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Feasibility of a Search Engine Based Financial Planning Service

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ABSTRACT OF THE
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In today's highly competitive financial industry it has become ever so important for companies to obtain and attract customer base. In this respect, Nordea is also looking to improve their customer service portfolio. This thesis focuses on the implementation of a new service, financial planning service. In more detail, this thesis aims to provide an answer on the feasibility of implementing financial planning service exploiting FAST Enterprise Search Platform.

The study was conducted by first identifying the requirements of the financial planning service. After the requirements were identified, the study proposed two different technical solutions, one based on the usage of FAST ESP and another one exploiting traditional relational databases, which are able to produce the desired service. These technical solutions were compared qualitatively and quantitatively to each other in order to evaluate the feasibility of the solution based on FAST ESP.

Based on the comparison, this thesis concludes that implementing financial planning service utilizing FAST ESP is not feasible. Qualitatively the technical solution based on FAST ESP offers better features. However, the costs of implementing the technical solution exploiting FAST ESP are far too large compared to the gained benefits over the technical solution utilizing databases.

Keywords: Search engine, assessing feasibility, financial planning

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Asiakkuuksien hankinnan ja ylläpitämisen tärkeys finassialan yrityksille on viime aikoina korostunut alan kilpailun kiristyessä. Tästä johtuen myös Nordea pyrkii jatkuvasti parantamaan ja laajentamaan asiakkaileen tarjoamia palveluita. Tämä diplomityö keskittyy uuden henkilökohtaisen taloudenhallinnan palvelun kehittämiseen. Työ pyrkii vastaamaan kysymykseen soveltuuko FAST Enterprise Search Platform hakukonealusta henkilökohtaisen taloudenhallinnan palvelun tuottamiseen.

Tutkimus aloitettiin keräämällä henkilökohtaisen taloudenhallinnan palvelun vaatimukset ja määritykset. Tämän jälkeen tutkimuksessa suunniteltiin kaksi teknistä ratkaisua, jotka pystyvät täyttämään palvelulle asetetut vaatimukset. Toinen ratkaisuista hyödyntää FAST ESP:tä, toinen puolestaan on perinteisempi relaatiotietokantoihin perustuva ratkaisu. Teknisiä ratkaisuja arvioitiin niin laadullisesti kuin määrällisestikin, jotta tutkimus pystyi vastaamaan FAST ESP:n soveltuvuuteen palvelun tuottamiseen.

Tämän diplomityön johtopäätös on, että FAST ESP ei sovellu henkilökohtaisen taloudenhallinnan palvelun tuottamiseen. Vaikkakin laadullisesti FAST ESP tarjoaa joitakin etuja verrattuna tietokantoja hyödyntävään ratkaisuun, FAST ESP:tä hyödyntävän ratkaisun kehittämiskustannukset ovat merkittävästi liian suuret.

Avainsanat: Hakukone, soveltuvuuden arviointi, henkilökohtainen taloudenhallinta

Preface

This thesis was performed for Nordea. For this reason, I would like to thank Nordea for providing me with the possibility to do the thesis study in my current place of work.

I would also like to express my gratitude to supervisor of the thesis Prof. Heikki Hämmäinen and the instructor of the thesis M.Sc (Tech) Pekka Kanerva. Thank you for your valuable comments and instructions throughout the thesis study.

In addition, I would like to thank my colleague Peitsa Hynninen for all his help and valuable academic views regarding my thesis. Thanks also to all my other colleagues who have taken part in the thesis in one way or another.

Espoo, 11.04.2011

Anssi Salohalla

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Background and Motivation

The turmoil on financial industry today has made it difficult for companies and organizations to survive in troubled market environment. Recently, we have seen both financial companies as well as national economies being faced with severe economical problems. Due to the situation, it has become ever so important for the companies to be able strengthen their position in the market in order to survive through the difficult times. Smith [1] analyzes the current situation from the Internet retail banking point of view. He emphasizes the importance of the Internet banking services and continues by listing differentiating from the competitors to possibly be the best tactic in the competition. By building services that are unique within the industry, company can possibly obtain new customer base or at least hold on to the existing customers. On the other hand, Niedermeyer [2] examined the importance of banks' secure sites, such as net bank, as a channel for sales. She proposes five different reasons to emphasize selling potential within secure sites. Most customers go straight to the secure site of the bank instead of browsing through the open pages. Consequently, the secure site is the most visited customer contact point. Furthermore, the customers using the online banking services are also more prone to buy new services. In addition, selling new services to existing customers is easier and, as the customers are identified on the secure sites, offers can be individualized. In this respect, increasing the service portfolio within the net bank may increase the amount of visits from customers, thus increasing the sales opportunities.

In recent years, the amount of information stored in electronic format has exploded. Most visibly this can be seen in the growth of the Internet. In addition to the growth of data in the Internet, the amount of stored data in organizations and companies has also grown rapidly. As a result, the amount of gathered data have become so great that organizations and companies are often facing problems in getting efficient use of it. Nordea Bank (the owner of the study) also stores large amounts of data on their customers and their financial behavior. However, today the use of this data is very limited.

Due to matters described above, Nordea is constantly aiming to develop new and better services for their customers. The purpose of this thesis is to research how the customer related data could be utilized better to meet the customer needs. The focus is on the detailed customer transaction data which is stored in the back end systems of Nordea. By exploiting this data, Nordea aims to offer a financial planning service for the customers. This service should enable customers to see where they have spent their money within selected time period. The information should be displayed in both graphical as well as in written format. However, the currently available transaction data lacks some of the necessary information to offer the desired service, thus the data

requires enrichment. Moreover, neither this enrichment of data, nor the searches to the data, can be performed to the back end systems to ensure the performance of the data collection. Performance of the financial planning service is equally important.

One possible solution to the problem is to utilize search engine technology (FAST Enterprise Search Platform) to offer the desired service. This thesis focuses on investigating the feasibility of this solution.

1.2 Research Problem

The main purpose of this thesis is to study whether it is feasible to implement financial planning service by exploiting the proposed technical solution, FAST ESP. Therefore, the research problem of the thesis can be summarized in to question:

- Is it feasible to utilize FAST ESP to provide desired financial planning service to net bank customers?

In order to provide a thorough answer to the question above, the financial planning service need to be specified in more detail. As a result, the thesis should also answer to following secondary research question:

- What is the financial planning service like?

Further divided into specific questions:

  - What features should the Nordea financial planning service offer?
  - What are the requirements for the Nordea financial planning service?

Furthermore, the technical capability of FAST ESP for providing the financial planning service need to evaluated. More specifically, the thesis should also answer following secondary research question:

- What technical requirements do the features of the financial planning service produce?

Further divided into specific questions:

  - Can the desired features be offered by utilizing FAST ESP?
  - What is the technical setup exploiting FAST ESP like?
  - How does implementing the service using FAST ESP compare qualitatively and quantitatively to implementing the service with a solution based on relational databases?

1.3 Scope of the Thesis

The scope of the thesis is to provide an answer to the study question by using the research methods described in the next chapter. In addition, the thesis provides a definition of the Nordea financial planning service in the form of a use case model and use case descriptions as well as a technical description in general level. The thesis scope does not include an actual implementation or any testing of the service. Furthermore, the analysis and the evaluation of all possible future opportunities of using FAST ESP within net bank for other services is excluded. In addition, the thesis study focuses only on utilizing FAST ESP for the purposes of the financial planning service. Therefore, the found results do not necessary apply outside of this case.

This thesis aims to act as a prestudy for implementing the Nordea financial planning service. The findings from the prestudy can be used as a basis for the decision making on whether to continue work regarding the service.

1.4 Research Methods

This thesis utilizes the case study research strategy. Yin [3] list five especially important components in the case study research design. The components are the study questions and propositions, the analysis units of the study, linking the data to the propositions and the criteria for interpreting the findings.

The study questions and propositions were already presented in chapter 1.2 describing the research problem. Three separate analysis units were identified for the study. The first unit is the financial planning service and its definition and features. The second analysis unit of the study was the two alternative technical solutions for producing the financial planning service. The third analysis unit of the study was the feasibility of the technical solution utilizing FAST ESP.

The data collection for the first analysis unit of the study was started by analyzing existing services similar to the financial planning service. The purpose was to examine these similar services from three different point of views. First, investigate what types of features the services offer. Second, analyze the functionality of the service from the customer's point of view, in other words, examining the use cases of the services. Third, canvas the look and feel of the services. This research method included three subjects, Balancion service, The Frank Bank concept net bank and the service provided by Ålandsbanken. Balancion was included in the analysis due to its reputation of being one of the best solutions available managing personal finance in the Finnish market at the moment. The service provided by Ålandsbanken represents a service already provided by a competitor of Nordea and The Frank Bank provided a point of view from the future net bank. Each of the analyzed subjects offers a somewhat different service. In addition to the analysis of the existing services, a review of related literature was performed. The related studies were collected by utilizing Google Scholar search engine. Finally, the

findings from the analysis of the existing services and literature review were compiled as a presentation.

The second part of the data collection for the first study unit was performed by organizing a stakeholder interview. The presentation created from the analysis of the existing similar services and the literature review acted as a basis for the stakeholder interview. This method aimed to gather all feedback for the financial planning service from the stakeholders. The stakeholders in the interview included business and IT representatives. As a result of the stakeholder interview, the requirements for the financial service were collected and documented and further processed to description of the service. As the stakeholder interview is perhaps the most important part of the research, it is described in more detail in chapter 4.

The description of the financial planning service was the collected data for the second analysis unit of the study. Based on the data, a technical analysis was conducted on implementing the desired Nordea service. The analysis included evaluating the existing database containing the account transactions and examining how to use the existing data in the database to provide the Nordea financial planning service based on the researcher's knowledge on the environment and the available tools. Two alternative technical approaches were presented as a result. The technical solution A is utilizing the FAST ESP, whereas the technical solution B is based on more traditional and familiar approach. The technical architecture of the solution B was selected in order to provide a good comparison point for the solution A. The technical solutions were secured in an informal discussion with IT architectural expert.

The data collection for the third analysis unit of the study was conducted in three phases. First, the qualitative analysis was performed by the researcher by comparing the technical solutions on how well the solutions met the requirements set for the financial planning service. Second, another stakeholder interview was held in order to gather the work amount estimations from the experts in the respective technical area. The work amount estimation interview is also described in more detail in chapter 4. Based on the work amount estimation a quantitative comparison was performed by the researcher. Finally based on the comparisons, the thesis was able to answer to the research problem.

No criteria for evaluating the quality of the collected data and the interpretation of the data was set nor evaluation performed after each analysis unit, but rather the quality of the whole research was evaluated by using the criteria presented by Yin; the four criteria are construct validity, internal validity, external validity and reliability [3].

1.5 Structure of the Thesis

The thesis is structured as follows. Chapter 2 contains a view to related services and literature around the research area of the thesis. It includes a review of existing services which are similar to Nordea financial planning service. In addition, it contains a review of some existing similar studies and technical solutions.

Chapter 3 introduces the current situation at Nordea. First, Nordea is briefly introduced as company in general. After this, the currently offered service is presented as well as available technical solutions and applications for providing the desired Nordea service.

Chapter 4 describes the stakeholder interview research method in detailed level.

Chapter 5 describes the suggested specifications for the service. It contains the use case model and the use case descriptions as well as the technical descriptions of the both alternative solutions.

Chapter 6 contains the solution comparison. In this chapter both technical solutions are reviewed based on their qualitative and quantitative features.

Finally, chapter 7 includes the conclusion of the thesis. It contains the results of the thesis, analysis of the results and research and views on possible future work.

2 Related Services and Literature

2.1 Review of Existing Similar Services

This chapter reviews three selected existing services similar to the Nordea financial planning service. The three selected existing services include Balancion, The Frank Bank and the service provided by Ålandsbanken. The information management, displaying of the information and the usage for the service is analyzed for each of these services individually.

2.1.1 Balancion

Balancion is a comprehensive web based service for managing, planning and monitoring personal finance [4]. It offers wider range of features than Nordea financial planning service will support. For this reason, the analysis focuses on the features of Balancion similar to the Nordea financial planning service. These features mainly include categorizing the account transactions and displaying the income and expenditure of the customer.

The customer's financial information is fetched to the Balancion service from customer's net bank. The service supports most net banks available in Finland. In addition, the information can be fetched from the Finnish credit card companies. The service offers an automatic categorizing for the transactions. However, based on the usage of this service during the study, the automatic categorizing seems to be inadequate in some situations. In addition to the automatic categorization, customer can manually add category to a transaction or change the automatically given categorization. The manually added category must be selected from predefined categories. When manually adding the category, the customer can choose to use the selected category to other similar transactions. Figure 1. depicts the process of adding category to transaction. Customer is not able to create own categories in the service. However, the predefined categories are abundant and should cover most transaction types. The categories also include different levels, for example, the higher level category can be health care and the more detailed category under it, dentist or drug expenses. Transactions can be categorized in either higher or in more detailed level. In addition to the category, customer can add personal tag for a transaction.

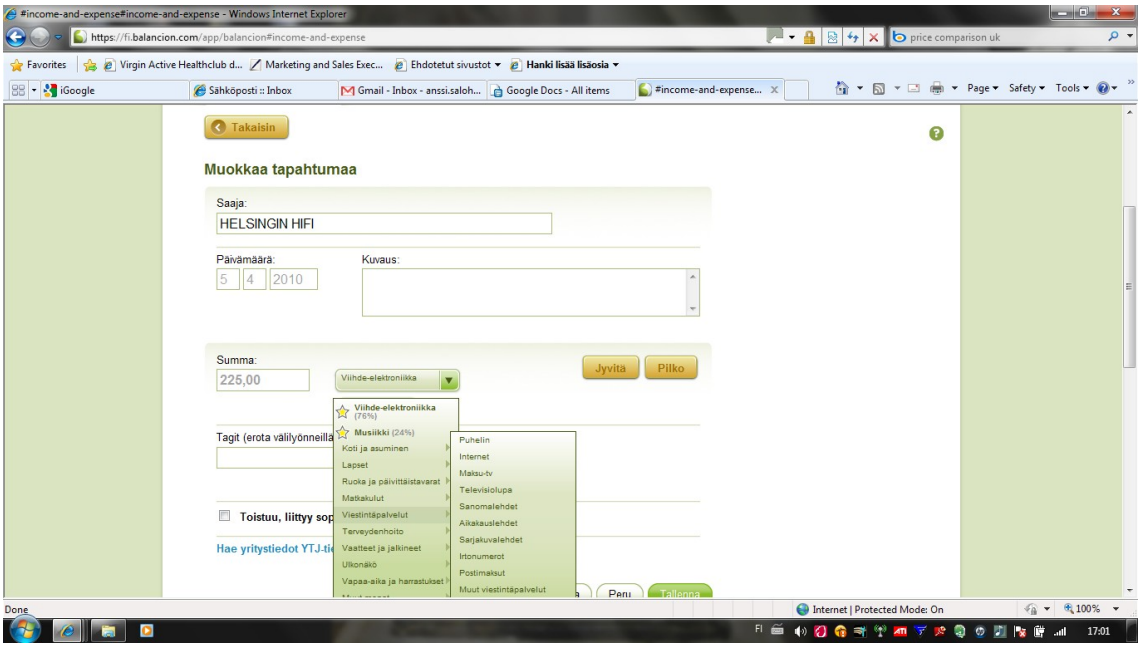

Figure 1: Adding categorization in the Balancion service [4]

The service offers many different types of graphs and statistics for the customer to utilize. The summary tab, displayed in figure 2, shows the overall situation of the income and the expenditure. The income and expenditure tab offers more detailed chart and statistics of the customer's income and expenses. This feature is shown in figure 3. The displayed information is offered on higher category level as well as in more detailed level within one higher category level. In practice, the customer is able to see, for example, how the expenditure is divided and, if he wishes to view how the expenditure is divided within a particular category, similar charts and statistics are offered on the more detailed level as well. The service also offers similar graphical information based on the tags given to transaction by customer. Customer can also view how his income and expenditure measures to different comparison groups. The groups are based on classifications such as occupation, income, age and home county. However, the comparison feature is not offered for the tags as they are customer specific and therefore cannot be compared between customers. Finally, the service offers trend graphs of the income and expenditure.

