standard component of the jQuery UI library which in turn is an extension of the jQuery library.

The portlets are placed inside another jQuery component called *Sortable,* allowing the user to move around the portlets and place them in any configuration she may desire. This means that if they have a lot of reports the user can place the report categories she uses the most at, for example, the top for easy access instead of having to go through them every time. Each portlet can also be minimized in case the user does not have to see them at all times.

The grey bar at the top containing the button for the Report Composer is the menu bar for the application. It changes depending on which part of the application the user is currently viewing.

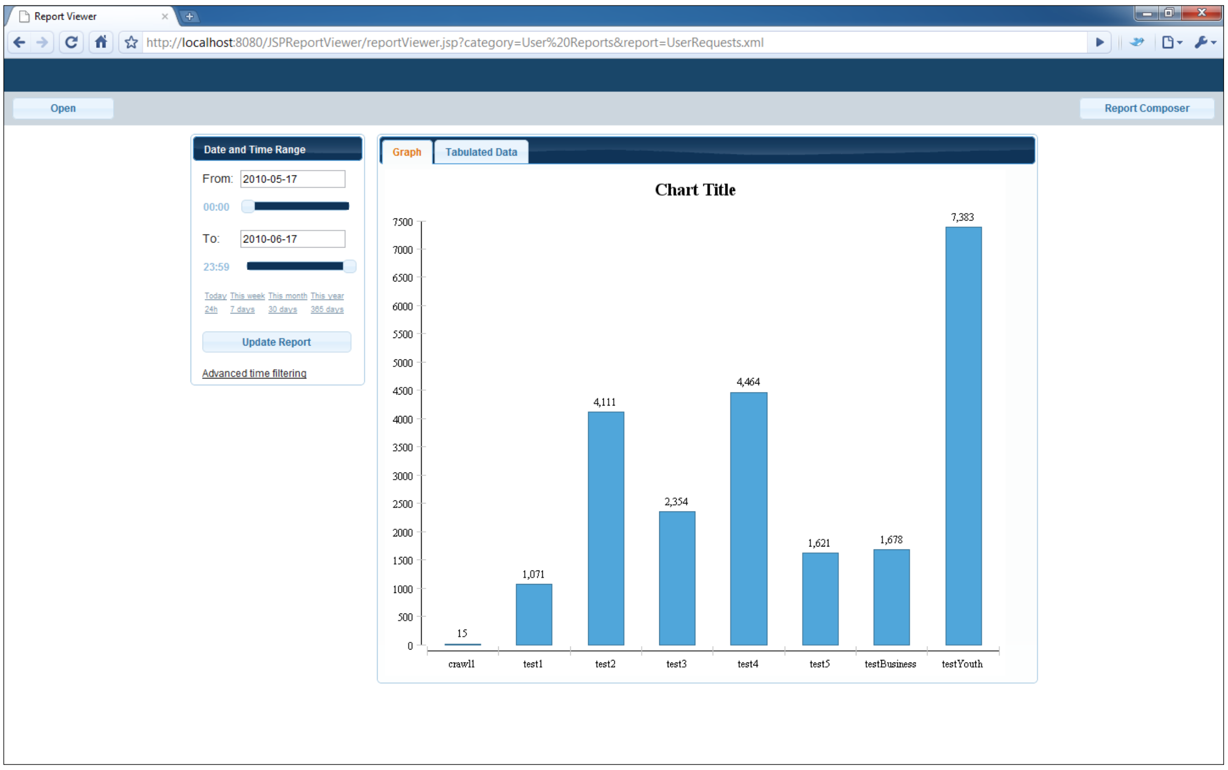


Figure 19. The main report viewer screen.

Main viewer

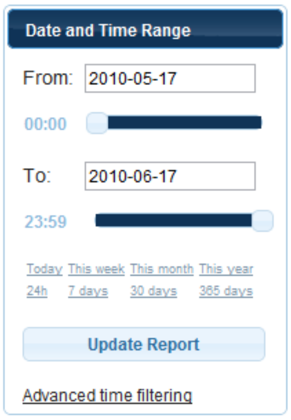
Once the user selects a report in the report selection screen she is brought to the main report viewer screen seen in Figure 19.

The report viewer contains two separate windows that look like larger versions of the portlets on the report selection screen. However, these cannot be moved nor minimized. The grey menu bar in the top still has the report composer button to the right but it now also contain a button to the left labeled *Open*. This button simply takes the user back to the report selection screen if she wants to open another report.

The main window of the report viewer is the one containing the graph in Figure 19. This is where the BIRT report files are rendered for the user to look at and as can be seen, it is divided into tabs. The tab system is, just as portlets, a standard component in the jQuery library. The idea behind dividing a report into a series of tabs is that one report might contain several sets of data. It might have, for example, a graph showing the total amount of purchases each day but also a table showing the same information or perhaps several graphs showing purchases of different items. So instead of having one long page with all this information or smaller graphs laid out in a grid pattern the tab system was used to allow for a more logical division of the data in a report.

The layout, names and contents of these tabs are up to the designer of the report and will be covered in more detail in 7.3.2.

The second, and smaller, window of the viewer is the Date and Time Range window. It contains all information and parameter settings for date and time. (Figure 20) The top input field is the date from which the report should show data and the blue slider below it indicates from what time on that date. The same applies to the other input field and slider, the only difference being that it is the end date and end time of the report and consequently the time slider is mirrored. This gives the impression of an interval between the two sliders that is intended to be easier to understand than two text fields.


Date and Time Range

From: 2010-05-17

00:00

To: 2010-06-17

23:59

Today This week This month This year
24h 7 days 30 days 365 days
Update Report
Advanced time filtering

Figure 20. Date and Time settings.

If the user clicks in one of the input fields to edit the start or end date a small calendar pops up, shown in Figure 21. The user can still edit the text field manually should she want to but the calendar was added to provide a more visual selection method and help the user pick the correct date. The calendar widget is a standard component of the jQuery library called *Datepicker*. To prevent the user from picking an end date that is before the start date or vice versa the datepicker widget disables all dates outside those limits.

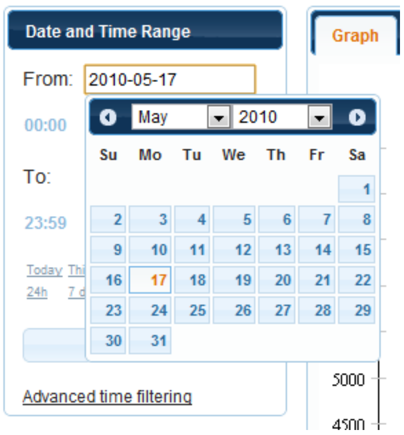
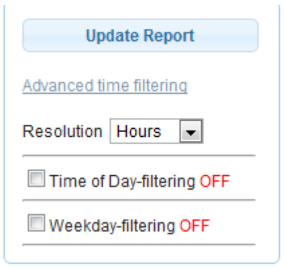


Figure 21. Date and Time settings with the calendar widget active.

Below the date and time settings is a small grid of eight links. Each of these represent a date and time range and are presets that sets the *From* and *To* date and time to its specific range. For example, assuming it is 2010, *This year* will set the *From* date to 2010-01-01 and the *To* date to 2010-12-31 while *365 days* will set the *From* date to the current date minus 365 days.

This is a feature that was actually present in one of the earlier versions of the MSDP Report Viewer but was, for reasons unknown, removed in a later release and has ever since been requested by some customers. It provides a quick way for the user to see the most recent data for the current report.

The *Update Report* button simply applies the time settings to the current report and updates the page showing the requested data.



Resolution: Hours

Time of Day-filtering OFF

Weekday-filtering OFF

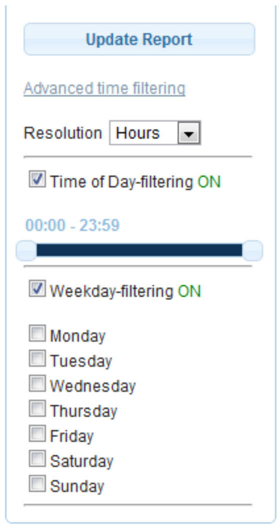
Figure 22. Advanced time filtering in off-mode.

At the bottom of the Date and Time Range window, below the Update Report button is a link called *Advanced time filtering*. It contains more specific time filtering options like what time of the day the report should show or which weekdays. When the user first clicks it it extends the Date and Time window and adds what can be seen in Figure 22. The first thing one sees is the red capitalized *OFF* label. It indicates that the current option is not enabled and is verified by the fact that the accompanying checkbox is not checked.

If the user ticks one of the checkboxes the OFF-label changes to a green ON-label to indicate that this option is now active. It also extends downward to display the actual settings for this option. InFigure 23 Figure 23 this can be seen with both options expanded. The *Time of Day* filtering is an option for selecting between which times the user wants to see data, e.g. between 12 and 16 each day. This option has the familiar slidebar but instead of only having one handle as the two slidebars in Figure 20 this has two handles, one on each side. The area of the slidebar between the handles are dark blue which indicates this is the selection made and also that it is an interval that is being selected.

The second advanced time filtering option is the *Weekday*-filtering which has a list of the weekdays with a checkbox for each meaning the user can select which days of the week she wishes to include or exclude. When the weekday-filtering checkbox is off this option defaults to all weekdays.

Above those is a dropbox labeled *Resolution* which is set to Hours (Figure 22 and Figure 23), this is also the default value. The resolution controls the granularity of the report, how fine or small time spans it should show data for. For example, if a report is designed to show data for the past two years you might not want it set to show data for each minute but for each month. Likewise if you have a report showing data for the past 24 hours, having it set to a resolution of days or above will not be very beneficial.



