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A User-Aware Financial Advisory System

by

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A User-Aware Financial Advisory System

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Abstract: Latest reforms on public retirement provisions brought about a need for consultation on the customers' side and require a vast amount of qualified consultation from the side of the financial service companies. At the same time both parties require a pre-selection of information. While it is important to customize information for private use because of the consumers personal background (eg legal status, number of children, financial knowledge), for the consultation it is merely a question of efficiently providing their employees with adequate data at minimal costs (taking eg search-time as a cost-driver into account). An online advisory system for these groups, which guides the user on the basis of his wishes and needs through the consultation process, is to be introduced in this paper.

1 Introduction

Retirement planning lately moved in the focus of interest of both the financial services companies and the customers in Germany after the public retirement provisions reform [Bu03]. The latter revealed to everyone that public retirement provisions will no longer be sufficient for an adequate standard of living. To ensure a satisfactory level, private savings for retirement - including company retirement provisions – need to increase substantially.

For establishing such services financial services companies need efficient ways, particularly in the retail segment, to provide adequate consultation at minimal costs allowing for profits in a highly competitive environment. For customers on the other hand retirement planning decisions are crucial if not vital and thus they are looking for excellent consultation in a universe of a very large number of - partially complex - products. Searching the internet for an adequate retirement planning system however shows that the majority of the offered online-tools does not consider the needs and wishes of the customer and provides no guidance through the multitude of questions and information, so that many users need help from a professional consultant.

Our approach aims to develop an online advisory system that does not only provide powerful financial tools but guides the user through the whole financial planning process, taking into account his needs and wishes, offering the user just the information he needs in his situation. As will be shown in the following chapters, the software consists of an interaction system that guides the user through the application, an interactive financial planning module for optimizing the individual portfolio and a product agent that retrieves adequate products for the user's needs. An adaptive information system is integrated, providing background information and decision support appropriate to the user's needs.

The questions that arise in this context are: How can information about the customer be used to individualize the consultation process and result? What influence do roles and situations have on the individualization? How can the consultation process and documents be adapted to the customer's needs? Where can we get adequate products that match the consultation result?

As we bring together various research areas in our project, our work is influenced by a range of other works. The major approaches in the field of user-aware e-learning and information systems are mostly based on the works of Brusilovsky **[Br97]** and de Bra **[BC98]**. The adaptation of workflows is currently considered an important topic that is eg also discussed within ADAPT$_{flex}$ **[RD98]** and in the works of van der Alst **[Va01]**.

The product searching and comparison agent was built using the experiences and results of the vast field of agent programming, outlined eg in **[JW98]** and **[MGM98]**. Other important topics include Knowledge Acquisition [Scott, Clayton et. al. 1991] and Representation using Ontologies **[Gu98]**, Preferences **[Da01]** and Internet Privacy **[Me99; Cr03; LCM03]** and Identity Management **[JG00; CK01].**

The project described in this paper is a result of our work in the Bavarian Research Cooperation for Situated, Individualized and Personalized Man-Machine-Interaction [FORSIP] that is funded by the Association of Bavarian Research Cooperations [ABAYFOR]. It aims at providing solutions that cover all the steps from detection of the environment and situation to intelligent action and reaction of the system to the current requirements of its users.

Our article is organized as follows: we start with an overview of our business case and give a detailed problem analysis in chapter 2, before we define certain terms that form the basis for situational adaptation, individualization and personalization (SIP) in chapter 3. Then we present some aspects of concept and design of our application and give an overview of its architecture in chapter 4. The article concludes with a summary in chapter 5.

2 Business Case and Problem Analysis

Description of the consultation process

A customer will be satisfied by a financial consultation if - given correctness in financial aspects - his wishes, needs, interests, his social and financial restrictions, respectively are well considered in the consultation and reflected in the proposed solution. This can be achieved by estimating the customer's "hard" goals, restrictions and "soft" wishes. Traditionally relevant goals are maximizing the rate of return and minimizing risk. But often other goals can also play an important role for the customer and should thus be reflected in determining adequate portfolios: flexibility, comprehensibility and manageability [BFK03].The individual goals for each customer can be concluded both from the attitudes of the customer and the consultant's judgment on the customer. While the attitudes reflect needs, wishes and interests of the customer himself, the consultant's judgment of the customer's social situation and financial restrictions may differ considerably [BFV03][1].