Figure 2: Summary tab in the Balancion service [4]

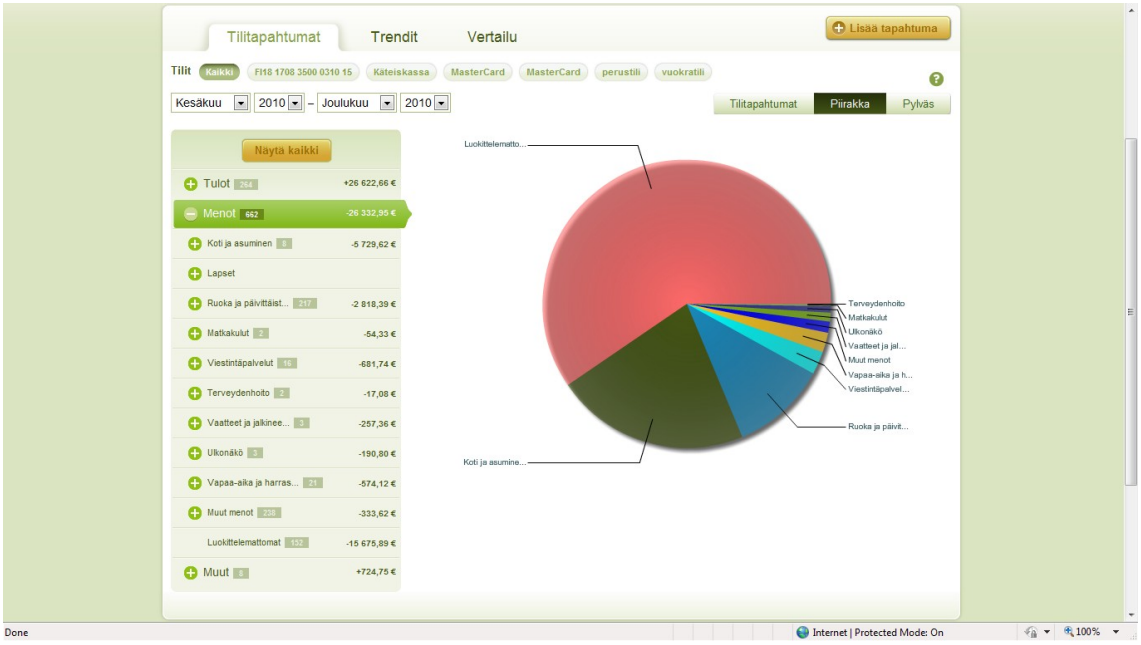

Figure 3: Income and expenses in the Balancion service [3]

Usage of the Balancion service is complex due to wide range of services. The service requires significant amount of familiarizing from the customer in order to fully exploit all the features. The large variety of services might be overwhelming to some customers. Balancion is independent service and it requires an own user account. Moreover, as the service is separate from customer's net bank or credit card system, it

requires customer to upload fresh data on every visit to keep the service up to date. Naturally, the uploads of transaction data require customer to fill in his credentials of the net bank or credit card system within Balancion service. Although Balancion service does not store the credentials in any situation, giving out the credentials for the Balancion service to use could be perceived as security threat.

2.1.2 The Frank Bank

The Frank Bank is a concept level net bank [5]. It offers all the services of a conventional net bank, but the user interface has been developed to meet the needs of a so called digital natives and The Frank Bank has taken influences from today's social media applications. As with the Balancion service, due to the wide range of features of The Frank Bank the analysis concentrates on the features similar to Nordea financial planning service.

In The Frank Bank, customer can categorize and tag the account transactions. The categories in the service are predefined and customer can not create own categories. Adding category for transactions is shown in the figure 4. The transaction category is used for displaying graphical information on the customer's expenditure. Graphical information of expenses is displayed in several locations within the net bank. On the overview tab the service offers possibility to compare customer's own expenses to reference groups. On the budget tab, shown in figure 5, the customer is able to see more detailed level graphical information on the expenses. On this tab, the charts can be drawn based on time frame, from one week up to a year. In addition, the customer can choose which accounts are included in the graphical presentation. The category information is also utilized in creating budgets. The customer can create category based budgets for a week, a month or a year.

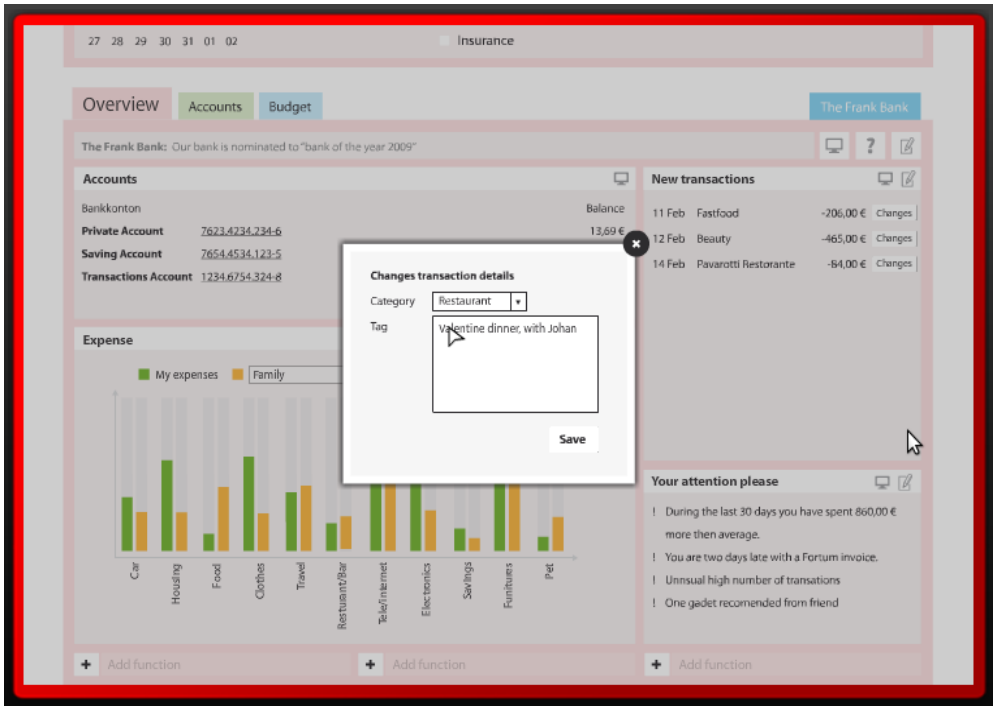

Figure 4: Adding categorization in The Frank Bank service [5]

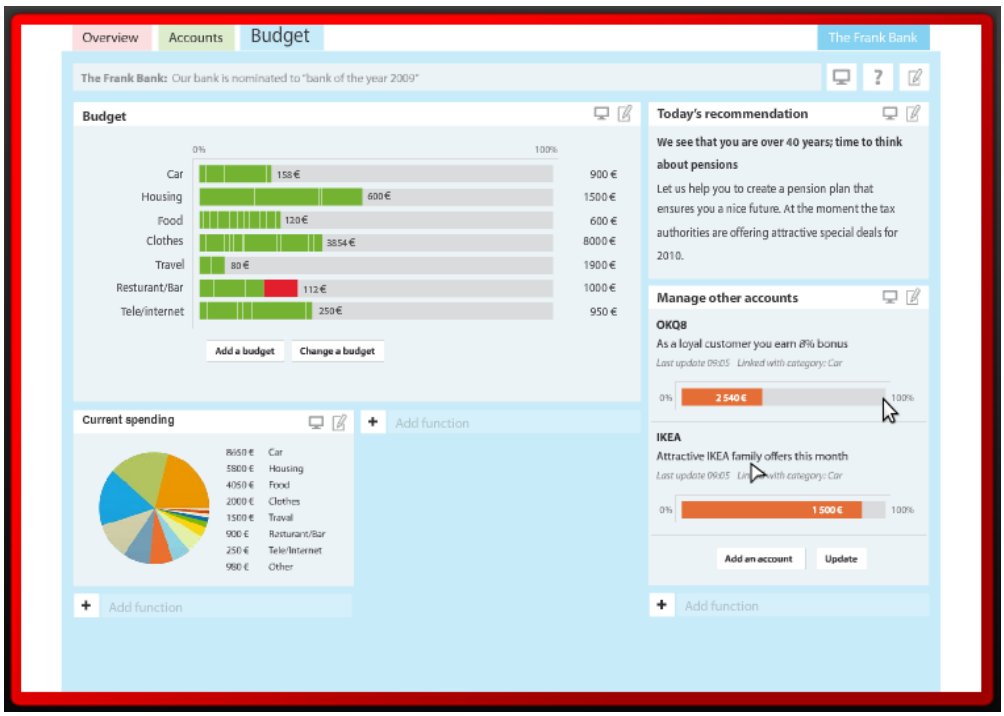

Figure 5: Budget tab in The Frank Bank service [5]

In the Frank Bank the transaction tag information acts only as a reminder to the customer. Customer can tag the transaction in order to remember what this particular transaction relates to. For example, card transaction from restaurant can be tagged as dinner with friend.

As the Frank Bank is still on concept level, the actual user experience is difficult to obtain. Nevertheless, the usage of the Frank Bank seems to be fairly straightforward. As the transaction related features are a part of the net bank, there is no need for an extra user account. Furthermore, there is no need for data uploading and the information in the service is always up to date. However, some parts of the service can be laborious. For instance, the category and the tag of the transaction need to be manually added for each transaction separately.

2.1.3 Ålandsbanken

The service Ålandsbanken offer as a part of their net bank is the most similar to the Nordea financial planning service of the three services included in the analysis of this thesis [6]. It is a simple service which features categorizing the account transactions and displays statistical and graphical information on customer's income and expenses. It does not offer any means of creating budget or other tools for planning for the future.

The account transaction information is automatically categorized on a very rough level. The automatic categories include such as card transactions, salary transactions and ATM cash withdrawals. For more detailed category, the customer needs to manually select the appropriate category for transaction. The process of categorization is displayed in figure 6. The service also offers a possibility to create personal categories. In addition, the customer can create an automatic categorization to particular type of account transactions.

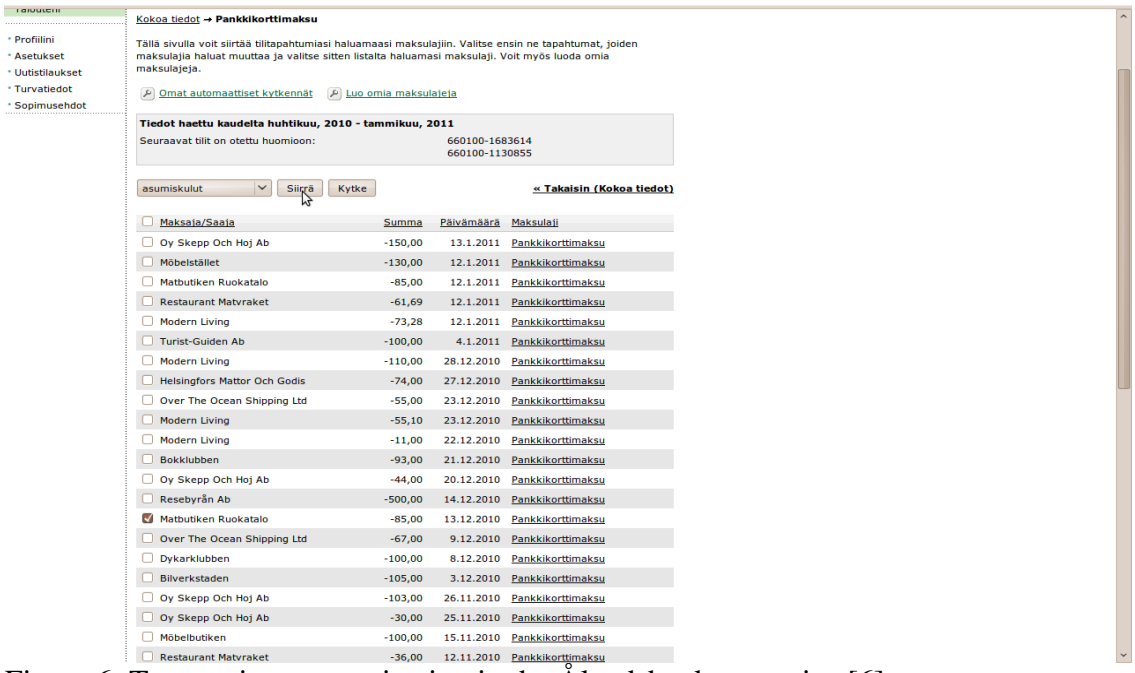

Figure 6: Transaction categorization in the Ålandsbanken service [6]

The statistical and graphical information is displayed after customer selects the accounts included in the run and the desired time period in months. The service shows summary list of both income and expenses as well as summary list of total financial balance on monthly level. In addition to the summary lists, the service displays a summary chart for income and expenses. Furthermore, a graph of total financial balance is presented. Figure 7. depicts the listed and graphical information shown in the service.

