

ANALYSING THE REQUIREMENTS OF MODERN BUSINESS TOWARDS USER INTERFACES

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Abstract: *A detailed and accurate business requirements analysis is critical to the success of any project. In order to maintain or increase their competitiveness software companies strive to deliver good user experience and intuitive user interfaces, which are effective, usable, responsive, visually appealing and properly tested. The research presented in this article is based on our analysis on the user interfaces of large amount of modern business information systems and our work with several big and forward-looking companies. The article summarizes their business requirements towards user interfaces, describes the implementation of the corporate identity into the designing process and presents the specifics about visualization of reports. We research how clients' requirements on the responsiveness of the design depend on the country and region, where the product is going to be distributed. It is also explained the importance of properly conducted usability testing and how to achieve optimum results depending on the number of participants. It is also represented how intelligently selected colour palette, shadows and shapes help the intuitive handling of the system and easier perception of information. This article describes generating and managing reports as main functionalities in business information systems. We examine different types of report customization, the use of visualization generator to create and publish interactive reports, applying different themes and dynamically altering the display density of table reports. In this article we also discuss different sample design solutions.*

Keywords: *user interfaces; business requirements; user experience; reporting; usability testing*

ACM Classification Keywords: *D.2.2 Design Tools and Techniques; D.2.1 Requirements/Specifications*

Introduction

In the last decades, forward-looking companies like Apple, Google and Microsoft focus on the design of exceptional products and delivering outstanding user experience. Their aim is to help the user feels comfortable with the use of the system. That way the company builds its relationship with the customers, earns their trust and builds on its corporate identity. Inspired by this approach, other

companies in the sector began to strive to deliver good user experience and intuitive user interface in order to maintain or increase their ability to compete on the market.

Designing user interface is often not an easy task. The team have to start creating wireframes and mockups of the design once enough technical requirements are gathered, systemized and analysed. A successful user interface focuses on users and their day-to-day tasks. The participation of clients and customers in the designing process is proven to be an effective practice [Trischler, Kelly, 2016]. In the user-centric approach user interfaces are driven by user profiles and user requirements.

The business analysis team and the user experience team should identify the users and user roles of the system. This is done through various techniques such as interviews with consumers, clients and empirical observations. The identification of valuable users or those who will contribute to the project is also seen in other areas such as the development of innovations [Stockstrom, Goduscheit, Lüthje, Jørgensen, 2016].

Crucial part of any software functionality is also reporting. Generating and managing reports is a requirement of any modern business and the information the end user receives from it must be customizable through themes and visualization generators in order to achieve flexibility and to be easily adjustable into the user’s daily workflow.

This article presents a detailed analysis on the requirements of modern business towards user interfaces. We examine the need of effective, usable, responsive and visually appealing user interfaces. We research how clients’ requirements on the responsiveness of the design depend on the country and region, where the product will be distributed. It is also explained the importance of properly conducted usability testing and how to achieve optimum results depending on the number of participants. This section also represents how intelligently selected colour palette, shadows and shapes help the intuitive handling of the system and easier perception of information. At the end of the section we research other requirements like the implementation of the corporate identity guidelines and the need of visualising Big Data on mobile devices.

This research describes generating and managing reports as main functionalities in business information systems. We examine different types of report customization – the use of visualization generator to create and publish interactive reports, applying different themes and dynamically altering the display density of table reports.

The Requirements of Modern Business towards User Interfaces

The research presented in this article is based on our analysis on the user interfaces of large amount of modern business information systems and our work with several big and forward-looking companies.

The first company is Australia's leading provider of mobile phones, mobile devices, home phones and broadband internet. The second company is a digital infrastructure management company, which provides the only monitoring platform, engineered for speed at scale and which seamlessly integrates infrastructure performance and end-user experience data. The third one is a multinational technology company that designs, develops, and sells consumer electronics, computer software, and online services. We summarized their business requirements to user interfaces into several sections:

- Effectiveness
- Usability
- Responsiveness
- Usability testing
- Visually appealing
- Other