Resolution: Hours

Time of Day-filtering ON [✓]

00:00 - 23:59

Weekday-filtering ON [✓]

- [ ] Monday
- [ ] Tuesday
- [ ] Wednesday
- [ ] Thursday
- [ ] Friday
- [ ] Saturday
- [ ] Sunday

Figure 23. Advanced time filtering in on-mode.

7.3.2 COMPOSER

The report composer looks very much like the report viewer except for some new buttons and functions which can be seen in Figure 24. The biggest change is the Tools window to the left above the time parameter window. This contains the tools needed to create a report, new graph, new table, new text and new tab. At the top left of the screen there are two additional buttons, *Save* and *New*. This allows the user to save the current report she is working on and create a new one. *Open* will open an existing report and allow the user to edit the report.

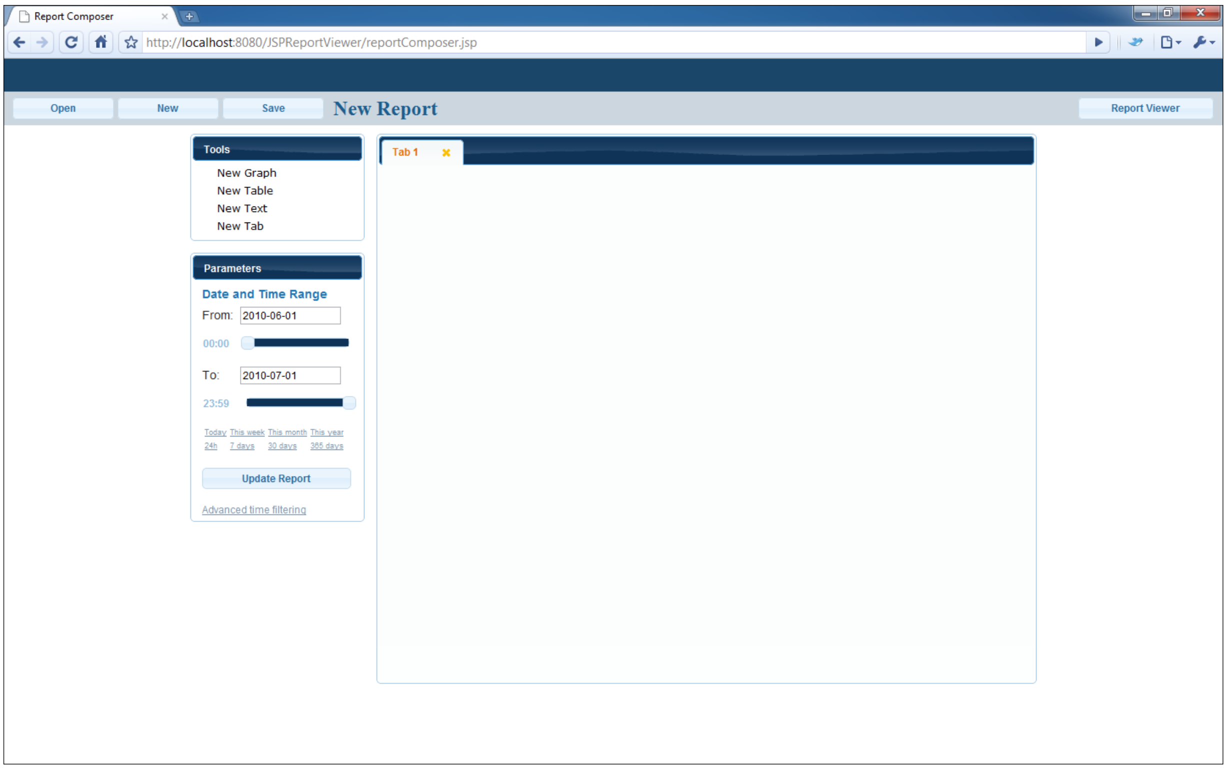


Figure 24. The main Report Composer screen.

The time and date parameters are the same as in the report viewer, the only difference being that the creator of the report can set them to certain values and then save the report. When it is then opened in the viewer those time and date settings are the preset for that report. However, the user can still change them if needed.

New Tab will prompt the user for a name for the new tab and then add it to the main window. It is also possible to remove existing tabs which is indicated by the cross icon the right of the tab name. The tab that the user has active determines where the report content is placed when one of the other three tools is used. If the user is not happy with the name of a tab she can double click on the tab text and a text input field will appear in its place in which the user can specify a new name.

Using the *New Text* tool will open a dialog window with a text field in which the user can write anything she wants. Its intended use, however, is to write information or comments about the report that other users can read in order to understand the report. Once done the user selects OK and it adds the text to the active tab.

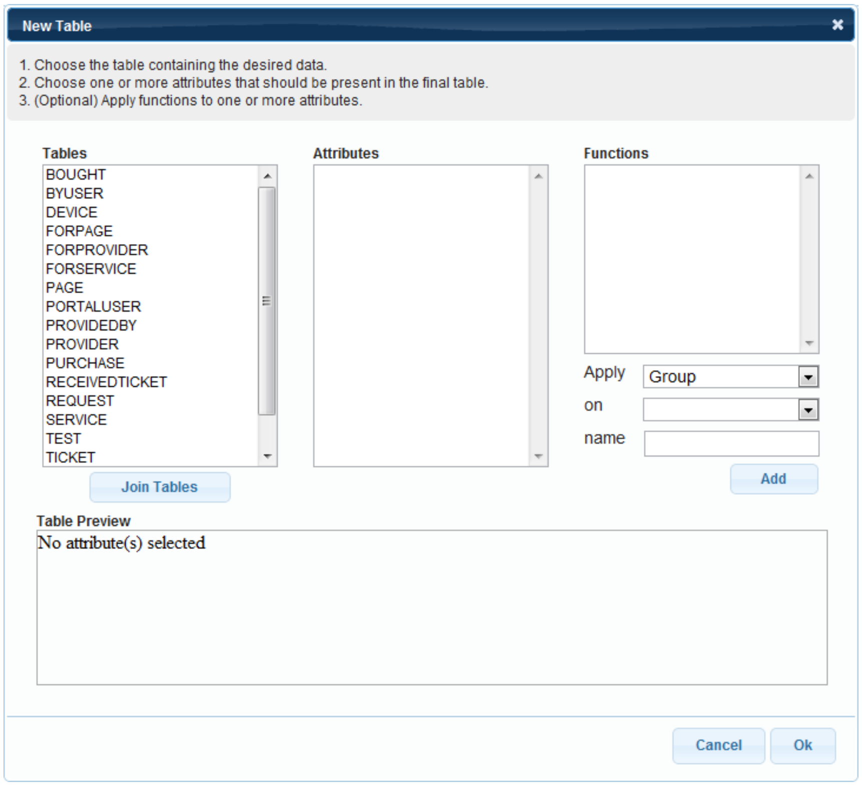
Table creator

When the user chooses the *New Table* tool a new dialog window is opened (Figure 25). In this dialog the user can create a new data table, i.e. a list of information, from the database tables containing the log information. It has four major components; a list of all database tables available, a list of all attributes in the selected table, a list of functions that the user has applied to one or more attributes and a table preview showing the users current selection.

Both the attribute list and the function list depend on the table selected in the table list. This means that if the user selects another table the contents in the attribute list is replaced with the correct attributes belonging to the newly selected table. The function list on the other hand is cleared from applied functions to show that there are no functions currently in use. The selection of attributes and creation of functions is not saved either, meaning that if the user reselects the previous table it will not repopulate the function list with what was there before.

This is done to prevent the user from believing she has selected things from more than one table at one time. The user will also get visual feedback on this in the preview window since that will clear as well when the user selects another table and display the message *No attribute(s) selected*, which can be seen in Figure 25. The preview will update automatically for each new attribute or function the user adds or remove so the user will always know what the result will be. This preview is set to only query one hundred rows from the database so that database performance is not a reason to wait for the preview to update.

Once done, the user presses OK, the dialog closes and the active tab is updated with the new table.


New Table

1. Choose the table containing the desired data.
2. Choose one or more attributes that should be present in the final table.
3. (Optional) Apply functions to one or more attributes.

Tables: BOUGHT, BYUSER, DEVICE, FORPAGE, FORPROVIDER, FORSERVICE, PAGE, PORTALUSER, PROVIDEDBY, PROVIDER, PURCHASE, RECEIVEDTICKET, REQUEST, SERVICE, TEST, TICKET

Apply: Group

Table Preview: No attribute(s) selected

Figure 25. Table creator.

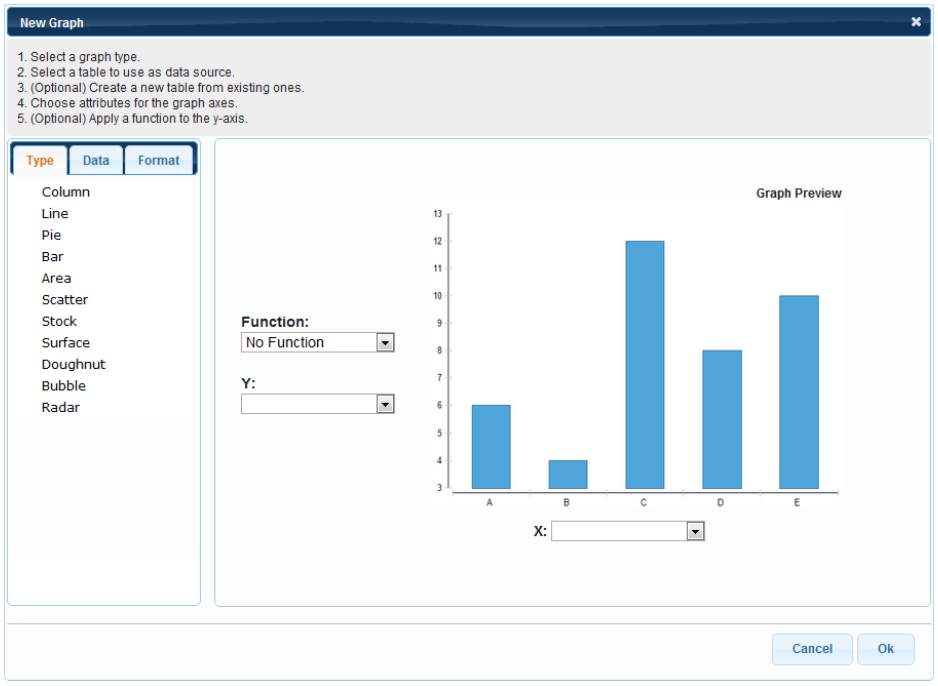
Graph creator

If the user instead chooses to create a graph she presses the *New Graph* tool in the tools window which opens up the graph creation dialog (Figure 26). This dialog allows the user to create a new graph or chart for the data in the database. It is divided into two parts, one configuration panel to the left, which in turn contains three tabs. The right side consists of a preview graph, two dropdowns for the x- and y-axis and one dropdown for applying a function to the y-axis.