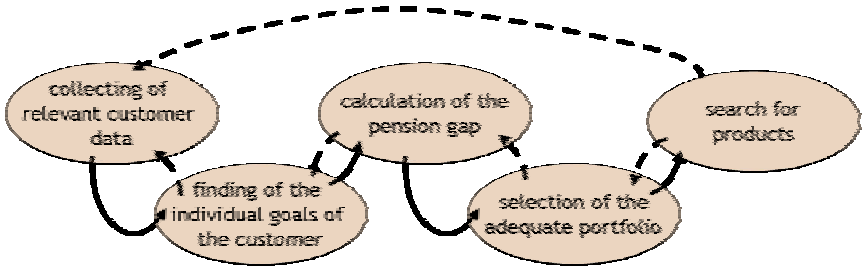

Figure 1 Consultation process

The consultation process itself is designed as follows: A retirement planning event is usually triggered by a change in the customer situation. Eg if the customer starts working after graduation he has more funds available and should start thinking about saving money for his pension time. Thus such an event triggers the customer's readiness to start a consultation and thereby describes both his current situation and the financial needs in the future. Hence the technical requirement comes up that the software must adapt to the customer's individual situation, social and financial expectations and restrictions, hard goals, soft wishes etc.

In the consultation relevant data like desired monthly retirement needs and existing retirement products are collected, if not already available in the consultant's database. In addition further information on the customer (other assets, activities, plans etc.) might and usually will be necessary to derive his goals, attitudes and judgments as discussed before. Also in this step of the consultation the advisory process must adapt to different customers depending on their current situation.

[1] The attitudes and judgements are part of the customer model on which the financial consultation is based on.

After the necessary information is collected the monthly pension gap can be calculated by subtracting the estimated existing monthly retirement provisions from the needed (or targeted) monthly retirement payments. The previously derived customer goals are finally used to pick two or three portfolios[2] from a large number of previously calculated efficient solutions.[3] In addition the customer should also have the possibility to create his own portfolio and compare it with the proposed portfolios: If he wants to change the weight of one goal eg because he thinks that the risk of the portfolio is too high he can reduce this weight and obtain a new portfolio reflecting his adaptation.

In the last step the products included in the portfolio which the customer selected are offered to him after being retrieved from different electronic market places. This implies the existence of an intelligent agent that searches these market places.

Throughout the consultation the customer should be able to inform himself about all relevant topics concerning the application domain. To implement this documents need to be available not only containing the requested information but also allow individual adaptation to the respective customer.

Information delivery in user-aware advisory systems

The advisory process illustrated above mainly consists of two kinds of user-interactions. One the one hand certain missing customer information has to be gathered from the user and on the other hand individual information is presented. Our application provides the following information for the user:

- Financial calculation results: The user gets recommendations for saving amounts, portfolio structures and so on.
- Process information: The decisions made by the system according to the users answers and each following consultation step presents the internally stored domain knowledge to the user.
- Document-based information: Background information is provided for the user as decision support and to improve traceability.
- Web retrieval results: The user is shown the results of a web search for products that match his requirements.

While the individualization of the first mentioned information is mainly given through calculations based on the customer's portfolio data, different approaches are required to choose the "right" information within the other ones. We introduce our concepts for individualized information in the following chapters.

[2] To give the customer a choice and to account for inaccurancies by the determination of the customer's goals we select not only one, but two or three portfolios that are presented to the customer.

[3] A solution consists of one or more product categories. Which product categories can be part of solution depends on the use case (eg for age precaution we used international equity funds, open property funds, bond funds, endowment policies and savings plans).

3 Modeling of "SIP" for Financial Applications

Definitions

To build a solid basis for our project, we first have to define certain terms. The term 'role' is used in different meanings depending on the range of application as shown by Kirn [Ki96]. Therefore an integrated approach is needed which combines various aspects of roles and includes consolidated findings of business and organizational sciences such as cognitive sciences or computer science as proposed by Suessmilch-Walther [Su02]. A role is thereby an objective set of rights, responsibilities and requirements which are associated with a role-bearer because of his or her position.

As a result in the context of our prototype a role represents a group of users, whose user data are similar in certain areas, which results in a comparable need for advisory services. Users with same user characteristics are allotted to the same role. On basis of rule sets special considerations are assigned to adequate roles. An excerpt of typical roles can be seen in Table 1.