Effectiveness

Effective is work, action or process that produces very good outcomes. The effectiveness of a single user interface helps the users to perform quickly and efficiently their daily tasks. For that purpose, before building a prototype, the tasks that users perform on the system in their daily work should be analysed. The term "task analysis" incorporates the application of various techniques for identifying and understanding the structure, sequence of actions and parameters of a task [Crystal, Ellington, 2004]. According to [Guerrero, Lemaigre, Gonzalez, Vanderdonckt, 2008] the task model is a logical description of the sequence of actions that are intended to help the user to reach any destination in an interactive system. Basically, the method of tasks analysis incorporates three main elements [Oliveira, Lepreux, Lepreux, Kolski, Seffah, 2014]:

- The iterative approach, which performs a sequence of actions described in the models;
- Models that capture aspects of a problem and convert them into specifications;
- Software tools used to accelerate and facilitate the process.

Task analysis are used to identify:

- What are the users trying to achieve? What are their goals?
- What actions they have to perform in order to complete their goals?
- What type of experience helps them complete those tasks: personal, social, cultural?
- How does the environment influence their actions?

There are several types of task analysis. The most popular of them are:

- Hierarchical Task Analysis (HTA) [Promann, Zhang, 2013]. In this approach, complex tasks are decomposed into simpler;
- Cognitive Task Analysis [Gallagher, Prestwich, 2013]. The purpose of this approach is to analyse the tasks that require cognitive activity from the user such as problem-solving, decision-making, attention and judgement, memory [Crandall, Klein, Hoffman, 2006].

The task analysis approach is often used in the earliest design phase before the prototyping. It can be used to support other aspects of creating better user experience:

- Gathering requirements;
- Creating a content strategy and information structure of the system (web page);
- Wire framing and prototyping;
- Usability test sessions.

Task analysis are used to decompose the main user tasks into simpler ones. That way the workflow of the use cases is identified. Knowing the workflow, the wireframe designers can produce accurate mockups that will lead the user through the interface effectively.

Usability

In the prototyping phase implementing the principles of the good design is essential in order to create effective and intuitive user interface [McRee, Anderson, Wilson, 2010]. The usability of the system could be measured by test sessions and heuristic analysis [Rubin, 2008]. Independently from the target group, most information systems will always have two types of users: novice and experts. Novice users should be able to learn quickly how to use the system, while the experts should be able to perform their everyday tasks efficiently. This may even mean the development of various interfaces. But in most cases the designers manage to combine the requirements of different types of users in a single interface.

A good user experience and interaction design technique is progressive disclosure. This approach sequences information and actions across several screens thereby the user stays focused on completing a task and does not feels overwhelmed. For example, this is a good approach for registration forms or where filling large amount of data is needed. It is also used for setting up a software or the so called “start-up” wizards.

Example: The user needs to perform several tasks in order to start monitoring their network, e.g. fill in many fields in different categories (for example IP address range or Subnet block, type of device, device name, objects and indicators, a time span filter, etc). Single and complex user interface might produce clutter, confuse the user and lead to uncomplete task or giving up. Disclosing information step-by-step and showing only the essentials for the current step helps the user manage complex and feature-rich

applications. Therefore, we divided “Enter information” task into five-steps wizard with form validation as shown on “Fig. 1”. Hereby even novice users managed to start monitoring their devices.