As mentioned the left side contains three tabs, *Type, Data* and *Format*. The type-tab is a list of all the different charts and graphs available to the user. Each type also has a set of sub types, example seen in Figure 27.

The second tab, data, is the same list of database tables as seen in Figure 25. If the user selects one of these tables the x- and y dropdowns to the right in the graph creator will update to hold the attributes belonging to that table. If the user has selected some attributes and produced a preview and then chooses to select another table, the dropdowns will update to the new attributes and the preview will show a placeholder image that only shows an example of the currently selected graph type.

The format tab is intended for graph settings such as heading, labels and colors.


New Graph

1. Select a graph type.
2. Select a table to use as data source.
3. (Optional) Create a new table from existing ones.
4. Choose attributes for the graph axes.
5. (Optional) Apply a function to the y-axis.

Figure 26. Graph creator.

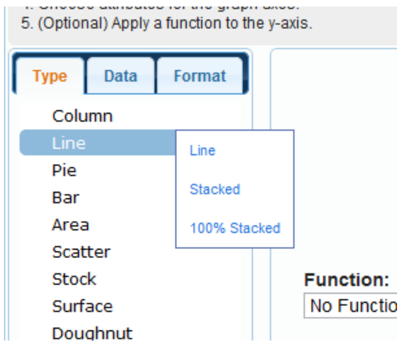

5. (Optional) Apply a function to the y-axis.

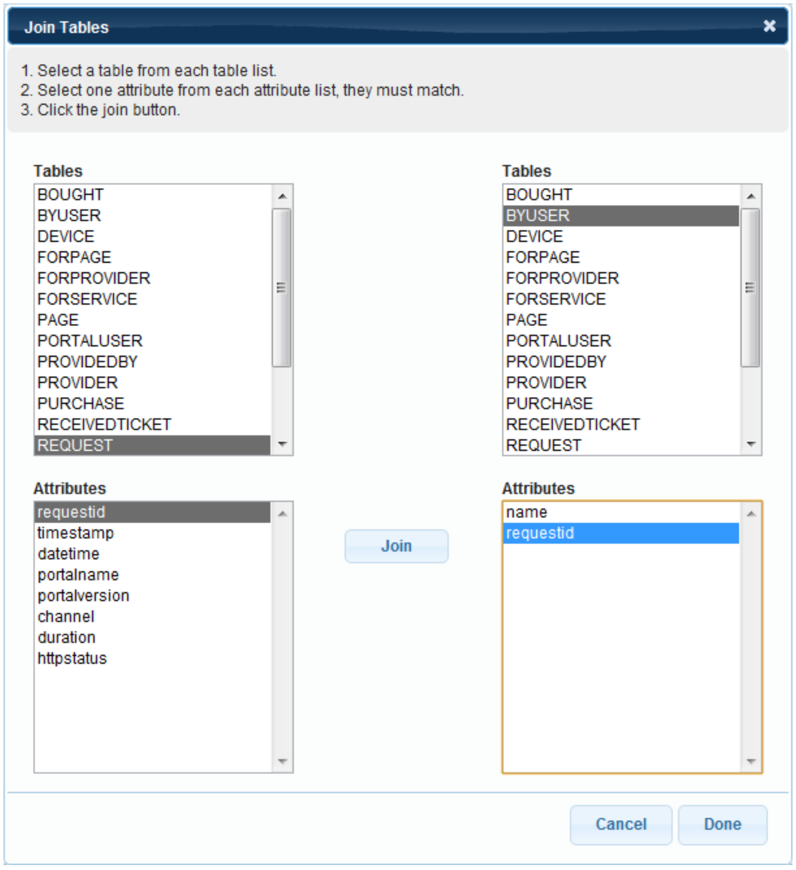
Figure 27. Line graph sub types.

Join tables

Below the lists of database tables in the create table and create graph dialogs there is a button named *Join Tables*. If the user cannot find the data needed in only one table but it exists in two or more she can press this button and open the join tables dialog (Figure 28).

This dialog consists of four lists, two named *Tables* and two named *Attributes* and one *Join* button. Just as in the two previously described dialogs, the attribute lists will update according to what table is selected in the tables list above, i.e. the lists are related vertically. The join button is by default disabled and grayed out.

Once the user has selected two tables she can choose one attribute in each list, at which point the join button becomes enabled. If pressed the user is presented with a prompt asking for a name for the new table and when the user confirms, it updates the lists with the new table and the user can either join more tables to the new one or join two others. When the user presses *Done* it closes the join tables dialog and opens the previous dialog, graph or table, and the user now has access to and can use the newly created tables.


Join Tables

1. Select a table from each table list.
2. Select one attribute from each attribute list, they must match.
3. Click the join button.

Tables
BOUGHT
BYUSER
DEVICE
FORPAGE
FORPROVIDER
FORSERVICE
PAGE
PORTALUSER
PROVIDEDBY
PROVIDER
PURCHASE
RECEIVEDTICKET
REQUEST

Tables
BOUGHT
BYUSER
DEVICE
FORPAGE
FORPROVIDER
FORSERVICE
PAGE
PORTALUSER
PROVIDEDBY
PROVIDER
PURCHASE
RECEIVEDTICKET
REQUEST

Attributes
requestid
timestamp
datetime
portalname
portalversion
channel
duration
httpstatus

Attributes
name
requestid

Figure 28. Join tables dialog.

7.4 USER TEST 2

The second user test was designed to test the final prototype. As in the first user test, two hypotheses were formulated but this time the testers were given more but smaller tasks in order to test as many of the different aspects of the application as possible. The hypotheses have been modified to reflect hopes that the interface has improved to a point where previous experience does not make a big difference.

7.4.1 HYPOTHESIS

1. Users with previous knowledge in databases and SQL will be equally confused about the interface as those without previous knowledge.
2. Users with previous knowledge in databases and SQL will perform the tasks equally fast as those without previous knowledge.

7.4.2 PROCESS

For the second test the number of test participants was kept consistent at four. Two of the testers from test one returned for a second session and two new testers participated.

The decision to have the testers arranged in this way was because being able to compare new testers that had not used the interface before to someone who had used it before seemed like an interesting metric. At the same time being able to compare some users' results from the first test with the second test to see if there were any improvements was considered important.

1. A little SQL, knows MSDP well (new)
2. Very little SQL experience, knows MSDP well (new)
3. Knows SQL, very little MSDP experience (returning tester)
4. No SQL experience, knows MSDP fairly well (returning tester)

Experience from the first test affected how the tasks were structured in test 2. Instead of two larger tasks, as in test 1, the testers executed six smaller tasks. This was able to be done since this time around there was a working, implemented interface that could handle more realistic input. All parts of the interface worked and the users could as such move more freely through the work flow.

Tasks

1. Create a table with a list of all pages.
2. Create a new tab.
3. Create a graph of number of requests over time.
4. Change the time span of the graph to the entire year.
5. Change the time filtering to only Wednesday afternoons during the last month.
6. Create a table showing the number of requests per page.

7.4.3 ANALYZIS AND CONCLUSION

The second user test was conducted at the very end of the implementation phase and provided a chance to see if changes done to the prototype had had any effects and if having a functioning interface had any effects on the testers' success.

This time around the commenting had pretty much the same character as last time with comments about details. Many of these details were known in advance but there had not been time fix them. One major thing of this test however, was that SQL was a much bigger problem compared to the first test. This is believed to be because of how the first test prototype was setup and how limited it was, there was simply less options to fail at.

The fact that the program's work process is quite short or has intermediary steps that you complete makes it so that mistakes are not that severe and that was noticeable during testing as the users could get back to where they were quickly even if they did a grave mistake where they had to start over.

Hypothesis 1 turned out to be false in this test. There was really only one tester this time that had real SQL experience and had his knowledge fresh in mind. This tester, tester 3, performed a lot better than the other testers. He was one of the returning testers but this did not seem to have that big of an impact as the other returning tester had the same problems as the testers that had never used the interface before. The other tester we had with SQL experience had used SQL in past but did not use it any longer. He showed most of the problems that testers that did not know SQL did. The hypothesis as it is phrased is true if you assume previous knowledge is in infinite time span backwards. If you assume previous knowledge instead is recent knowledge, the hypothesis is false; users with recent knowledge are less confused.

Hypothesis 2 has precisely the same result as hypothesis 1 in that the speed follows closely to the amount of confusion about the interface the user has. Less confusion - less time taken.

7.4.4 OUTCOME

This section describes the result of the final user tests and in some cases proposed changes for some of the issues. However, due to the time constraints of the project, no time was available to correct them.

