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FCG WINTRA

- an Implementation of Paperless Office Concept

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This bachelor's project was carried out to reengineer Intra, the current intranet system of FCG Finnish Consulting Group Oy to develop a new intranet system called FCG Wintra.

The FCG intranet system Intra contains different manuals and instructions regarding the facilities provided by FCG as an employer to the employees. It also allows FCG management to publish announcements, news and press releases to keep the employees up-to-date with the current situation at FCG. Intra is also connected with FCG's other tools that are used widely by the employees for the day-to-day work life.

As Intra was developed already in 2009, its overall structure and look and feel have become out-dated, and performance has dropped due to high volumes of data. Therefore, a decision was made to reengineer Intra and develop Wintra, which would contain the existing features in an optimized manner with improved user-friendly interfaces along with some new features. A plan was made to create a multi-level easy-to-navigate top menu, module-wise side-sub-menu, slider image carousel and breaking news in the home page, new faces of the recently recruited employees, employee MIS that will be populated from the Active Directory server where the employee information is entered via the Human Resource system. Wintra will also contain web forms to request for visiting cards as well as propose a new idea or initiative to FCG management regarding anything and everything so that the management can communicate further with the person and decide whether to implement the proposed idea.

Wintra has been developed on the top of Drupal 8 framework, using PHP & MariaDB technology on Nginx web server environment based on a CentOS server operating system.

Wintra is also integrated with other existing systems of FCG that are used on a regular basis, such as Project time tracking tool, Purchase requisition tool, Office expense reimbursement claim tool, etc. The outcome of this project is the new intranet system Wintra which has already become the standard for the internal applications of FCG, in terms of look and feel, user-friendliness of the interfaces as well as server structures.

Keywords	Paperless office, FCG Wintra, Intra, corporate intranet system

Acknowledgement

This bachelor's project report has been produced to fulfil the partial requirement as thesis work to achieve the degree of Bachelor of Engineering in Information Technology from Helsinki Metropolia University of Applied Sciences, Finland. The report has been produced based on the project developed by the fellow student of Metropolia Mohammad Shahidul Islam while he has been working for the project company FCG Finnish Consulting Group Oy, headquartered in Käpylä, Helsinki.

The project has been developed by a one-man development team, Mohammad Shahidul Islam from Metropolia UAS. Welat Nehri, ICT Planning Manager of FCG was the initial planner of the project who initiated and communicated with FCG top management and came up with a brief structure of the application as well as the interface layouts. Later on, Oosi Matti, ICT Manager of FCG joined the project team as the Scrum Master who introduced Eeva Kokki, the Human Resource Director of FCG as the Product Owner and Eeva's team as the Product Owner's team. He also introduced Margit Saukkonen to the testing team who also conducted the editor level user groups training sessions in cooperation with the development team. Besides leading the project and keeping the product owner up-to-date through scrum meetings, Oosi also guided the developer to make effective plans and implementations since he is the developer's direct supervisor.

During the different stages of the development, the developer got various help from other members of FCG's ICT team, such as Rami Aapasuo and Tapio Kujala, the two Systems Specialists of FCG helped with the configuration of the production as well as the test servers, sub-domain creation and pointing to Wintra, SSL certificate creation, setting browser default to Wintra and also to get access to the AD servers for login as well as to fetch employee data. Hannu Niemi, the Chief Developer helped with the LDAP query to generate JSON data for employee MIS and along with the other Developer Juho Jantunen, helped with Nginx configuration and AD login with SimpleSAMLphp. Robert Stankevich, the other Developer helped throughout the development phase to understand the flow of Drupal core, sharing the best practices as well as problem solving.

Under the overall academic supervision of Kimmo Sauren, and the language supervisor Sonja Holappa, Senior Lecturers from Metropolia, this writing has been published.

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List of Abbreviations

AD	: Active Directory
ADFS	: Active Directory Federation Services
CEO	: Chief Executive Officer
CMS	: Content Management System
DFD	: Data Flow Diagram
DSDM	: Dynamic System Development Method
FCG	: Finnish Consulting Group
FDD	: Feature Driven Development
FTP	: File Transfer Protocol
GA	: Google Analytics
GB	: Gigabyte
GHz	: Gigahertz
HR	: Human Resource
HTTP	: Hypertext Transfer Protocol
HTTPS	: Secured Hypertext Transfer Protocol
ICT	: Information and Communication Technology
IE	: Internet Explorer
IP	: Internet Protocol
IIS	: Internet Information Services
JSON	: JavaScript Object Notation
LDAP	: Lightweight Directory Access Protocol
MB	: Megabyte
MIS	: Management Information System
MS	: Microsoft
OS	: Operating System
PDF	: Portable Document Format
RAM	: Random Access Memory
RDBMS	: Relational Database Management System
SDLC	: Software Development Life Cycle
SMTP	: Simple Mail Transfer Protocol
SQL	: Standard Query Language
SRS	: System Requirement Specifications
SSH	: Secure Shell

SSL	: Secure Socket Layer
TDD	: Test Driven Development
URL	: Universal Resource Locator
VPN	: Virtual Private Network
WBS	: Work Breakdown System
WinSCP	: Windows Secure Copy
WYSIWYG	: What You See Is What You Get
XP	: Extreme Programming
YAML	: YAML Ain't Markup Language

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1 Introduction

This thesis focuses on the development of the Intranet system at a Finnish based multi-national company, FCG Finnish Consulting Group Oy. From this point forward "FCG" will be used to refer to the company, "Intra" will be used to refer to FCG's old Intra system and "Wintra" will be used to refer to the new reengineering Intra system of FCG. FCG is presented in more detail later in this chapter along with both Intra and Wintra. The last part of this chapter describes the target group who will be using this Wintra application regularly.

1.1 Company Background

FCG is a multi-skilled and multi-expertise company that works in various fields and provides services in developing various public and private sectors that include infrastructure, environmental and urban design, multi-disciplinary training etc. FCG's operations are based on its values of responsibility, innovation and openness. FCG produces sustainable and innovative services and solutions for its customers, instigated by customer needs.

Being headquartered in Helsinki - Finland, FCG, the parent company acts as a service centre for its conglomerates and subsidiaries by providing the required financial and IT management services as well as communication and Human Resource services. The four conglomerates (FCG Consulting Ltd, FCG Training Ltd, FCG Design and Engineering Ltd, FCG International Ltd) are located in thirteen different cities of Finland (Helsinki, Joensuu, Kuopio, Lappeenranta, Kotka, Jyväskylä, Turku, Seinäjoki, Vaasa, Rovaniemi, Oulu, Tampere, Pori). FCG is doing business in local projects and operations that include management consultancy, well-being and ICT services, business development and research services as well as training and coaching services. The company also offers services in community planning, housing construction and renovation, water supply engineering and environmental consultancy, international project management services and so forth. FCG's subsidiary companies are running extensive global operations located in six different countries (Sweden, Estonia, Romania, Bulgaria, New Zealand and Singapore) and representative offices located in 3 different countries (Ecuador, Greece, and Turkey). Besides these conglomerates and subsidiary companies, FCG has five daughter

companies, namely FCG Datawell Ltd, FCG Datawell AB (Sweden), FCG Nirvaco AS (Norway), FCG Kuntarekry Ltd, FCG City Portal Ltd. FCG, the parent company is owned by Kuntaliitto, The Association of Finnish Local and Regional Authorities [1; 2]. Figure 1-1 shows FCG's turnover in 2015.

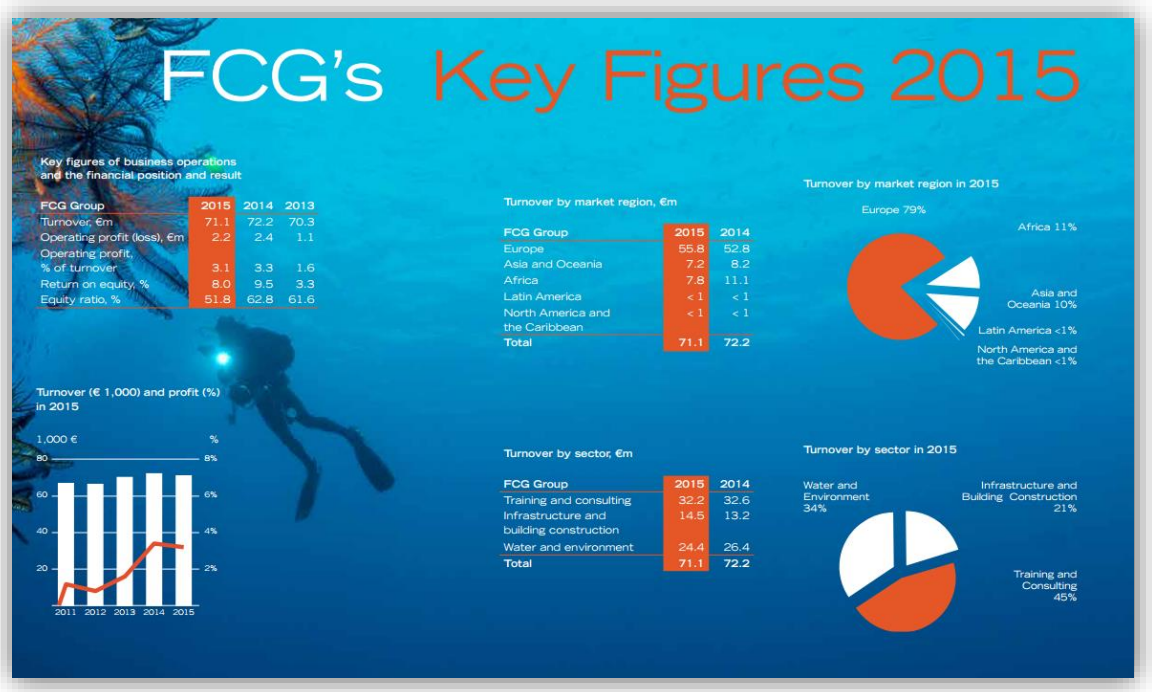

Figure 1-1: FCG's turn over as of 2015 annual report [3]

In order to give some idea about the size and financial value of FCG, Figure 1-1 has been presented here by extracting FCG's 2015 Annual Report that shows the annual turnover of FCG Group in the year 2015 and the increment in comparison with the year 2014.

FCG's four conglomerates (FCG Consulting Ltd, FCG Training Ltd, FCG Design and Engineering Ltd, FCG International Ltd), located in thirteen different cities of Finland currently employ a total of 530 employees. These 530 people will be the primary users or Wintra. Besides the conglomerate companies' employees, the employees of FCG's five daughter companies, (FCG Datawell Ltd, FCG Datawell AB (Sweden), FCG Nirvaco AS (Norway), FCG Kuntarekry Ltd, FCG City Portal Ltd) will be the secondary users of Wintra. In addition, FCG's parent company Suomen Kuntaliitto has more than 360 employees who will also be the secondary users of Wintra.

1.2 Intra Challenges

Intra is the intranet system that has been used by FCG since it was developed in 2009. The main purpose of Intra is to make announcements and disseminate notifications regarding specific departments, projects, well-being events, FCG's achievements etc. If there are any announcements or notifications, employees can read them and then like the notification to acknowledge it or give ratings to express their opinions. And, if there is any event announcement, the employees can read the details and signup by following the specific Uniform Resource Locator (URL) for the event signup. Figure 1-2 shows the landing page (also called home page) that a regular authenticated user can see after logging in. The reason the Figures are shown in Finnish is that the official language of FCG is Finnish, and therefore Intra (and also Wintra) has been developed only in the Finnish language. A few English words might be seen in the interface, which is because of the language of the development tool itself.

Figure 1-2: Screenshot of the home page of Intra.

The editor level users get the access to modify the contents as well as add new contents. The technical features and the know-how on Intra are explained in more detail in Chapter 2.

Despite the many advantages of Intra, its overall structure and look and feel has become out-dated, and its performance has dropped due to high volumes of data. It has also become clear that new features are required from the Intranet system. This is explained in more detail in chapter 3. In order to solve these problems and modernize Intra, a decision was made to reengineer Intra and develop Wintra.

1.3 Objective and Outcome

In light of the current challenges with Intra, the objective of this project is to create a reengineered version of Intra by solving the problems identified and by adopting new and advanced technologies whilst maintaining Intra's current strengths. This means that also Wintra will be used to make announcements and disseminate notifications regarding specific departments, projects, well-being events, FCG's achievements etc. In addition, for acknowledging or expressing opinion regarding those announcements and notifications, the users will be able to write comments and reply against replies, just like conversation. This will make the system more open and transparent to the employees. The look and feel will be much more compact and user-friendly than that of Intra. Accordingly, the outcome of this study is a re-engineered version of Intra.

1.4 Thesis Outline

This thesis consists of eight chapters. The first chapter is to introduce FCG as the customer as well as the primary user of the project on which this report has been produced. The first chapter also explains Intra, the existing system and its challenges. The second chapter explains details about the existing system study, technical know-how as well as the user groups of Intra. It also tells about the problem findings and analysis of Intra for which the decision was made to reengineer the Intra and develop Wintra. All aspects of system analysis and design of a software application development have been presented the third chapter along with the benchmarking of the tools and technologies, the chosen

ones as well as the selection method. The fourth chapter describes Wintra, its scope and limitation, system structure as well as different phases starting from the planning till the development and testing phases. The project team and stakeholders as well as overall project management steps have also been explained in this chapter. Data migration from Intra to Wintra, production release and deployment along with the user group training and inauguration have been explained in chapter five. Learning new technology, innovation, challenges while developing the project as well as how those challenges have been mitigated, are explained in chapter six. Chapter seven tells about the future scope and extension possibilities of Wintra. Chapter eight concludes the report by validating the proposed plan and actual implementation as well as the author's recommendations.

2 Existing System Study

This chapter has been divided into four parts and it explains the technical know-how of the existing system, Intra, along with the users and user groups who have been using this application on a regular basis at work as well as the problems identified which have been solved by Wintra after detailed analysis. The first part of this chapter tells briefly about the technical details and theories on which the system is running and also a few words about those base systems. The second part of this chapter explains the users and user groups, how they are using Intra and what kind of roles and access they have. Problems with Intra have been identified in the third part which have then been analysed in detail in the fourth part.

2.1 Technical Know-How

FCG's Intra system was built in DotNetNuke framework on top of Microsoft .Net technologies. The application runs on Microsoft's own web server known as Internet Information Services (IIS) 7.0 on Microsoft Windows Server. IIS accepts requests from the client computers (or similar devices such as tablets or mobile phones) and returns related responses in the form of Hypertext Mark-up Language (HTML) based static webpages using Hypertext Transfer Protocol (HTTP) or Secured Hypertext Transfer Protocol (HTTPS) [6]. The database of the Intra system runs on Microsoft's relational database management system (RDBMS), namely Microsoft SQL Server. The main function of Microsoft SQL Server is to store and retrieve data according to the needs and requests of the applications. Besides, it also allows to analyse data and generate reports as per the necessity [7].

The user groups and user policies are based on Microsoft Domain Forest and located on Microsoft's Active Directory Federation Services (ADFS). ADFS, a part of Microsoft's Active Directory Services, is a system component that runs on Microsoft's Windows Server operating system and it provides the single-sign-on access to systems and applications availed across the organizational boundaries by using claim-based access-control authorization model. By establishing trust between two security realms, ADFS establishes identity federation between two (or more) applications [8].

The client-server architecture of Intra is also completely based on Microsoft Technology. The web application runs on Microsoft's web server, dataset on Microsoft's SQL server and the client applications are running Internet Explorer browser which is also part of the Microsoft Operating System.

2.2 Users and User Groups

All the employees of FCG and its concern companies can access Intra with a valid username and password while at any of FCG's work premises or by connecting to FCG network via Virtual Private Networking (VPN) technology.