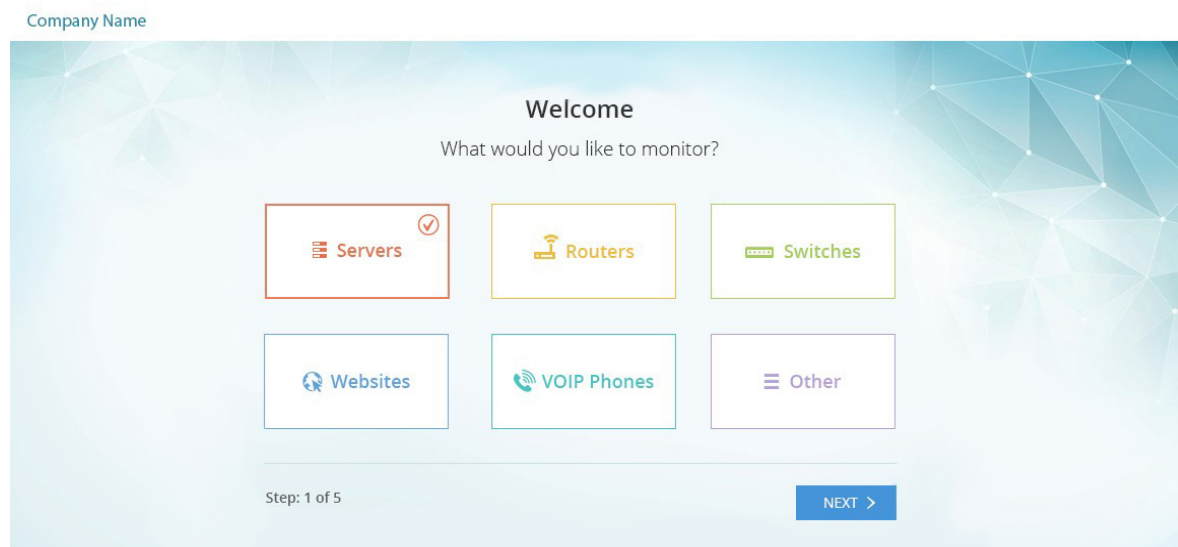


Fig.1. Progressive Disclosure helps users handle complex tasks.

Responsiveness

Interface that adapts to the device on which it is displayed is called responsive [Marcotte, 2011]. There are several modern techniques used for creating responsive UI: media queries (CSS3 module which detects the specifics of the screen), fluid grids (columns that make up the adaptive mode), flexible media files and images. In the last decades this is actually one of the main demands from the business stakeholders - the UI has to look good on all types of devices - from mobile phones with different screen sizes and resolutions to big computer screens and smart TV-s. Testing on all types of devices in the development process is required, but it is achievable as there are multiple types of good browser emulators representing the performance on the real physical devices.

.Clients' requirements on the responsiveness of the design depend also on the country and region, where the product will be distributed. For example, stakeholders from China, require the mobile version of the application to look properly on the most used mobile OS platform for Asia. According gs.statcounter.com this is Android with nearly 71% of market share for the period (Jan 2016 - May 2016) [gs.statcounter.com – a), 2016]. In the United States of Amerika iOS leads with 58%, followed by Android with 39% for the same period of time. That is why the clients from USA demand visually appealing user interface mainly on the both operating systems. Windows Phone is used only by 0,92% of the mobile users for the same period in USA [gs.statcounter.com – b), 2016]. In some countries in Europe the market share for Android is even higher than in Asia. For example, in Bulgaria nearly 81% of the mobile users have Android smartphone, 14% - iOS and only 3% Windows Phone

[gs.statcounter.com – c), 2016]. As a whole, in Europe most of the users (58%) use Android OS, followed by iOS with 36%. In Australia though iOS has a leading role with 67% vs 30% for Android [gs.statcounter.com – d), 2016].

Usability Testing

After having developed the first prototype, UX designers test their "assumptions" for efficient and intuitive design with a targeted group of users. To test the quality and level of intuitiveness of the user interface there can be used a variety of tools and frameworks [Islam, Bouwman, 2016]. Usually the test sessions with users are recorded and later on used for further analysis. After the test session issues are identified, fixed and if there is enough budget, the company performs a second usability testing.

User interfaces should provide their users the most efficient, easiest and fastest way of completing a task. The problem is that the users are different and the best way for completing a task for one might not be the optimum way for other. That is why the system should provide at least several approaches for the users to accomplish their everyday tasks. Implementing different ways of completing a task usually improves the usability palpably.

User interfaces should provide their users the most efficient, easiest and fastest way of completing a task. The problem is that the users are different and the best way for completing a task for one might not be the optimum way for other. That is why the system should provide at least several approaches for the users to accomplish their everyday tasks. We analyzed the users' needs and feedback from usability test sessions on a sample prototype of Big Data monitoring system conducted in a live environment. The “shadowing” method of observation and user’s thinking out loud when going through the test case scenarios led us to several conclusions. While some of the tasks were completed with ease by part of users, others experienced not only difficulties but even inability to move forward. We analysed the work experience, personal user habits and preferences and how they influence the user decisions and expectations. Basic example is renaming a tab. Users that are used to Microsoft products click twice on a HTML tab element and they expect the inside text to transform into a text field. The other users use right mouse click in order to open an additional menu with options like “Delete”, “Rename”, etc. This resulted in developing a sample adaptive prototype of a system (“Fig. 2”), which offers different ways of completing a task. The second usability test session with different users, both novice and experts, showed task completion by 92%, which is 22% higher than the first test session.