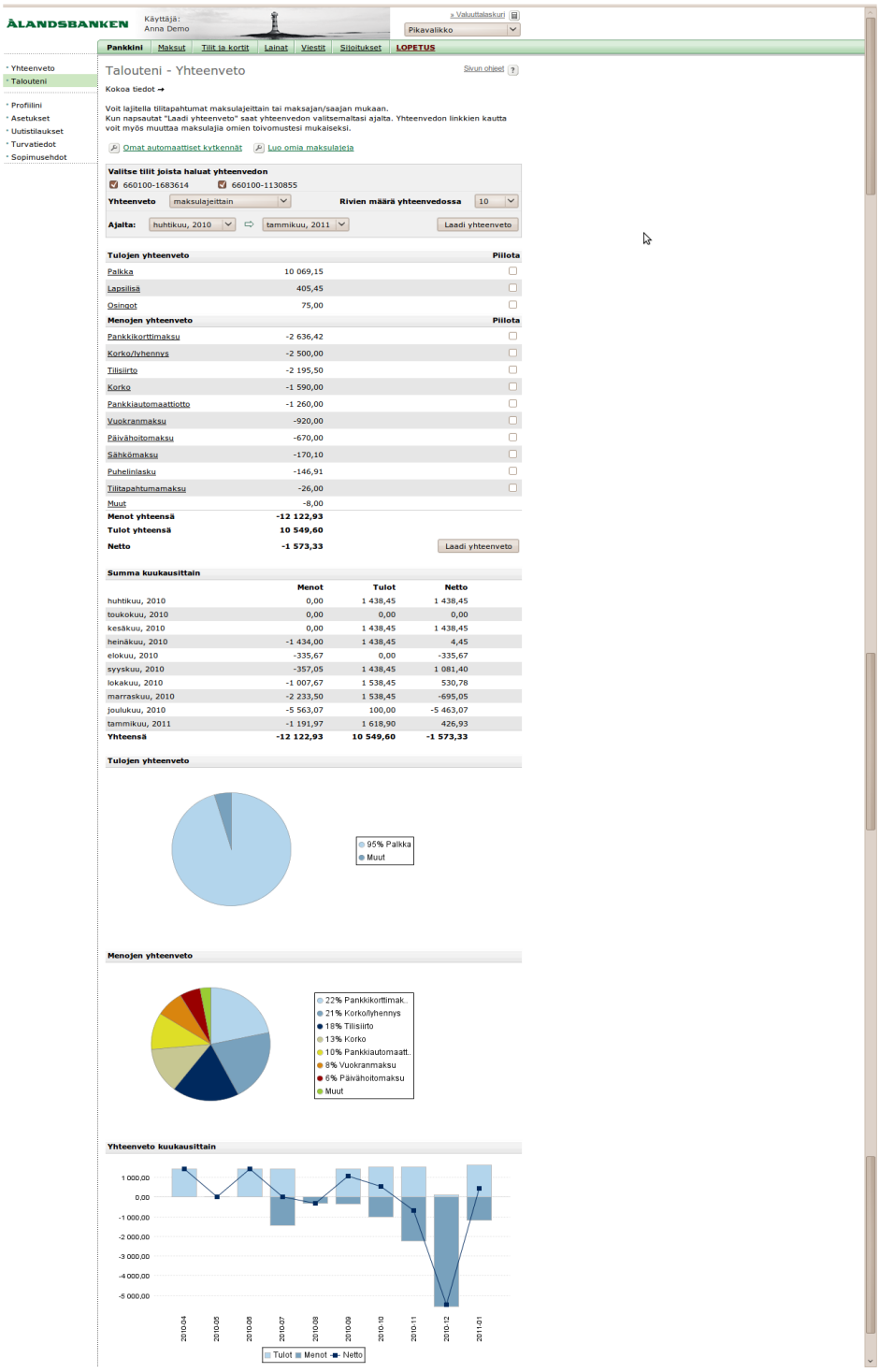

Figure 7: Information shown by the Ålandsbanken [6]

Usage of the Ålandsbanken service is easy as the service is simple and does not include complex features. Similar to The Frank Bank, the Ålandsbanken service is a part of the net bank and therefore does not require additional user account or data uploading. The whole service is offered under my finance menu point within the net bank and is not visible on the net bank front page.

2.1.4 Summary of Reviewed Existing Services

Although reviewed services differ to some extent from each other, there are some similar features which are offered in all the services. Table 1 represents features available in the three reviewed services. Whereas Balancion is a comprehensive service for all personal finance management and The Frank Bank and Ålandsbanken services are only additional tools within net banking service, they all have similarities regarding the transaction categorizing and the displayed information. All services offer a possibility for customer to manually configure category for a transaction. Balancion and Ålandsbanken services also categorize transactions automatically. All services allow customer to choose the time period from which the graphical information is shown. In addition, they also share similarities in the way the graphical information in overview and detailed level is displayed.

Table 1: Summary of features offered by the reviewed services

Feature	Balancion	The Frank Bank	Ålandsbanken
Information:			
Automatic categorization	x		x (on very rough level)
Customer based categorization	x	x	x
Category levels	x		
Selected category can be set for other similar transactions	x		x
Displayed information:			
Selection of time period for displayed information	x (monthly based)	x	x (monthly based)
Income/expenses overview	x	x	x
Detailed charts/graphs on income and expenses based on categories	x	x	x
Trend graphs	x		

Comparison to customer groups	x	x	
Budgets	x	x	
Usage:			
Service requires separate user credentials	x		
Service requires data uploads	x		

2.2 Review of Existing Similar Studies and Technical Solutions

This chapter presents some of the existing studies and technical solutions which are related to the research problem of this thesis. The reviewed topics range from importance of information and information availability to integrating traditional relational databases and search engines as well as issues regarding enterprise search solutions and evaluating cost-benefit ratio for web-based information systems.

In a journal article published in Journal of Applied Collaborative Systems, Matei addresses the importance of information to organizations [7]. He argues that a company must efficiently exploit the information it possesses not only to succeed but to survive in highly competitive market environment of today. To address this challenge, he proposes using a Business Intelligence system (from here on BI system). In the article, he uses following description from his previously published article for BI system, “an information system with an open and flexible architecture that integrate innovative technologies that are able to ensure a uniform and consistent storage of all data that are relevant for their organization and the environment it is acting in, turn data into information and knowledge, and use it judiciously use it in the decision making process, so that to conduce to gaining competitive advantages against competition” [7]. He emphasizes BI system's need to be able to gather important information from all areas of the organization as well as it's capabilities to provide a search for the user to retrieve the desired information. He continues by stating that a good BI system supports the decision making process within company by providing crucial information. Based on the information, that is accurate and provided in a timely fashion, the management can make decisions that will prove to be beneficial for the company. In regard of this thesis, one could consider FAST ESP to act as data storage for a BI system. Although in this thesis we concentrate on utilizing FAST ESP for providing one particular service, FAST ESP can fulfill the criteria for BI system. FAST ESP supports several different data sources from which the search index can be created, thus enabling usage in most areas of the organization. Naturally, it also provides tools for easy searching of information. The service described in this thesis is aimed for customer usage. However, the service and the information that has been stored in FAST ESP index, could just as well be used

to provide important information for example for sales related decision making. In addition, Matei describes the development of a BI system. He argues that a successful BI system is developed by completing several iteration cycles. In that respect, developing the service of this thesis could be considered as the first step towards a complete BI system.

Hamilton continues with the possible utilization of BI system [8]. Through studying use BI system in travel industry, he proposes how BI system can be exploited to offer better suiting traveling options to customers. In contrast to Matei's study, BI system is here utilized to the benefit of the customer. Although Hamilton's study focuses on travel industry the same advantages can be shifted to financial industry. By proper use of BI system, the bank could be able to for example highlight services suitable to customer in their particular situation.

There have been numerous studies conducted on integrating databases with information retrieval tools and search engines. Weikum et al. examined the integration of traditionally separated database systems and information retrieval methods as a resolution for ever growing need of semantic knowledge discovery [9]. The authors' approach to the subject is more on theoretical level and they address the motivation, challenges and possible solutions through few example cases.

However, several studies are performed in more practical level. Harrington et al. investigated the use of search engine to conduct queries to relational database [10]. The authors' proposed solution resolves the problem of integration by using URLs which contain the database query. However, this approach requires an extra layer of software which can translate URLs to database queries and vice versa between the search engine and the database. For this purpose Harrington et al. introduce a RDB wrapper. The RDB wrapper is utilized when search engine crawler is creating the search engine index. The search engine index is created by a search engine crawler crawling through the database and storing the URLs containing the database query for each record in the database. As a result, user can do a keyword search in search engine which returns all the URLs for the particular keyword. These URLs are then used to fetch the actual data from the database. The RDB wrapper is equally utilized for these database fetches.

In an article by Yi et al. the authors introduce a system to address the current shortcomings in keyword searches to relational databases [11]. Traditionally these searches are implemented by building a set of query templates that map keyword searches to full-text matching within one or more attributes. This solution suffers from lack of search capability and flexibility. To improve these two factors, Yi et al. propose a dedicated search engine, called SPARK, for databases. SPARK is constructed from three key components: a non-free tuple set constructor, candidate network generator and query processor. These three components can together provide the functionality of a

traditional search engine without having to create a search engine index from the original data in the database.

The studies by Weikum et al., Harrington et al. and Yi et al. presented above have one thing in common which makes them inapplicable in regard of this thesis. They all aim to avoid duplicating the information stored in the database. On the contrary, the database used as the information source in this thesis cannot be used as it is, but in fact, the information needs to be duplicated into the search engine index. This is due to that it lacks some of the information needed to provide the desired Nordea financial planning service. The required information cannot be added to straight to database to ensure performance and consistency.

Brauer et al. [12] and Fagin et al. [13] have studied on improving search result accuracy in information retrieval systems. Brauer et al. concentrate on enterprise search systems and tackle the issue by addressing the problem of identifying enterprise concepts in the searchable data. Fagin et al. concentrate on improving search results by enhancing the use of auxiliary database of search engine. Both studies focus on highly unstructured data. In contrast, the data, which this thesis focuses on, is well structured. Therefore, the methods presented in the studies for improving the search results are not applicable in the scope of this thesis.

Konopnicki et al. mainly concentrate on the Internet search engines and on the current limitations of them in their article [14]. Although the main focus of the article is not related to the subject of this thesis, the authors pose an interesting claim on the future trends in search solutions. They propose that in future the Internet search engines should be able to create their indexes from very varied information sources. The same trend will surely be seen also in corporate environment as exploiting the information possessed by company becomes increasingly important as presented by Matei in [7]. In that respect, using FAST ESP would also enable this type of usage as it already supports various data sources through content aggregators which can be developed separately for each purpose.

Hawking examines the need of enterprise search to a company and lists the most common challenges with providing an efficient enterprise search system [15]. In the article he categorizes enterprise search to include any organization with text in electronic format and the following searches: search of the organization's external website; search of the organization's internal website (Intranet) and search of other electronic text held by the organization in such forms as email, database records and documents on file shares. By identifying the needs and use scenarios of enterprise search, he presents a list of problems currently concerning the enterprise search.

- Defining an appropriate enterprise search test collection.
- Effective ranking over heterogeneous collections of characteristic of enterprises.
- Building an employee portal – A distributed information retrieval problem.
- Effective search over collections of e-mail.
- Estimating document importance for documents which are not part of the web.
- Exploiting search context within enterprise searches.
- Providing effective search over foreseeable future enterprise collections of interlinked continuous media.

As Hawking's approach to enterprise search is very general, most of the above listed challenges have no impact on the study subject of this thesis. Nevertheless, especially an adequate search test collection is also essential for the Nordea financial planning service. The service is showing very sensitive customer information and therefore it is crucial that customers can only see their own information in the service. For this reason, the test information needs to be sufficient for test runs in order to verify correct operations of the service. The other challenges presented by Hawking, are important to consider when contemplating the possible future usage of FAST ESP.

Yi et al. address the enterprise search security [16]. The authors identify user authentication and authorization and communication encryption as the most important security features for the enterprise search. Users must be authenticated in order to authorize them to see only the documents that they are allowed to see. In addition, the communication between user and system must be encrypted in order to prevent communication eavesdropping and man-in-the-middle attacks. In regards of the thesis subject, as the service is provided within net bank, both of the security features are handled by the net bank security. User must be logged in the net bank to use the service and is only able to see information there he is authorized to see. Furthermore, all communication between customer's browser and net bank system in encrypted by use of SSL and HTTPS.

In a research by Paris et al [17], the researchers have contrived a method for evaluating cost-benefit ratio of web-based information systems. In order to perform the evaluation, the researchers divide the participants of the system into four roles and then evaluate the cost-benefit ratio of each role. The four roles are:

- the information seeker,
- the information provider,
- the information intermediaries,
- the system provider.

In this thesis, the interesting roles are the information intermediaries and the system provider. As the financial planning service features from the customer's point of view and the data that the financial planning service is based on remains the same regardless of the technical solution, the cost-benefit ratio of information seeker and the information provider does not change. The evaluation criteria proposed in the study for the information intermediaries and the system provider roles is displayed in the table 2.

Table 2: Evaluation criteria for cost-benefit ratio for the information intermediaries and the system provider [17]

Role	Information Intermediaries	System Provider
Benefits	Ease of knowledge creation & content modelling	System usage Reliability Response timeliness Correctness
Costs	Time to create and intergrate the resource	Implementation cost of hardware and software System maintenance System integration

These evaluation criteria will taken in to consideration later on in the thesis when evaluating the two technical solutions.

3 Description of the Current Situation

This chapter describes the current situation in Nordea. First, Nordea is introduced as a company and some of the key facts and figures are presented. Second, the current service, Private Netbank, which Nordea offers to its private customers, is presented. In addition, this chapter shortly describes the new desired features to the current service. Finally, the currently available technical solutions and applications are introduced which could be utilized in providing the desired service.

3.1 Nordea Bank in General

Nordea operates mainly in Nordic financial market. Clients of Nordea consist of both corporate as well as private customers. Within the Nordic region, Nordea has around 10 million customers of which more than six million are also users of e-services. [18] According to statistics collected by Private Netbank organization, in Finland Nordea has over million private customers which are using net banking services actively. Monthly, approximately 8 million net bank sessions are started in Finnish Private Netbank. In these sessions over 8 million payments are made.

Nordea has a desire to offer good e-services to its customers. In this respect, Nordea is continuously looking for new services and new ways of improving the offered service portfolio. In addition, some of the competitor banks already offer similar services to their customers.

3.2 Current Service Provided by Nordea Bank

As the desired service, in which this thesis focuses on, is aimed at the private customers we only concentrate in describing the net banking services of private customers. Private net banking service, Private Netbank, offers wide range of services to users. It is web based service providing customers most of their daily banking services. Offered services can be divided in six areas: account, payment, card, loan and credit, investment and insurance related services.

In regards of this thesis, the interest lays in the account related services. The account services provide possibility for the customer to check the real time account balances. In addition, customer can order account alerts to mobile phone and electronic account statements. Most importantly, in the account services customer is able to see his/her account transactions from the last 90 weeks. This service will act as a basis for the new desired service covered in this thesis. The account transactions include all transactions within the respective account. Transactions include such as paid payments and invoices, card transactions and salary transactions. Furthermore, the service displays date, transaction type, beneficiary and amount of each transaction. Currently, there are no means for the customer to search the account transactions except for fetching account

transaction from a specific time period. Moreover, the service lacks a possibility to group transactions and to provide information on the amounts of particular type of transactions.

Due to the shortcomings described above, there is a need for a new type of service. This service should offer a possibility for the customer to group his transactions. Transaction groups should include, for example, such as insurance payments, car payments, grocery shopping, restaurant payments, traveling related payments and salary transactions. In addition, the new service should provide a possibility for the customer to visually see the ratio between the different transaction groups. In fact, the new service should be a tool for the customer to manage his financial situation. The customer should be able to quickly observe whether incoming and outgoing funds are in balance. Furthermore, the service should provide means for the customer to conclude which transaction groups consume more funds than planned.

3.3 Currently available technical solutions and applications for providing the desired service

Today, transactions displayed in Private Netbank are stored in transaction database. The database contains transactions for each account from the last 90 weeks. As described earlier, the database lacks information for providing the desired financial planning service. The service aims to display all transactions of the customer separated in transaction groups, thus providing a quick overview of the financial situation. As a result, the financial planning service demands an additional field of information in the database containing the transaction category of the transaction. However, adding the required information in the database poses two challenges. Firstly, performance issues caused by adding the additional field in the database need to be considered. Moreover, there are other restrictions that limit the possibilities of performing changes on the data.