There are four different user groups currently using the intra system. The very first group can be identified as "authenticated users" group who has mostly reading and commenting rights in most of the contents, but not all. Then, the next user group is "Editor". Normally the spokesperson or secretaries of individual departments have this role. With this role, a user can update any content and post a new content or announcements and such. And the third user group is known as "managers" and generally, the department heads belong to this group. Managers have limited content editing rights to general contents and full access rights to some confidential managerial documents, such as documents relating to hiring and firing, work-agreement, and so forth, which are not accessible by the other users. Only one or two persons belong to the fourth user group category. This category is called "administrator" who has full access rights to the entire application.

2.3 Problems Identification

Intra was built in DotNetNuke framework in 2007, and technology has evolved quite much since then. Thus, a system that has been developed more than 9 years ago definitely cannot be up-to-date anymore since technology has seen continuous progress. Besides being an outdated system, there are several other problems that are presented in the next subsection. Among the other problems, Intra has the following major problems that will be solved by the new Wintra system:

- Navigation system is not very user-friendly. For example, it requires at least 4 clicks to go to a fourth level navigation page. With a proper modern menu, it is possible to make the navigation several levels which can allow users to visit a page of even a fifth or sixth navigation level for just one click.

- By using the browser tools, it has been measured that each page takes an average of 20 seconds to load and in some cases even longer than that. Figure 2-1 shows the details from the screenshot. But if the page is optimized properly, this load time can be minimized by half.

- It is strictly recommended to use only Internet Explorer due to some content formatting issues even though Chrome and Mozilla are much more popular and effective browsers. Many employees detest Internet Explorer but still they are bound to use it for Intra.

- Intra is developed in .net technologies that require IIS web server, and an IIS web server requires a Windows server operating system. A Windows server operating system license costs money whereas open source operating systems as well as web servers are completely free.

- The overall application structure is old school and it is not the easiest job for the editors to update any contents or add a new one due to the limitation with the text editors.

- The look and feel of the application is also rather old school and not very alive even though it is not so difficult now-a-days to make web-based application content very attractive and eye-catching and reader-friendly.

- Even though there is a section called “Henkilöstö” (= personnel) in Intra, it is still missing the employee database information.

2.4 Problems Analysis

The analysis has been done in two parts. The first part of the analysis is regarding the existing system’s functionalities and performance. In order to do that the application was

accessed from different user-group's points of views and used some tools such as browser extensions of Mozilla and Chrome to measure the performance and execution time. Figure 2-1 shows such an example where Mozilla developer's tools have been used to measure the load time of the home page of FCG's Intra system.

Figure 2-1: Loading time of Intra home page.

The second part of the analysis was based on theories and text books to find out the appropriate solutions for the problems mentioned and design and plan for the proposed system. Theories from Systems Analysis and Design books as well as the opinions from experts from the Drupal developers' community have been taken into consideration for the detailed analysis of the specified problems and project scopes. Based on the findings from the analysis, scrum meetings were held along with the development team, scrum master as well the product owner and agreed with features to be developed for Wintra and prepared the system requirement specifications (SRS) which later on have been added as "epic" and "story" in the project management portal Jira.

3 Systems Analysis and Design

System Analysis and Design is the most important part in the software application development lifecycle (SDLC). An improperly analysed or poorly designed system cannot succeed the SDLC and will not achieve the ultimate goal. Therefore, after going through the system analysis phases, conceptual planning has been done by taking the feasibility analysis into consideration and Data flow diagram (DFD) and use case diagram has been drawn as well. Then, based on the conceptual plan, benchmarking has been done for the tools to be used thoroughout the SDLC. This chapter tells the step-by-step phases that has been followed to analyse the feasibility and design Wintra.

3.1 Feasibility Study and Analysis

In this phase, the development team studies the Intra system to learn the detail flows of each modules and sub-modules as well as the functionalities and prepares a list of features of the existing system. This list along with the list of the problem findings has been brought to the system requirements specification (SRS) meeting where the brainstorming has been done to populate the list of the desired features for Wintra. Product owner's team as well as the scrum master participated actively in the SRS meeting along with development team. A brief skeleton has been drawn based on the agreed SRS along with an estimation of development as well as implementation time to determine how realistic and feasible the reengineering plan as well as the development plan will be. After analysing the skeleton and the SRS for Wintra, and when the plan was found feasible, a work break-down specification (WBS), based on the SRS, was populated using Microsoft Project. Microsoft Project is a desktop based software application that has been developed by Microsoft Corporation to be used as a project planning and management tool. Later on, the WBS was fed to Jira to be used throughout the development phases so that overall development status could be monitored by the development team, scrum master as well as by the product owner. The WBS secured both parties promises and agreements regarding the features as well as time estimation and usage of Jira ensured that there is no communication gap or misunderstanding between the development team and the product owner.

3.2 Data Flow Diagram

Data flow diagram (DFD) is a diagram that illustrates the flow of data in terms of inputs and outputs of a system. The diagram consists of processes of the system that receives requests from internal as well as external entities and response to those requests by communicating with other processes and/or data storages, based on the type of requests [9]. Depending on the level of depth and details of the process break-down, the DFDs are labelled. For example, the top level DFD of a system can be drawn as a process representing the system and an entity as the primary users which are connected both-way arrows. Such overviews are labelled as level 0 data flow diagram. Figure 3-1 shows such an overview illustration of Wintra where the process Wintra is connected with the entity Users which refers to FCG employees. And since this is the overview DFD, that is why it is also labelled as DFD level 0.

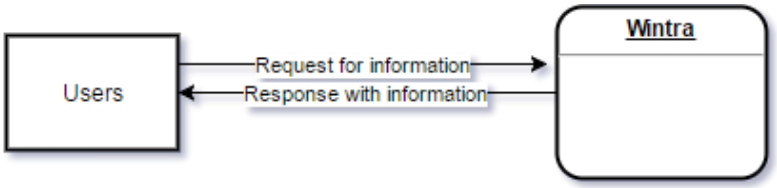

Figure 3-1: Data Flow Diagram level 0.

After the overview DFD, the Wintra process can be broken down into a slightly more detailed diagram where the main Wintra process is interacting with an external process to authenticate the user before processing user's request and responding to the user. Since the process has been broken down one step, therefore, this level of the DFD is labelled as level 1. Figure 3-2 illustrates the level 1 DFD for Wintra.

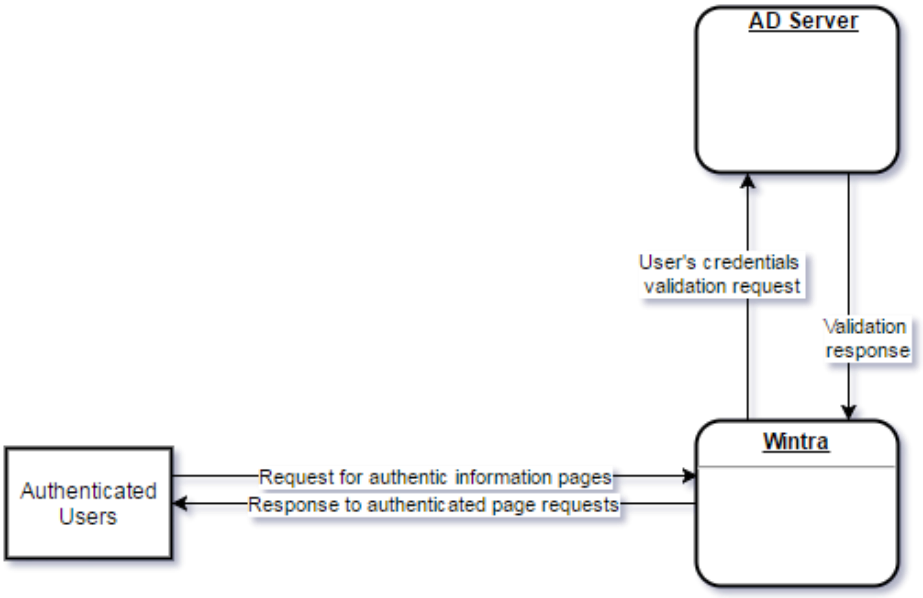

Figure 3-2: Data Flow Diagram level 1.

Level 1 DFD is then broken down for a more detailed specification to identify the system components such as the web server, compiler, database server, etc. and the DFD is labelled a following number. In case of Wintra level 2 DFD, the system components can be clearly identified, such as the AD server for user authentication, Nginx as the web server, Maria DB as the database server, etc. Figure 3-3 shows the data flow diagram on 2nd level that depicts different system components of Wintra.

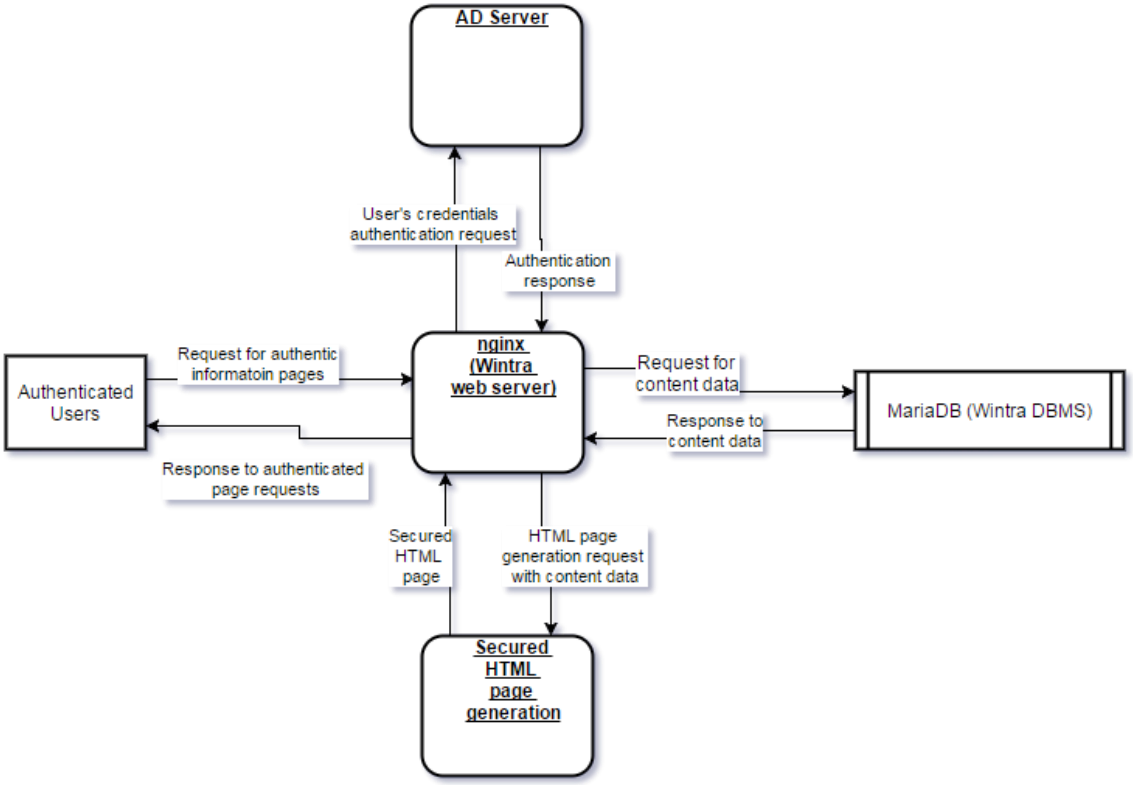

Figure 3-3: Data Flow Diagram level 2.

As can be seen in Figure 3-3, Wintra is a relatively simple system. Depending on the complexity of a system, the number of internal and external entities as well as variations of processes, the DFDs can be broken into several levels. For example, in case of an ecommerce web store or inventory management software application can have DFDs up to level 5 or 6 or even more. Since Wintra is a relatively simple system, a level 2 DFD can be good to identify the components and proceed with the next steps.

3.3 Licensing and Platform Comparison

Licensing is one of the most important factors in terms of deciding a platform for a new system development since the type of licensing defines the recurring expense and / or fees that need to be counted by the organization. This is one of the main reasons for choosing Drupal, an open-source solution for developing Wintra. And then again, if an open-source solution does not serve the purpose, then it does not make sense to spend money on developing an open-source system. Therefore, both financial as well as functional aspects should be met with the new system. In order to ensure that, an extensive benchmarking and comparison was carried out. The comparison can be found as Appendix III where top four CMS type platforms such as Microsoft's SharePoint, Drupal, WordPress and MODX have been compared with each other in relation to the most important features, such as basic features, setup and management, performance, security, adaptability and integration, support from the developer community, commercial support, responsiveness, and so forth. Taking all those into consideration, Drupal 8, the latest core of Drupal was chosen as the base platform for Wintra.

3.4 Tools and Technologies

Wintra was developed on the top of Drupal 8 platform. Drupal 8 core installation requires a web server to run on which can be Apache 2.x or higher, Nginx 1.1 or higher, Microsoft IIS 5 or higher or any other web server with the support for executing PHP scripts. For Wintra, Nginx 1.1 web server was used on CentOS Linux release 7.2.1511 operating system. Drupal 8 also requires PHP 5.5.9 or higher version of PHP as scripting

language support. For Wintra, PHP 5.6.29 was installed. As of database, Drupal 8 requires MySQL 5.5.3 / MariaDB 5.5.2 / Percona Server 5.5.8 / PostgreSQL 9.1.2 / SQLite 3.4.2 or higher with PDO. MariaDB 5.5.2 was installed for Wintra [10]. Drupal 8 also recommends to have a minimum of 100 MB of free disk-space for swap files for the core. On the top of that, sufficient disk space is required for database, media files, user files, backup, etc. Wintra was deployed on a virtual machine with quad-core processor @ 2.6 GHz processor, 16 GB of RAM and 250 GB disk storage that fulfils Drupal's hardware prerequisites well enough.

As for the development tools, Notepad++ was used throughout the development phase for writing the scripts and phpMyAdmin was used as the interface to access the database. Drush 8 was used to install and configure Drupal modules and WinSCP was used as FTP software for transferring the files between the development machine and the production server. PuTTY was used for SSH connection and communicating with Cent OS 7 and writing the cron jobs for scheduling task to take regular back up as well as to generate and update the JSON file by fetching employee data from the AD server to be fed to Drupal node for updating the employee MIS.

Deveo, a Git based source control tool was used as version control for Wintra and as already mentioned earlier, Atlasian's Jira was used as the project management tool that has been followed at the scrum meetings throughout the development phases. Besides, Microsoft Project was used for preparing the primary work breakdown specification and Microsoft's Paint.Net was used for image rastering.

3.5 Architecture and Environment

Wintra was developed on three tier-based client-server architecture, which means that if a user wishes to access Wintra, they will make a client-request to the server via FCG network using the client computer or tablet or mobile device's browser. Once the frontend application server (Nginx web server in case of Wintra) receives a request, the server communicates with the data storage to validate the request and send response to the client request accordingly. It can be mentioned that the client-server architecture requires all the servers as well as the client devices connected in the same network. For maintaining an additional security layer, Wintra server has been deployed within FCG

network and thus the client devices also have to be connected to FCG network in order to access Wintra,

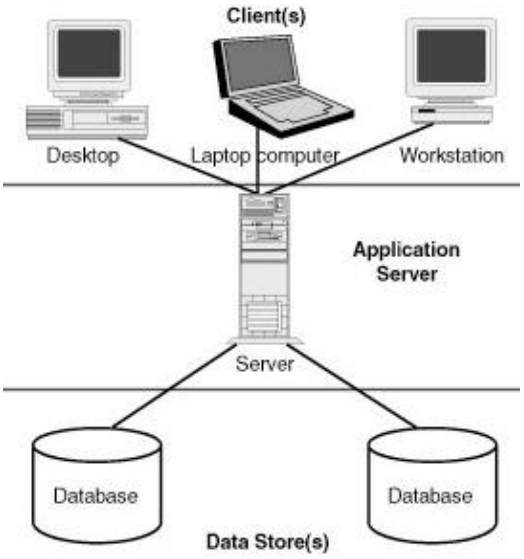

Figure 3-4: Client-Server Architecture [11].