Optimal Results through Number of Participants

Prototypes are useless unless they are used for testing with real users. The obtained information is used for the next iteration of sketching, prototyping and testing. Usually software development is associated with a limited budget and time. Therefore, testing at an early stage prevents some of the

errors at a later stage. According to a mathematical model there is no need to test with large amount of users [Nielsen, Landauer, 1993]. The best results which take into account time, budget, and number of issues found are obtained by testing of no more than five users. The author of the mathematical model recommends budget to be allocated between three different test sessions with five users each for optimal results.

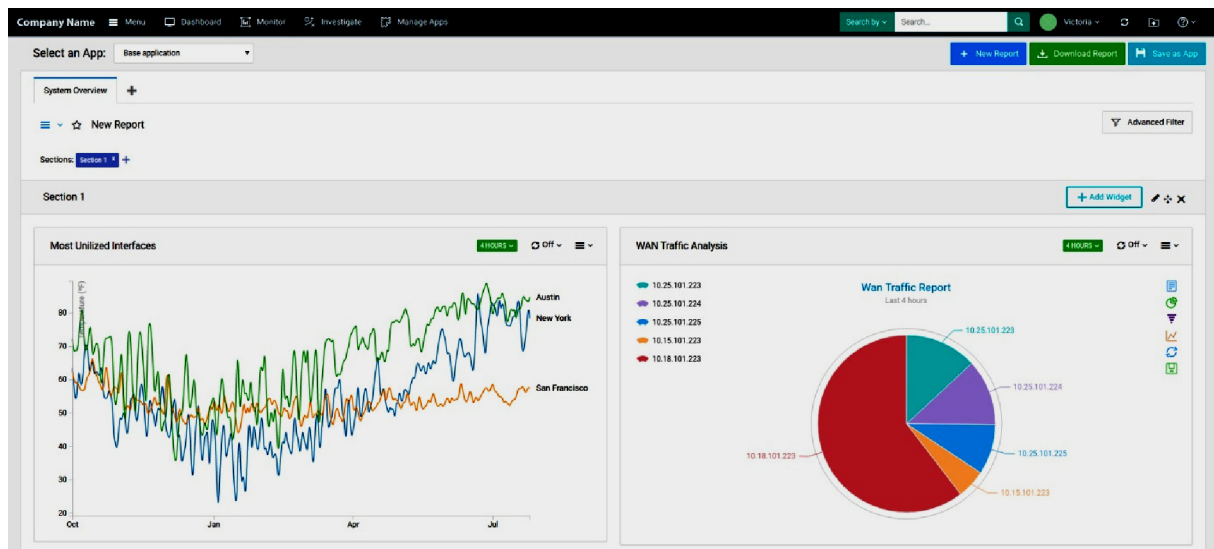


Fig. 2. Sample prototype of a system that implements different approaches for completing a task

Personas

If for some reason the GUI cannot be designed and tested with real users, the designer can use custom prototypes or personas [Nagel, 2016]. “Persona” is a descriptive model of a certain type of user based on data from a customer survey [Marshall, Cook, Mitchell, Summerskill, 2015]. Building the software personas requires describing their profession, habits, goals, motivation and daily tasks, which they will perform on the system. All this Information can be collected through business analysis.

Visually Appealing

Business Needs

Almost everyone could tell whether if they like or not a user interface. The combination of clean and minimalist design, intelligently selected colour palette, light shadows that show the depth of objects helps the intuitive handling of the system and easier perception of information. And this is exactly what the modern business is looking for. On “Fig. 3” is shown an authors’ user interface of a data monitoring system, that is created according clients’ requirements of modern, well-structured and visually

appealing design. All of the selected colours are used to guide users’ attention to the different sections. The main background image in the center part of the page is used to relax the user and make them feel comfortable in completing their day-to-day tasks. This image is dynamically changing according to the seasons, day time and user’s visits so that every time the user opens the system is surprised with something new. This is also part of the system-user interaction.