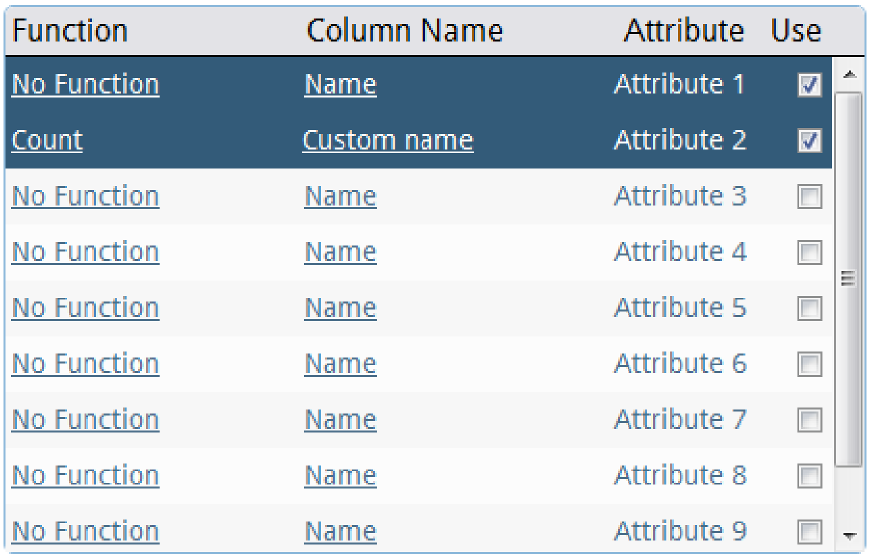
7.4.4.1 TABLE

A noticeable trouble for the users was to understand what the different tables contained. Changing their names and maybe even consolidating a few of them into the same tables could alleviate the troubles.

The disabled 'Join' button in the join window was invisible to some users under some lighting conditions, changing its opacity or parts of its opacity might resolve this.

When a join has been made and the user returns to the 'New Table' dialog, the user does not receive any feedback that what she has done is now active. Selecting the new table in the list will show that it is now there and usable.

The functions part of the 'New Table' dialog caused trouble for most users and since all changes from test one had not had time to be implemented a second redesign was done. The sketches for the redesign were looked over and further changes were made to it. Instead of just redesigning the 'Functions' section of the dialog, the 'Attributes' list and 'Functions' section were combined into one new section taking the space of its predecessors. When the user selects a table in the 'Tables' list the new 'Attributes and functions' list populates with a row for each attribute in the table. Each row has the name of the attribute, the name you want on the column for that attribute, what function is applied to it, if any, and a checkbox for if you want it included in the table you are creating. It is also sortable by drag and drop so that the user can rearrange the order of the columns in the final table. This redesign is shown in Figure 29 but it was never implemented into the real application.



Function	Column Name	Attribute	Use
No Function	Name	Attribute 1	☑
Count	Custom name	Attribute 2	☑
No Function	Name	Attribute 3	☐
No Function	Name	Attribute 4	☐
No Function	Name	Attribute 5	☐
No Function	Name	Attribute 6	☐
No Function	Name	Attribute 7	☐
No Function	Name	Attribute 8	☐
No Function	Name	Attribute 9	☐

Figure 29. The new attribute/function list which allows for greater customization. It has fields for functions, user specified name and it is possible to sort the attributes.

7.4.4.2 GRAPH

The right side preview of the graph builder was not obvious that it was a real time preview until you made big, noticeable changes to it. To the top right of the preview was added the word 'Preview' to indicate that it actually was a preview. The user can look for any changes she was hoping for in it when an option is changed.

Empty spaces for columns that do not have any values should be added as an option. Currently, there are only columns shown for periods where there is data, no matter the time span chosen. Illustrated by Figure 30.

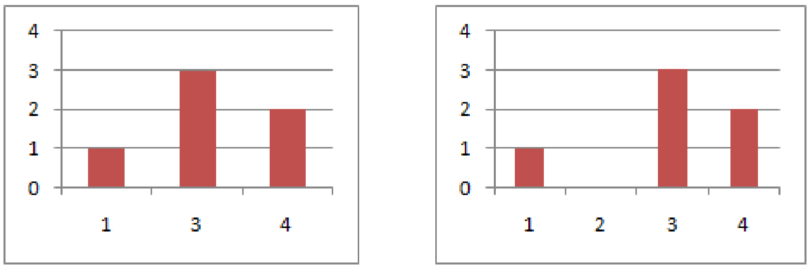


Figure 30. Left: Graph with hidden empty column. Right: Graph with empty column.

The 'No Function' alternative that is the default for the 'Function' drop-down in the graph builder is a little too much like a warning. It should be changed to 'None'.

The chosen function in the 'Function' drop-down should be cleared as you change the source table to avoid accidental application of functions.

7.4.4.3 GENERAL

The users would like more tooltips and other just-in-time help. Tooltips could be used e.g. for explaining what different functions actually do.

The button for regenerating the report after changing time settings stays in the same place when you extend the advanced settings. Either it needs to follow the advanced settings and have a new place at the bottom of the advanced settings, or there needs to be a second button at the bottom of the advanced settings.

Adding a new tab should be able to be done in the tab bar containing the tabs, as in most modern web browsers. This can be done by always having a small tab in the tab bar be the button for new tab as if there is always a clean tab available to be named and used. Returning from either creating a graph or table should leave the tab you added the new element to as the active tab.

Right now, all dialogs are immovable objects that can't be dragged around. Several users expressed desire to be able to move them and peek at what they had done behind it.

There is no undo feature. Supporting undo in the current system structure would be a huge undertaking as some things are done on the server, some in the client and some on both. Instead, the interface has short intermediary steps to doing a task and each step can easily be deleted and redone. So there is a kind of undo, but not a chronological history that you can traverse.

There was a request for more "flashy" charts. When the export feature of BIRT is implemented, enabling exporting to CSV there should not be any problem implementing Open Flash Charts and having nicer looking charts.

8 DISCUSSION

Existing users

Our first, intermediate goal with the project was to gather feedback from real users at the MSDP customers. This was supposed to help us develop a set of user needs and requirements into personas that we would then use in the design of the application. Together with our supervisor at Ericsson we decided on three different operators from three different countries.

However, as an interaction design student you become a bit naïve, thinking people will want to help if it could, in any way, help them. It turns out this is not the case, at least not for some of them. One of the customers was very happy to help us and got back with answers to our questionnaire in a few days. However, the other two never got back to us with answers, even after some inquiring into why it was taking so long. The reason for this is unknown but we suspect they forgot about it, did not have time or simply did not want to.

At this point we did not really have a backup plan for gathering information for personas since we assumed the questionnaires would not be such a problem. We could have asked three more customers but we felt that we did not have time to go through it all again. So we started looking at existing studies done by Ericsson to try to learn about the users that way and we also sent out a number of emails to various Ericsson employees who have frequent customer contact. It did not give us much new information but rather cemented what we already knew from talking with our supervisor and other employees.

Consequently, the idea of using real users from a local customer for the final user test was scrapped early in the project. This was very unfortunate since they were the ones that would potentially benefit from a redesigned report viewer. But as an interaction designer you are counting on their goodwill and willingness to help, and if they do not want to or do not care there is not much you can do about it especially if it is in another company and it is “just” for a thesis.

The backup plan for user testing was to try to match the user profiles with employees at Ericsson. This seemed to turn out quite well, we had a broad spectrum of people and skills and they provided good feedback on the prototypes. However, the take-away point is: plan for at least two scenarios. It will not hurt to spend some time to create a backup test, possibly by finding people outside the organization that match the real users. Using people who you know or that belongs to the same organization introduces bias and social restrictions. One group do not want to hurt your feelings by telling exactly what they think and one group has a stake in what you are doing and might hold back critical information because of it.

Easy to use vs. easy to learn

The user base for this application was divided into two distinct camps, those who would use the application regularly and learn everything that is to learn and those who rarely use it. The skills of the two groups were also very distinct, one very knowledgeable with the MSDP and system administration, the other group have no knowledge with the MSDP and do no administration or development. That meant designing for any of these groups would mean alienating the other since it would either be too hard to use for the novices or not efficient enough and too abstract, i.e. lack of details, for the experts. But that also meant designing an application that could satisfy both of these extremes, which meant compromises had to be made.

We decided on designing an application that would be primarily easy to learn and easy to remember with a few distinct features. It is a bit like Microsoft Excel, if you are a new user you do not really know how to create a nice looking graph but you can try it out and you grasp the basics quite fast. To support this previews were added to give immediate feedback to the user about his or her action and most tasks are cancelable.

Existing reporting system vs. custom system

Was it worth using an existing system as opposed to creating one? Since we did not explore creating a custom system it is a difficult thing to answer. However, during the course of the thesis there have been numerous occasions where we have wondered if a certain feature or function wouldn't have been easier to do by ourselves. BIRT is such a large system that it is sometimes hard to understand what to do or how to do it. And for a prototype of the scale created during this project it would certainly have been possible to create a custom report system.

However, there are a lot of advantages to using an existing system, especially if it is free. Perhaps the most compelling reason is that you do not have to invent stuff that has already been done by someone else. This will, in the long run, save development time and money. However, if the time limit on the project is short, learning the system might take up a large portion of the development time, which was the case with this thesis.

A related issue was if the choice of BIRT was the right one. In the end of the evaluation process the choice of reporting system came down to us placing more trust in the Eclipse Foundation than any of the other companies. We think the Eclipse IDE is a very good development environment and there was no reason to think BIRT would be any different. And thanks to it being part of Eclipse it also became part of the Eclipse community, which was as far as we could understand, the largest of the reporting systems evaluated.

In the end we do not believe any of the other systems would have been better than BIRT and we are pleased with the relatively short learning curve for a system of BIRTs size. However, for this thesis it would probably have been easier to create a new system due to the limitations of the final application.

In the end we were satisfied with the choice of BIRT, not because it was better than the other systems, we cannot guarantee that, but because BIRT was not bad at anything.