Figure 3-4 illustrates a typical picture of client-server architecture where a client can be the browser of user's desktop, laptop or workstation that sends the request to the application server. The application server then fetches data from the data storage and replies to the client.

Wintra is a browser based application which means the client device does not have any operating system limitation which can mean that the client device's operating system (OS) environment can be Windows, UNIX, Ubuntu, Mac, iOS, Android, or any other OS. As long as the client device is connected to the FCG network, it can access Wintra using any browser application such as Chrome, Mozilla, Internet Explorer, Safari, etc. Both the application server (web server) and the database server has been deployed in a Linux based server, running on Cent OS 7.0.

3.6 Development Methodology

Agile scrum development methodology was observed throughout Wintra development. Scrum is an agile project management methodology which is primarily used for software application development projects. The main principle of agile scrum is to create a list of

sprints by splitting the modules and sub-modules into time-box periods, which contain specific tasks and can be accomplished within the sprint time. Sprint time is usually 2 – 4 weeks, but it can be as short as 1 week as well. A scrum team consists of a Scrum Master, Product Owner and the Development Team [12]. Sprint planning is done at the earlier stage of the product planning and then backlogs for product as well as sprints are created. At the end of every sprint time, the backlogs are reviewed and sprints are released for the testing team. Figure 3-5 depicts the model of agile development.

Figure 3-5: Agile development model [13].

As can be seen in Figure 3-5, backlogs are iterated to accomplish an individual sprint during each sprint time. Since this methodology follows the iterative technique, therefore, this methodology also known as iterative methodology. There are several other project development methodologies, such as Lean and Kanban software development, Extreme Programming (XP), Test Driven Development (TDD), Features Driven Development (FDD), Dynamic System Development Method (DSDM), etc. But agile scrum is the most effective and popular methodology. Therefore, agile scrum was followed throughout Wintra development.

3.7 Drupal Overview

Drupal is a content management system (CMS) which has been designed for non-technical users who need simplicity as well as flexibility. CMS is a computer application that is used to create, modify as well as publish contents using information and communication technologies. A CMS can be built on open-source technologies such as Drupal, Joomla, WordPress, etc. At the same time, CMS can be closed source as well, such DotNetNuke, mojoPortal, Umbraco, etc. Among many other differences, the most important difference is, a closed source CMS is owned by a company or such which means there will be a fee to use that CMS and also the site-builder will have limitation to extend or customize the features. On the other hand, an open source CMS is developed by groups of developers from around the world by communicating through developers' community so that each component they build is compatible to work with others which means the possibility of customization is limitless and there is no fee for using an open source CMS. Drupal is such an open source CMS that can be modified limitlessly and there is no fee for using it either.

Drupal 8 has been built on the backbone of Symfony2 components which is a set of PHP library. The components are Class loader that provides tools to autoload classes and cache their locations, Routing that maps http requests to callback functions and defines the access permissions and EventDispatcher that provides the tolls to enable components communication by dispatching events and listening them. HttpFoundation defines object-oriented layer for http specifications, HttpKernel provides a structured process to convert an HTTP request to a response using EventDispatcher and DependencyInjection standardizes and centralizes object constructions in an application. Serializer handles the transformation of objects to other formats such as XML or YML, YAML handles the parsing of YAML string to PHP arrays and vice-versa and TWIG is not really a component but part of symphony framework stack. Translation provides the set of necessary tools to localize and internationalize Drupal and Validator provides tools to validate classes, and so forth [19]. Drupal base consists of Drupal core modules and subsystems. Core modules are the main skeleton of Drupal which is self-dependent but the subsystems are dependent on core modules. Figure 3-6 depicts Drupal 8 information flow between the layers.

In order to learn more about Drupal core modules and subsystems, it is important to understand the information flow between the system layers which can be considered as a 5-layer system. Figure 3-6 shows those layers and how they depend on each other.

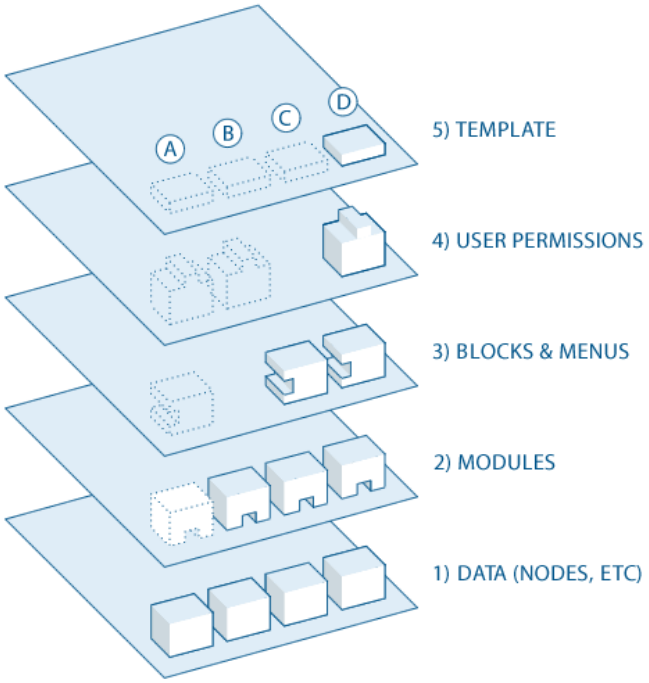

Figure 3-6: Drupal 8 information flow between the layers [18].

The first layer is called the data layer, which is basically a collection of nodes holding the system as the base. Above the data layer, module layer is built which is a set of functional plugins that are built on Drupal's core functionality and it allows the developers or the site builders to customize the data items. Blocks and menus can be found on the top of the module layer. Blocks may be the output from a module or can be completely user defined and customized. And the Menus are the navigators of a Drupal site which are also core elements of Drupal to provide links to all the pages. The next layer is known as permission layer, which allows the developer to determine and configure the settings and access permissions. The top layer is the template layer, which is also known as the skin. The skin is developed predominantly of XHTML and CSS along with Twig variables intermixed. The top to bottom directional controls make Drupal system work [18].

Drupal is a very flexible CMS and its installation is very easy as well. After installing the prerequisites as mentioned in chapter 3-4, with a FTP upload and few interactive steps the whole installation can be done including connecting with the database and settings the database connectivity configuration to Drupal settings. Once Drupal is installed, then the skin as well as plugins and other subsystems can be installed using the administration panel of Drupal.

4 The Proposed System and Development

Wintra, the proposed system was developed by using the latest technologies and following best practices throughout the system development life cycle (SDLC) of the project development. This chapter explains the details about all those steps of SDLC. Besides, this chapter also explains the scope and limitation of the project as well as the project team and stakeholders who were directly as well as indirectly involved in the project during the project development as well as implementation.

4.1 The Wintra

Wintra is the new and reengineered version of intra, so naturally it contains similar functionalities for solving the problems explained in chapter 3 whilst adopting new and advanced technologies. This means that also Wintra will be used to make announcements and disseminate notifications regarding specific department, project, well-being event, FCG's achievements etc. For acknowledging or expressing opinions regarding those announcements and notifications, the users will be able to write comments and reply against replies, just like conversation. This will make the system more open and transparent to the employees. The look and feel will be much more compact and user-friendly than that of Intra. Figure 4-1 shows the simplified and more user-friendly navigation system along with the more improved structure and layouts of the contents.

Announcements in Wintra, regarding events, will give users the scope to sign up in the event registration system of FCG. In addition to those features, Wintra also includes the employee information management system ("Henkilöstöhakemisto", the Finnish word for Employee MIS), employee requisition management system (for example, requisition for visiting card, etc.), and employee idea proposition system where employees can express their opinions or ideas to the management. Wintra is also integrated with the ICT purchase requisition and ordering system ("Hankkari" in Finnish, the shorter form of "ICT-Hankintaehdotus" which means the purchase requisition system for ICT tools and equipment). Figure 4-1 illustrates the Wintra homepage and its main navigation.

Figure 4-1. FCG Wintra homepage depicting the main navigation.

Wintra is also integrated with several other systems that the FCG employees have been using for quite a long time, namely, project-based time tracking system, application for claiming official expenses, Workflow, event registration system etc.

4.2 Scope and Limitations

At the initial stage of Wintra planning, many ideas were generated. Later on, taking the development time and resource into consideration, the ideas were minimized and framed with some detailed specifications. The scope of Wintra phase I includes but is not limited to the following mandatory and optional features:

- ✓ Single-sign-on authentication for all the FCG AD users.
- ✓ User role comes as the token from the AD that defines the access right of the user.
- ✓ The application will be accessible only within FCG network, under FCG's subdomain.
- ✓ Multi-level easy-to-navigate jQuery top menu.
- ✓ Sub-navigation as the sidebar in the inner pages.

- ✓ Content and metadata based search engine.
- ✓ Banner carousel and breaking news as slider in the home page.
- ✓ Specific number of selected general announcements in the home page.
- ✓ Categorized announcements and articles for different sections as well as the different business concerns.
- ✓ Socializing and well-being event publishing along with the enrolment option.
- ✓ Listing and detail view of custom contents for the managers only.
- ✓ Employee MIS will be populated and updated on a regular basis (i.e. midnight everyday) based on the employee data in AD.
- ✓ Newly recruited employees will be randomly displayed in the home page.
- ✓ A separate section that will contain instructions related to use all the available facilities provided by the employer.
- ✓ Webforms for ordering visiting cards and also to propose new ideas regarding anything and everything to initiate with the management.
- ✓ Food menu at the cafeteria as well as other general information.
- ✓ Manager sections will contain the agreement related documents, instructions relating hiring and firing, development discussion guidance and other necessary related forms.
- ✓ Media files will be stored in the media library from where everyone will have access to the common files.
- ✓ Site administration as well as maintenance rights based on user roles.
- ✓ Editor level users will be able to create content pages following the specified content types.
- ✓ Access control has been done by following the user role as well as content types.

As of the implementation of the phase I, Wintra has the following limitations:

- Employees will not be able update their own profile which has been planned for phase II.
- Publishing and unpublishing is completely manual, which means that the editor level user will have to publish or unpublish a content manually from the site maintenance panel.
- The employees in the “New Employees” (“Uudet työntekijät”) section are not linked with the “Employee MIS” (“Henkilöstöhakemisto”).
- The main navigation will be limited to 3 levels and the sidebars for the sub-navigation will be limited to maximum 5-level in order to populate the sub-navigations automatically.

- The links to any document or directory in the network drives will not be opened on click except Internet Explorer due to security protection by the browser.

4.3 Project Team and Stakeholders

The project team can be divided into four different sub-teams. The first one can be labelled as Product Owner Team consisting of the Management Committee of FCG and led by the Human Resource and Communication Director who represents the CEO of FCG as well as the Human Resource and Communication team. It can be mentioned that the Human Resource department team-members have been also very active to provide inputs and opinions occasionally throughout the project development. The second sub-team is the Development Team, which consists of the developer and designer and the development team is led by the Scrum Master, Matti Oosi, the Head of Information and Communication Technology department. Welat Nehri, the ICT Planning Manager of FCG has been also involved in the Project Development Team who initiated the Wintra project as well as coordinated to develop the structure as well as the WBS of Wintra and different phases. The third sub-team is the Testing Team, which consists of one person, Margit Saukkonen who took care of both black-box as well as the white-box testing and provided feedback to the development team accordingly. The fourth team is the Training Team, which consists of the developer and the tester. Since several groups had to be trained, several sessions of training with different agendas were designed and conducted cooperatively.

Besides the above mentioned project teams, the rest of the stakeholders are either a regular user or editor category user from any subsidiary of FCG. And since FCG is owned by Suomen Kuntaliitto ry, therefore, any employee from Suomen Kuntaliitto can also be part of either a regular user or editor category user.

4.4 Wintra System Structure

Based on the requirement specification and feasibility study and analysis, Wintra was divided into seven main modules that consist of a combination of static and dynamic

pages as well as external links. Since all the users of Wintra are somehow Finnish speakers, therefore, all the interfaces have been labelled in Finnish as well. Thus, the titles of those main modules are: “Ajankohtaista”, “Konserni Tutuksi”, “Liiketoiminta”, “Ohjeet”, “Esimiesopas”, “Toimitilat” and “Pikalinkit” that can be translated as “Announcements”, “Knowing FCG”, “Business Units”, “Instructions”, “Managers’ Guide”, “Work Premises” and “Quick links” respectively. All the modules consist of combination of static and dynamic pages and both static and dynamic pages are of custom made content types that were customized based on the variety and types of the contents to be published. The content type has been also separated to control the access of different user groups. For example, the contents under the module “Managers’ Guide” will be only accessible to the managers and contents will be managed by the users who belong to the Human Resource Admin (HR Admin) user group. Other than these two user roles, no one else will be able to access the contents from this sections. Therefore, the managers have only the view right to those contents and HR Admins have modification right. Similarly, the published contents of the static and dynamic pages as well as the articles can be viewed by all the authenticated users but those are only updatable by legitimate editor level users. Figure 4-2 illustrates the overall structure of Wintra that has been planned at the earlier stage of Wintra planning.

WINTRA Preliminary Structure	23.2.2016/ EK, WN					
Homepage						
Announcements	**About Business Concens**	**Business Units**	**Instructions**	**Managers Guide**	**Work Premises**	**Quick Links**
	(FCG Visitors)	(Unit-wise Subpages)	(Policies)	(visible only to Managers and HRD)		
	Value, Vision and Mission	Consulting	Human Resource Aspects	Decision-Making	Restaurant / Food Menu	INREO
- FCG-News	Key Projects	Training	- Orientation	Procurement Rights and Policies	Rescue Plan	PROTO
- FCG-Management-News	Company Information	Planning and Technology	- Human Resource Mannual	Recruitement	Conference Rooms	TEM
- Winnings and Success News	Organisational Structure	International	- Travel Instructions	Employment Contracts	Lobby Services	Workflow
- Business Units News	Responsible Persons and Teams		- Cooperations	Development Discussion	Post Service	AREAn matkaportaali
- ICT-News	Teams Introductory Section		- Free-time Activities	Forms	Access Control	ICT-Procurement
- Other Announcements	Contact Information (Billing etc.)		Occupational Health Care	-Employment Contracts	Property Matter	STE Proto
- FC Go News	Employee MIS		Costs and Acquisitions	- Employee Information Changes	Visitors at FCG Building	Etc.
External Feeds	Job Open Positions		Communication and Marketing	- Remunaration Forms	Other Work Premises	
Blogs	Code of Conduct		- Sales Map (communication tools)	- Results and Targets Discussion	- Subpage for Other Work Premises	
Event Calendar	Initiative		- Graphics Instructions	- Etc.		
New Faces			- Exhibitions and			
FCG-Market Square			IT Service Management			
			Project Management			
- Contact Persons' Information						

Figure 4-2: Preliminary structure of Wintra.

The initial structure has been slightly modified in terms of types of features and contents and then divided between different development phases. For example, the dynamic "Business Units' News" has been removed from the "Announcements" ("Ajankohtaista") module in the final implementation and "Business Units" ("Liiketoiminta") modules have been combined with static and dynamic contents instead. Sub-modules, highlighted with the blue colour under "Announcements" ("Ajankohtaista") has been planned for the development phase II. Figure 4-2 shows the content administration menu for Wintra for editor level users.