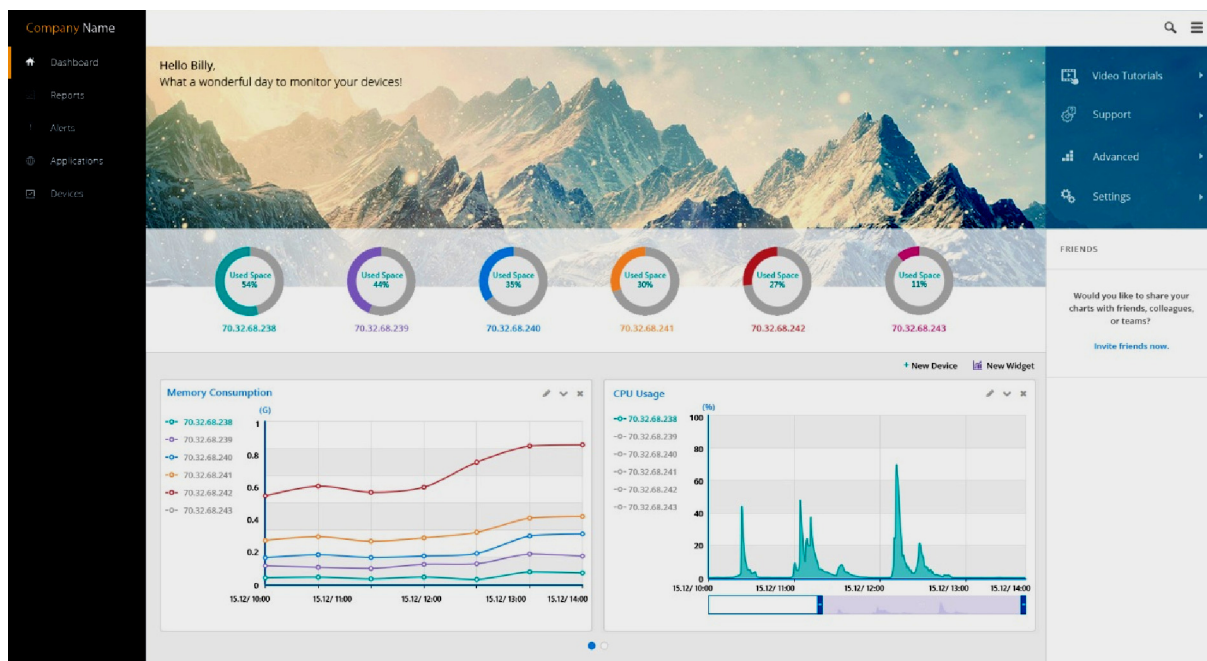


Fig. 3. Modern and minimalistic, visually appealing example of a user interface.

Just like in fashion, the sense of beauty in the graphical user interfaces evolves and changes in time. While the gradients and 3D like buttons were considered pretty in the past, now user interfaces strive for clarity and simplicity. There are many factors that influenced the simplification of the design.

Design Trends and Movements

- **Minimalism**

The Minimalism arose in the 1950s [Encyclopedia Britannica, 2016]. The main principle of this movement is simplicity of shapes and content.

Minimalism uses intelligent and well-planned colour palettes. Fonts are clean and easy to read. The images are small in number but have strong impact on the viewer.

- ***Flat design***

With the release of Windows 8 in 2011, Microsoft starts the trend of the “Flat design”. This is type of minimalistic design, which emphasizes on the usability and simplicity. There are no complicated graphics, heavy colour combinations but rather simple shapes and clean tones. All 3D elements are removed and there are no more shadows, gradient or textures. This approach points out several advantages: First the load time is minimized (the cascade style sheets have smaller size, most of the backgrounds are CSS based instead of images). Second the use of fluid grids accelerates the development process as that way the application could be easily tailored for mobile devices. Designers do not use any heavier shadows, textures and fixed images as they will not be visually appealing on mobile phones. The flat design trend helps users perceive the content faster and stay focused while completing a task. The similar look and feel of many modern software products on one hand does not surprise the users and makes them feel comfortable but on the other hand more and more web systems start to look tedious, uninspired and uniform.