Currently, the transaction database contains account transactions of all Nordea customer accounts. Consequently, the database is very large. Adding additional information for each transaction in database would increase the size of the database even further. Moreover, additional information in database would make the queries to the data more complex, thus having negative influence on the performance. The current transaction service in the Private Netbank fetches the data from the database in collections of ten transactions. Performancewise this process does not strain database and database connections considerably. However, for the needs of the financial planning service, all the available transaction data should be retrieved from the database in the same query. Performing this query, possibly several times, in every Private Netbank session may present a performance issue of significant magnitude.

In addition to possible performance issues caused by adding the additional information to existing transaction database, there are other issues to be considered. The current transaction database is fully optimized for read only use. Therefore, adding and maintaining the transaction category information in the transaction database is not optimal means for providing the service. In addition, the transaction information stored in transaction database represents the exact information the bank has received about the particular transaction. For this reason, there is a desire to preserve this information unchanged as it can be used as an audit log of transactions if needed.

Utilizing FAST Enterprise Search Platform (from here on FAST ESP) could provide means to resolve both challenges. FAST ESP product overview guide describes FAST ESP as follows, “FAST ESP is an integrated software application that provides a platform for searching and filtering services. It is a distributed system that enables information retrieval from any type of information.” [19]. The possible solution would be to create FAST ESP index from the transaction database. The index would contain all necessary information from the transaction database and the information in the index could be enriched by the system or by the customer from the Private Netbank, thus adding the required information on the transaction category. The queries of the financial planning service service would be performed to FAST ESP index instead of the transaction database, thus removing the additional performance strain from the database. Furthermore, FAST ESP offers great performance even on large data amounts. This thesis concentrates in studying the feasibility of this solution.

4 Stakeholder Interview

This chapter presents the most important research method, stakeholder interview, in more detail. During the thesis study, two stakeholder interviews were performed. The first interview was performed to gather information on the requirements of the financial planning service in order to create specifications of the service. The second interview was performed to gather the work amount estimations for implementing the two technical solutions.

4.1 Objectives of the Interviews

The first interview aimed to clarify the requirements of the desired Nordea financial planning service. Gathering adequately detailed requirements for the service was essential in order to proceed with the thesis study. The service definitions were created based on requirements gathered from the interview and the service definitions in turn acted as the bases for the two proposed technical solutions.

During the first interview we aimed to cover requirements from three point of views, the functional and non-functional requirements of the service as well as the look and feel of the service. Regarding the functional requirements we specified what features the service should offer and how the customer should be able to use the service. The gathered non-functional requirements included such as real timeliness and the performance demands of the service. We also defined in a general level what service should look like.

The second interview was held in order to gather the work amount estimations for implementing the two technical solutions. The work amount estimations were the bases for the quantitative comparison of the two proposed solutions. During the interview we identified the areas needed to be developed or changed. Furthermore, the work amount estimations for each area were created.

4.2 Stakeholders in the Interviews

The stakeholders in the interviews were selected by utilizing the purposeful sampling method presented in [20] and [21]. The selection was based on the interviewees' previous knowledge of the financial planning service and their background in the company. By selecting correct stakeholders for the interviews it was possible to gather required data in a trustworthy manner without having several interviews with one subject or a large group of interviewees in one interview.

The stakeholders in the first interview included a product owner and a user interface specialist representing Nordea business point of view. In addition, one IT architect was present to give a more technical point of view to the discussion. The stakeholders in the

second interview included two IT specialists with deep knowledge on FAST ESP and a software architect with broad understanding on technical environment in Nordea.

The stakeholders in both interviews are presented in more detail in appendix A.

4.3 Material and Structure of the Interviews

The objective for the interviews material was to act as a foundation for the discussions. The interviews were conducted in a semi-structured manner presented in [21]. The material and questions posed in the interview were presented to guide the open conversation and to ensure that all required areas were covered.

The material for the first interview was mostly collected from the results of the existing similar services analysis. Findings from existing services provided a good starting point for defining the Nordea service. The first part of the interview was to present the existing features. By analyzing the positive and negative features based on the material, it was easier for stakeholders to conclude which features are desired for the Nordea service. Furthermore, the material also provided views on the usage of the existing services. Based on the usage of existing services the attendees were able to assess the positive and negative aspects of them, thus making it easier to define the usage of the Nordea service. After the presentation of the existing services, the discussion was directed at the requirements of the Nordea financial planning service. Through series of questions, the most important aspects of the financial planning service were covered.

The financial planning service descriptions and the descriptions of the two technical solutions acted as the material for the second stakeholder interview. The interview was started by introducing the financial planning service by explaining the features that it offers. After, the two technical solutions were presented to the interviewees and the main development areas of both solutions were discussed. Finally, the work amount estimations of each area were defined.

4.4 Interview Questions

Stated interview questions in the first stakeholder interview were part of the interview material. The main aim for the questions was to guide and arouse discussion around the key functionalities of the Nordea service. The questions were left open intentionally. This was done in order to leave sufficient room discussion and innovation for the specification of the Nordea service. The presentation of the existing services provided enough background information for the discussion to be productive.

The stated questions can be divided in three sections, questions associated with functional requirements, questions associated with non-functional requirements and questions associated with the look and feel of the Nordea financial planning service. Functional requirement questions included the following.

- How should categorization of the transactions done by customer be handled?
- Should the service offer automatic categorization?
- Should the customer be able to create own categories or should they be predefined?
- What types of graphical information and from which time periods should the service provide?
- Should the service offer group comparison features?

Non-functional requirement questions included the following.

- Should the transaction information be available real time or is some latency accepted?
- What performance requirements should the service fulfill?
- Are there some restrictions, for example legal restrictions, on displaying the data?

Service look and feel questions included the following.

- Where within net bank should the service be offered?
- How should the service pages look in the net bank?
- How should the features be divided among the service pages?

The second stakeholder interview contained only two separate questions.

- What are the main development areas?
- What are the work amount estimations for each of the development areas?

5 Proposed Solutions for the Service

In this chapter, two alternative technical solutions are introduced to implement the required service. We begin by explaining the requirements for the service and continue by describing the use case model and the use case descriptions as well as the storyboard description of the service. The use case model, the use case descriptions and the storyboard descriptions are a part of Nordea system development process, SDP. Finally, the thesis presents the two alternative technical solutions. Solution A is based on exploiting FAST ESP to provide the service, whereas solution B is more traditional approach utilizing database.

5.1 Service Requirements

This chapter presents the requirements for the financial planning service in detailed level. The requirements were gathered in the stakeholder interview. The main focus areas are functional and non-functional requirements as well as requirements from the look and feel point of view. The requirements are defined in sufficiently detailed level to provide means for the definitions of the two alternative technical solutions.

5.1.1 Functional Requirements of the Service

The new service will be based on the data in the account transactions database. As this data does not include all the necessary information such as category, the data requires enrichment. Enrichment of data cannot be done directly in to account transactions database. Therefore, the data must be duplicated to another data repository where the enrichment can take place. The most important enrichment of the data is the category information of a particular transaction.

Several requirements for the transaction categorization in the service were gathered and defined based on the feedback from the stakeholder interview. Customer should be able to manually add appropriate category for a transaction. In addition, the customer should be able to select whether the same category should be added to all similar transactions based on the beneficiary information. The service should also be able to add a category for transactions automatically. If the customer has previously selected category for similar transaction, the service should follow this selection automatically for a new transaction as well. On the other hand, if no previous selection exists, the service should add category for the service based on for example the beneficiary information.

The service should offer predefined categories versatile enough to cover most areas of normal customer expenditure. However, predefined categories might lack the detail required by some customers. Consequently, the service must offer a possibility to add as well as remove own categories for the customers.

At the first stage of the service, the category levels are not part of the offered features. Furthermore, the group comparison and budgeting features are not included in the scope. Nevertheless, all these features might be added to the service on later stages, thus making it important that the technical solutions will support implementing these features in the future.

The customer should be able to freely select the start and the end month for the graphical presentation of the data. In addition, the customer should be able to select the accounts included in the graphical presentation. The service should display the income and the expenses of the customer separately from the selected time period and accounts. Furthermore, it should be possible for the customer to select only particular categories for the graphical presentation. The graphical presentation should include following possible types for customer to choose from: charts, graphs and lists.

5.1.2 Non-functional Requirements of the Service

Based on the stakeholder interview, one of the most important requirements is that the data displayed in the service should be available online. This requirement influences significantly the design of the technical solutions as the data needs to be duplicated.

In addition, the stakeholders found the performance issues very important. Effective and fluent use of the main banking services must be ensured in the net bank; hence the financial planning service must not affect this performance. On the other hand, the performance of the service itself must be on acceptable level, that is, fulfill the performance requirements set for the net bank itself.

As the service is basically only displaying already existing data of the customers, there are no legal or company image related issues to be expected. However, group comparison feature might contain some legal restrictions and therefore these restrictions must be investigated before implementation of the feature. This investigation is not included in this thesis study as the comparison feature is not in the service scope.

Although no requirements were set by stakeholders for deleting account transactions from the financial planning service, the service should be designed so that it will support deleting transactions based on transaction date if seen necessary later on.

5.1.3 Look and Feel of the Service

During the interview, few requirements related to usability of the financial planning service were noted. These requirements overlap with the functional requirement, but as they are can be considered as an extensions of the functional requirements and have a direct impact on the user interface of the service the usability requirements are listed here.

Naturally, the financial planning service must follow the user interface guidelines of the net bank.

One of the functional requirements is that user must be able to manually add or change the category of a transaction. This functional requirement was further on extended to usability requirement in which the customer must be able to select several transactions in the user interface for the category update. Furthermore, if the customer selects this change to apply to other similar transactions as well, this personal automatic categorization rule must be stored for all transactions included in the change.

The earlier presented functional requirement demanded a possibility for the customer to add and remove personal categories. This functional requirement was further extended to also cover editing the personal category. In practice, this means that the customer can change the name of the personal category without first removing the category and then adding it with correct name again. In addition, when removing a personal category, it should be possible for the customer to select new category for the transaction having the category about to be deleted.

5.2 Use Case Model of the Service

Figure 8. depicts the use case model of the Nordea financial planning service. The use case model was designed based on the requirements presented in the previous chapter. The use case model consists of four use cases of which three are customer use cases and one is technical use cases. The customer use cases are view graphic data, add category to transaction and maintain categories. The technical use case is data refresh. Actors in the use case model include customer and system actor. The customer is the net bank customer, whereas the system actor is an application which triggers the use of the use case.

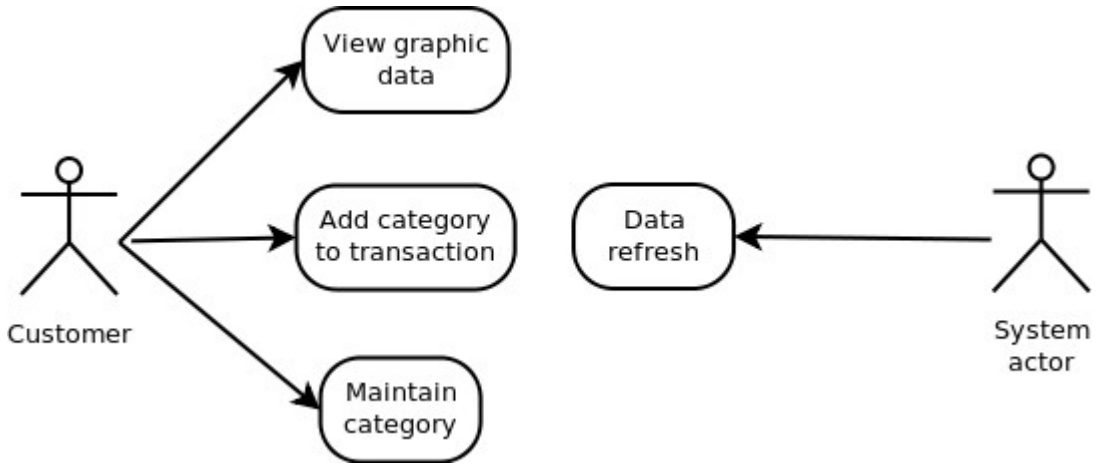

Figure 8: Use case model of Nordea financial planning service

In the view graphic data use case the system draws the graphic data for the customer according to the selected preferences.

By using the add category to transaction use case the customer can add category for transaction or group of transactions.

Maintain categories use case offers customer a possibility to add and remove categories.

Data refresh technical use case is required to offer online service from customer's point of view. Use case is responsible for uploading the most recent data in the service. This use case is triggered when customer uses the service in net bank.

5.3 Use Case Descriptions of the Service

5.3.1 View Graphic Data Use Case Description

Actor in this use case is the net bank customer. This use case enables customer to view the graphical data offered by the service. Pre-conditions of the use case are that the customer has a net bank agreement and that the customer has account transactions.

Basic flow of the use case:

1. Customer logs in the net bank.
2. Customer selects to use the service.
3. System displays the service front page, containing graphical data from predefined time period and list of transactions.
4. Customer selects the desired time period for the data to be displayed.
5. Customer selects the desired accounts which are included in the displayed data.
6. Customer selects which categories are included in the displayed data.
7. Customer clicks a button to view graphical data.
8. System displays the data as per preferences selected by customer.
9. Customer selects type (pie or bar chart) of graphical presentation.
10. System updates the view according to the selected type.

The use case ends.

5.3.2 Add Category to Transaction Use Case Description

Actor in this use case is the net bank customer. This use case enables the customer to manually add category to transaction or a group of transactions. Preconditions of the use case are that the customer has a net bank agreement and account transactions.

Basic flow of the use case:

1. Customer logs in the net bank.
2. Customer selects to use the service.
3. System displays the service front page, containing graphical data from predefined time period and list of transactions.
4. Customer selects to update category of a transaction or group of transactions.
5. System displays predefined and customer's personal categories for selection.
6. Customer selects the appropriate category for the transaction.
7. System updates the category for the transaction or group of transactions and returns to service front page.

The use case ends.

Alternative flow, customer wants to add same category for all similar transactions:

At the step 5. of the basic flow, system displays predefined and customer's personal categories for selection.

1. Customer selects the appropriate category and selects to update the same category to all similar transactions.
2. System updates the category for all similar transactions, stores the personal automatic categorization rule and returns to service front page.

Alternative flow ends.

5.3.3 Maintain Categories Use Case Description

Actor in this use case is net bank customer. This use case enables customer to maintain categories within the service. Preconditions of the use case are that customer has a net bank agreement.

Basic flow of the use case:

1. Customer logs in the net bank.
2. Customer selects to use the service.
3. System displays the service front page, containing graphical data from predefined time period and list of transactions.
4. Customer selects to maintain categories within the service.
5. System displays the customer's personal categories.
6. Customer adds new personal category and selects to save it.
7. System saves the category to customer's personal categories.
8. System displays the customer's personal categories including the new personal category.

The use case ends.

Alternative flow, customer wants to edit personal category:

At the step 5. of the basic flow, system displays the predefined and customer's personal categories.