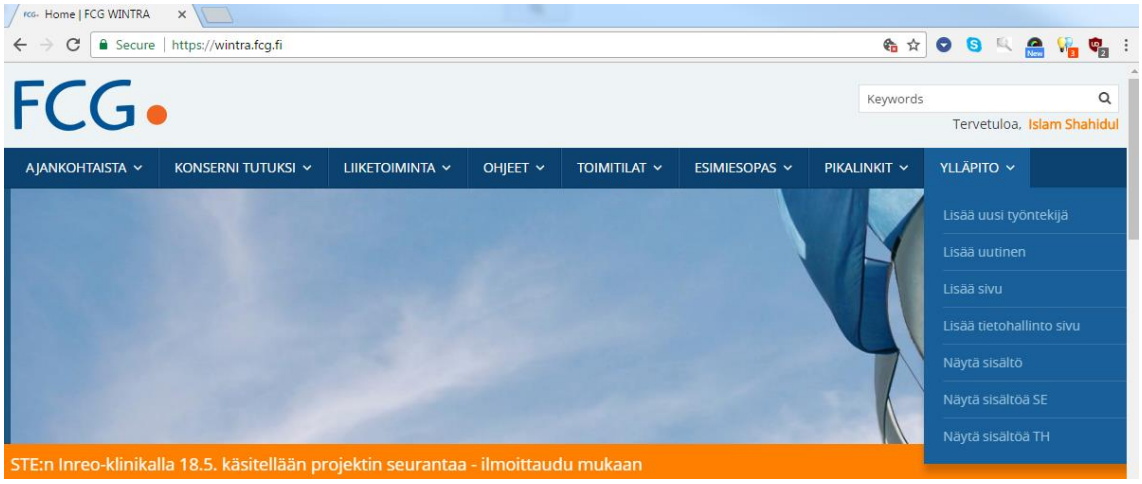

Figure 4-2: Content administration menu for Wintra for editor level users.

As it can be seen that Sub-module "Initiative" ("Aloitelaatikko") was renamed and moved under "Instructions" ("Ohjeet)" module. "Quick Links" ("Pikalinkit") modules was populated with thirteen pre-planned as well as post-planned links that is connected with thirteen different internal as well as external systems used by FCG employees during their regular works. In addition to those planned seven main modules, another module, titled "Maintenance" ("Ylläpito") was created as part of the main navigation, which refers to site content administration and is not visible to the regular users but only to the editor level users. Figure 4-2 shows the available option for different editor groups that allows the editors group users to list the contents with the possibility to edit and delete, add new static page, new announcements of different types as well as new employee information. All those options are available based on the access right of the logged in user.

4.5 Time Management and Status Update

Once the idea of Wintra was initiated, an extensive time plan was made along with estimated dates and milestones. Figure 4-3 shows those milestones along with the estimated dates. It can be mentioned that even though the time was estimated while planning the project, the developer was not assigned for Wintra development due to the developer's involvement in a different project. As a result, the milestones were not achieved according to the planned schedule. The slides of Wintra initial planning have been enclosed as Appendix IV for reference. Figure 4-3 depicts the initial development time plan for Wintra phase – I which has been estimated 4 months starting from the project kick-off till the deployment.

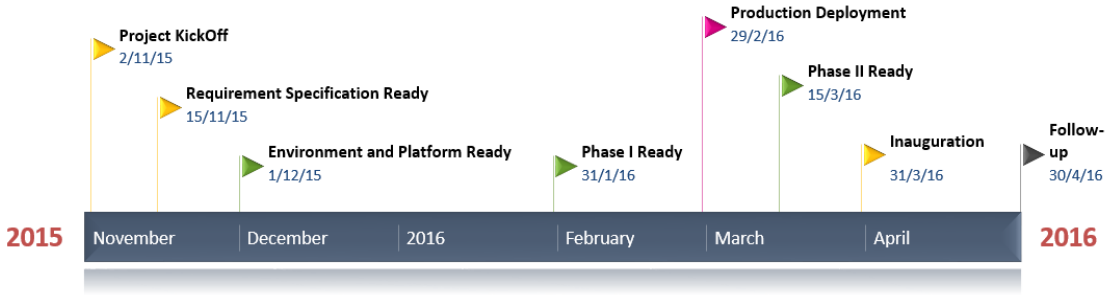

Figure 4-3: Initial development time plan for Wintra.

Even though the initial plan was made in autumn 2015 and the actual development started already in January 2016 but still the project did not fulfill the project milestone of deployment date of Wintra Phase – I. This situation occurred due to the involvement of the developer in different project for higher priority as well as the accident of the developer that caused almost 3 months as well. Nevertheless, the total time spent for Wintra development, testing and deployment met the proposed working hours. Figure 4-4 shows that a total of around 533 hours has been spent during the year 2016 and around 60 hours has been spend during the year 2017 for the development, testing as well as the deployment of Wintra Phase – I which is around 4 month.

Figure 4-4: Total time spent for the development of Wintra Phase I.

It can be mentioned that Figure 4-4 has been extracted from Toggl, an open source project tracking tool that has been used throughout the development phase [14]. Figure 4-5 shows the proportion of the features has been added to Jira, the project management too, as well as the proportion that has been developed and closed. It also shows that a big proportion of features still in the "To Do" stage, which actually refers to the features for phase-II which has already been added in the Jira. Also, it can be mentioned that Jira has been taken into use in the middle of the project for which the graph is not completely accurate, but accurate enough to present during the regular scrum meeting.

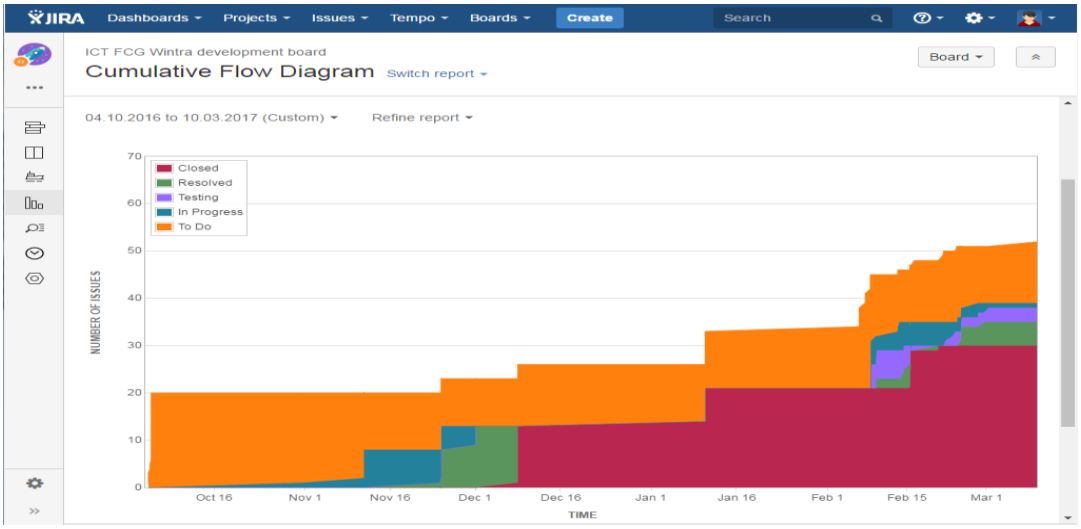

Figure 4-5: Extract from the project management tool Jira.

Regarding the status updates in the scrum meetings, it has already been mentioned in the earlier chapters that the project management portal Atlasian Jira was used to follow the agile scrum development methodology throughout the development phase. It helped the development team as well as the product owner team to be in the same level of understanding and to avoid all possible misunderstanding regarding project status and such. All the features were added to Jira as epics and stories by using plain language so that the product owner team does not face any difficulties with the technical terms and such. Figure 4-5 shows the different stages of the tasks that were added to Jira. It can be mentioned that a "To Do" list with the features from phase II have already been added to the project management portal for which Figure 4-5 shows there are still many tasks to be completed.

4.6 Prototype

Based on the initial project plan and structure, it has been decided that a readymade Drupal 8 template will be purchased that fulfils the requirement of the agreed interface layout of Wintra. This idea was brought to make the development easier and quicker since Drupal 8 template is quite different from Drupal 7 and there is no expert template designer available. Therefore, based on this idea, the planning manager presented three different templates among which one of them was chosen by FCG top management. Based on the selection of the template by FCG management, the template was bought and brought into implementation along with the agreed customization which has been done step-by-step and day-by-day by the development team. The use of this readymade template was definitely a good idea since the template was done by the professionals using best practices of Drupal templates. And since Wintra is an in-house application, it was not necessary to pay a big amount of money to buy a unique licensing for the chosen template.

4.7 Coding and Development

The development of Wintra was basically a full-stack development since it has been developed by a single developer. The developer who does the full-stack development, is known as full-stack developer which means that the developer knows and deals with each

and every layer of the application. As a full-stack development, the developer started with the customization of the interfaces first to make the look and feel as agreed with FCG management. The modules were developed and implemented with a set priority level that was also added to Jira as sprint backlog, which was presented later on during the scrum meetings to keep the product owner up-to-date. It can be mentioned that Notepad++ was used throughout the development phases for coding and scripting, which was later updated to the server using WinSCP. Since Wintra is the first Drupal project for the developer, there was a great deal of studying and learning involved to get the ideas how Drupal core works together with the views and models. Fellow colleagues and developer communities have been of great help in that regard as well.

4.8 Testing and Feedback

The testing team has been following the white box testing as well as the black box testing techniques to find the possible vulnerability of the project along with the occasional co-operation from the Head Developer. Testing has been carried by using different role based test user accounts to ensure that the content access rights works as per expectation. The testing team also tested with different set of data to exploit the possible security holes. Appropriate feedback along with proper explanations have been reported in Jira to make sure the development team is aware about the findings from the testing of specific sprint releases. Based on the comments and explanations from the testing team, the development team took care of the reported bugs or findings. Thus, with a gap-less communication between the development and testing team, it became possible to release and deploy a bug-free product in the production environment for the use of FCG employees and stakeholders.

5 Implementation

The implementation part has been divided into four parts and this chapter explains in detail all four parts. The first part explains in detail the procedure regarding the migration of existing data from Intra to Wintra. The second part explains the procedures of production release and deployment. Since a new system requires some level of training for the advanced level users, several training sessions have been arranged for different level of user groups. Therefore, the third part of this chapter explains how the training has been conducted. The last part of this chapter focuses on demonstration and launching of the new Wintra to be used by the end users.

5.1 Data Migration from Existing System

Since the Intra system was mostly being used for announcement purposes there was not much complication for the data migration. One complicated part was the user group and policies since the Intra system follows the Windows built-in architecture and the Wintra system has been developed using open-source technologies. However, that problem has been solved by implementing SimpleSAMLphp solution to authenticate the user via Microsoft's own authentication system that comes with Microsoft's Active Directory (AD) server. Only one additional thing was needed to be done, i.e. to create some new property to the AD users to define the role of the user in Wintra. A Lightweight Directory Access Protocol (LDAP) module has been used to fetch the employee information from the AD server to create the employee Management Information System (MIS) in Wintra. The current version of Wintra only fetches all the information of the employee from the AD server that is being inserted to AD by the Human Resource (HR) software application. The next version of Wintra will provide the possibility to add more information about the employee to the employee MIS and possibility to update the AD info from Wintra as well.

Regarding the static contents migration, in most cases, the content has been reproduced since the Intra contents were quite outdated. Besides, the Intra system also had content dependencies, in terms of attachments of official referential documents such as MS Word, Excel, PowerPoint, Images or PDF files where the end users had to browse the network drives to get access. But in Wintra, that problem has been fixed by creating a

document library where all those documents are uploaded and listed in a way so that the editor can just browse to the necessary documents thru browser to link the document with the contents. Then the end user will just click on that link title to access the document. Figure 5-1 shows the “Rescue Plan” (“Pelastussuunnitelma”) page where the necessary instruction-guides are attached along with the contents.

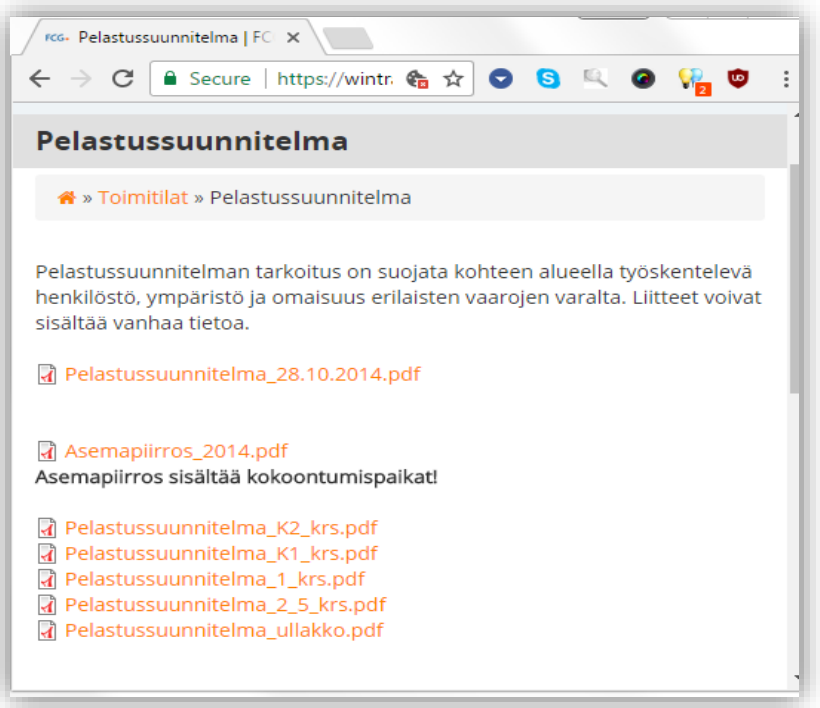

Figure 5-1: Rescue Plan document links as content attachments.

As shown in Figure 5-1, the end-user just needs to click on the link to access the document and doesn’t have to explore the network drives anymore. Since the login system already defines the user access rights, they will not need to authenticate anymore to access the desired document.

Regarding the announcements and other contents, JavaScript Object Notation (JSON) parsing has been used to export the contents from Intra and after validating the formatting, the data has been imported to Drupal nodes of custom-made Drupal content type. Employee pictures and article images have been resized and reshaped using the photo editing module namely ImageWidgetCrop to make the image responsive and Wintra interface friendly. Other contents and graphics are produced as new since those did not exist in Intra.

5.2 Production Release and Deployment

The features and functionalities for the first version of Wintra were agreed in the scrum meeting along with development team as well as the product owner. Once the functionalities were ready, they were availed to the editor group users to get used to the system and input the necessary contents in the test server with an Internet Protocol (IP) address. Once the editor group users got used to the new system, the Wintra production release was prepared and deployed in the production server using Drush, a UNIX scripting interface for Drupal. After deploying Wintra in the production server, a new subdomain, “wintra.fcg.fi” was created under the parent domain “fcg.fi” and propagated the subdomain with Wintra production server so that the users can use Wintra by browsing to the subdomain while residing within the FCG network. It takes time to transform from an existing system to a new one, which is why Intra is still accessible up to an agreed time of 3 months using the Intra’s own URL.

5.3 Editor level User Groups Training

Since Wintra has many more features in comparison to Intra and developed using different technologies, it requires some training for the editor level user groups who will be adding and managing the contents. Therefore, in cooperation with the development, testing team, a training team was formed whose job was to set the agenda based on different user groups and agree on a schedule to conduct the training. Since FCG is a big company and editor group consists of several roles where each role contains several users, therefore several training sessions were necessary. The number of editor level users and volume of access areas have been taken into consideration mainly to determine who will be attending in which training session. For example, the ICT support team will have access to more areas of the application in terms of the editors of the Business unit’s editor level users, but the number of editor level users is much higher than the number of the ICT support team. Therefore, a separate agenda was required for those different roles. Similarly the Human Resource and Communication team has some different role and authority in terms of the content access to ICT or Business unit’s users which required a separate agenda as well.