- ***Skeuomorphism***

While Microsoft works on their flat design, Apple introduces new approach called Skeuomorphism. It uses graphics resembling objects and materials from real life - wood, leather, paper. But in 2013 Apple abandon this approach and adopts the minimalistic and flat vision for iOS7.

Most likely "Flat" design will also be replaced by something new and exciting as it happened with the style before that. The usability testing shows that this approach has drawbacks such as lack of visual hint that the element can be clicked.

- ***Material Design***

In 2014 Google introduced Material Design which began to gain popularity in 2015 after YouTube, Gmail and all other mobile and desktop Google applications adopted it. It combines classical principles of good design, science and new technologies of today. This visual language is based on how people perceive real objects. With the help of surfaces, shapes, angles, shadows and shades, animations and images the designers draw the attention of the users and hint the different functions of the elements [Google material design, 2016].

Other

Corporate Identity

Every company has its own corporate identity. In general, it consists of a logo, corporate title and set of guidelines. These guidelines describe how the identity is applied and include approved colour palettes, typefaces, page layouts and other such. Every customer demands the user interface of their product to

be created according to the company’s corporate identity. This requires designer’s attention to several important elements:

- **Logo**

The logo should not be changed. It might only be resized according to the space given in the header. Typically, a good logo should have black and white versions as well as colourful. If the header background is white the designers typically use the colourful version of the logo. If the colour is black, they might use white or colourful version of the logo. The most appropriate place for the logo in the user interface is the top left corner. It is often used for “Home” button as well. According to the Gutenberg Diagram in web design this is the Primary optical area [Lidwell, Holden, Butler, 2010].

- **Colour palette**

Colours should be used according to the corporate identity. Typically, every company has selected colour palette which communicates with the clients in the best way. For example, Telstra, Australia's leading provider of mobile phones, mobile devices, home phones and broadband internet, chose an identity that incorporates the full spectrum of colours, tones and emotions after their rebranding in 2012. “That way Telstra can communicate with greater meaning and with the flexibility to talk to different customers at different times, in a manner that’s not only relevant but also engaging” - says Joao Peres, the designer behind the new Telstra identity [Telstra identity, 2016].

- **Colours in the charts**

Creating a user interface of an information system with charting functionality requires careful planning of the colour palette that is used by the graphing engine. If the customer has more colours (like Telstra), it is easy to create beautiful and communicating colour palette for the charts. But if the company has only two primary colours it is nearly impossible to build a good charting colour palette using only shades of these two colours. That is why most companies which do not have enough colours in their corporate identity pack do not require using their colours in the charting engine. Instead they use all colours in the rainbow so that the charts represent the real data using the meaning of the different colours.

- **Typeface**

Implementing font family of the brand is one of the client’s important requirements during the designing process because the typeface is also used to communicate visually with the users. One of the most used font families for web is Open Sans, developed and used by Google [Google fonts, 2016]. It can be integrated into a web system for free and it is popular in flat design-style web design. Similar to Microsoft’s Verdana it is extremely well readable on all devices and screens. It is also used as a default typeface in the Mozilla style guide [Mozilla Style Guide, 2016].

After careful exploration of the company’s identity and incorporating all brand guidelines, the user interface corresponds better with the users, builds trust and good relationship as it becomes part of the software family of the company as shown on “Fig. 4”.