Blend vs. Paper Prototyping

We have our doubts whether prototyping in Blend was worth the effort. Maybe we could have just used paper prototyping and used Paint.net or Adobe Photoshop to do a mock up of some aesthetics prototypes for choosing colors, borders, fonts and so on. While Blend is an excellent prototyping tool for creating interactive prototypes that can behave as a real application, for someone who does not know it, it might be a bit hindering. But so is doing a non interactive mockup in Photoshop if you do not know that program.

In retrospect it might have been beneficial to only use paper prototyping since learning to use Blend took quite some time. It was easy to start off with but the details took time and we would have had time to do more iterations and versions of the interface if we had used paper prototyping. From purely a prototyping perspective this is very likely the case since we, ourselves, did not really use the interactivity to evaluate our own designs. The interactivity was mostly tested by the testers in the user tests.

Testing on a high-fidelity prototype

The first user testing was done on a prototype made to look like the real thing in Microsoft Blend. Making the prototype like this took quite some time and we had to learn Blend to make it happen. If the prototype we tested instead would have been a paper prototype with pages upon pages of screens and the options of them, the creation time would have been shorter. The preparation before the test itself would have been greater as you have to know the prototype better when you yourself are the one "acting" as the interfaces logic. The fact that it is you that "are" the interface has a very big advantage compared to a high fidelity computer driven prototype, you can adapt.

If the user wants to try something that you have not prepared or have not thought about you can adapt to that. You know roughly what would happen and can as such just draw up a screen as it would have looked. If something is unclear about it, all the better, you can discuss changes with the tester immediately. A computer made prototype would have to have coded logic in behind the interface to accommodate for this and if this is done, it would be more of an implemented solution than a prototype you had done for the reason to not have to do a time consuming implementation.

This happened with the prototype we had done. Several users did minor things wrong but clicking OK produced the same result as the prototype could not actually process any information and just went to the next step as if the user had done roughly the right thing. We did not really think this would be that big of a deal and that we would get valuable data anyway. While there still was useful data extracted from the testing it is our feeling that more and/or better data could have been produced with a prototype that responded better to what the tester did.

Something the high fidelity prototype did very well, however, was that many of the testers commented on how good the design looked. Prototyping the aesthetics in paper is a lot harder than on a computer since that is the natural environment of the final program and has the power to display a 1:1 representation of the sought after design.

If you are prepared in the sense that you know your interface and what it should do, using a paper prototype for the first user test is the way to go.

SQL – layering

One aspect of having the users create their own reports that proved very difficult was making them understand, or at least be able to use, SQL. When dealing with simple SQL queries like selecting a number of attributes from one table or even applying a function to one or more of them it is possible to hide that with some kind of interface. But if the user is to be allowed to retrieve information from more than one table at a time she needs to be able to join tables together and this is where things become tricky.

We tried to explore several ways of doing this, both text based and visual, and there is probably a few good ways of doing it. But we also considered in what environment and by whom should this application be used and realized that a visual approach was probably out of the question due to it being slower and more inefficient. A potential user of the application was also the current users who actually know a great deal about the system and some might even have knowledge in SQL. We did not want to alienate those users by creating an interface that hides what is happening, making them less likely to understand the application and frustrate them because of lack of fine-control.

On the other side of the spectrum is creating an SQL editor where the user simply enters the SQL code and retrieves exactly the information she wants. Consequently this alienates more people than the previous version since more people are likely to not know SQL than know it. The compromise between the two is the version seen in the final implementation, two table lists and two attribute lists and the ability to join on two tables that share an attribute.

Our final user test showed that most users would probably have trouble with grasping the whole concept of joining tables but they expressed an understanding of it once they had tried it once. This brings us back to the concept of not necessarily easy to use but easy to learn.

The database

As was mention in chapter 1.5 the creation of a new database was necessary but not a focus of the project which meant we would try to not spend as much time on it. However, designing the database proved quite tricky since the MSDP logs contains so much different information that is connected to each other.

In most, if not all, cases when designing a database you have to adhere to certain naming restrictions and conventions, especially if the database is part of a large company. This database, however, was going to have tables read by users not familiar with databases which meant the names of both the tables and their attributes had to make sense, i.e. be readable and also give a hint to its content.

As a consequence to this it is not really possible to use just any database with this application since you won't be able to read the database and attribute lists. One possible solution, which we did not explore, is to save a humanly readable name of the table inside it or possibly a reference table for both table and attribute names. In that case it would be possible to save formatting of the name as well, i.e. spaces and capital letters. That could also lead to having an initial setup that only consists of supplying the application with this reference table to get access to the other tables.

The final aspect of the database that we discussed at great lengths during the project was performance. With our design it will grow very fast, in fact it would probably hold several million, possibly billions, rows of data for each table since it is saving the raw data. This means that performing calculations and joins on those tables would be extremely slow and probably be even slower than the current solution.

JavaScript/JQuery

JavaScript is, for someone who knows at least Java, easy to learn and get started with but it is not easy to use to do useful things, e.g. the tabs in the report viewer. We had not planned on using jQuery to help us with our JavaScript, in fact we had never heard of it before this project. When we started implementing the application we were looking for a way to create a pop-out calendar for date selection and we came across the calendar widget on the jQuery UI site. For some time afterwards we only utilized the widgets provided by this extension library without paying much attention to the core jQuery library.

However, it was not long until we realized the potential of the library and started using it extensively. It makes HTML element selection very easy and provides a multitude of methods and events for manipulating such elements. Consequently, a large part of the final application is controlled by JavaScript functions and events through the use of jQuery and allows most of it to run on the client.

Another part of the application that comes from using jQuery is most of the visual style. The jQuery UI library comes with a number of different complete visual styles and we felt that instead of putting a lot of time into creating those things ourselves we used one of these premade styles.

There is no real downside with using jQuery; it is a solid library that really does what it claims. The real problem lies with JavaScript. Since it is a client side scripting language it is disconnected from what is happening on the server. For our application, that has to do quite a lot of file handling, it means JavaScript has to continuously send information to the server and wait for response, which can potentially take some time. Luckily jQuery has a built in function to communicate with the server using the JSON protocol.

The use of dialogs

Dialogs are, as have been mentioned before, used extensively in the desktop application world but not so on the web. In many cases the dialogs that we do come across are browser related asking if we want to navigate away from a page or that some form content is being resent to the server. The other type of window that many would label as dialogs and vice versa are pop-ups, of which very nearly all are ads. In a web environment these pop-ups interrupt what we are doing and are generally considered a nuisance.

We chose to use dialogs because they are a great way of isolating specific functions and tasks, such as creating a new graph, while still keeping the user in the same place. The idea was to transfer the feel of a desktop application to the web environment to make users feel more at home. But also to move away from the interruptive nature of normal web pages, the reloading of content each time the user navigates to another page or performs an action. This is why such a large portion of the application is JavaScript based, it allows for content manipulation at the client side without contacting the server.

A way of helping the users accept the use of dialogs in that environment is to make sure it fits into the rest of the application, not stand out by having a different style or different colors. The jQuery library was a great help in that the dialog components it provides are not actually real dialog windows generated by the browser but in-page dialogs, they are part of the content on the page. These dialogs therefore only exists on the page they are a part of, they are not separate windows, which has the advantage of not jumping out at the user. But as any dialog, they can be moved, although only within the browser window.

However, in our case we felt that they would be too big to move, it wouldn’t make any sense but also that it might be possible to place them outside of the page, making them impossible to get to. However, this decision was probably not completely correct since testers during the last user test tried to move them to see what was behind, a way of reminding them what they were doing or what they should do.

In the end we believe that the use of web applications will increase and that many of the design guidelines specified by companies such as Microsoft for desktop applications will either be transferred to or adopted for the web. We, as end users, expect the same, or close to, the same functionality from web applications as from desktop applications. In some cases it will not be possible to create an application as a web application simply because the server-client architecture cannot support it and because we are, so far, limited by what we can do in terms of interfaces and performance on the web.

9 CONCLUSION

If you are in the market for a reporting system and do not need 100% control of its internal functions then it is recommended to go with an existing system instead of creating one by yourself. The main reason for doing this is to cut development time. An existing system will still take time to learn but most likely not nearly as much as creating one from scratch with equal functionality. Secondly, as long as you are not aiming to develop a new reporting system, it is not likely that you ever can match the functionality of an existing system that has been developed solely for this purpose.

On the other hand, if you want or need complete control over your reporting system using an existing framework depends on your systems size and complexity. If you are going to create a limited system with few functions it is probably better to create that system from scratch instead of first learning to use the framework. If your intention instead is to create a feature rich and powerful report creator you will save time in the long run by using a framework.

If you are going to create a fairly large and complex reporting application and have the time to learn an existing framework BIRT is a good choice. After using it in this project we cannot recommend against because of a number of reasons. It is open source and free, it is extensive and has a large community. The reports it creates can be highly customized to fit into your application and the reports can be exported to a number of different formats, either for direct use or to use in another library or application.

In the struggle between making the interface easy to learn or harder to learn but effective to use, our conclusion for this type of interface where many people will use it infrequently you have to go for easy to learn first. This should not rule out that the interface can be made effective for the frequent user as well, but easy to learn should have priority when you have to choose.