1. Customer selects to edit personal category.
2. System displays a view where customer can edit the name of the personal category.
3. Customer edits the name of the personal category and selects to save the change.
4. System save the new name of the use case
5. System displays the customer's personal categories including the personal category with new name.

Alternative flow ends.

Alternative flow, customer wants to delete personal category:

At the step 5. of the basic flow, system displays the predefined and customer's personal categories.

1. Customer selects to delete personal category.
2. System displays the available categories (predefined and personal categories) and asks customer to select new category for transactions having the category to be deleted.
3. Customer selects a new category for the transactions.
4. System updates the category for the transactions and removes the personal category from customers list of personal categories.
5. System displays the customer's personal categories.

Alternative flow ends.

5.3.4 Data Refresh Technical Use Case Description

Actor in this use case is the net bank application. Data refresh use case uploads net bank customer's data of account transactions not yet uploaded to the Nordea financial planning service service from the account transactions database. Precondition for the use case is that customer has logged into net bank.

Basic flow of the use case:

1. Customer selects to use the service.
2. System reads new account transaction from the transaction database.
3. System does the automatic categorization based on personal or predefined automatic categorization rules and stores the new account transactions in the system.

Use case ends.

5.4 Storyboard Description of the Service

The purpose of the storyboard description is to describe the user interface flow of the service and also provide a general outlook on the service web pages. The user interface flow is described in the storyboard workflow and the individual web pages in the storyboard wireframe figures.

Figure 9 presents the workflow of the financial planning service. The dark blue box represents a logical page, that is, the page has its own menu point in the net bank menu structure. The light blue boxes represent user input and action pages. The blue arrows depict the link association between pages. The green arrows show positive workflow and the red arrows negative workflow. The workflow of financial planning service consists of one logical page, the front page of the service, and six user input and action pages. The workflow has three separate flows starting the financial planning service front page, a flow for transaction category change, a flow for account selection and a flow for personal category administration.

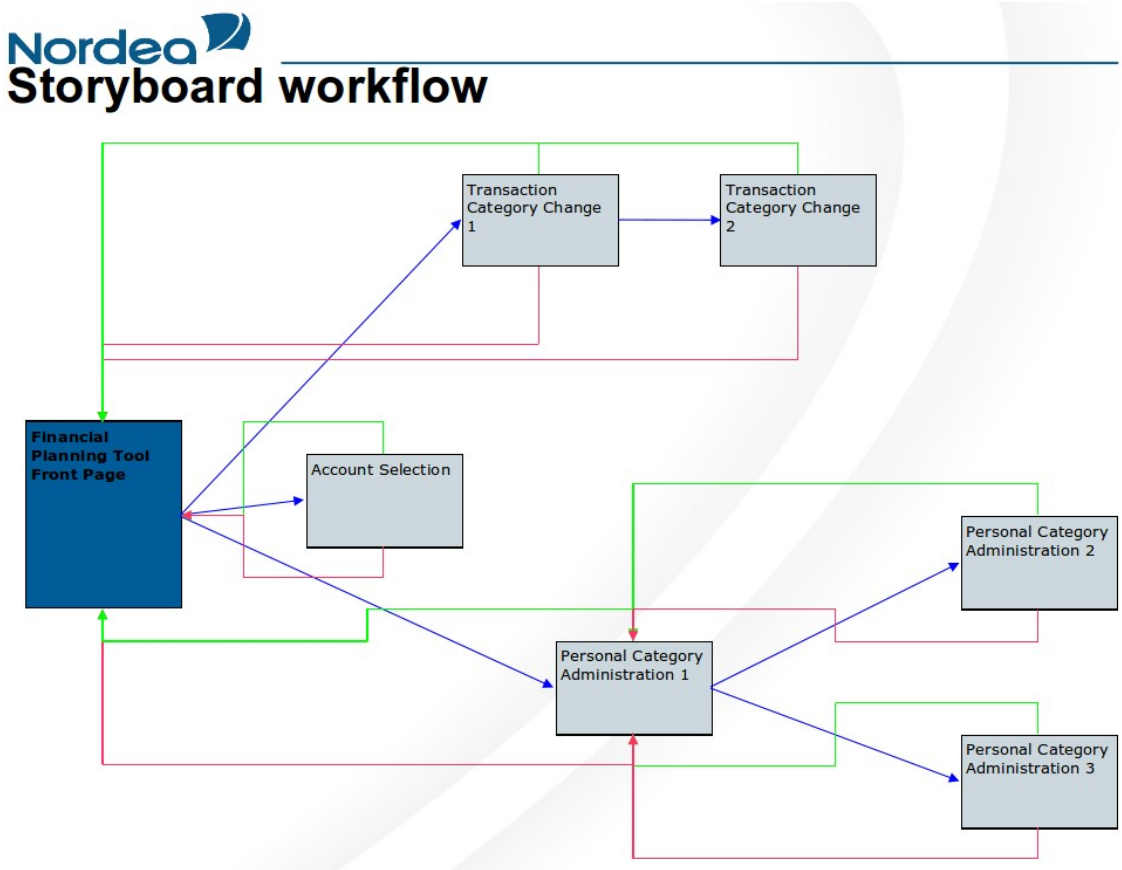

Figure 9: Storyboard workflow of the financial planning service

The transaction category change flow consists of two separate user input and action pages. These pages are displayed in figures 10 and 11. The page 1 of the transaction category change flow presents the how user can select one or many transactions for the category update as well as the list of available categories. The page 2 of the transaction category change flow shows how user can select to update the category for the selected transactions only or to do the change for all similar transactions. Both pages also contain a possibility for the user to cancel the action.

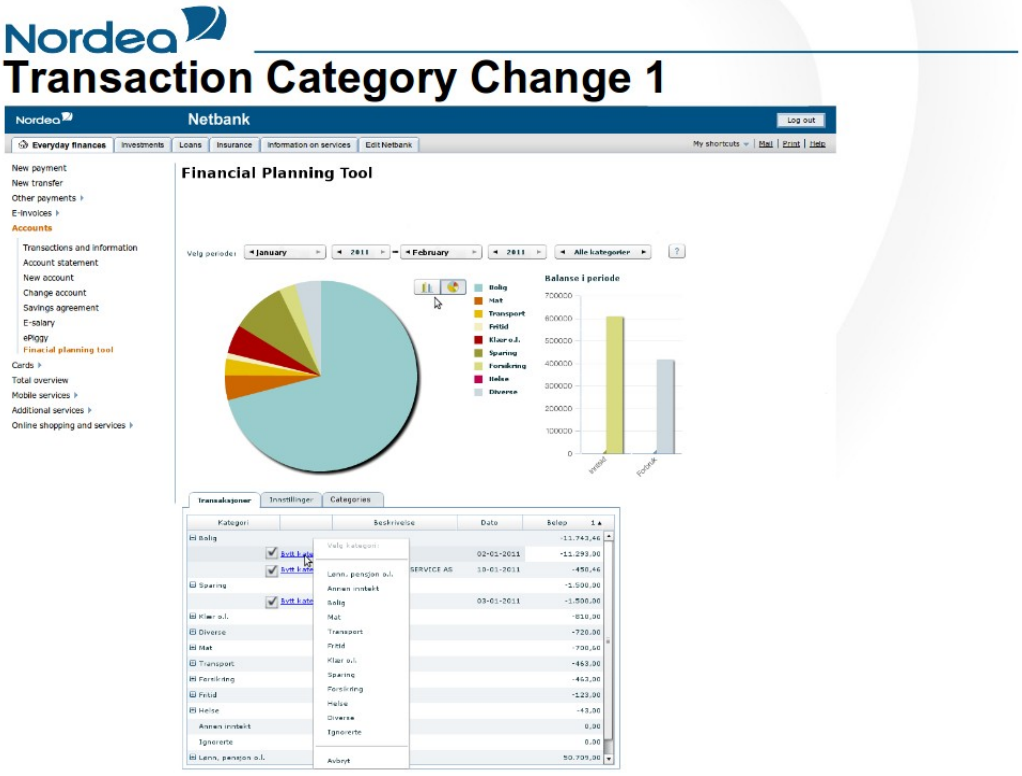

Figure 10: Page 1 of the transaction category change flow

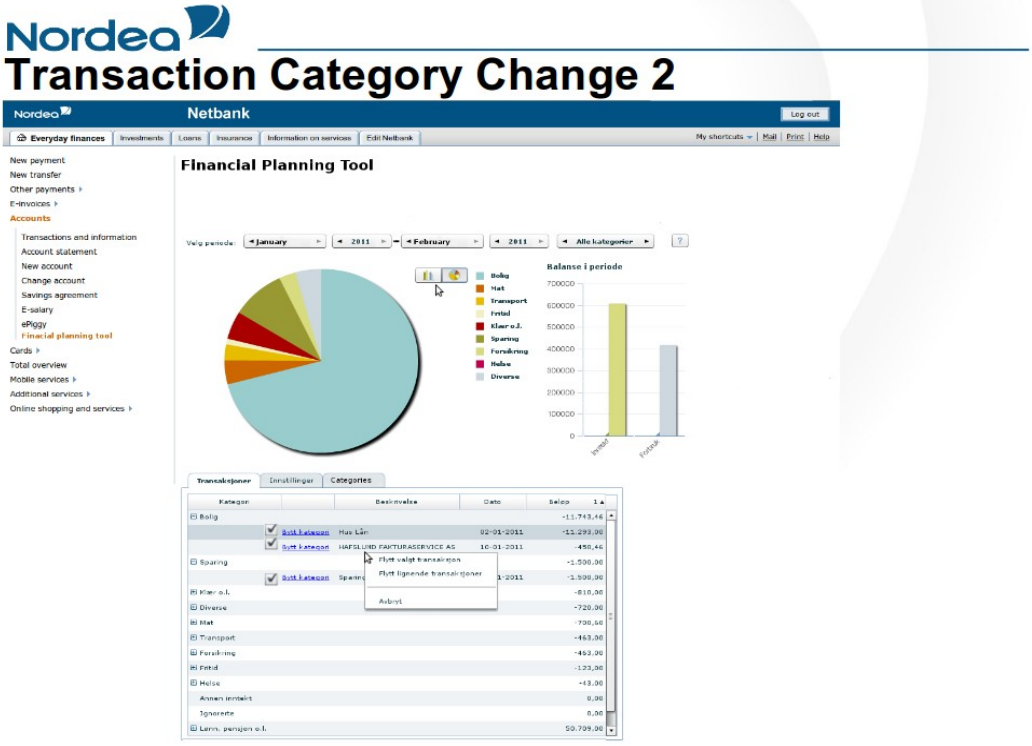

Figure 11: Page 2 of the transaction category change flow

The account selection flow contains one user input and action page. Figure 12. depicts this page. The page shows how user can select the accounts to be used in the graphical presentation of the information.

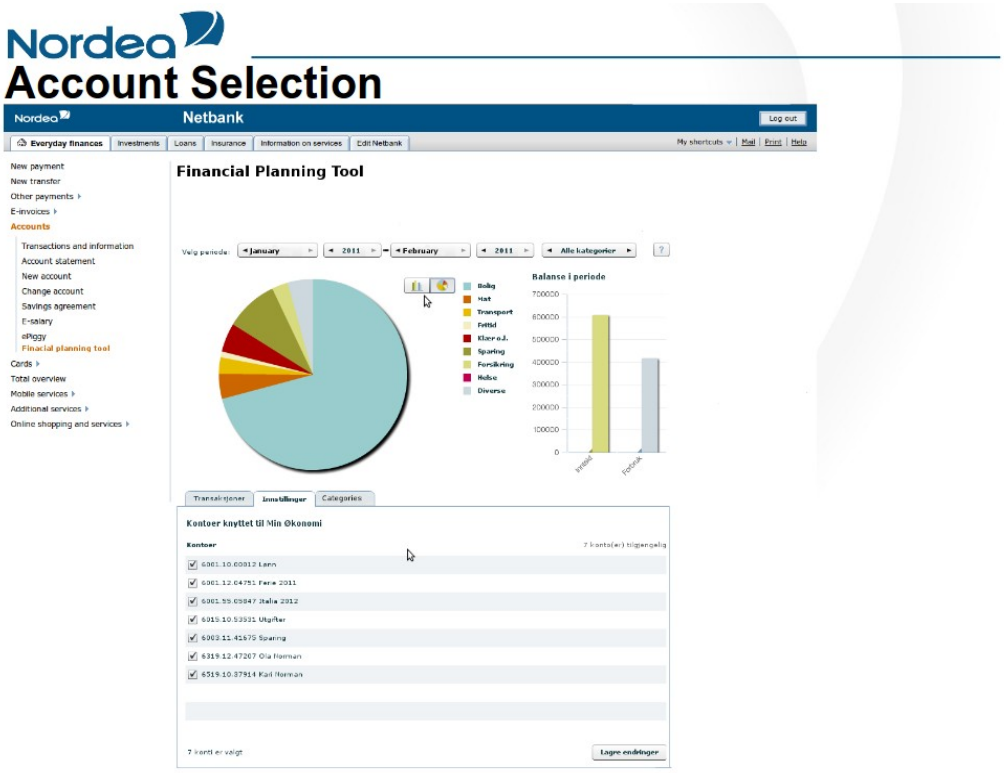

Figure 12: The account selection flow page

The personal category administration flow consists of three user input and action pages. These pages are shown in figures 13, 14 and 15. The personal category administration flow branches out on the personal category administration page 1 to separate pages for editing the personal category, personal category administration page 2, and for deleting personal category, personal category administration page 3. The personal category administration page 1 displays how user can add a new category or proceed by selecting to edit or delete personal category. The personal category administration page 2 shows how user can edit the name of a personal category. The personal category administration page 3 displays how system requires user to select a new category for transaction having the category about to be deleted.