Role	Attribute	Role type
Employee	PositionTitle = not homemaker, pensioner	occupational
Single parent	Marital Status = {single, divorced, widowed}	private
	Number Of Family Members ={1}	
	Number Of Child Allowance Persons = {1}	

Table 1: Typical roles in financial services

Personalization in our context is the adjustment to attributes, needs and knowledge of a user. It affects as well the appreciation of information as the presentation style. A risk-averse customer will eg ask for more information then a risky one [SG03].

A situation generally designates the collectivity of the present circumstances and conditions. In our context it is a set of all implementation-relevant information that derive from the individual or global surrounding.

If a certain event occurs, which changes a situation into a new one, a need for consultation is created and actions in the sense of information processing are triggered. For example after giving birth the income of women drops on average by 42 %, which results in an additional need for consultation regarding retirement provisions [Gu03]. An overview of some relevant situation changes can be seen in Table 2.

Situation Change	Attribute
Marriage	Marital status
Divorce	Marital status
Start of Pension	Pension entering age

Table 2 Overview about typical triggers

Information and their individualization

The information people require in a certain situation depend on personal and situation-oriented factors. Besides this, there are two main categories which group the collected information:

- Individual information refers to a single person. One can differentiate between data that derive from the personal background and others that are rather job-related. All these originate from internal sources.
- Global information relate to a group or the users as a whole. These are mainly information on taxes, pensions or laws that derive from external sources.

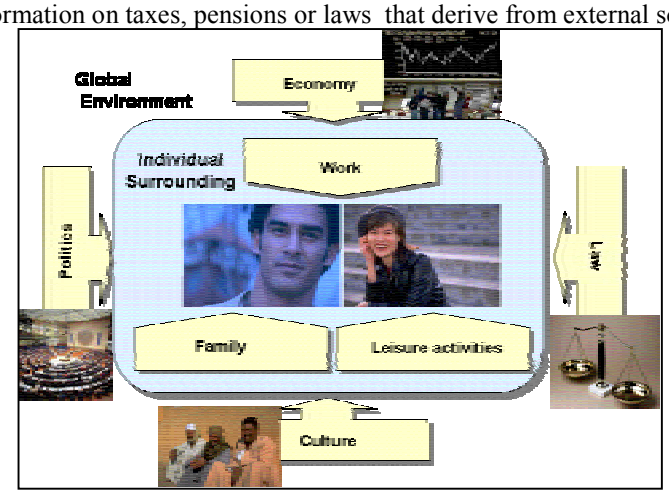

Figure 2 Fields of information sources

This background is the basis to design a system that provides information and gives advice with regard to the general situation of the customer as well as individual requirements of the user. For delivery of information, the idea of "Real-time-Knowledge-Delivery" presented by Davenport serves as a role model [DG02].

The prototype offers the possibility to adopt automatically generated recommendation of the system manually to preferences, aversions and knowledge of the user.

4 The design of a user-aware consultation system

The feature base for individualization

As shown in the last section, individual and global information form the general base for individualization of information. Considering the usage of an advisory system itself, we have additional parameters concerning the context in which the application is used. We define the usage context of our application as a union of the following feature sets:

- The Application Context describes the user's "position" within the application, in our case mainly given by the current step within the consultation process.

- The Technical Environment defines the technical usage conditions like display capabilities, connection bandwidth and so on.
- The Usage Mode contains information about the operating mode of our application as it can be used in a “self-consulting mode” for direct use by customers as well as in an “assistant mode” to support consultants.

Additionally in some cases not the situation itself is the reason for the adaptation to the user’s demands, but it is the change of this information that causes the adaptation. For this reason, the history of individual and global information has to be stored and managed as well as the current information. Figure 3 shows the resulting feature sets that form the base for individualization:

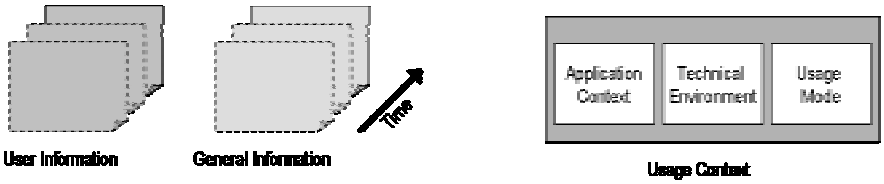

Figure 3 Different feature sets used as base for individualization

Modeling of documents and processes

As the adaptation of an information system to the user’s situation usually results in numerous variations of corresponding information units, it is impossible to consider all imaginable use cases by authoring different information units for each situation. A formalism is required that on the one hand gives the possibility to specify variations for adaptation and on the other hand allows the definition of rules for obligatory information units or process steps.