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APPENDIX A DATABASE SCHEMA

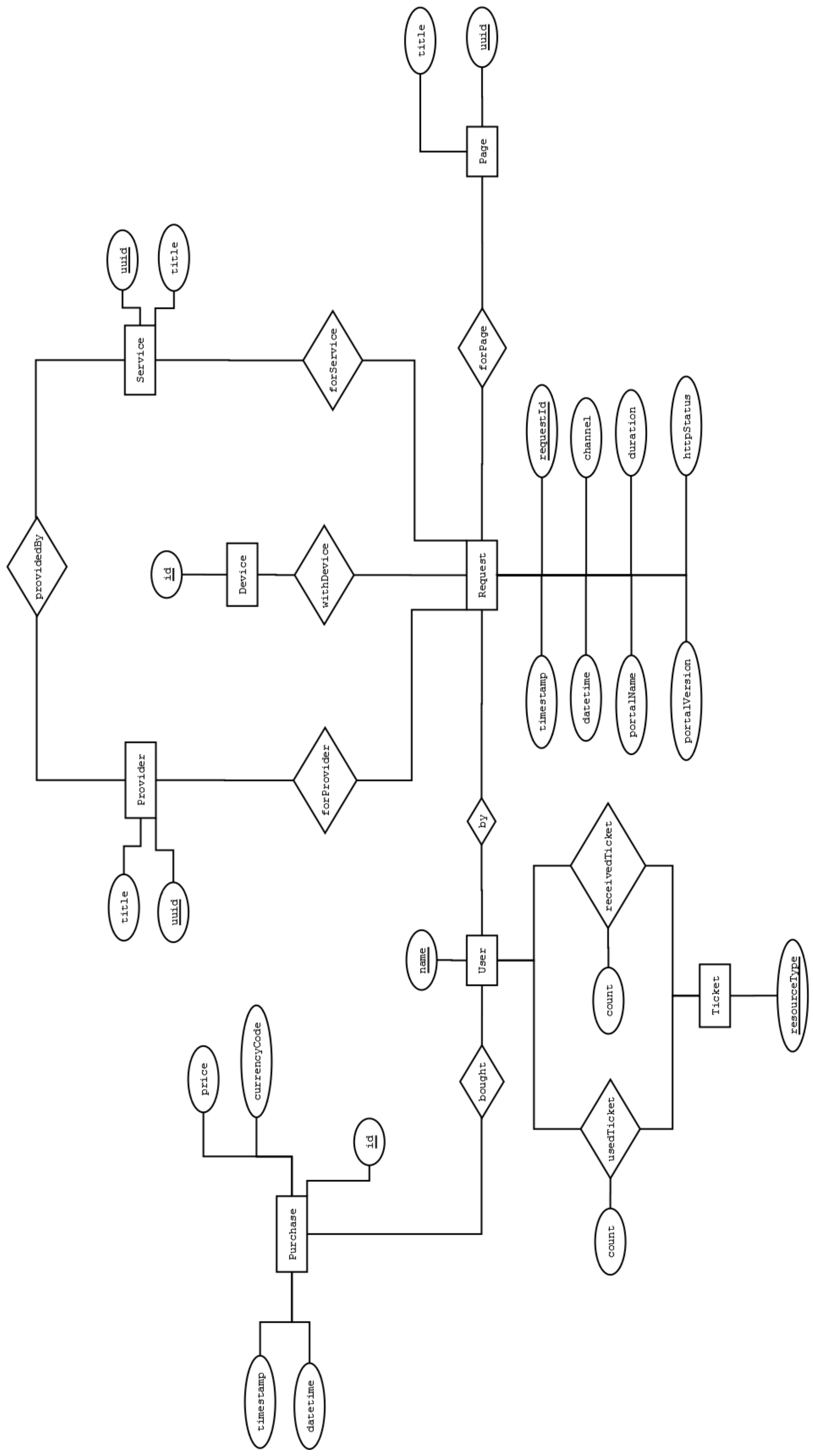


Figure 31. The complete database schema used in the new database.

APPENDIX B USER TESTING FEEDBACK

This appendix contains the result from the user test sessions. They are based on the notes taken during the test sessions and in some cases there are few or even no notes.

B.1 TEST 1 - 2010-05-04

This is the results for user test 1. Below are the two tasks the users were asked to perform.

1. Create a graph showing the number of unique users per page.
2. Create a table showing the total number of requests per page for the last month.

B.1.1 TESTER 1

Time: 30 minutes

Gender: Male

Knowledge: SQL and MSDP

Task 1

The user has no trouble finding the graph builder. Here he spends some time going through the User and Page tables to see if they contain what he needs and if he can use them. They appear to hold the correct data but he can't get information from two tables in the graph as it is. He then tries the "New Table" button.

At this point he sees the radio buttons for inner- and outer join and comments that he recognizes them but can't remember the difference. It is apparent he only partially reads the instructions; he keeps reading a bit, trying something and then continues reading. He thinks the instructions are good but thinks a wizard might be better if a user should really follow it. He also commented on how he avoided the instructions due to the gray background and that he found it harder to read. Thinks the instructions can be highlighted depending on where the user is. Comments on the order of the done and cancel buttons in the bottom right corner and that maybe they should be switched to comply with the Windows standard.

Task 2

Starting out on the second task the user takes some time to read the instructions on the top of the screen wanting to avoid further complications. The same problem as in task one shows itself again with the user not remembering what an inner or outer join is. On the 'Add table' screen the user struggles with the belief that there are some interaction connections between the attribute list and the functions section. The grouping function is misunderstood to control the time span of the report rather than its actual function. The user did not fully understand how to choose attributes to include in the result list from the 'Add table' screen. It was not clear if an attribute was selected for this or not and the user thinks a preview would have helped here.

B.1.2 TESTER 2

Time: 40 minutes

Gender: Male

Knowledge: SQL

Task 1

When given the task the first thing the user did was to check the report viewer to see if there was already an existing report that showed the information he wanted. In the 'Add graph' screen the user almost immediately realized that he had to click 'New table' to produce what he needed for the graph. When in the 'New Table' screen the user went through most of the tables to look at the attributes, but cannot find one to join on due to the low fidelity of the mockup. The user gave several comments on the interface in general. Some feedback in the graph builder when a table has been selected is needed such as with a preview. It is strange that you are able to select the same attribute for both the X and the Y axis. The function drop-down is well placed, felt connected to the Y axis. Connection between X and Y is not that good. It is not obvious that they are as dependant on each other as they are. The 'New table' button could be an entry ion the drop-down instead of situated next to it, feels more intuitive. The flow of the graph builder is OK, but maybe move 'graph type' and 'format graph' to the diagonal flow. The radio buttons should probably have a default selected. The interface as a whole is very clean and nice. The 'New table' button is the biggest issue but the window it opens is good.

Task 2

When the user is trying to select attributes to include in the attribute list there is not an obvious indication of them being selected, the user wants to double click them to place a guaranteed selection. The user did not grasp the connection between the attribute list and the function list and tries to move attributes from the attribute list to the function list by selecting them from the attributes list and clicking the 'Add' button. The user wonders about removing functions from the function list, there is no button for it. The problem of arranging functions in order, does it matter what order they are in? The user wants the possibility of seeing the SQL code here to better be able to decide if the order will matter. He comments on that arrows or '<'s might be useful for showing what different elements affect what others.

B.1.3 TESTER 3

Time: 27 minutes

Gender: Female

Knowledge: MSDP

Task 1

The user starts the test with writing down the task so as not to forget it. The user starts up the report composer and starts with entering the table creator instead of the graph creator. She comments on this as this is basically how it is done in Microsoft Excel, you need a table before you can create a graph. When the user tries the 'Add Graph' option instead she reaches the correct screen for the task and continues with reading through the instructions thoroughly. Once the user understands how to create a graph she selects the user table from the table drop-down and picks username from the y-axis drop-down. The user then chooses the page table from the table drop-down and proceeds to set the x-axis to page name. The user believes this is correct because the mockup did not clear the y-axis drop-down as intended and it therefore, wrongly, matched her mental model of how the task can be solved.

After the user understands this is incorrect she tries the 'New Table' option. The user now understands that the existing tables are raw data tables and proceeds to select the user and page tables from the table lists and clicks join. The mockup produces a new table containing the combined attributes and the user clicks done. After this the user has no trouble creating a graph from the newly joined table.

Task 2

Since the initial part of the two tasks is almost identical, the user has no trouble creating a joined table with the information she needs. The user understands the instructions for selecting one or more attributes but is unsure whether or not she has actually selected an attribute. The time grouping dropdown continues to confuse and the user picks month from it thinking it means the last month. The user comments on that the instructions are good to have the first few times but that they might interfere once you know what to do.

B.1.4 TESTER 4

Time: 30 minutes

Gender: Female

Knowledge: None

Task 1

The user started with choosing the report viewer first since she thought it meant that a viewer is a viewer of a page, i.e. a user. After the user finds her way into the report composer and the graph creator she reads through the instructions and comments on how the controls need to match the instructions. This means the choice of graph should be moved to the left instead of having it on the right side. The user comments on how she does not understand what the 'New Table' button does or might do and does not understand what the function drop-down is related to. The user tries to select one attribute on one axis from one table and another attribute from another table on the other axis.

Once the user reaches the new table windows she wonders if it matters in what order you pick the tables when joining. When the user joins two tables she does not see that a new table appeared in the table lists at the top of the window and is therefore confused as to what happened. The user comments on how she found the instructions helpful but that they could be more elaborate and that there might be a separate help section with much more detail.

Task 2

The user still has problems understanding that she can join two tables together to access the data in both tables. The time grouping is once again mistaken for time span. She had problems understanding that more data can be accessed by joining tables and asked for help when creating a new table. Even when given some instructions the user did not fully understand the concept. This user also used time grouping to try to solve the subtask of just showing the last month.

B.2 TEST 2

Test results from the second test on the final prototype. In this test the testers were asked to grade their knowledge in SQL and the Ericsson MSDP from 1 to 5.

B.2.1 TESTER 1

Gender: Male

SQL: 2

MSDP: 4

Task 1

The user starts out with clicking New Report to know he starts fresh. He then chooses New Table from the tools menu and becomes a bit overwhelmed with the dialog popping up. The user then starts to scan through all of the tables available before deciding trying to select one. He hesitates between page and forpage before choosing page and is satisfied with his choice. The attributes are not entirely clear if they are selected or not. The Add button is unclear as well as to what it will do if pressed. Selecting multiple attributes were no problem as the user found the shift/ctrl modifier for multi-selection, though he did not find it entirely obvious that that was how you were supposed to do it.