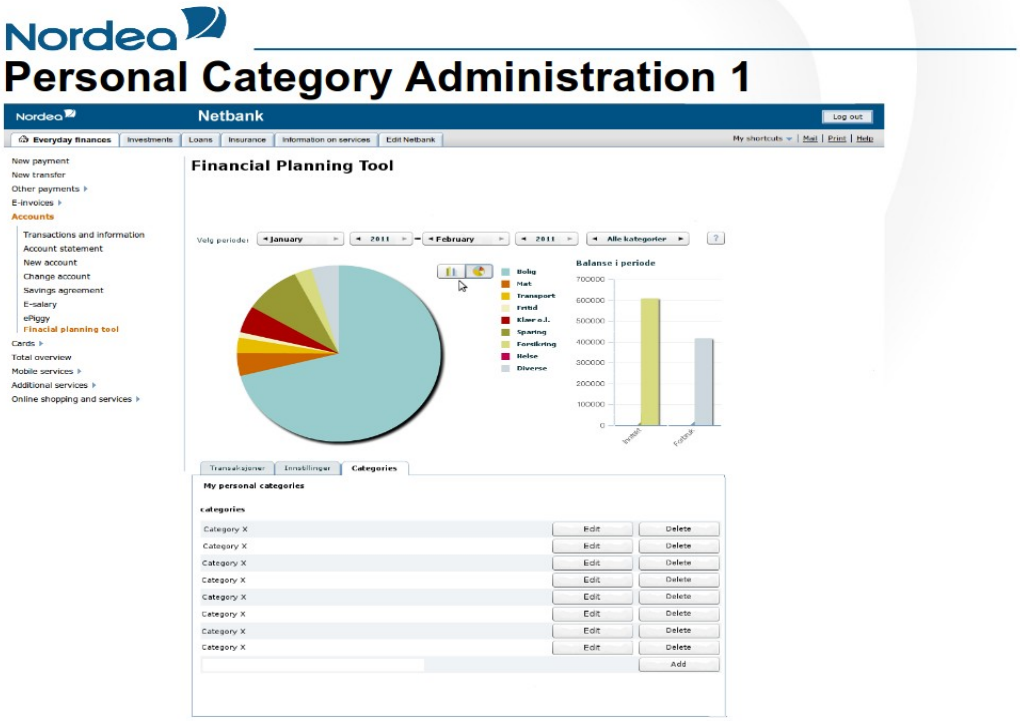

Figure 13: Page 1 of the personal category administration flow

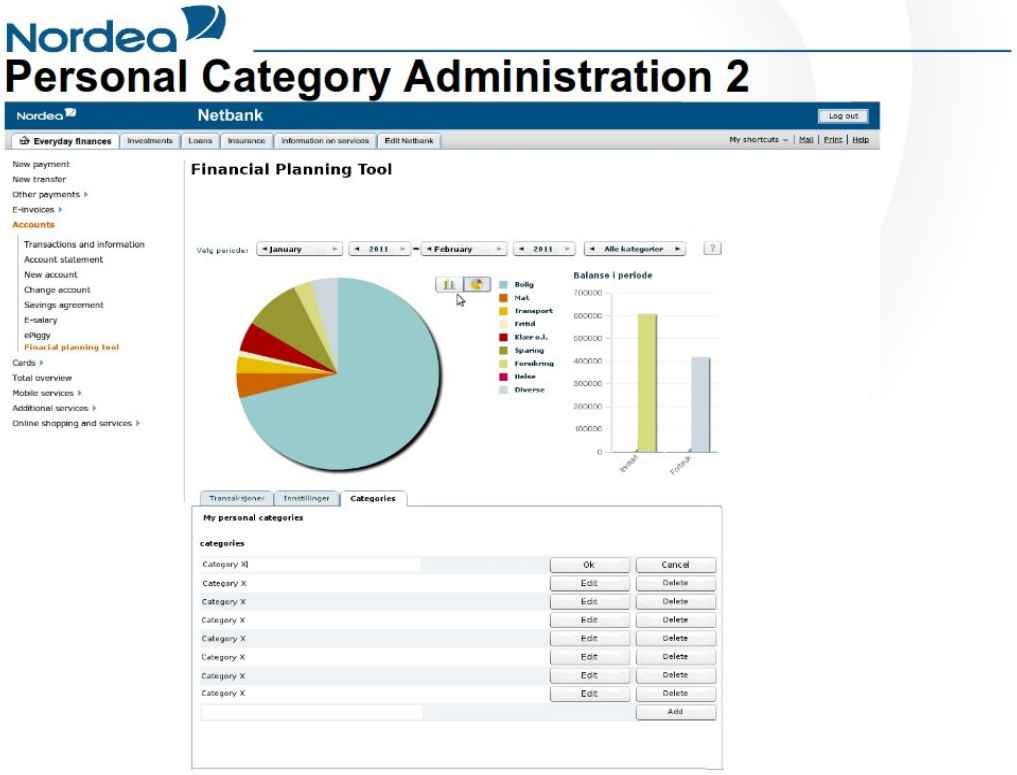

Figure 14: Page 2 of the personal category administration flow

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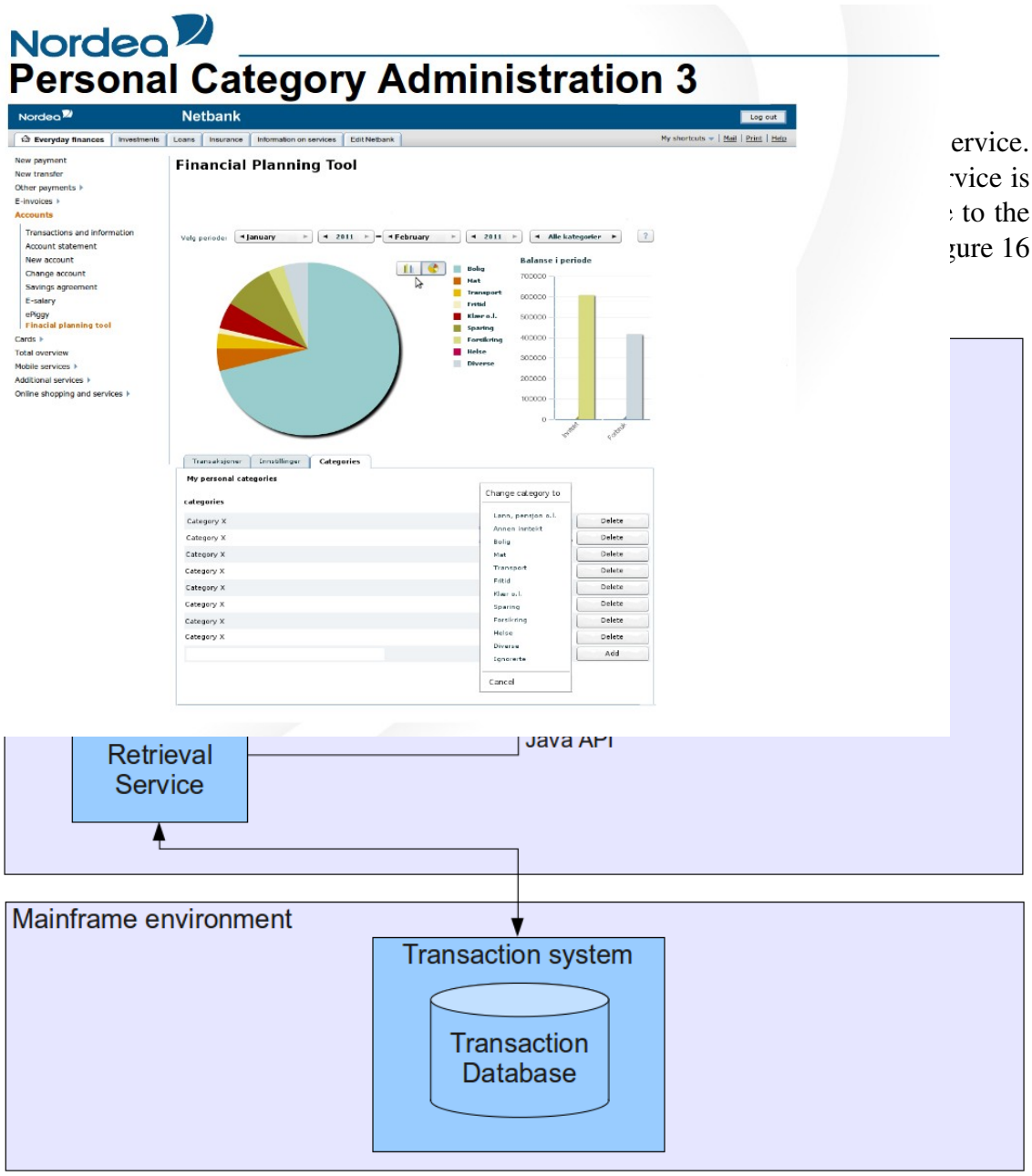


Figure 16: Technical architecture of solution A on a rough level

5.5.1 Transaction System

The transaction system contains all account transactions of all Nordea customers. In other words, it also contains the account transactions of customers who are not using Private Netbank and therefore will not be users of the financial planning service. For this reason, it is impractical to fetch all information from the transaction system, but

instead the service should only retrieve the information for the customers using the service.

The transaction system displayed in the figure 16 is simplified presentation of the system. In fact, not all transactions are stored in the transaction database in real time. Transactions from the current date are stored in temporary database where changes, such as transaction corrections, can occur. These changes made on the temporary databases are not transferred to the final transaction database, thus improving the transaction database data quality. However, the use of temporary databases makes implementing financial planning service more complex. The transactions from the temporary databases need to be included to display real time information in the service. On the other hand, the service needs to be able to correct the information in the FAST ESP index according to final transactions stored in transaction database after the possible corrections of the current date have been removed.

Transaction system operates on Nordea mainframe environment. Mainframe environment differs significantly from the netbank portal environment. The differences between the two environments could pose a series of challenges. However, these challenges have been resolved by exploiting already existing transaction retrieval service which will be presented on the next chapter.

As previously mentioned, the transaction system lacks information to be utilized in the service as such. Nevertheless, it contains the most important information for the service. Each account transaction in the transaction system contains amount, beneficiary information, date, message and from account of the transaction. Although this information alone is not enough to produce the desired financial planning service, it will act as a crucial foundation for the service.

5.5.2 Transaction Retrieval Service

The transaction retrieval service is an existing service which is currently used by the Private Netbank. Private Netbank calls the service to retrieve account transactions of particular account from the transaction system and displays these within the customer user interface. The retrieval process returns ten transactions at a time.

The same transaction retrieval service can be utilized for the purposes of the financial planning service. Existing connections from netbank portal environment to mainframe environment can be exploited by using the same transaction retrieval service, thus removing the need of implementing similar connections between environments again. However, some modifications need to be implemented in order it to suit the needs of the financial planning service.

Currently, the transaction retrieval service interacts only between transaction system and Private Netbank. The interaction needs to be further developed to also cover the

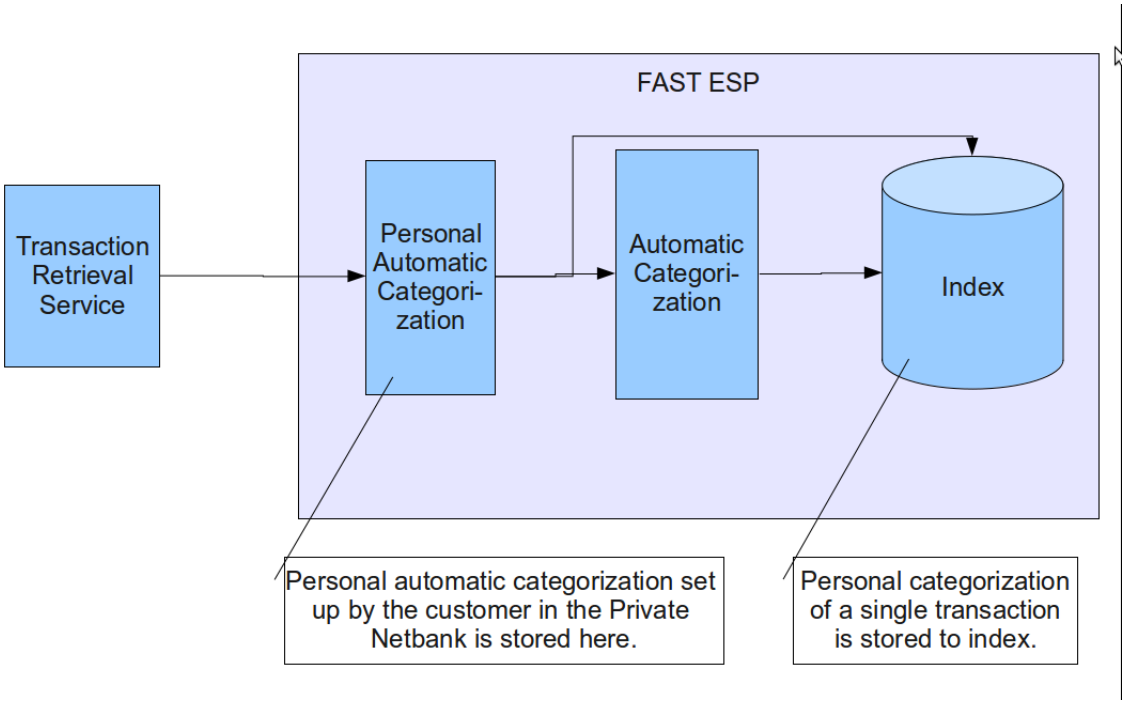
needs of the financial planning service. For the purposes of the financial planning service, the transaction retrieval service should be able to interact also with FAST ESP. In other words, the transaction retrieval service should be able to supply the transaction information to FAST ESP through the FAST content API for content refinement. FAST content API is a Java based interface which is included in the FAST ESP product.

The financial planning service is required to be personal, that is, uniquely administrable within one net bank ID. As the net bank IDs of the customers are not available in transaction system, this information needs to be added from some other source. The proposed solution here is to deliver the net bank ID from Private Netbank to transaction retrieval service which in turn delivers it forward to FAST ESP as a part of the transaction information. For the moment, transaction retrieval service does not utilize the net bank IDs, so functionality for delivering the net bank IDs needs to be developed for the whole process from Private Netbank to FAST ESP.

The transaction retrieval service fetches the account transactions in batches of ten transactions. This logic should remain unaltered in order to secure the stability and the performance of the transaction retrieval service. However, as all the requested account transactions should be delivered to FAST ESP, the transaction retrieval service should be able to do the retrieval of all transactions and deliver them onwards to FAST ESP without the need of Private Netbank calling the transaction retrieval service numerous times.

5.5.3 FAST ESP

FAST ESP is the essential part of the proposed solution. FAST ESP will act as a main storage of the information for the financial planning service. In addition, FAST ESP will also execute the automatic categorizations of the transactions. Figure 17 depicts the content refinement process of FAST ESP. Content refinement process ensures that the automatic categorization is executed before the transaction information is stored in the FAST ESP index for further exploitation.



The information to FAST ESP is received from transaction retrieval service through the FAST content API. The information is stored to FAST ESP in a two step process. First step is the personal automatic categorization. If customer has selected to use a specific category for all similar transactions, this information is stored in the personal automatic categorization rules. For each transaction received from the transaction retrieval service, FAST ESP examines whether a personal automatic categorization rule is found. The rules consist of customer's net bank ID, beneficiary name, beneficiary account and category. If FAST ESP finds a rule that matches the transaction, the transaction information is stored straight to FAST ESP index including the category. If FAST ESP is not able to find a match between the rules and the transaction, the transaction information is sent forward for the second step of the process.

The second step of the content refinement process is the automatic categorization. If no personal category was found in previous step, the transaction information processed in this step for non-personal categorization. Automatic categorization rules are based on the beneficiary name containing a keyword based on which the system can make a best guess regarding the category for the transaction. Similarly to automatic personal categorization, if FAST ESP finds a rule that matches the transaction in this step, the transaction information is stored straight to FAST ESP index including the category. The automatic category rules, that are key word and category pairs, must be maintained manually through FAST ESP administrator interface. Automatic categorization rules cannot cover all possible transactions. Hence, a common “uncategorized” category is also needed. The “uncategorized” category is added to all transactions which could not be matched in either of the process steps with a proper category before storing the transaction information to FAST ESP index.

After the content refinement process, all transaction information can be found from FAST ESP index. Each transaction in FAST ESP index contains following information:

- beneficiary name,
- beneficiary account,
- from account,
- amount,
- date of the transaction,
- message,
- customer's net bank ID,
- category.