From the adaptation perspective, we consider documents (resp. document fragments) and processes (resp. sub-processes) as equivalent objects. As they both represent information to be delivered to the user, they could both be described by suitable metadata sets and will both be selected by matching this metadata with the user’s situation description. So we will call them information objects in this chapter.

In our approach information objects are modeled at an abstract level by so called "skeletons” which define the rough structure of these objects without specifying their very details. Based on the skeletons, the variable parts of the objects are selected at runtime by queries to object repositories, considering the objects metadata and the user’s situation. Through this process, the information objects are adapted to, or rather built for, the user’s current demands. Regarding the adaptation process, we can distinguish the following cases:

- Variants of objects: They specify information objects with "equivalent” content apart from adaptation to special situation requirements. In terms of software engineering one could state that object variants all satisfy the same interface but vary in the concrete implementation. For the selection of the concrete object takes place at runtime, this is also comparable to the notion of late binding. Object variants allow the definition of obligatory objects through skeletons as

they allow adaptation to the user's situation while granting the selection of an object of the required class.

- Optional objects: In contrast to object variants, these objects are only selected in the generated object when they match the user's situation due to their metadata description. They allow the delivery of additional information extra process steps for special situations.
- Parameterization of information objects: Information documents as well as process definitions must be configurable through parameters as they are often connected to data that is changed very frequently or is even user dependent. Especially in the financial domain documents contain data as tax rates, income limits and so on, which are changed regularly. So information objects must be configurable by external data sources.

The description of information objects through metadata forms the basis of individualization [DL01][SF99]. The metadata schema we use to describe information objects is, like most of the common metadata standards, based on the Dublin Core Metadata Element Set [DC03]. In our application we need metadata to control the maintenance of information objects as well as metadata to describe the objects' content and its usage. So we have organizational metadata (1), content related metadata (2) and technical descriptions (3), whereof (2) and (3) are used for individualized information delivery.

In our approach document skeletons, just like document fragments, are authored in an extension of LMML [SF02] a model-based XML-framework for educational and information documents. It supports the required fragmentation of documents into smaller units and the description of these objects through the above mentioned set of metadata. This facilitates the storage and retrieval of these documents in XML-repositories.

In a similar way, the definitions of process skeletons and sub-processes can be stored as XML-Documents, described by a set of metadata and also stored in an XML-repository. Beyond this, a process controlling engine is required that allows "late binding" of sub-process instances through feature-based selection at runtime. The process controller of our application is built upon the workflow-engine ULTRAflow that uses a rule based specification language and therefore provides a natural partitioning of process specifications into smaller fragments, what facilitates the evolution of workflows as described in [FRF02].

Searching and filtering of marketplace products

Our advisory system not only provides the user with well grounded domain information, in this case with an apt portfolio for their retirement planning. It also takes the consultation process a step further by providing actual product recommendations. The product recommender agent module is called "Trustee", since apart from implementing a product search function, it features confidentiality and anonymization in order to guard the user's privacy.

For all categories of the portfolio (eg funds, endowment policies or savings plans) a set of products descriptions is collected from internet resources of sellers in real-time. The products are then assessed and filtered according to the user's needs. The best two matches of each category are presented to the user who can then decide over the compilation of their customized personal portfolio. At the very end of the consultation process, a smart portfolio of purchasable products and a collection of complementary information provided by the other modules are handed over to the user as a result.

The functionality of Trustee touches the very core subject of information logistics. Questions like from-where and to-where have to be answered in a flexible manner, but even more interesting is the what-question concerning the information content that is transferred in both directions between the customer (here between Trustee acting as a trustee in lieu) and the seller. Recent studies show [Od03] that sellers increasingly use profiles of potential buyers to fix prizes according to the buyer's assumed willingness to pay [LSY03]. Usually buyers are not aware of where and when they leave traces and clues while surfing the internet [JG00].

In order to get reliable and suitable product proposals from the sellers, certain user data have to be submitted. Eg, to get a realistic estimation for the monthly contribution of an endowment policy, the age of the customer is of vital importance. Therefore to submit a birth date that is in proximity to the real date of the customer is advisable here. By hiding the real birth date, it is much harder for a profile collector to draw cross-references between several enquiries or purchases. This kind of meta-knowledge is the real strength of Trustee. The agent uses domain knowledge and technical knowledge for the benefit of the customer. It is also capable of perusing literally hundreds of product offers in short time.