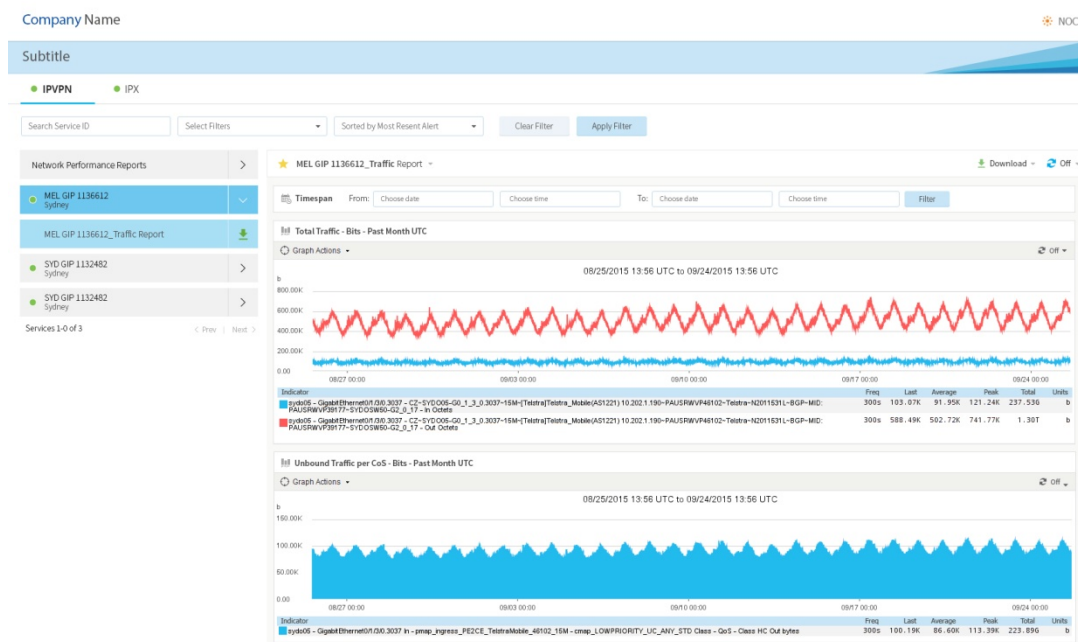


Fig. 4. User interface designed and build according company’s corporate identity guidelines.

Visualizing Big Data on Mobile Devices

Typically, most of the clients require a responsive user interface. But they are not aware of the difficulties that working with Big Data introduces when there are tens of millions of data to present. Authors research different approaches and techniques for collecting, analysing, processing and visualization of Big Data on mobile devices by using cloud computing and NoSQL database management systems like Google’s Big Table, Apache’s Cassandra, MongoDB, HBase, DynamoDB, Voldemort and others [Wang, Liu, Soyota, 2014].

With mobile-cloud computing user can access Big Data anywhere at any time. If the software company that provides the Big Data analytics software does not have integrated cloud computing solution, the mobile version of the software will work slower and the loading time will be much bigger. In the last decades the mobile devices became more powerful. Many of the desktop operations could be done using a smartphone. Still, they are not powerful enough to handle analysing Big Data.

Example: The interface below (“Fig. 5”) shows the mobile version of the software shown on “Fig. 4”. The system generates very detailed reports showing hundreds of data points. There are two

approaches on visualizing such data on small screens: The first one is to present a simplified graphic. It will show the basic flow of the data but it will not be accurate enough. The user will not be able to see the detailed data information. The second approach is to generate smaller version of the report and give the user the ability to zoom in and out on certain parts of it (as shown on “Fig. 5”). We adopted the second approach, based on the client requirement – the mobile version of the software should be the same as the desktop version. That means visually the report has to be identical on all screens and devices.



Fig. 5. Visualizing Big Data on mobile phone

Reporting

One of the main functionalities in a business information system is generating and managing reports. This component of the business software is the highlight of intel that the end user receives.

Basic Reporting Requirements for UI Controls

- **Main UI Controls**

Typically, the users expect to have all basic operations implemented into a report system. That includes zoom in and out on the charts, drill-down (reaching to more detailed information by clicking on parts of the report - e.g. table row, part of a chart, etc.), change the time span and the filter, search by keywords,

as well as the basic operations: create, view, edit, delete, plus duplicate and download/export report. Depending on the specific business types a report might have additional functions.

- ***Download, Export and Import***

Typically, a report could be downloaded/exported in several types: PDF, Excel, Microsoft Word, as an image file and other. More complicated reports, which will be imported into another system (e.g. Big Data analytics system), might be exported as csv or log files. The customer requirements depend on the use and storage space of the report. Microsoft Report Builder gives the users the ability to export reports as XML file with report data, CSV (comma delimited), TIFF file, PDF, MHTML (web archive), Excel, PowerPoint, Word. Users also want to be able to import different data sources into the data monitoring system.