In addition to the content refinement process, the FAST ESP will also provide APIs towards Private Netbank. The information retrieval from FAST ESP index is done through query API. The category information updates for single transactions utilize content API. Finally, the administration API is used for updating the personal automatic categorization rules.

5.5.4 Category Database

The financial planning service should offer a possibility for customer to use personal categories. In the proposed solution A, personal categories are stored in the category database. The category database contains all personal categories based on net bank ID. In addition to personal categories, the category database will also contain the predefined categories. All categories stored in the category database also have a unique category ID which represents the category information stored in the index. The category ID is required in to support languages available in Private Netbank. Using the category ID also enables editing the personal categories without updating FAST ESP index.

The category database interacts only with Private Netbank. Possible actions from Private Netbank are viewing the categories, adding, editing and removing a category.

5.5.5 Private Netbank

Private Netbank is the customer user interface for financial planning service. The user interfaces of all offered features of the financial planning service are developed in Private Netbank. Therefore, the technical interfaces to other needed parts for the financial planning service need to be developed in Private Netbank. These connections include interactions with the transaction retrieval service, the category database and FAST ESP.

Private Netbank already uses the transaction retrieval service to fetch account transactions to be shown at customer in the Private Netbank session. However, using the service for the purposes of financial planning service differs from the current usage. Currently, Private Netbank provides the account number for the service and receives the account transactions of that account in batches of ten transactions. For the use of the financial planning service, Private Netbank needs to deliver all required account numbers from which the account transactions are needed to transaction retrieval service. Furthermore, rather than delivering the transaction details back to Private Netbank the transaction retrieval service delivers them to FAST ESP for processing and notifies Private Netbank of success or failures in operation. Private Netbank will also store the information when the financial planning service information has been last updated. Each visit to the service will trigger a data update. Due to previously presented issues with the account transactions of current date in transaction system, the update of the information will be requested always from one day before the last updated date to correct the data in FAST ESP index in case of transaction corrections.

Private Netbank will also act as a customers' user interface towards the category database. In the financial planning service, customers will be able to view their existing personal categories. In addition, customers can add new, edit or remove existing categories. For this purpose, the database connection to category database will be developed in the Private Netbank. The connection to category database is also required for fetching the actual textual name for the categories as FAST ESP index will only contain the category ID of the transaction.

As the information in which the financial planning service is based on is stored in the FAST ESP index, Private Netbank needs to be able to retrieve that information. In the proposed solution Private Netbank will use the FAST query API to search the information relevant for customer from the FAST ESP index. In addition to information searching, Private Netbank must also store the category ID information for a transaction in FAST ESP index if customer changes it. In practice, the change of category means a partial update of the FAST ESP index. Partial updates to index will be done by utilizing FAST content API. It provides means for a single update to be done without any latency. Furthermore, Private Netbank needs to store the customer's automatic personal categorization in the FAST ESP content refinement rules. For storing the automatic personal categorization, the proposed solution uses FAST administration API.

5.5.6 Key Development Areas of Proposed Solution A

This chapter will present the most important development areas regarding the proposed solution A. Some of the areas need to be developed completely, whereas some areas already exist but require new additional functions.

The most central development area is FAST ESP. Currently there exist no implementation of FAST ESP in netbank portal environment. This means that the whole FAST ESP infrastructure need to be set up and deployed. Furthermore, the content refinement logic needs to be configured. Nevertheless, FAST ESP provides several ready made tools for the solution including the required APIs and administration user interface.

The category database is also required to be set up completely as such database does not exist at the moment. However, the technical set up of the category database is very simple and it can be deployed on existing infrastructure.

The transaction retrieval service needs to be further developed to meet the needs of the financial planning service. Future features should include sending account transaction details, including customer's net bank ID, to FAST ESP. The retrieval should also support fetching account transactions from several accounts.

The implementation of the financial planning service requires considerable amount of development in the Private Netbank. Private Netbank contains all the customer user interfaces including the creation of the graphical presentation of the information. In addition to developing the user interfaces, integration with FAST ESP through APIs and with category database needs to be developed.

5.6 Technical Description of the Proposed Solution B

Proposed technical solution B presents a more traditional approach for providing the financial planning service. Solution B is based on utilizing several databases to provide the financial planning service. The main idea in this solution is that the account transaction data used in this service is stored in the portal transaction database. The heavy retrievals of the information are performed to portal transaction database thus removing the strain from the account transaction database. Figure 18 illustrates the technical architecture of the solution B on a rough level.

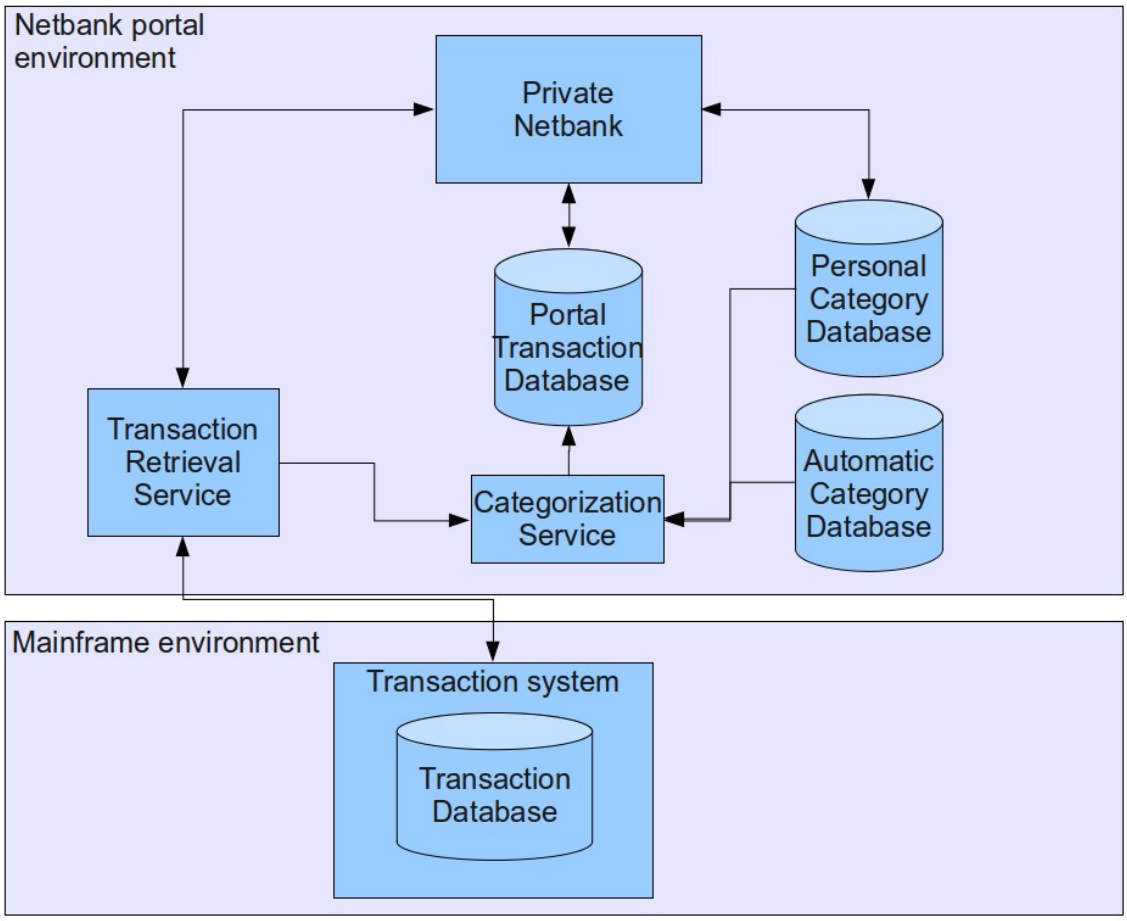


Figure 18: Technical architecture of solution B on a rough level

5.6.1 Transaction System

The existing transaction system acts similarly in both proposed solutions. Consequently, it suffers from the same limitations and requirements in solution B as in solution A. The information available in the transaction system functions as bases for the financial planning service, but it does not include all the required information. The transaction system does not contain customer's net bank ID or category information of account transaction. Both pieces of information are crucial in providing the financial planning service. Similarly to solution A, as this missing information cannot be added to transaction system, the solution B must be able to resolve the insertion of the additional information someway.

In addition to missing information, the implementation of the account transactions of the current date in transaction system needs to be taken into account in solution B.

5.6.2 Transaction Retrieval Service

As in the solution A, solution B also utilizes existing transaction retrieval service to fetch the account transactions. Using the transaction retrieval service eliminates the need for implementing additional connections between the netbank portal environment and the mainframe environment.

The transaction retrieval service requires changes in order to meet the needs of the financial planning service. Currently, the transaction retrieval service acts as a mediator between Private Netbank and transaction system. In proposed solution B, the role of the transaction retrieval service is further extended to also interact with the categorization service. This interaction is needed to transfer account transactions from transaction system towards financial planning service database, which is the portal transaction database.

In addition to increased interaction, there is also need for some changes in the transaction retrieval service logic. At the moment, transaction retrieval service receives the account number and time period from which the account transactions should be fetched from transaction system. The transaction retrieval service in turn delivers the account transactions back Private Netbank in batches of ten transactions. In proposed solution B, this logic needs to be altered. Private Netbank will deliver all customer's account numbers and the time period. The transaction retrieval service can still fetch the transactions in batches of ten, but instead of sending them back to Private Netbank, the account transactions should delivered forward to the categorization service for further processing. The transaction retrieval service will only notify Private Netbank of the success or failures of the process.

The financial planning service is offered on personal level. Therefore, the account transactions stored in the system need to be customer specific not account specific. The transaction system contains the account identification information but it does not contain any customer identification information. For this reason, Private Netbank will deliver the customer's net bank ID to transaction retrieval service which will send the net bank ID further with the account transactions received from transaction system to categorization service.

5.6.3 Categorization Service

The categorization service handles the required automatic categorization for the account transactions loaded in the financial planning service. The categorization service receives the account transactions from the transaction retrieval service. The categorization service performs the automatic categorization in two step process. First the categorization service checks if personal categorization is found for the transaction. If the personal categorization is not found, the service checks the general automatic categorization.

Personal automatic categorization is based on categorization rules stored in the personal category database. The categorization services checks from the personal category database whether any of the categorization rules matches the account transaction which is being processed. The rules are based on the beneficiary name and account as well as customer's netbank ID. If a match in the rules is found, the account transaction is stored in the portal transaction database with the respective category information. If match is not found, the account transaction progresses to second step of the automatic categorization process.

Similarly to the personal automatic categorization, the general automatic categorization is based on the categorization rules stored in the automatic category database. The categorization service checks the account transaction against the general automatic rules. The general automatic categorization rules are based on finding a keyword in beneficiary name based on which the system selects the best suited category for the transaction. If the service is able to find a match, the account transaction is stored in the portal transaction database with the category information. If the service can not find a match, it stores the account transaction to portal transaction database with “uncategorized” category.

The category service needs to be able to interact with several databases. It needs to be able to read the categorization rules from the personal category database and the automatic categorization database. In addition, it needs to able to store the account transactions to portal transaction database.

5.6.4 Category Databases

The category databases in proposed solution B consists of two databases, personal category database and automatic category database. Personal category database fulfills three purposes. It acts as storage for the customers' personal categories created in the Private Netbank. In addition, it will also contain the automatic rules for personal categorizing utilized by the categorization service. Furthermore, it will also contain predefined categories for the financial planning service.

All categories stored in the personal category database have a unique category ID. The category ID is used as a category information in the portal transaction database. The category ID enables the usage of languages available in Private Netbank. Using the category ID also enables editing the personal categories without updating the portal transaction database.

The automatic category database contains the rules for the general automatic categorization. The database consists of keyword and category ID pairs. These pairs need to be manually updated in to the database. To make the administration of the pairs as easy as possible, a simple user interface might have to be developed, although technically it is optional.

Both category databases also include the stored database procedures for administrating the database records. In the personal category database this includes all actions performed from Private Netbank, such as adding, editing and deleting personal category. In the automatic category database the stored procedures are used for administrating the keyword and category ID pairs.

For illustration purposes the two databases have been separated. However, there are no technical restrictions on both databases existing within one logical database. The data from both databases can stored within one database on separate database tables.

5.6.5 Portal Transaction Database

The portal transaction database is the main information source for the financial planning service. It contains all the necessary information to Private Netbank for producing the graphical information in the user interface. Possible category changes for the transactions are also stored in this database. The portal transaction database contains the same information on account transactions as the FAST ESP index in solution A. Each transaction in portal transaction database contains following information:

- beneficiary name,
- beneficiary account,
- from account,
- amount,
- date of the transaction,
- message,
- customer's net bank ID,
- category.

The portal transaction database also includes stored database procedures for searching and updating the account transactions in the database. These stored procedures are used by Private Netbank.

5.6.6 Private Netbank

As in solution A, Private Netbank contains the user interface of financial planning service towards customer in proposed solution B. In fact, the user interfaces in both proposed solutions are identical and should provide the same user experience for the customer. Although the user interface towards customer is the same in both solutions, some areas of the user interface implementation in Private Netbank differ significantly.

Changes needed in the way Private Netbank uses the transaction retrieval service are similar in both solutions. Private Netbank will include customer's netbank ID in the calls to the transaction retrieval service. In addition, calls must include all required account numbers from Private Netbank. Private Netbank will also need to handle notifications of success or failure from the transaction retrieval service.

The update of the account transactions information to financial planning service is triggered on every customer's visit to the service. Private Netbank will store the information on last update of the transaction information and based on that will request update for dates not yet updated to the service. Private Netbank needs to manage the earlier discussed issues of current date account transactions in similar fashion to solution A.

As main information of the financial planning service exists in portal transaction database, Private Netbank must be able to extract this information from the database. For this purpose, Private Netbank user interface will use the stored database procedures

stored in the portal transaction database. The portal transaction database will also contain stored procedures for customer's category updates for the account transactions.

Private Netbank will also act as customer's user interface towards personal category database. Personal category database contains both customer's personally created categories as well as customer's personal automatic categorization rules. Administration of both features will be implemented to Private Netbank. This will be performed by utilizing the stored database procedures available in the personal category database.

5.6.7 Key Development Areas of Technical Solution B

This chapter will present the most important development areas regarding the proposed solution B. Some of the areas need to be developed completely, whereas some areas already exist but require new additional functions.

As the proposed solution B is based on utilizing databases to provide financial planning service, most of the development is around databases. This development includes setting up new databases and implementing required stored procedures in the databases and the use of them from the user interface side.

The category databases are required to be set up completely as such databases do not existing at the moment. In addition to category databases, obviously the portal transaction database is required to be developed completely. However, the technical set up of the databases are fairly simple and they can be deployed on existing infrastructure.

The transaction retrieval service needs to be further developed to meet the needs of the financial planning service. Future features should include sending account transaction details, including customer's net bank ID, to categorization service. The retrieval should also support fetching account transactions from several accounts within one request.

The categorization service functions must also be developed from the very beginning. The main actions regarding categorization service, in addition to automatic categorization logic, are building the interaction with category databases and transaction retrieval service.