Considering all the above mentioned criteria, seven official training sessions were conducted on different dates for different user groups with different agendas. The first training session took place on 14 December 2016, the second one on 5 January and the rest of the sessions took place on 5 different dates in February 2017. Details regarding some of those training sessions and attendees can be found in Appendix - I. Besides official training, there were some informal unofficial training sessions as well, especially when some bug was discovered in the program or some new techniques or new module had been implemented.

5.4 Launching and Demonstration

As per the preliminary plan, it was agreed that Wintra will be launched sometime in autumn 2016. However, an unforeseen accident involving the main developer pushed the launching date to spring 2017. When the main developer was able to resume Wintra development again, many changes in the requirements had appeared which required additional work outside the pre-planned work schedule. After fulfilling the agreed requirements, Wintra has been demonstrated to the top level management committee of FCG. Based on the management decision and after conducting the necessary training sessions, Wintra has been officially launched on 3 March 2017. The launching announcement was published in FCG Intra and it was also emailed to all the employees of FCG. Figure 5-2 depicts the Intra announcement regarding the launching date of Wintra.

Figure 5-2: Wintra launching announcement in FCG Intra.

Besides, the default browser settings of all FCG computers have been updated systematically by the system administrator and propagated the initial page settings from Intra to Wintra. Figure 5-3 below presents the homepage of FCG Wintra, depicting the overall structure as well as some published contents.

Figure 5-3: FCG Wintra home page.

It can be mentioned that the screenshot was taken by the administrator while browsing Wintra, which is why the main navigation also shows the managers' access area ("Esimiesopas", Finnish word that refers to "Managers' Guide"). This is not visible to anyone except the Managers, HR Admin and Administrator.

6 Learning and Challenges

Wintra is a project that was carried out to develop and modernize FCG's intranet system by adopting new technology. Therefore, Wintra has been developed using the latest technologies by following the best programming practices as well as web application security aspects. Thus, the development team needed to learn many new and advanced technologies as well as innovate a number of things for ensuring the best and most efficient product. Naturally this learning and innovation brought many challenges which were needed to be faced and mitigated to make a successful delivery. Accordingly, this chapter briefly explains those technical aspects that the development team learned while developing Wintra. The second part of this chapter gives a picture regarding the innovation and the third part explains the challenges the development team faced and how those challenges were faced and mitigated.

6.1 Technical Learning

Drupal 8.0.0 is the latest core of Drupal technologies that was released on 19 November 2015 by adding many more features to its earlier versions availed [15]. In addition to the many new features, Drupal 8's new core runs on a completely new technology called YAML technology. YAML is abbreviated as "YAML Ain't Markup Language" which is a data serialization language that was designed to be human-friendly as well as capable of working with modern programming languages to fulfil everyday needs. YAML files have the extension *.yml. Similar to JSON and Perl, YAML also allows the use of traditional indicator-based scoping [16]. In order to develop Wintra, this brand new technology was needed to be learnt.

Besides, since the core of Drupal 8 is completely new and different from its earlier versions, naturally the libraries and modules of the earlier versions of Drupal were not compatible with Drupal 8 anymore which required to develop most of modules again, from scratch, so that those work with the new version of Drupal. For example, Drupal modules for SimpleSAMLphp or LDAP or WebForm of even SMTP that were developed for the earlier versions of Drupal were not compatible with Drupal 8 anymore. Instead, new Application Program Interfaces (APIs) along with very critical configuration settings were

implemented which is not a plug-and-play solution anymore. Besides customizing several modules, it was also necessary to develop some new modules as well.

In addition to learning those new technologies, it was also necessary to learn some Drush command to update Drupal core, Drupal security patches as well as Drupal Database. It was also necessary to learn some bash programming to add the task of making a regular back of the database as well as the entire application using UNIX Cron job. It was decided that DEVEO would be used as the version control tool for the source codes and Google analytic tool would be used for producing the statistical analysis and reports of Wintra usage by using Google analytics code and Google tracking manager. All these technologies were necessary to learn by the development team in order to make a successful release of the production of Wintra.

6.2 Innovation

Since Drupal 8.0.0 is a completely new architecture with a very limited number of library and resources, most of the features of Wintra can be treated as innovation. But since all those interfaces and look and feel and functionalities have been used already for quite a long time already, theoretically they are not really innovation. On the other hand, the idea of using the existing Active Directory domain and Microsoft's overall infrastructure as the main base for authentication for Wintra was completely new to the development team. This overall flow of AD authentication to allow Wintra access to the users is the primary innovation in Wintra. A secondary innovation is the combination of LDAP and JSON modules to fetch employee information from AD server, load them into Drupal node and populate the employee MIS. Besides these two major innovations, some minor innovations can be observed in Wintra. These include implementation of page name pattern which helps the system to create meaningful and structured URLs, implementation of new Simple Mail Transfer Protocol (SMTP) to send emails and notification or confirmation, Drupal views customization to show data by following specific layouts, role specific content access control with the help of some separate module customization, etc. All these innovations together convinced the management that the promised requirements have been achieved well enough, which in turn, resulted in the implementation and launching of Wintra and archiving Intra gradually.

6.3 Challenges and Mitigation

Working with technology is always a challenging job and it is even more challenging to develop something using a set of new technology. Thus, there were definitely challenges and difficulties in almost every step of the development. But with the help from the developers' online community and fellow colleagues, the development team succeeded in accomplishing the objectives for the first phase of Wintra. A few of the biggest challenges faced and handled by the development team can be seen below:

- While developing Wintra, the biggest challenge was to implement the single-sign-on feature to allow Wintra access to the AD users without going through a separate registration process. After trying several solutions, finally the problem was solved by customizing the SimpleSAMLphp module which is an application that was developed using native PHP to deal with authentication [17]. It can be mentioned that the web server was changed from Apache to Nginx to make sure that this SimpleSAMLphp module works smoothly. Thus, it can be concluded that this challenge has been mitigated successfully.

- The second biggest challenge was to fetch the employee information from the AD server to populate the employee MIS. Using the theory and practice of the LDAP modules developed for the earlier versions of Drupal, several new solutions were created but neither of them worked perfectly. Thus, at the end, to meet the deadline, one of those solutions that were developed was implemented by customizing one of the LDAP modules in combination with JSON export and import features. A scheduled cron job was implemented to import the JSON data and load to Drupal nodes. It can be mentioned that even though the challenge was met and the problem was solved it was not the best solution. This is because, in order to populate the JSON data, the LDAP credentials were used as plain text in the source code. It is not a very risky solution since this module cannot be accessed outside the FCG network and also it is well hidden from FCG general users, but still, since the credentials are in plain text, it can be treated as a minor vulnerable solution in critical security scanning. Therefore, more research on this matter has been scheduled before releasing the next version of Wintra.

- The third most critical challenge was to customize Drupal view in some specific format in order to follow the agreed layout. To be specific the customization of a

view to show the detailed information of any selected employee from the “Employee MIS” (“Henkilöstöhakemisto”). After doing some extensive research on Drupal 8 views, the best solution was found which needed to create a separate yml page that solved the problem in a perfect way. And this solution was developed by following Drupal 8 best practices, as recommended by the experts from the online developers’ community.

There were several other challenges emerging during the development, such as generating random set of records of “New Employees” (“Uudet työntekijät”) in the home page, customizing the right-side navigation in the landing pages, customizing the paging bar for the announcements, customizing the filters for “Employee MIS” (“Henkilöstöhakemisto”), etc. Still, those were comparatively easy to solve by following best practices.

7 Future Scope

As per the management committee of FCG, Wintra is an on-going project which will be developed step by step and phase by phase by accommodating as well as replacing other old and existing systems. Therefore, there are features already decided to be implemented in the next versions of Wintra. The first part of this chapter explains the specific features that have been decided and agreed to be implemented in the second version of Wintra. The second part of this chapter explains the future scopes and possibilities of FCG Wintra.

7.1 Plan for Phase II

Even though FCG Wintra has been implemented with many new features that never existed in FCG's Intra, it still does not contain all the features that FCG management wishes to have in their intranet system. Several features are already decided and agreed to be developed and implemented in the second version of Wintra. Among several other features, the following will be implemented in the second phase of Wintra:

- Event calendar that will publish the event information along with the integration to the event registration system. The event calendar will also publish the important happening that might not have any registration option as well.

- Enhancement of employee management information system that will allow the users to integrate employee profile as well as the feature to update the AD information directly from Wintra.

- "New Employees" ("Uudet työntekijät") section will be integrated along with the "Employee MIS" ("Henkilöstöhakemisto") which is not part of the "Employee MIS" in the first version.

- Users will be able to post comments on the announcements and articles to make the system more transparent and interactive.

- "Initiatives" ("Aloitteet") section will be enhanced so that the ideas and proposals can be commented and replied to as in conversation.

- Document library will be customized in a way so that it can control the access to the documents according to the user's role and allows specific document and document folders to specific users.

7.2 Further Scope

Wintra has been planned and developed in such a way that it can accommodate most of the tools that are necessary to an intranet system and fulfil all the purposes and the corporate office can be run as a "paperless office". In order for that, Wintra has been designed in a way so that it can be used as base system for reengineering and updating FCG's other existing systems such as Project time tracking tool, Office expense reimbursement claiming tool, Project lists and clients, etc. since these other systems have been developed using different technologies and platforms and have been used by FCG for a long time already. Once those tools are reengineered and developed enhancing Wintra even further, then Wintra will be a complete and true "paperless office" and that is the ultimate objective of FCG Wintra.

8 Conclusion

Concluding a software application development project is quite tricky. Several aspects can be dependent on each other which may have both pros and cons. This chapter explains those different aspects of the overall project first by summarizing and then by discussing those pros and cons and validating the primary objectives how those have been achieved. Later, in the last part of this chapter a recommendation has been made on the basis of knowledge and experience gathered by the development team.

8.1 Summary

The idea of reengineering FCG's Intra and developing Wintra was proposed in autumn 2015. Since then FCG management has been looking forward to seeing the implementation of what was initially proposed. Since the development team consists of only one developer who was also involved in another project at the same time while Wintra was planned, the starting of Wintra development was not as smooth as it could have been. Even though a ready-made template was chosen initially for the development, later on that template was modified so much that now it is almost impossible to recognize the base template. Also, several change requests in the layout as well as overall structure in different stages of the development made the overall project time much longer. In addition, the three-month sick leave of the developer added another extension to the development time. As a result, instead of launching in spring 2016, Wintra was inaugurated in spring 2017. The initial plans for the different development phases of Wintra can be found in Appendix – IV.

Even though Wintra development as well as its inauguration were delayed, the delay brought many advantages with it. The first advantage is that the developer was able to use the sick-leave to learn Drupal which made the development phase quite fast. And another important advantage is that many libraries and modules were developed in the meanwhile by the developer community which made the development even faster. And, since the Drupal modules and libraries had become rich by then, multiple options became available to choose the best solution for Wintra.

However, learning a new technology and developing a new system based on that new technology is a challenging job and the development team made this happen by the successful completion and implementation of the phase I of Wintra for FCG employees. Many challenges and obstacles also appeared during the development but those were mitigated in an appropriate manner.

8.2 Discussion

In order to ensure that the problems mentioned in chapter 2.3 have been solved and the proposed objectives have been achieved, the development team decided to analyse different aspects of Wintra after deploying the first release in the production server. First, the overall look and feel of the interface and ease of use has been ensured by taking feedback from the editor level users during the training sessions.

A random user's opinion has been asked as well to ensure that the overall navigation and look and feel is user-friendly enough. Besides, a new feature called "aloitteet" has been implemented which refers to "initiatives" or "ideas" in English. This means that every user can propose ideas and suggestion regarding the look and feel as well as the functionalities of Wintra which will be taken care of later by agreeing with the Product Owner as well as the Scrum Team.

The next step of the analysis was to measure the page loading time using browser's extension. Figure 8-1 shows the load time of Wintra home page is 1.79 second whereas the load time on the Intra home page was 20.05 seconds. Wintra contains more than twice the contents compared to Intra which prooves that Wintra has been optimized well enough for smooth performance.

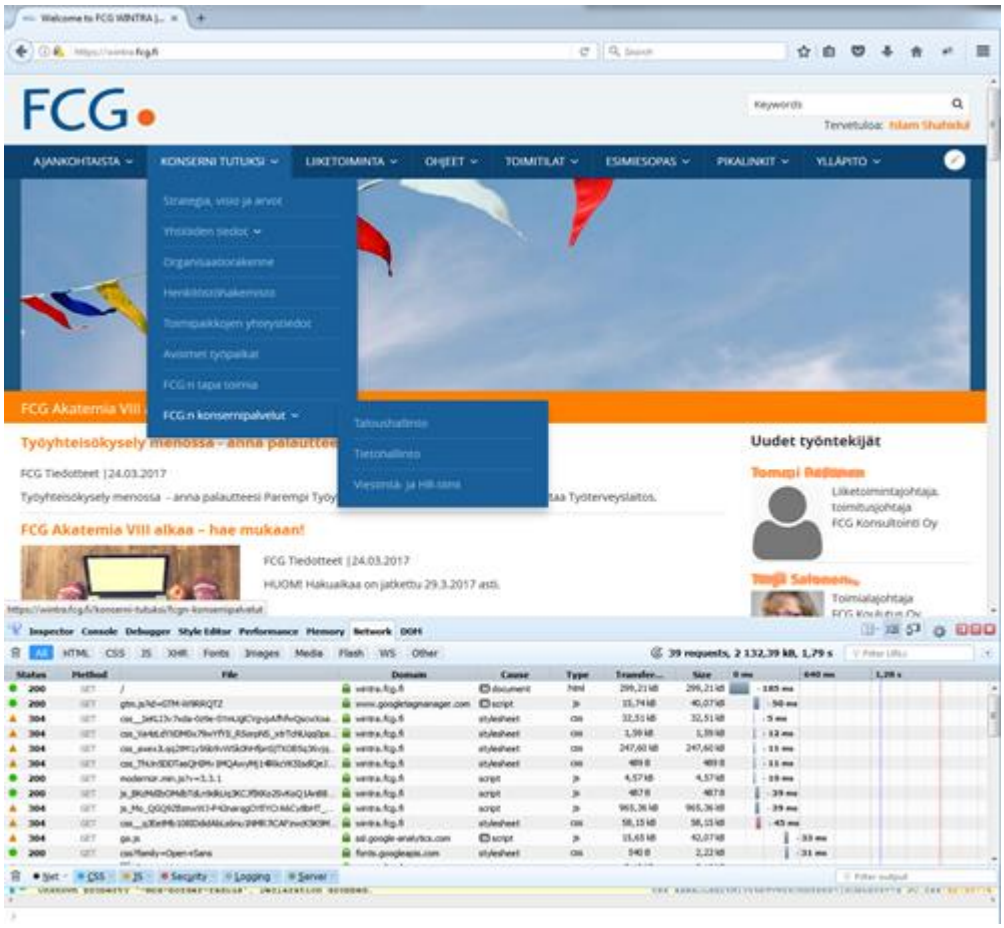

Figure 8-1: FCG Wintra home page loading time.

Google Analytic (GA) tool has been implemented to generate statistical reports on the overall usage of Wintra as well as to monitor if any part of the application is bouncing back or failing to return the expected response to the users. Figure 8-2 is such a statistical report that shows a report based on the visit per session per user as well as the time spent by the user. It also shows how often the users come back to access Wintra.