- ***Print Report***

When previewing a report, the browser or the software application gives the user the ability to print out the document. According to studies [Liu, 2008], around 80% of the users prefer printing out electronic documents and do the reading from them. Using electronic source for reading helps you search keywords, but reading from printed document is much more user-friendly and less distracting. Participants in another study report that print documents enable easier comparisons to be made among all gathered resources [Liu, 2005]. It is very likely that users will continue printing out documents, therefore UI designers and front-end developers should focus on the print layout of the report as well.

- ***Chart Colours in Reports***

Colours for the charts should also be meaningful. The users get confused if a line in the line chart is red and if it's meaning is good (e.g. the line does not represent a warning or an alert). Therefore, the colours should carry their own meaning. Many reports use traffic light system. Red for alert, orange/yellow for warning and green for normal. In addition, Big Data reports require more colours, e.g. more than 20, so the colour palette in these systems use bigger spectrum of colours. For example, the user wants to monitor 50 devices. For each one of the devices the report system draws a line in a different colour. If the list of the colour reaches its end, the colours starts from the beginning. Another approach is to generate colours with a computational algorithm.

- ***Chart Types in Reports***

Another nice to have feature is dynamically changing the chart type. This is possible by adding the required chart types (e.g. line, pie, funnel, etc.) as small icons in the chart navigation. When the user clicks on one of the icons, the chart below immediately transforms (accompanied by a pleasant animation) using that type of draw. Currently this approach is implemented very successfully by Baidu, a Chinese IT company into their JavaScript library eCharts [echarts.baidu.com].

Customisable Charts and Tables in Reports

- **Charts**

- *Visualisation generator*

Having a dashboard with similar diagrams and charts distracts users' attention and makes their everyday work slower. That is why creating a distinctive diagram for certain types of reports is significant. That could be achieved by using a visualization generator that can create and publish interactive charts. Typically, the goal workflow is as follows: First, the user selects a data source, e.g. Excel, xml, log, txt, etc. or device, device group, objects, indicators, etc. After that the user chooses a chart type, then applies a filter, e.g. time span, IP address range, indicator, etc.

- *Charting themes*

Interactive and customizable reports might be achieved by giving the user the ability to choose a theme. That way the creation of a report is transformed from everyday obligation into a game. Using the techniques of chromotherapy, the user spends some time playing with the colours which helps them relax and feel more comfortable. This experience is even more important for the users who have synesthesia [Cytowic, Eagleman, 2009]. Human brain and eyes detect even the smallest differences and nuances. Considering the time information technology specialists spend behind the screen that could have a significant impact.

A lot of chart properties could be customized and changed: background (type and image), title (text, colour, size, font weight, title position), legend (vertical, horizontal, visibility), tooltips (placement, background, colour, font size), animation (type, timing). Also there might be sample themes implemented with predefined different values of these properties, e.g. “Flat”, “Monochrom”, “Dark”, “Light”, etc.

- **Tables**

Tables in a report might also have different themes but their appearance is mainly limited to border type, colour, thickness, row colour, row mouse over effect, tooltips, title. Nice to have feature is altering the display density of the rows. Google Mail supports three types: Comfortable (37px height), Cozy (30px height) and Compact (25px height), where comfortable is the default row height. When the table has hundreds of records, one might want to change the view into compact so that more rows appear on a single page.

Conclusion

Looking at the next five years, the role of user interfaces will continually increase as companies compete to gain a larger market share worldwide. A weak implementation of the graphical user interface could lead to failure even a stable and well-designed software. Understanding the business needs in combination with deep and focused business requirements analysis will lead to the success any project. We divide business requirements into six different sections: effectiveness, usability, responsiveness, usability testing, visually appealing and other. In the section “Other” are included the need of accurate implementing the company’s corporate identity and visualizing Big Data on mobile devices. As additional business need for the user interfaces of business information systems we describe generating and customizing chart and table reports. In conclusion, three usability test sessions with no more than five participants each will eliminate most of the user experience issues which might occur in future.

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