The implementation of financial planning service requires considerable amount of development in the Private Netbank. Private Netbank contains all the customer user interfaces including the creation of the graphical presentation of the information. In addition to developing the user interfaces, the integration with the databases needs to be developed.

6 Solutions Comparison

6.1 Qualitative Comparison of the Solutions

This chapter compares the previously presented technical solutions based on how well each solution performs in fulfilling the required services. The solutions are also compared based on other features such as the ease of implementation and possibilities for future use. Both technical solutions provide the same features and the same user experience for the customer. However, from implementation point of view they are very different and have different qualitative attributes.

Technical architecture of solution A is simpler. Most of the service logic is in FAST ESP and Private Netbank. FAST ESP performs and provides the automatic categorization, administrative tasks of the automatic categorization, storing and updating of the data, whereas Private Netbank provides the user interface for the service and the data processing to graphical presentation. In solution B the service logic is more spread out. Private Netbank is similarly responsible for providing the user interface and the data processing to graphical presentation, but the data is stored in several databases which makes the implementation in Private Netbank more complex. In addition, a new service is required to perform the automatic categorization.

FAST ESP used in solution A has never before been implemented in Private Netbank environment and is therefore an unknown development environment. This might result in difficulties in foreseeing possible problems and challenges. On the other hand, FAST ESP is a system which should integrate easily to most environments and the out-of-the-box APIs should make integration simple. The implementation of the more traditional database based solution B is similar to many existing already implemented services. As a result, the implementation of solution B should be more straightforward and possible issues and challenges foreseeable.

As FAST ESP is a search engine platform, it has been developed to manage great number of search request to its index. In other words, this means that it will provide sufficient performance for the information retrievals by financial planning service from Private Netbank. From the financial planning service point of view, this results in perceived performance of the service being in required level. However, as the categorized account transaction data is very structured and all data fields have limited lengths, the use of FAST ESP for storing and searching the information does not provide significant performance advantages. The solution B, utilizing database for storing the categorized account transaction data, can provide equal performance through successful database indexing.

If the financial planning service becomes very popular service among customers and there is a need for scaling up the service for performance reasons, the FAST ESP used in solution A scales up easily as upscaling search engine performance is standard procedure by adding hardware for FAST ESP. Database solution B can also be scaled up to guarantee required performance. However, this process is not quite as simple. It requires an investigation of the bottle necks of the process and planning and executing the required actions to improve the performance. The reasons for poor performance in solution B can for example be lack of database connection from Private Netbank or inadequate indexing in databases.

The search queries performed from Private Netbank to categorized account transaction data are fairly static. For this reason they can be implemented from Private Netbank to either FAST ESP of solution A or the database of solution B. However, implementing the search queries to databases requires implementation of the stored database procedures in the databases and the use of these procedures from the customer user interface. FAST ESP has more flexible query interface, thus likely decreasing the amount of changes needed to be implemented in the databases and Private Netbank in the case of alternations of the financial planning service.

In solution A, FAST ESP also offers an out-of-the-box user interface for administrating the automatic categorization. Through this user interface Nordea product owner can easily update the automatic categorization rules and the changes are in effect immediately. The same user interface would as well provide means for updating customers' personal automatic categorization rules if the need for such changes would arise. As the automatic categorization rules are stored in database in solution B, the updates need to be made by directly manipulating the database records with database scripts. Other way of resolving this type needs is to build a separate user interface for the automatic categorization administration. In either case, solution A based on FAST ESP provides more straightforward approach to the issue.

FAST ESP also provides out-of-the-box tools for the content refinement, in financial planning service content refinement is needed for the automatic categorization process. However, automatic categorization process is straightforward and it can be implemented with separate categorization service presented in solution B. The efficient content refinement capabilities of FAST ESP would only be fully utilized if the content would be refined from several sources. In financial planning service all categorization rules are stored within FAST ESP. Therefore, FAST ESP in solution A does not provide considerable extra value for automatic categorization process compared to categorization service of solution B.

Utilizing FAST ESP provides additional value by offering reporting from for example performed search queries. The provided reports would supply valuable information on the usage of the service, thus giving important information for the future development

of the financial planning service. In addition, FAST ESP includes alert service in which alert rules can be specified. The alert service can be setup to send an automatic alert for example if FAST ESP recognizes that several users have added same personal category. Based on the alert, a decision could be made whether to add the popular personal category to the set of predefined categories in the service. Furthermore, FAST ESP provides means for managing search query results by search filters called navigators. Navigators can be used to for example automatically group the search query results. In other words, FAST ESP could group the account transactions requested by Private Netbank based on the category, thus providing required information for the graphical presentation and relieving Private Netbank from this data processing.

Solution A exploiting FAST ESP provides more possibilities for further development. Due to its flexibility, FAST ESP can easier be altered to meet the changed requirements of the financial planning service, thus making it faster and cheaper to implement new features. Furthermore, having an implementation of FAST ESP in Private Netbank environment offers possibilities to utilize the platform for other services in Private Netbank as well. Solution B is more fixed and the use of the implemented system and technical architecture for other services is very limited.

The use of the transaction retrieval service in both solutions ensures the online transaction information in the financial planning service. In addition, this approach also guarantees that only information that is actually needed in the financial planning service is stored in the service.

Both solutions offer equally opportunities for implementing the removal of the account transactions from the financial planning service, in case there is a need for a scheduled deletion of the outdated transactions. In the solution B, the removal can be handled simply by deleting all database records which have transaction date older than the set value. In the solution A, FAST ESP out-of-the-box tools can be used to perform similar action.

Table 3 summons the comparison results of the two technical solutions. In the table solution marked with “x” offers better means for fulfilling the feature in question. Based on the qualitative comparison solution A seems more suitable for implementing financial planning service. However, most of the features where solution A exceeds the solution B, such as additional features and future development, are not part of the original requirements or may not ever actualize.

Table 3: Comparison summary of technical solutions

Feature	Solution A	Solution B	Arguments
User interface, user experience	x	x	Both technical solutions provide identical user interface and user experience.
Technical architecture	x		Technical architecture is simpler in solution A.
Familiarity of technical solution		x	Solution B is based on technical components that are already in use in Private Netbank environment.
Performance	x	x	As the financial planning service is based on structured data, similar performance can be offered with either solution.
Scalability	x		Scaling up solution A is simpler.
Search query implementation	x	(x)	Search queries from Private Netbank can be implemented from both solutions. However, solution A search query interface is more flexible and may adapt better to possible changes.
Administration tools and user interfaces	x		FAST ESP of solution A provide out-of-the-box administration user interface for maintaining automatic categorization.
Enrichment of information	x	x	Both solutions offer possibilities for implementing automatic categorization. Although FAST ESP in solution A offers efficient tools for data enrichment, these tools are not fully exploited in the financial planning service needs.

Additional features	x		FAST ESP provides out-of-the-box tools for reporting, alert service and navigators (filters for search query results)
Future development	x		Implementation of FAST ESP in Private Netbank environment provide numerous possible future uses.

6.2 Quantitative Comparison of the Solutions

This chapter compares the technical solution A and technical solution B based on their quantitative features. In practice, this is performed by comparing the work amount and cost estimations of implementing the solutions. As both types of estimations are considered to be company confidential material, the estimations are displayed in work and cost units. The units were calculated by multiplying all work amount and cost estimations with the same coefficient, thus hiding the actual values but retaining the ratio between the amounts and costs in both solutions.

Tables 4 presents the work amount estimations for the implementation of the two technical solutions. Overall, implementing financial planning service utilizing FAST ESP costs nearly four times more than with solution based on utilizing databases. The main difference is caused by implementation of FAST ESP to netbank environment. Implementation of FAST ESP has proven to be very laborious in previous projects as well. In addition to implementation costs, there are also licensing costs related to utilization of FAST ESP. The licensing cost is related to the number of required FAST Search Servers. The licensing costs are displayed in more detail in table 5.

Table 4: Estimated work amounts / costs for solutions A and B, work amount estimations and costs are relative, not absolute (not in hours / EUR)

Task	Solution A	Solution B	Comments
Private Netbank UI and required connections to other systems	252 / 22 680	294 / 26 460	
Database(s) implementation	84 / 7 560	360 / 32 400	
FAST ESP implementation	3 600 / 324 000	-	No FAST ESP implementation for solution B
Transaction retrieval service changes	42 / 3 780	42 / 3 780	
Categorizing service implementation	-	198 / 17 820	No need for categorizing service in solution A
Documentation and testing	300 / 27 000	300 / 27 000	
Total	**4 278 / 385 020**	**1 194 / 107 460**	

Table 5: FAST ESP license costs, costs are relative, not absolute (not in EUR)

Number of FAST Search Servers	Max. number of transactions stored	Costs
1	15 000 000	78 000
5	75 000 000	390 000
10	150 000 000	780 000
20	300 000 000	1 560 000
50	750 000 000	3 900 000

Estimating that five percent of the one million active net bank customers would use the financial planning service and each of these customers have approximately 1 500 account transactions stored in the transaction system, this would already equal 75 000 000 transactions stored in financial planning service. Consequently, this amount of transactions would require more than five FAST Search Servers to have some room for

growth and yield to over 390 000 in licensing costs. In fact, the licensing costs alone will double the implementation costs of the solution based on the FAST ESP. Moreover, the amount of transactions would grow with over 4 million transactions every month. As a result, the number of FAST Search Servers would need to be increased very soon after the service launch. The account transaction estimations are based on statistics of the average card transaction and payment amounts due a lack of adequate account transaction statistics.

The costs of hardware has been disregarded in these estimations as the need of hardware is approximately the same for both solutions. Furthermore, the hardware costs are not a cost driver in the evaluation. The cost of hardware compared to costs of work and the FAST ESP licenses are minor and can therefore be disregarded. In addition, no operation costs, such as technical support work or application maintenance expenses, have been included in the estimations. Operation costs of both solutions can be expected to be on the same level as the solution features are alike and therefore operation costs were excluded from the estimations.

7 Conclusions

7.1 Results

Implementing the financial planning service by utilizing FAST ESP offers some advantages over the more traditional implementation based on the usage of databases. The solution using FAST ESP has a simple technical architecture. Furthermore, the implementation of searches over out-of-the-box provided API is straightforward and offers flexibility. In addition, the provided user interfaces of FAST ESP ease the administration of the financial planning service. Solution build on FAST ESP should also scale up easily if this is required due to performance reasons. FAST ESP also offers additional features, such as reports on performed searches, configurable alert service and search result filters, which can be used to ease the implementation or to further improve the financial planning service. In addition, the implementation of FAST ESP in the netbank portal environment would enable usage of FAST ESP in the net banking area for other purpose in addition to the financial planning service.

However, due to significant difference in the implementation costs it seems unfeasible to implement the financial planning service by utilizing FAST ESP. All required features of the financial planning service can be also offered by implementing the service by using of databases with significantly lower costs. In fact, implementing the financial planning service with FAST ESP is over seven times more expensive, including the licensing costs of FAST Search Server, than by utilizing database approach in providing the service. Although the solution based FAST ESP offers some advantages, the value of them comes with excessive costs. Some of the advantages are such in nature that they might never be exploited. The high licensing costs reveal main factor which makes using FAST ESP unsuitable for the purposes of the financial planning service. The transaction data stored in the service consists of great number of individual records, but each record contains very little information. The advantages of FAST ESP emerge in the opposite situation. Each data record can contain large amount of information, even in unstructured format, and, if the number of data records is not as great as in the case of financial planning service, the licensing costs of FAST Search Servers will not rise so high.

7.2 Result Analysis and Limitations of the Study

This chapter analyzes the study result validity by utilizing the validity criteria presented in chapter 1.4 describing the research methods. Yin lists four different validity criteria, construct validity, internal validity, external validity and reliability [3]. The result validity will be analyzed based on the construct and external validity and reliability. Internal validity analyze will be disregarded as it valid only within studies examining causal relationship.

7.2.1 Construct Validity of the Study

The study was constructed by identifying three analysis units, definitions of financial planning service, the two alternative technical solutions providing the financial planning service and the feasibility of implementing financial planning service with solution utilizing FAST ESP. The data for the first and the last analysis unit was collected in a stakeholder interview, whereas the definitions of the financial planning service acted as the data for the second analysis unit. Due to current resource allocation situation at Nordea, the number attendees to the interviews was very limited as well as the time attendees could spend on the task. This may have caused some imperfections in the data collection, thus altering the final result of the thesis. Moreover, the two presented technical solutions were designed on a rough level and further examination might reveal faults in the design that can have effects especially on the quantitative comparison. However, as the difference of the solutions in quantitative comparison was significant and the result of the thesis was mainly based on this difference, it is unlikely that these shortcomings of the study would change the final result of the thesis.

7.2.2 External Validity of the Study

The external validity of the thesis is very limited. In fact, the result of the thesis is only valid within the respective research problem and cannot be generalized to any other area. The used methods and the course of the study can be utilized in any similar study examining the feasibility of implementing a service in Nordea's net bank.

7.2.3 Reliability of the Study

The data collection for the study was mainly based on the responses gathered from the stakeholder interviews. Changing the stakeholders in the interviews may result to different outcome. Moreover, the designs of the two technical solutions was created by the researcher and although the designs were reviewed with an expert, different designs of the solutions are also possible. However, regardless of the changes in the interview results and designs, it is unlikely that the final result of the study will change. Therefore, although some partial results may change, the final result of the study can likely be reproduced by performing the operations of the study again.

7.3 Future Work

This chapter lists suggestions for future work. The suggestions include future work regarding the thesis as well as some other views on implementing financial planning service.

If a decision is made to proceed implementing the financial planning service with either solution presented in this thesis, the work amount estimations need to be clarified. As mentioned earlier, due to limited resources available for the estimation task the work amount estimations are on a rough level and are not detailed enough for project

budgeting. In addition, the definitions of the financial planning service might require some clarifications. The service definitions used in this thesis were created in order to provide enough information for the solutions design and work amount estimation task and, therefore, might not meet the requirements of definitions for development.

Although utilizing a business intelligence system for providing the service was disregarded in this thesis, this might present an interesting study subject. There are some similarities in the financial planning service and business intelligence systems. Business intelligence systems are traditionally utilized to support decision making within company, but as discussed by Hamilton in [8] business intelligence system can be utilized to offer services for customers as well.

During the execution of the study, Tieto and Balancion announced their agreement on co-operation. Tieto provides the net banking software platform used currently in Nordea. The co-operation of the two companies will likely result in Balancion service features to be added as part of the net banking software platform. In practice, this could mean that soon Nordea will receive all features of the financial planning service as a part of the net banking software platform, thus making the implementation of Nordea financial planning service futile.

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Appendix A – Stakeholder Interview Attendees

Attendees in the first stakeholder interview, held at Nordea on 27.1.2011:

- **Jarna Manssila**: Private Netbank Business Developer
- **Tomi Hakari**: User Interface & Research Specialist, Private Netbank
- **Timo Sutinen**: IT Architect, Netbank Platform team

Attendees in the second stakeholder interview, held at Nordea on 25.2.2011:

- **Teemu Pesonen**: Senior IT Infrastructure Specialist, Technology platforms, FAST ESP
- **Teemu Reingoldt**: Senior IT Infrastructure Specialist, Technology platforms, FAST ESP
- **Tero Kivisaari**: Software architect, Fidenta Oy