Task 2

The user does not find New Tab immediately; he was looking for it in the tab bar before looking anywhere else. He also renames the tab.

Task 3

He assumes that the preview would change to reflect what you are hovering over in the graph type menu. The user thoroughly goes through that table list as he did for adding a table to the report. When going to select to plot time on one axis he chooses timestamp instead of datetime. He does not realize the need of applying a function to the y-axis.

Task 4

The user immediately goes for the calendar, but does not spot the quick links. He found them eventually and commented that they might have to be in another color for him to spot them. Otherwise he really liked the time and date controls.

Task 5

At first the user tried selecting several dates by using ctrl as a modifier when clicking in the calendar. He soon found the advanced settings when he noticed that it did not work.

Task 6

He started with checking in the requests table again but did not find anything useful in the attributes. While checking the drop-boxes he commented on that the drop-box with the selected function should probably be cleared as you switch around attributes.

After a hint he found the join button and tried to join page and request.

In the end he thought it was kind of a hard process, but the problems he had came from not knowing SQL. He would like more tooltips and more previews to alleviate this and explain what the different things mean. He would also like to be able to look behind the dialogs that come up and see what he had already done.

B.2.2 TESTER 2

Gender: Female

SQL: 1

MSDP: 4

Task 1

Starts out with clicking on New Table and thinks it is alot of things in the new dialog that comes up so she feels she needs to read the instructions. To select multiple attributes she would have liked to have ssome sort of checkbox system instead of using ctrl. Since the list for functions was empty she thought that there were nothing available.

Task 3

Starting up the New Graph window she sees a big graph greeting her and feels that she has come to the right place. She would like the graph type menu show which graph was selected in the list as well as showing how it would look like. She wonders about the meaning of table, not sure about a if what she thinks is a table is the same thing in SQL. The user tries moving the dialog. She is not sure about what to do but tries looking for time in the list of tables. The user does not find anything referring to time and instead looks around in the drop-downs. She gets a bit confused when the graph disappears due to the database not returning anything from the current query.

She tries thinking about the last task and tries with a new table. The attributes could be named a bit simpler. No Function does not sound so good. The user now moves outside the task and tries to get requests per page instead. There is a problem with differentiating between Sum and Count. The database had an error in the query she made and that error text was not any good at all for her. She then thought about using another attribute instead and tried portal version. She wondered about the format on datetime when it was printed out on the graph. It would be nice if the tab selected when you were done in the Graph builder was the one you placed the tab on so you can see that it had been created.

Task 4

The user begins by going to date settings and chooses last year in the calendar drop down. She updates the report and it satisfied with the result. She would like to be able to save the report now but does not see any save down to the right where she thought it was.

Task 5

She had already seen the advanced time settings while doing the last task so there was no need to start looking for anything else. She skips the resolution drop-down and instead manipulates time of day filtering and weekday filtering. The sliders were very nice, she likes that the on and off indicators on the filers are in color to be more clear. She misses the time links and did not immediately find Update Report when the advanced time settings were expanded.

Task 6

It took a little while for her to find Join Tables and she thought it was a bit unexpected to get an entirely new dialog when she clicked it. As she inspected the new dialog she was a bit surprised that attributes were below their tables instead of to the right of them as in the previous dialog. The Join button was almost invisible to her and she was looking for it to the bottom right. As she returned to the previous dialog she would have liked the table she had just created to be selected and ready for use.

A comment included that it was a bit complicated due to the SQL and she had an interface mishap with accidentally closing a tab.

B.2.3 TESTER 3

Gender: Male

This tester did not have any major problems at all. On task 4 he tried using multiple selections to get several months instead of picking a year long time span.

He commented on the difference of implicit and explicit joins and that some users might have one or the other as a mental model and using the other than the one you are used to can be somewhat harder.

B.2.4 TESTER 4

Gender: Female

Task 1

This is a returning user and to refresh her memory she reads through the instructions before whe sets off. She comments on how nice it is with a preview now in the implemented version. A problem arises when she wants to name the tables name and uses the box for naming functions to do it.

Task 3

At first she does not read the instructions but reads them later. She has some problems finding the right things, does not really know what she is looking for and never tries the function drop-down. There are SQL problems with Sum and Count.

Task 4

At first she went for the calendar and completed the task there but afterwards she saw the quick links.

Task 5

She comments on that advanced settings sounds advanced, but has no problem completing the task.

Task 6

After trying a bit she reads the instructions but are still unclear on whom you know when you are supposed to use Join Table.

APPENDIX C SKETCHES

This appendix contains the various interface control sketches done in order to explore some of the designs.

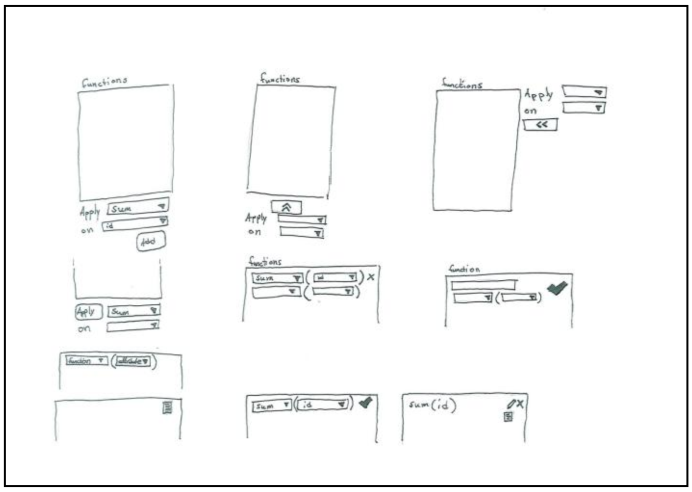


Figure 32. This sketch shows the various designs for handling functions in a table. The top left is the one used in the prototype. Since that caused confusions during testing a number of other designs were done in order to rectify the problem. Sadly these did not make it into the final prototype.

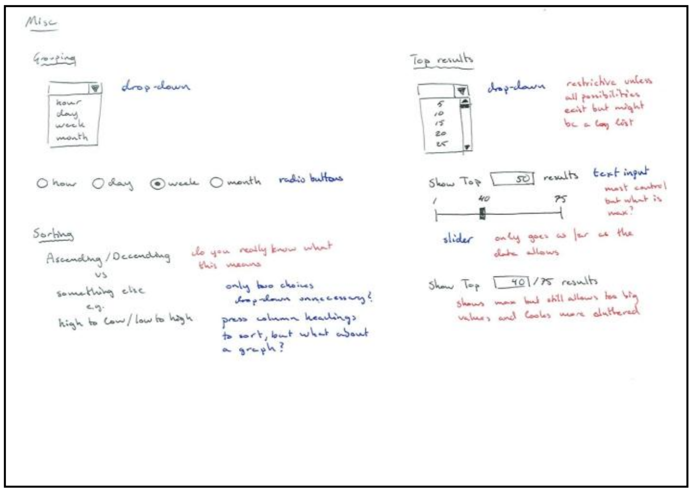

Misc
Grouping
drop-down
hour
day
week
month
hour
day
week
month
radio buttons
Sorting
Ascending / Decending
vs
something else
e.g.
high to low / low to high
do you really know what this means
only two choices
drop-down unnecessary?
press column headings to sort, but what about a graph?
Top results
drop-down
5
10
15
20
25
restrictive unless all possibilities exist but might be a long list
Show Top
50
results
text input
most control but what is max?
1
40
75
slider
only goes as far as the data allows
Show Top
40
/ 75 results
shows max but still allows too big values and looks more cluttered

Figure 33. Figure contains sketches for grouping-, sorting and top result controls. Only grouping made it into the final prototype.

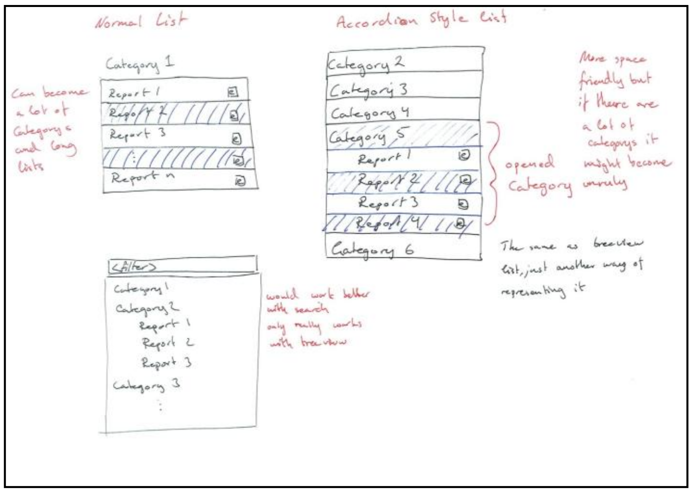

Normal List
Accordion Style List
Category 1
Report 1
Report 2
Report 3
Report n
Can become a lot of categorys and long lists
Category 2
Category 3
Category 4
Category 5
Report 1
Report 2
Report 3
Report 4
Category 6
opened Category
More space friendly but if there are a lot of categorys it might become unruly
The same as treeview list, just another way of representing it
<filter>
Category 1
Category 2
Report 1
Report 2
Report 3
Category 3
would work better with search
only really works with treeview

Figure 34. An early exploration of the report selection list. The idea was to have this to the left in the report viewer so the user had easy access to the reports. This did not work since it should be able to hold a great number of reports while still being usable.