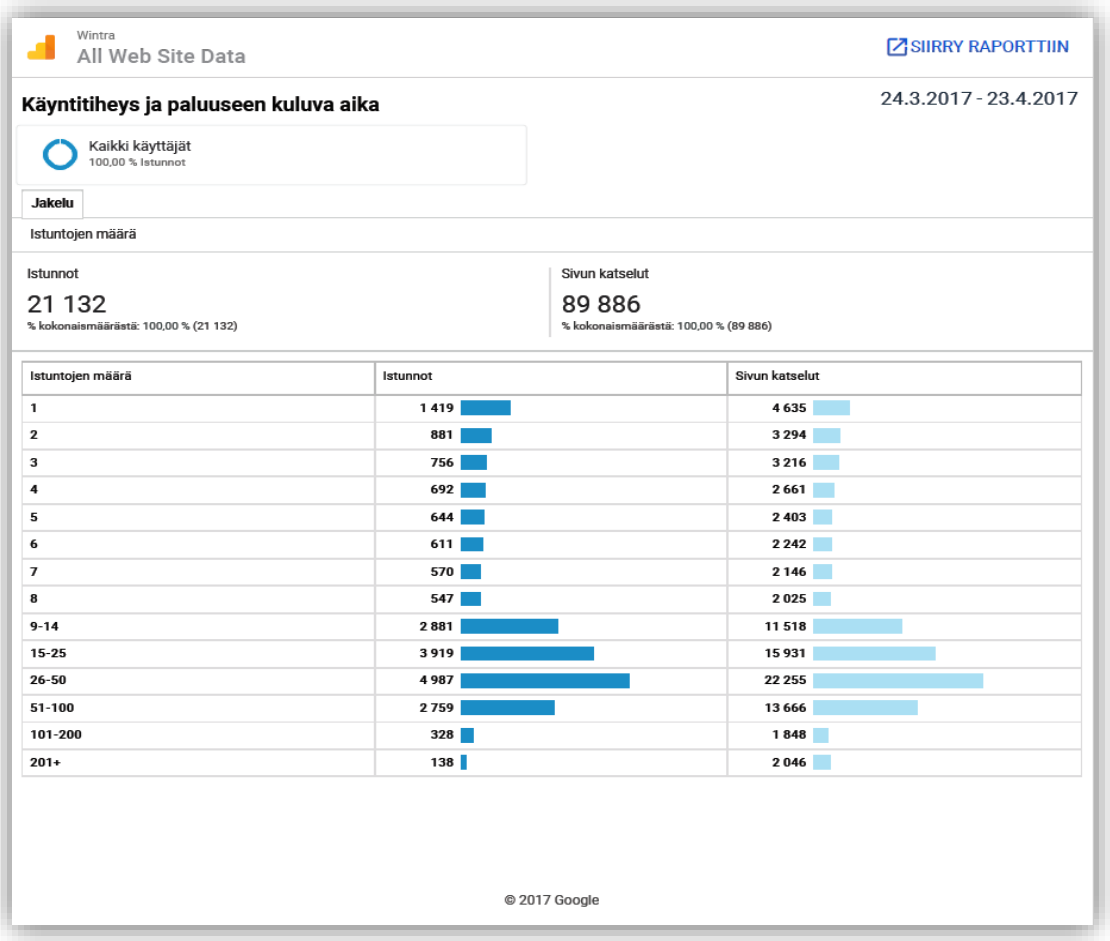

Figure 8-2: Google analytic report on visit and time spent on Wintra by the users.

This statistics report is important in order for the management to see the importance of this application. The more time the users have spent on this system refers to the fact that the users are accessing Wintra on a regular basis and are spending a significant amount of time on it. And as per the analysis of the “initiative” form, since there are only ideas and no complaints, it proves that the users are quite happy with the interfaces and functionalities.

Figure 8-3 below shows another Google analytics report that has been populated based on the usages of client browsers to access Wintra.

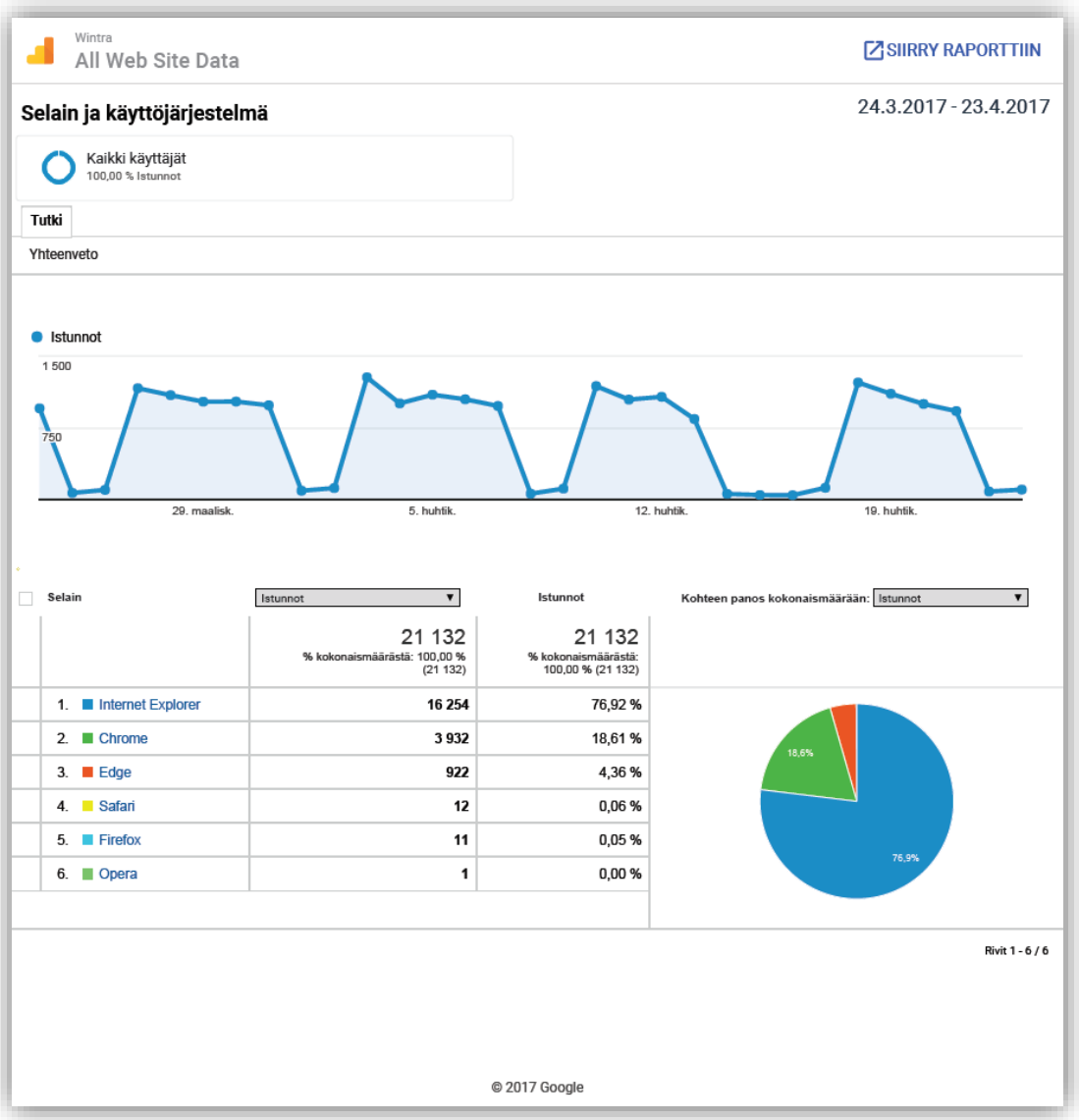

Figure 8-3: Google analytic report on different browsers to access Wintra.

The report in Figure 8-3 says that Internet Explorer is used by more than 70% of the users, which makes sense since almost all the employees are using Wintra from their work computers, which are running in most cases on the Windows operating system and therefore Internet Explorer is the default browser in those machines. But since Wintra is browser independent, almost 30% of the total usage is from other browsers whereas Intra was only accessible from Internet Explorer. This 30% usage from other browsers was in the second month of Wintra deployment but this is expected to increase even more in future.

Wintra is Drupal 8 based open-source solution, which is completely free and no licensing fee or such is required. The overall look and feel and the interface have been developed

in a responsive way by following the modern design and techniques which also allows the editor level users to use rich text editors that uses What You See Is What You Get (WYSIWYG) technique for adding content with special formatting and such. The “Employee MIS” (“Henkiöstöhakemisto”) section has been also populated with the employee information by retrieving the employee data from the Active Directory server.

8.3 Recommendations

Considering all the pros and cons, the fulfilment of the requirements as mentioned in the SRS and as promises by the development team is remarkable. Even utting it humbly, the launching of the first phase of Wintra shows a great achievement from both product owner’s side as well as from the development team’s side. Based on the result analysis and discussions, it can be concluded that despite the learning stages, Wintra phase I is a great success by the development team. Accordingly, the development team is looking forward to a chance to proceed with phase II and phase III respectively. Also, while planning for developers and other resources, it is important to think about the availability and involvement of the developers as well as the resources with other projects so that the project timeline can be followed properly and milestones can be achieved systematically in a planned way.

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Appendix – I: Outlook Invitations for Wintra Training Sessions

Figure A-I-1, A-I-2 and A-I-3 shows the list of the participants who were invited to attend the last three training sessions. These were outlook invitation and the lists were printed from Microsoft Outlook program.