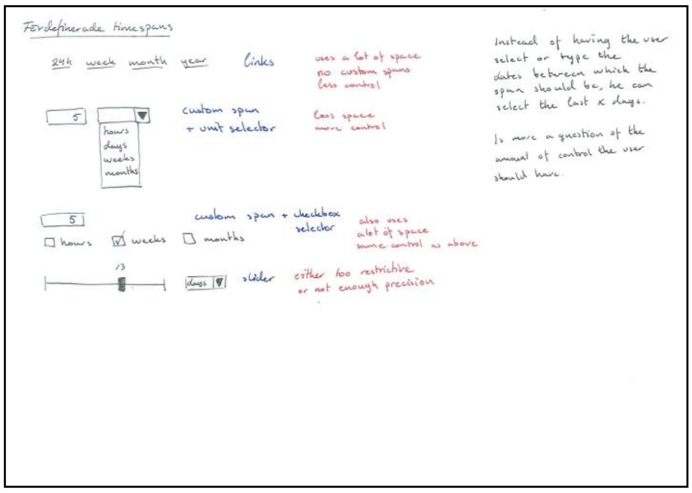

Fördefinerade timespans
24h
week
month
year
Links
uses a lot of space
no custom spans
less control
5
hours
days
weeks
months
custom span + unit selector
less space
more control
Instead of having the user select or type the dates between which the span should be, he can select the last x days.
Is more a question of the amount of control the user should have.
5
hours
weeks
months
custom span + checkbox selector
also uses alot of space
same control as above
13
days
slider
either too restrictive or not enough precision

Figure 35. The sketch is showing the various designs for a time span selector. It details some of the disadvantages for using the designs. The top design is one that was present in an earlier version of the MSDP report viewer but that was removed. That feature has later been requested by the customers.

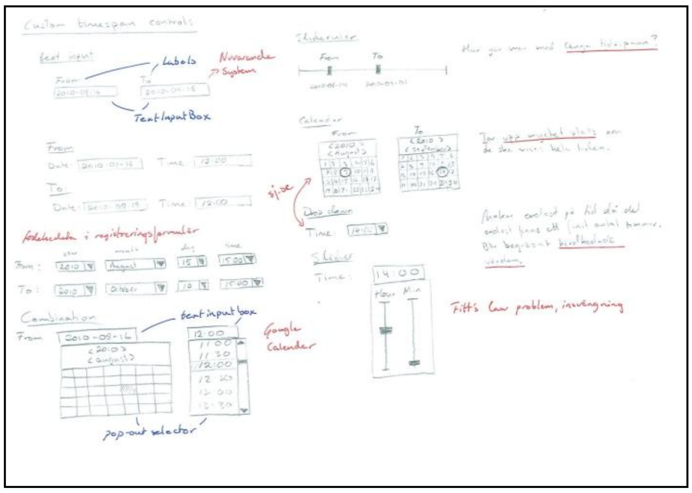


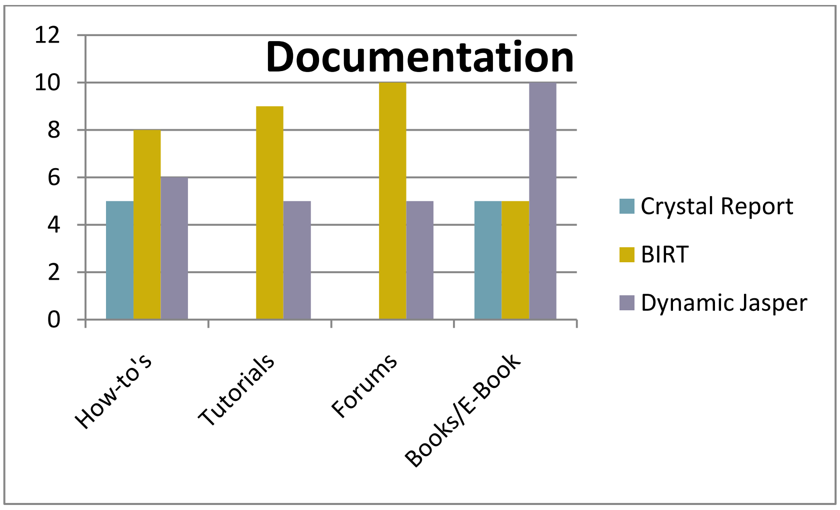
Figure 36. An exploration of time and date selection controls. It contains the controls from the current report viewer (top left) and also examples from various online services.

APPENDIX D QUICK SCORE OF REPORT SYSTEMS

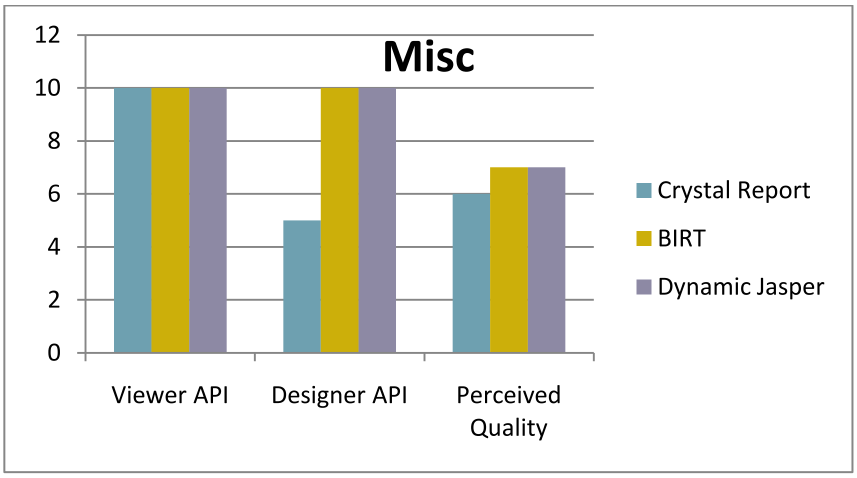
Below follows the result from the quick score evaluation of the final reporting systems. The score is based on the information readily available on the internet.

	Crystal Report	BIRT	Dynamic Jasper
Viewer API	10	10	10
Designer API	5	10	10
Documentation			
How-to's	5	8	6
Tutorials	0	9	5
Forums	0	10	5
Books/E-Book	5	5	10
Existing Implementation			
Report Builder	7	6	6
Web Builder	0	0	0
Web Viewer	7	8	4
Perceived Quality	6	7	7
Sum	45	73	63

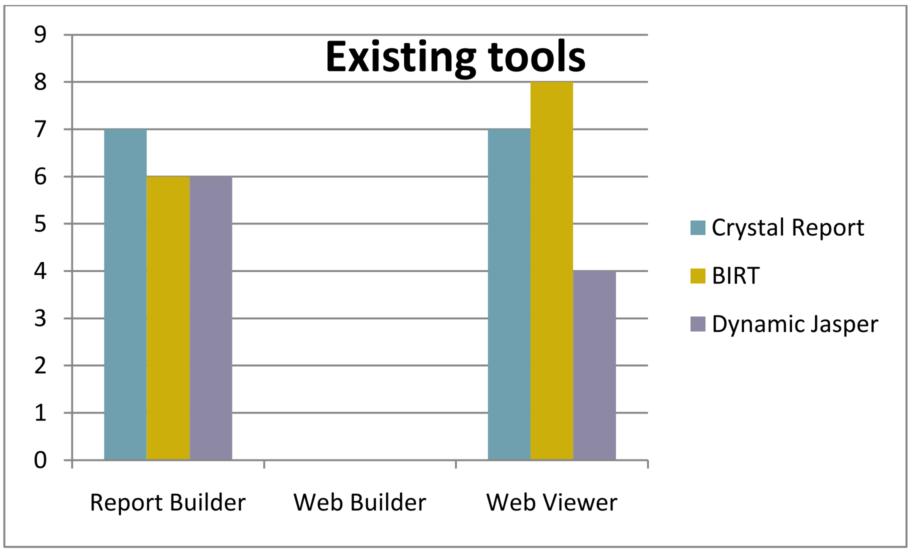
Table 1. The quick score results from the evaluation.



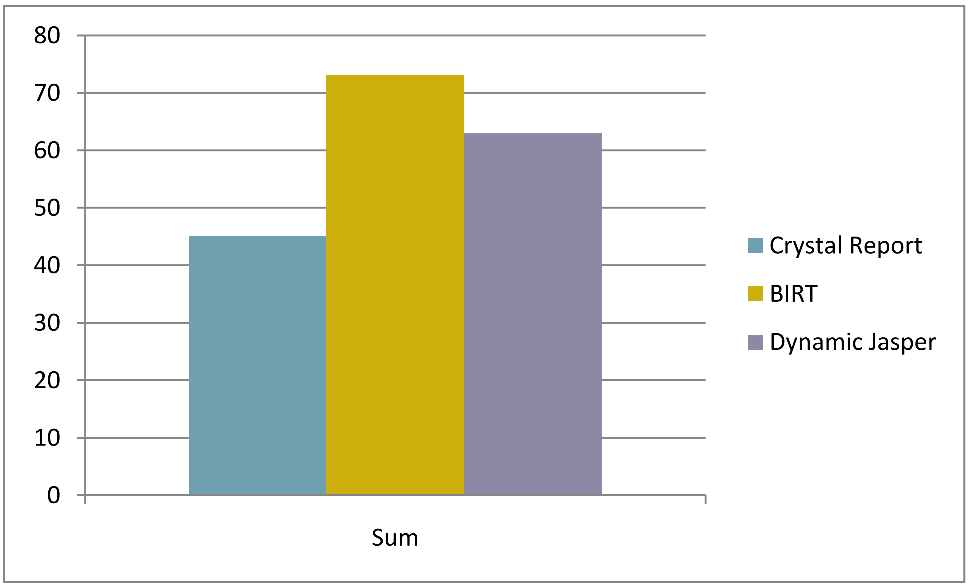
Graph 1. A graph showing the quick score result for the documentation.



Graph 2. A graph showing the quick score result for APIs and the overall quality.



Graph 3. A graph showing the quick score result for existing tools.



Graph 4. A graph showing the total of the quick score result.