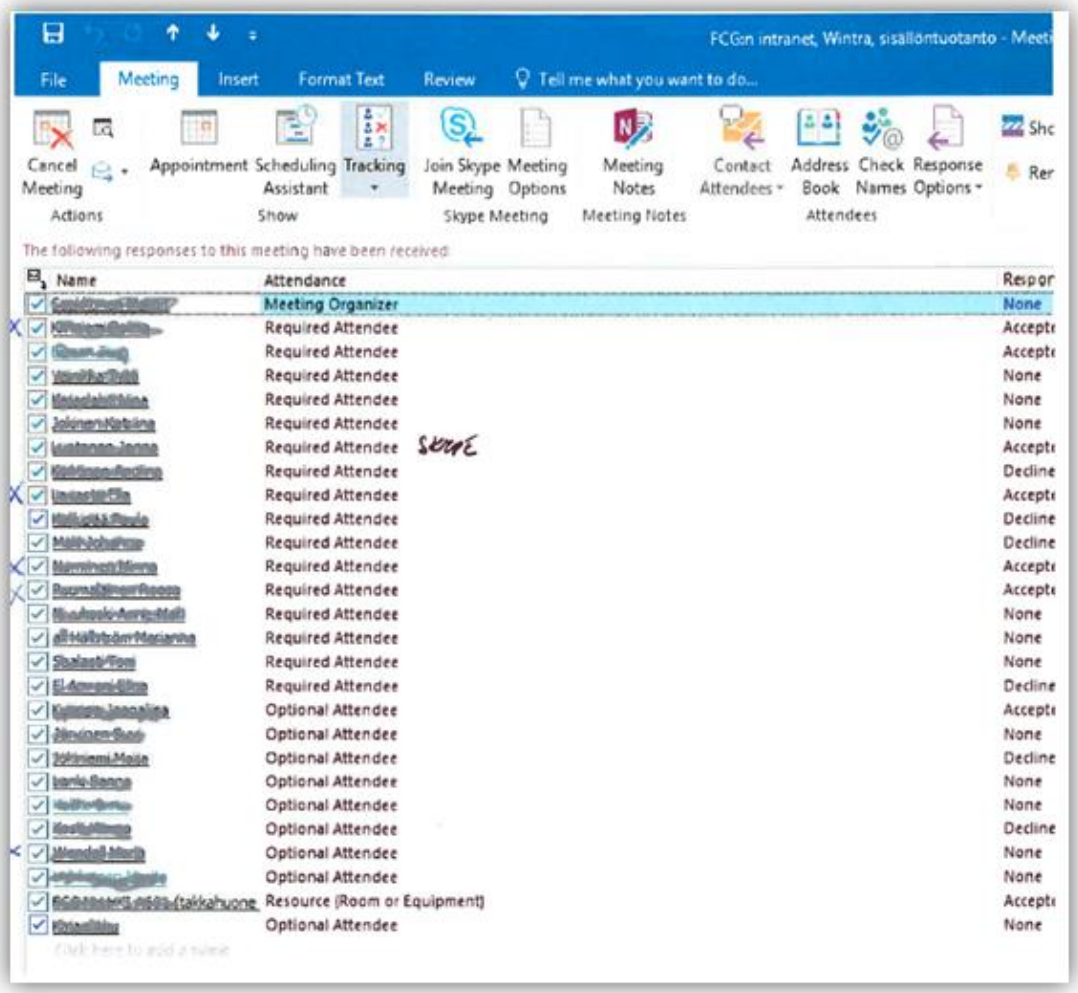


Figure A-I-1: List of participants invited for the training session 15.02.2017

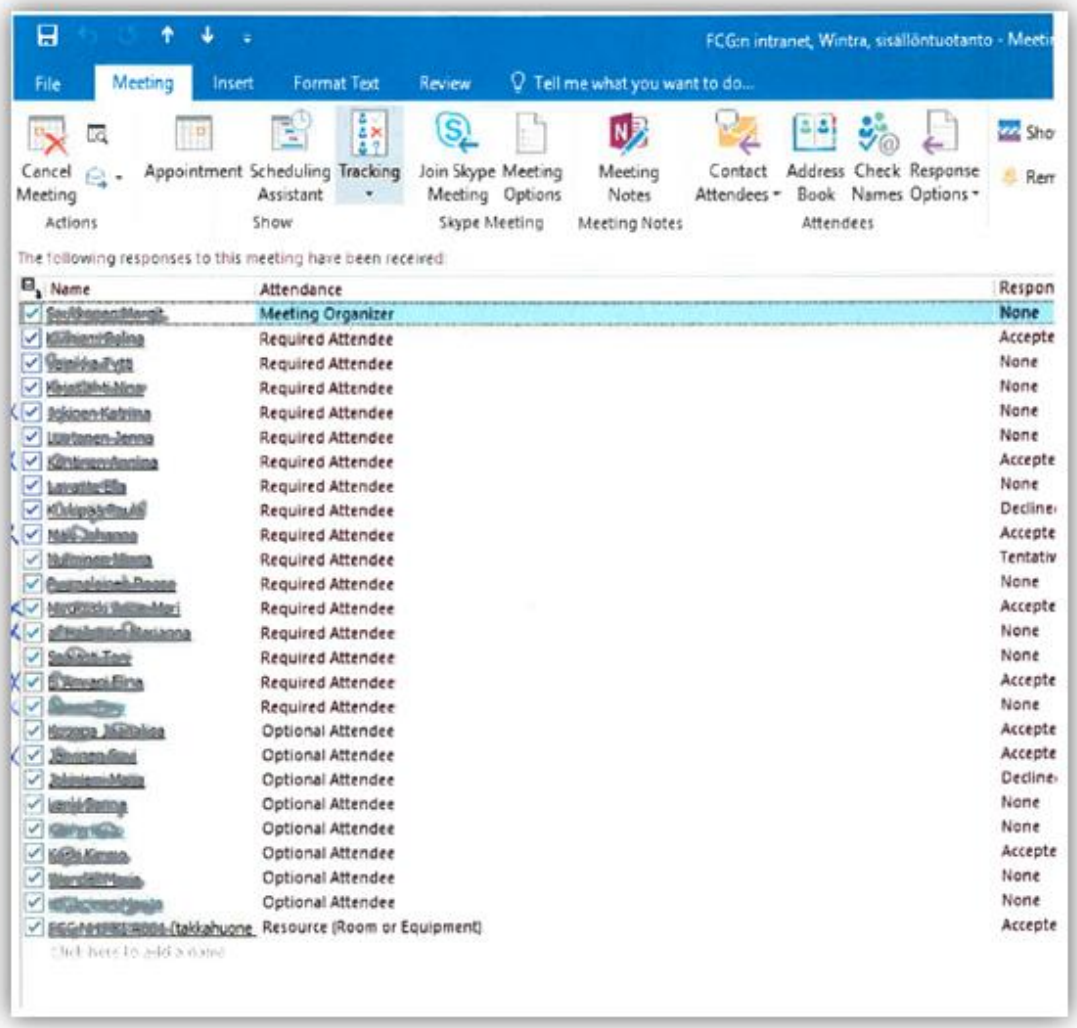


Figure A-I-2: List of participants invited for the training session 20.02.2017

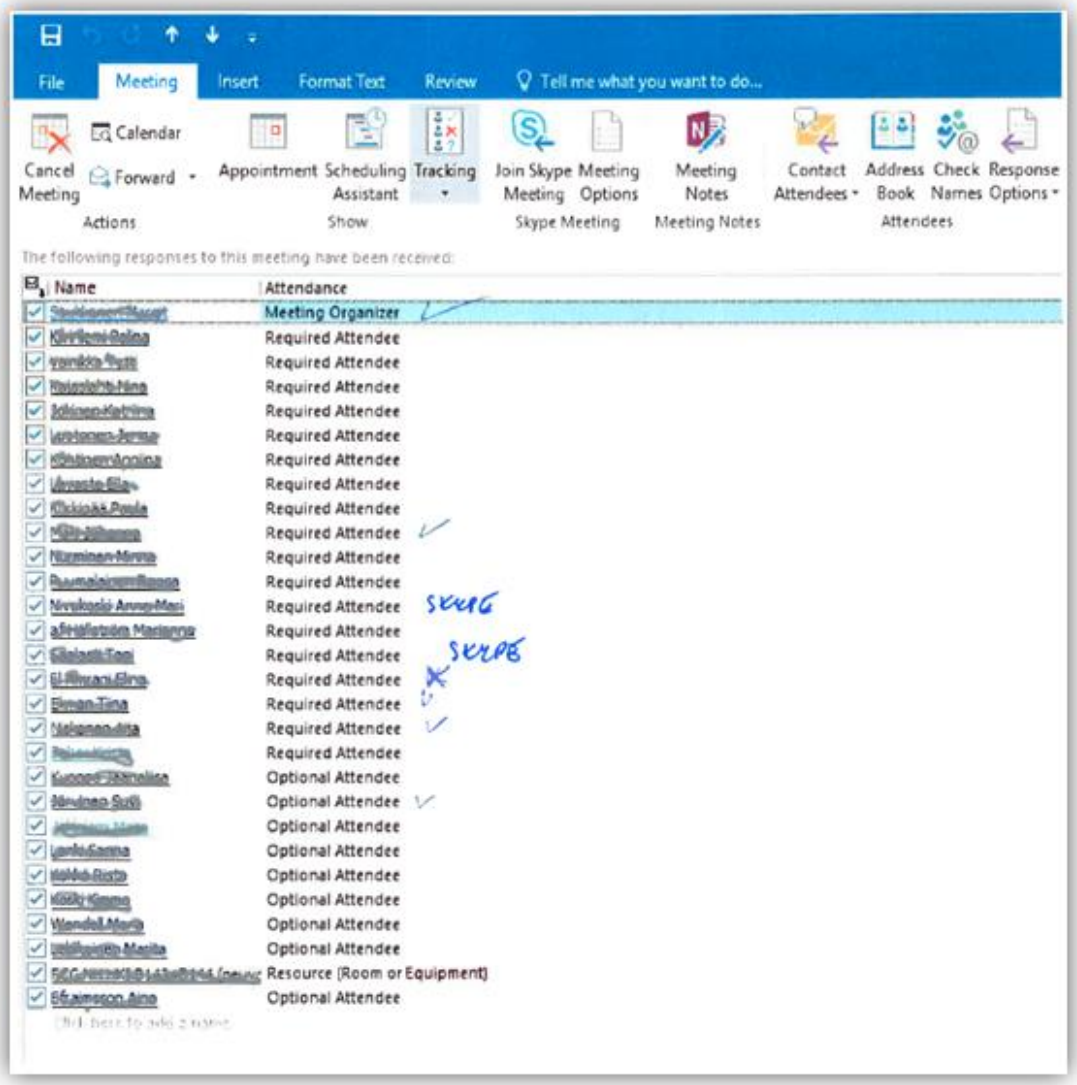


Figure A-I-3: List of participants invited for the training session 23.02.2017

Appendix – II: Wintra Usage Statistics from Google Analytics

Following statistical reports have been extracted from Google Analytic tools that show the analytic report on Wintra based on what browser tools are used to access Wintra, ratio of existing users and new users, how much time is spent in general as well as the percentages of which pages are accessed.

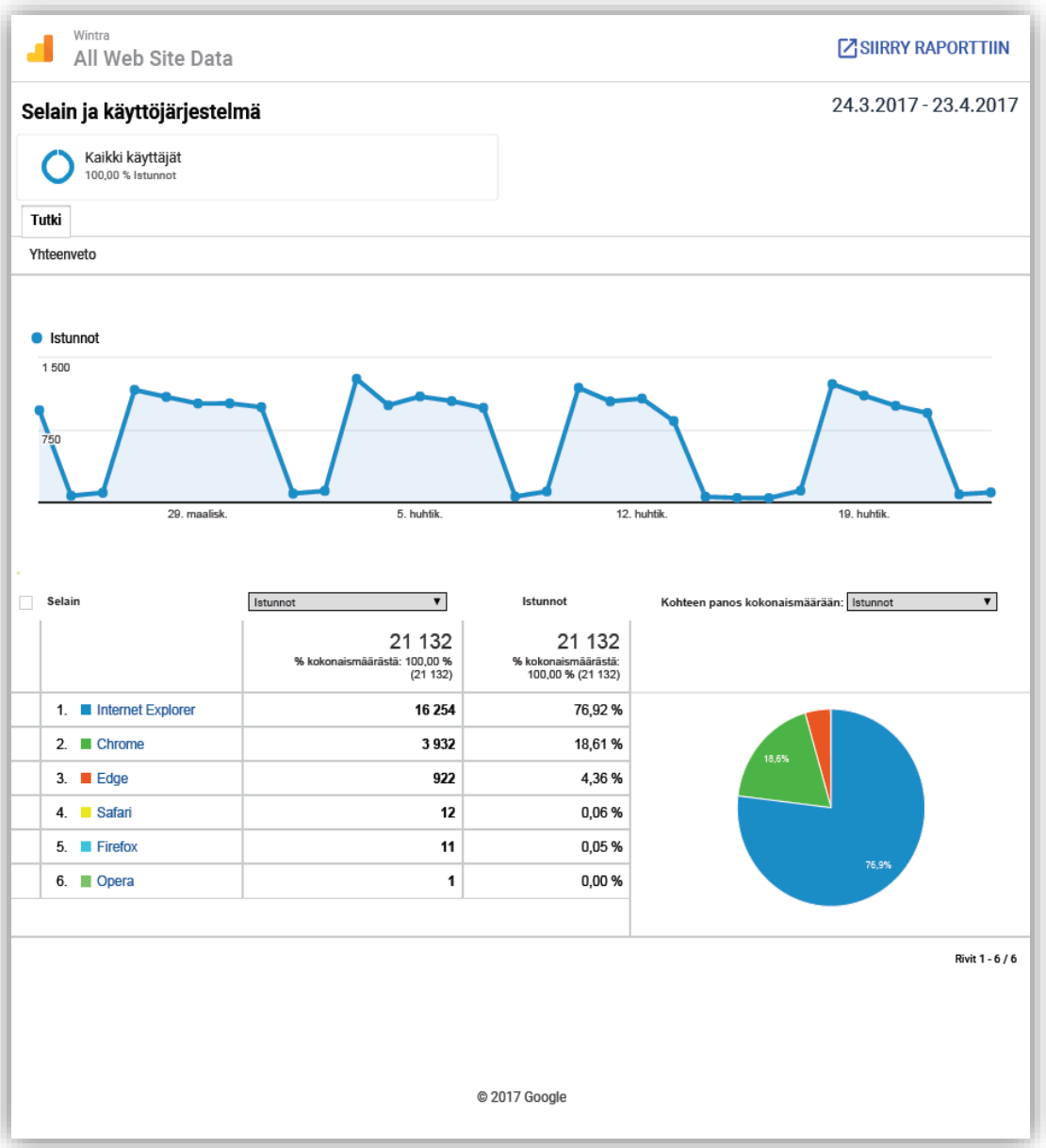
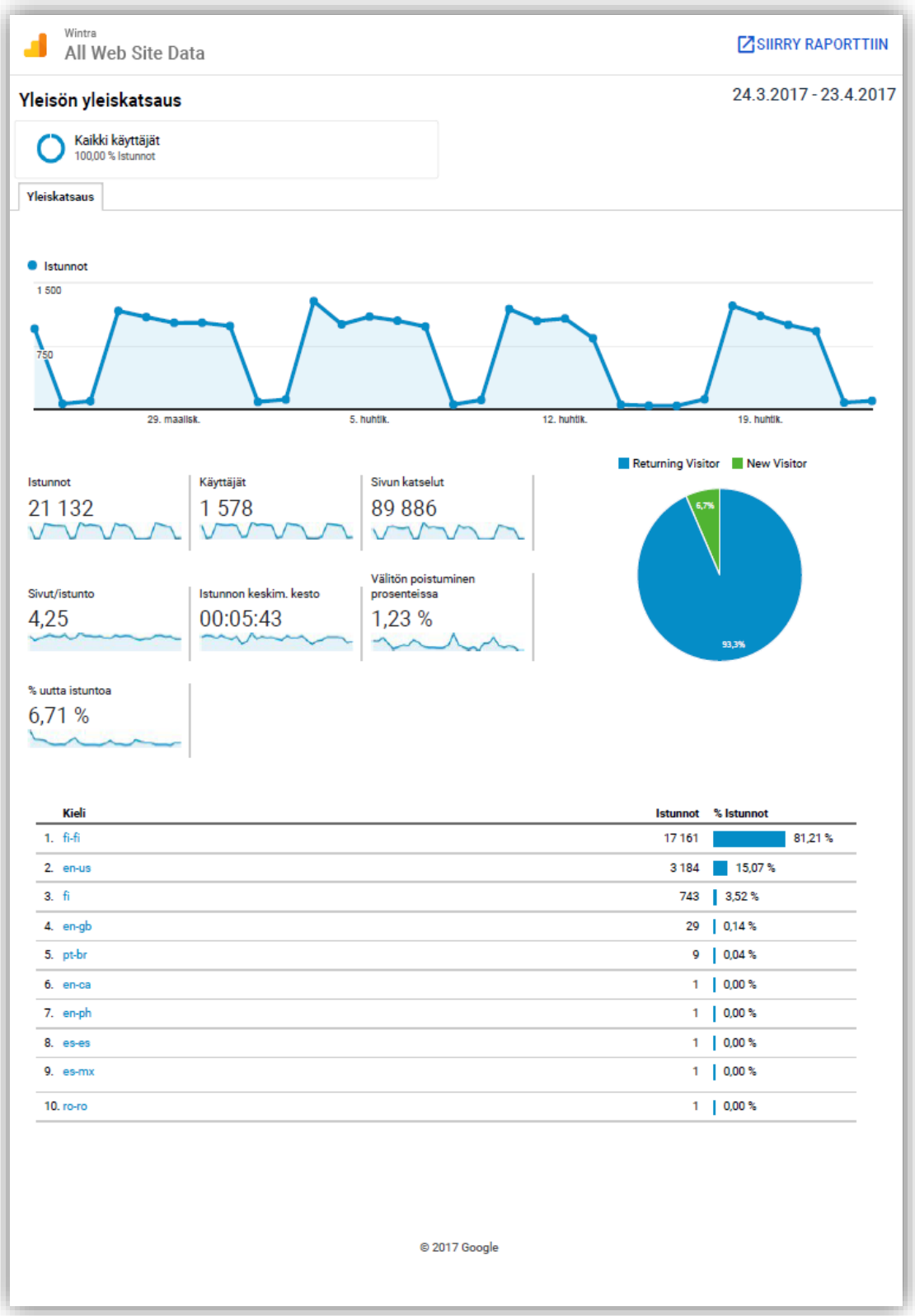
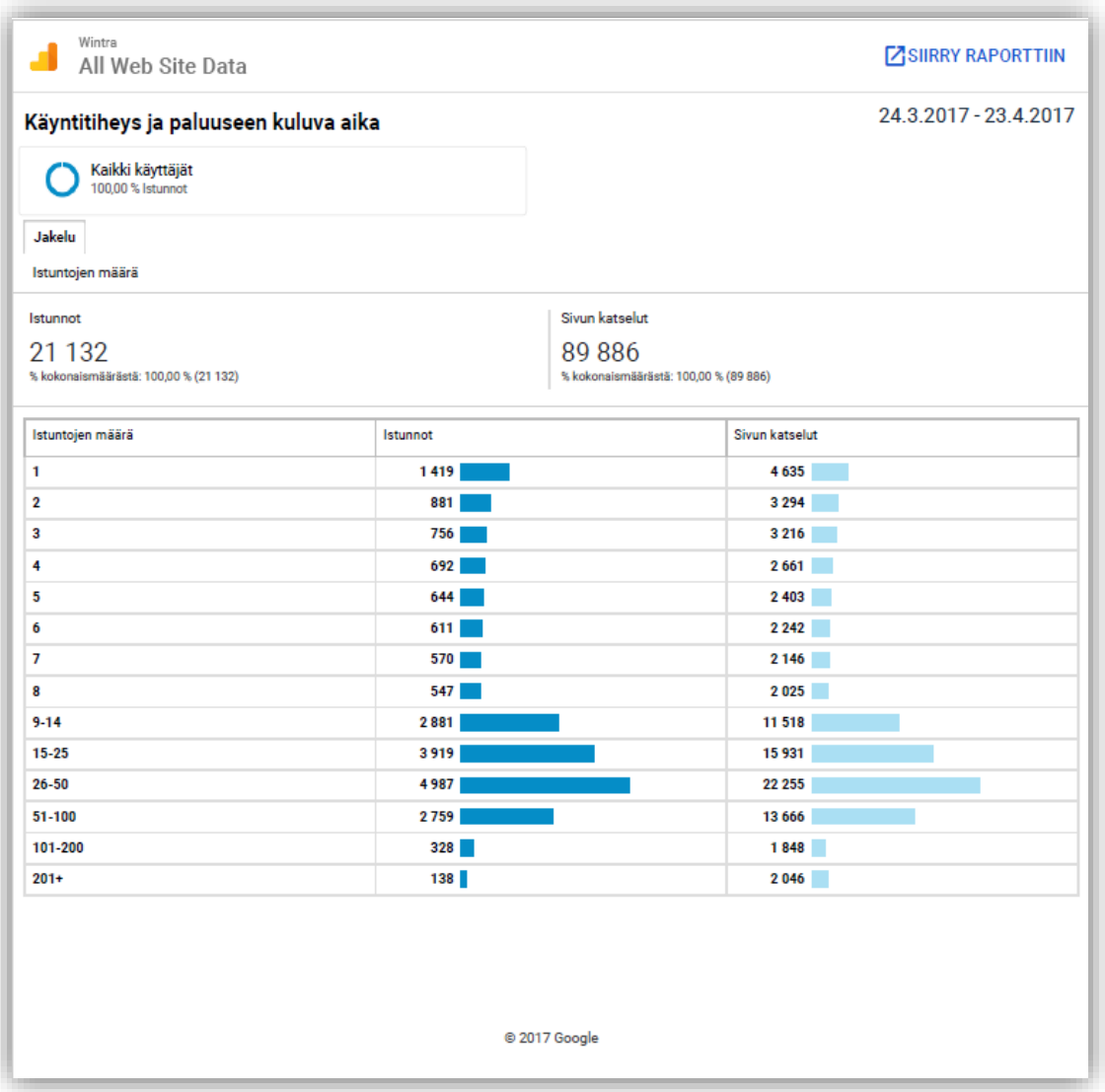


Figure A-I-2: List of participants invited for the training session 20.02.2017


Wintra
All Web Site Data
SIIRRY RAPORTTIIN
Yleisön yleiskatsaus
24.3.2017 - 23.4.2017
Kaikki käyttäjät
100,00 % Istunnot
Yleiskatsaus
Istunnot
1 500
750
29. maalisk.
5. huhtik.
12. huhtik.
19. huhtik.
Istunnot
21 132
Käyttäjät
1 578
Sivun katselut
89 886
Sivut/istunto
4,25
Istunnon keskim. kesto
00:05:43
Välitön poistuminen prosenteissa
1,23 %
% uutta istuntoa
6,71 %
Returning Visitor
New Visitor
6,7%
93,3%
Kieli
Istunnot
% Istunnot
1. fi-fi 17 161 81,21 %
2. en-us 3 184 15,07 %
3. fi 743 3,52 %
4. en-gb 29 0,14 %
5. pt-br 9 0,04 %
6. en-ca 1 0,00 %
7. en-ph 1 0,00 %
8. es-es 1 0,00 %
9. es-mx 1 0,00 %
10. ro-ro 1 0,00 %
© 2017 Google



Wintra
All Web Site Data

SIIRRY RAPORTTIIN

Käyntitiheys ja paluuseen kuluva aika

24.3.2017 - 23.4.2017

Kaikki käyttäjät
100,00 % Istunnot

Jakelu

Istuntojen määrä

Istunnot	Sivun katselut
21 132	89 886
% kokonaismäärästä: 100,00 % (21 132)	% kokonaismäärästä: 100,00 % (89 886)

Istuntojen määrä	Istunnot	Sivun katselut
1	1 419	4 635
2	881	3 294
3	756	3 216
4	692	2 661
5	644	2 403
6	611	2 242
7	570	2 146
8	547	2 025
9-14	2 881	11 518
15-25	3 919	15 931
26-50	4 987	22 255
51-100	2 759	13 666
101-200	328	1 848
201+	138	2 046

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Wintra
All Web Site Data

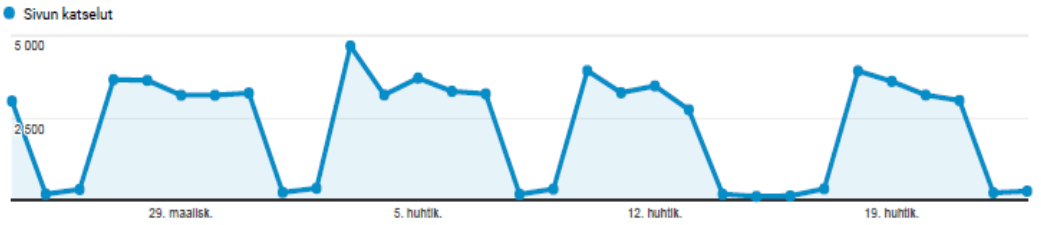
SIIRRY RAPORTTIIN

Sivut

24.3.2017 - 23.4.2017

Kaikki käyttäjät
100,00 % Sivun katselut

Navigointiyhteenveto



Ryhmittele sivut: Ryhmittelemätön Nykyinen valinta: / Näytettävät rivit: 100

Saapumiset 24.3.2017 - 23.4.2017: 29,34 %

Poistumiset 24.3.2017 - 23.4.2017: 27,56 %

Edelliset sivut 24.3.2017 - 23.4.2017: 70,66 %

Seuraavat sivut 24.3.2017 - 23.4.2017: 72,44 %

Edellisen sivun reitti	Sivun katselut	% Sivun katselut
/toimitilat/ravintola-ruokalista	312	9,31 %
/ajankohtaista/fcg-tiedotteet/henkiloston-tiedotustilaisuuden-materiaalit	110	3,28 %
/ajankohtaista/vapaa-ajan-toiminta/viking-linen-henkilokuntaedut-vapaa-ajan-matkoille-0	96	2,87 %
/ajankohtaista	85	2,54 %
/liiketoiminta/fcg-suunnittelu-ja-tekniikka/fcg-mukana-fingridin-vuoden-2017-hyva-yva	84	2,51 %
/ajankohtaista/fcg-tiedotteet/sten-referenssit-paivitetty-nettisivuille-akklle-leffalippuja	76	2,27 %
/liiketoiminta/fcg-suunnittelu-ja-tekniikka/liito-oravaa-etsimassa	70	2,09 %
/konserni-tutuksi/avoimet-tyopaikat/fcg-suunnittelu-ja-tekniikka-hakee-suunnittelijoita-ja	69	2,06 %
/ajankohtaista/uudet-tyontekijat	67	2,00 %
/ajankohtaista/ict-tiedotteet/varovaisuutta-tuntemattomasta-numerosta-tulevista-puheluista	65	1,94 %
/ajankohtaista/fcg-tiedotteet/fcg-vahvistaa-asemaansa-sosiaali-ja-terveydenhuollon-johtamisen	63	1,88 %
/sten-inreo-klinikka-starttaa-ilmoittaudu-mukaan-koulutukseen	53	1,58 %
/ajankohtaista/fcg-tiedotteet/aluetoimipaikat-ohje-tiedotustilaisuuden-nauhoittamiseen	49	1,46 %
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/liiketoiminta/fcg-suunnittelu-ja-tekniikka/fcg-has-won-uzbekistan-district-heating-energy	47	1,40 %
/ajankohtaista/fcg-tiedotteet/hankintalaki-uudistui-112017-osallistu-koulutukseen-fcg-talolla-114	46	1,37 %

Seuraavan sivun reitti	Sivun katselut	% Sivun katselut
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/ajankohtaista/fcg-tiedotteet/henkiloston-tiedotustilaisuuden-materiaalit	195	4,27 %
/ajankohtaista/vapaa-ajan-toiminta/viking-linen-henkilokuntaedut-vapaa-ajan-matkoille-0	125	2,73 %
/konserni-tutuksi/avoimet-tyopaikat/fcg-suunnittelu-ja-tekniikka-hakee-suunnittelijoita-ja	122	2,67 %
/konserni-tutuksi/henkilostohakemisto	116	2,54 %
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/liiketoiminta/fcg-konsultointi/nimikilpailu-julistettu-hjr-tarvitsee-uuden-nimen	73	1,60 %
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/ajankohtaista/fcg-tiedotteet/terveystalo-ja-diacor-yhdistyvat	44	1,31 %
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Appendix – III: Platform Comparison

1. Basic features

	Drupal	WordPress	MODX	SharePoint
Open Source	Yes	Yes	Yes	Closed Source
Platform Independent	Yes	Yes	Yes	Windows only
Technology	PHP & MySQL	PHP & MySQL	PHP & MySQL	C# & MSSQL
Application Server	Apache			IIS / .Net
Web Server	Any	Any	Any	IIS

2. Setup and Site management

Drupal	WordPress	MODX	SharePoint
• Advanced programming skills needed to install, configure or customize. • Multi-lingual sites can be easily deployed. • Steep Learning Curve. • Database is upgradable and the code is not. • Upgrading from versions are more intensive and usually revolve around a re-design.	• Very easy to develop & deploy. • WordPress has an amazing theme market for do-it yourselfers. • Limited content management capabilities. • Even though WordPress is infinitely customizable, most WordPress installations still look like WordPress installations.	• Advanced programming skills needed to install, configure or customize.	• Advanced skills needed to install, configure or customize. • Multi-lingual supported. • The code is upgradable but the database requires an upgrade which is done seamlessly in the background.

3. Developer-friendly features

Drupal	WordPress	MODX	SharePoint
• Rich and diverse theming. • Very powerful and flexible responsive experience. • Very minimal limits in terms of future scalability and integration with additional systems. • Good community support on drupal.org, stackexchange and other websites. • Lots of video trainings available.	• Poster-child of the open-source developer community, which has developed hundreds of thousands of plugins for it. • UI is easy to use and highly intuitive, even for first-time bloggers. • Strong SEO Capabilities. • Easy customization. • Flexibility.	• Absolute control over your CMS. • This CMS is built to be customized.	• Substantial developer resources, yet, responsive is difficult to accomplish. • Taxonomy and managed metadata for SEO. • Highly scalable across internal enterprise environments. • Developer friendly. • Enterprise friendly. • Community support and video training available.

4. Performance

	Drupal	WordPress	MODX	SharePoint
Page load times	Default caching features are very robust	Caching plugins available	Enabled by default	Enabled by default
Database Replication	Built-in	Free Add-on	Built-in	Built-in
Static Content Export	No	Free Add-on	Yes	No

5. Security

Drupal	WordPress	MODX	SharePoint
• Drupal architecture is secure and security updates are timely. • Enterprise level security and site scale. • Numerous government websites are built with Drupal, with the most famous being Whitehouse.gov.	• hackers can target a vulnerability inside a plugin and wipe out hundreds of thousands of sites. • There's some street cred. behind the damage that can be done to the WordPress ecosystem.	• Less security issues than WordPress.	• Very high enterprise level security. • Complex level of access rights administration.

6. Adaptibility and integration

Drupal	WordPress	MODX	SharePoint
• Supports multiple site stakeholders. • Robust features for app and API Development for complex projects. • Admin experience for content editors. • Because of its enterprise-first roots, most good Plugins/modules are not free. • 3rd party integration is very easy and APIs are well documented. • Stable and built-in version control.	• Advanced Custom Fields module for admin experience for content editors. • Often incompatible with older plugins. • 3rd party API integration is easy.	• Third party plugins are not widely developed yet.	• Supports multiple site stakeholders. • Multi-level admin and user group and user access management. • 3rd party API integration is easy. • Stable and built-in version control.

7. Dev. community and comm. support

Drupal	WordPress	MODX	SharePoint
• Huge developer community. • Plenty of free library and resources. • Commercial supports also available.	• Very large developer community. • Plenty of free library and resources. • Commercial supports also available.	• Limited developer community. • Commercial support lacking.	• Large developer community. • Limited free library and resources. • Commercial supports available highly.

8. Responsive and mobile development

Drupal	WordPress	MODX	SharePoint
• Responsive Design and Development plugins. • does not have a native app, but Drupal 8's admin is responsive and executes a solid mobile first strategy.	• Responsive Design and Development plugins. • Has native mobile app for updating blog in real time.	• No such special plugins/features	• No such special plugins/features

9. Best suitable for:

Drupal	WordPress	MODX	SharePoint
• Both small and large web sites and applications with complex features and 3rd party integration. • Responsive and mobile applications.	• General marketing web sites and blogs (especially for small or medium sites) with minimal content type. • Responsive and mobile applications.	• Large websites with integrated blog and varied features.	• Large and secured enterprise applications. • Internal document management and sharing. • Business intelligence and reporting.

Appendix – IV: Wintra Project Planning Document

FCG

FCG Intra – ideoita toteutuksesta

Welat Nehri

FCG Intran toteutus

- Lähtökohta: Vaatimuslistaus 08.05.2015 (162 kohdetta)
- Fokus: vuorovaikutteinen ja viestinnällinen intranet
  - Työnimi: Wintra
- Rajaus: ERP / CRM / HR –toiminnallisuudet sekä dokumenttienhallinta ja prosessienhallinta jätetään pois
  - Ainakin alkuvaiheessa
- Ketterä toteutusmalli
  - Priorisointi, ositus ja aikataulutus sovitaan yhdessä
- Julkaisujärjestelmä: Drupal
  - Valmiiden komponenttien käyttö aina, kun mahdollista
  - Valmiin teeman käyttö mahdollisuuksien mukaan
  - Responsiivinen toteutus
- Sisältö uuteen ympäristöön tuotetaan manuaalisesti
- Eksaitti.fi työtilakäyttöön?

FCG

Wintran vaiheistus

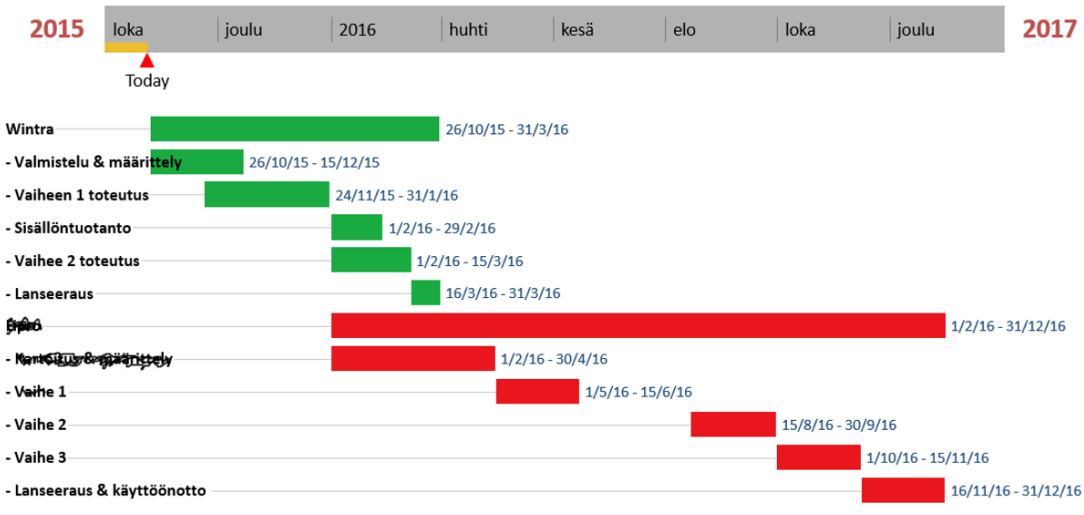
Tavoitteet
- Fokus & rajaus
- Priorisointi ja aikataulutus

Tekniset valinnat
- Teknisesti ja visuaalisesti toimivan teeman hankinta
- Soveltuvien moduulien kartoitus ja hankinta

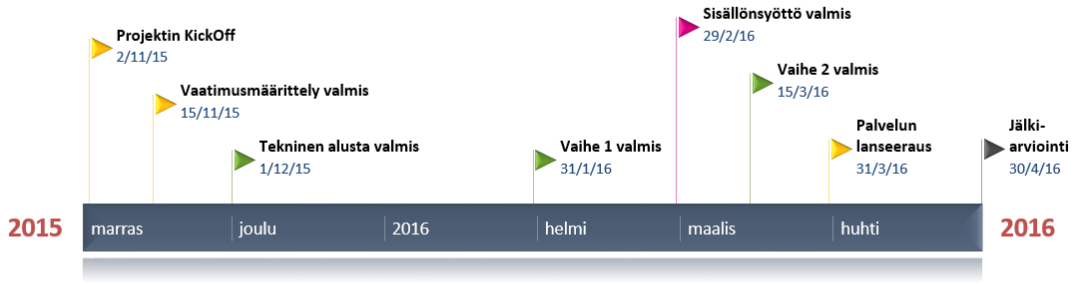
Toteutus
- Viestinnällinen mukautus (logo & tyylit)
- Toiminnallisuuksien sovitus & koodaus

Käyttöönotto
- Sisällön syöttö ja sovitus
- Jatkokehitysideoiden keräys ja projektointi

Wintran ja Lipron kokonaisaikataulu



Wintran vaiheistus



Tavoitteet
- Fokus & rajaus
- Priorisointi ja aikataulutus

Tekniset valinnat
- Teknisesti ja visuaalisesti toimivan teeman hankinta
- Soveltuvien moduulien kartoitus ja hankinta

Toteutus
- Viestinnällinen mukautus (logo & tyylit)
- Toiminnallisuuksien sovitus & koodaus

Käyttöönotto
- Sisällön syöttö ja sovitus
- Jatkokehitysideoiden keräys ja projektointi

FCG