Architecture of the FORSIP consultation system

The architecture of the FORSIP advisory system (as shown in Figure 4) can be divided into the four layers of modern web based information systems:

- The storage layer contains information objects as documents and processes (skeletons and fragments) as well as user information and product data.
- The access to data and information objects is controlled by the web service-layer that provides high-level-methods for storage and retrieval of all data objects.
- The application modules of the FORSIP consultation system comprise a consultation controller (that controls the main consultation process), a financial optimizer (that performs all financial calculations), a customer model component (determines the attitudes and estimations and the concluding aims of the consultation goals of the customer), a product recommender agent (that retrieves adequate products from the internet) and a document server (that provides user- and situation-adapted information).
- The presentation layer does the processing of information objects for the presentation on different user devices and technical environments and provides the user interface.

As the application is planned and developed as a distributed architecture consisting of numerous modules, clearly defined interfaces and a common vocabulary play a major role in the design of this application. User data and product data are used and modified by all modules of this application, wherefore the use of standard interchange formats for this data on the one hand and well controlled access mechanisms are essential.

For modeling information about the user, we use an extension of the Extensible Customer Information Language (xCIL) [Oa03] that describes an open, flexible structure for the representation of customer centric information. We enhanced this structure by some additional substructures (mainly attitudes of and estimations about the user), that are compliant with the underlying standard specification, so that we can share user information with many other applications, built upon this standard. The same applies to the modeling of product categories and data about single products, wherefore we use BMEcat [Bm03], a German industry standard for product catalogs.

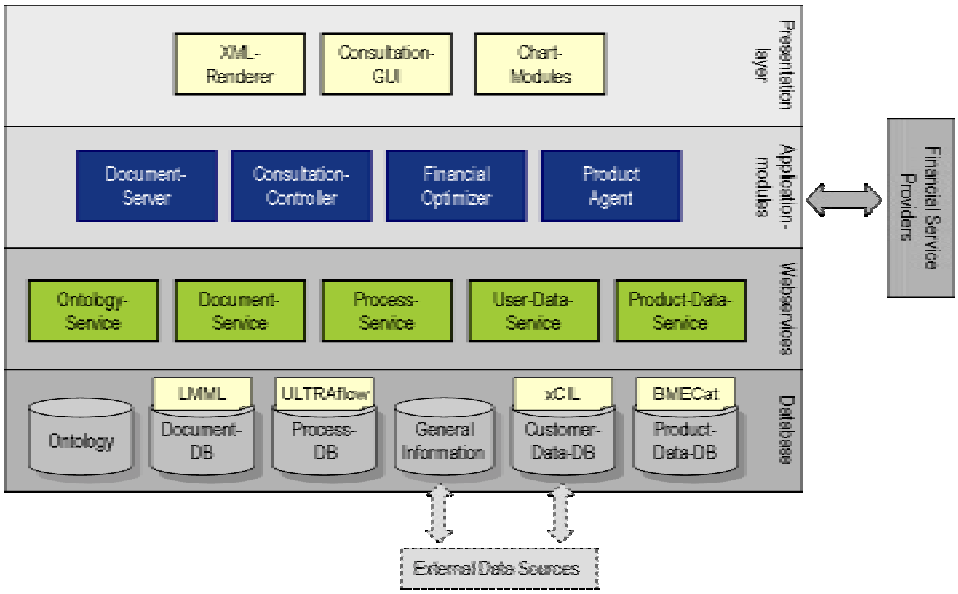

Figure 4 Architecture of the FORSIP advisory system

Whereas the above mentioned standards define the necessary structures for the retrieval and storage of these data, the bulk of vocabulary to use can't be specified by these standards, as most of it is quite application specific. Since the modules of our application however must "understand" the meaning of the user data and product data values, a common ontology is used in our project that determines the available data vocabulary as well as the relationship between different terms.

The latter facilitate the retrieval and adaptation processes in our application, as the metadata attribution of the information objects often is performed at another granularity level as user and product data are modeled. In our system eg we store very detailed information about the user's graduation. For the presentation of background information we just distinguish low, medium and high graduations. The classification of the particular user graduation into one of these categories is then given by the ontology.

5 Conclusion

Our advisory system prototype gives an example how a customer can be led through a complex financial consultation process, without loosing his bearings in this complicated domain. Our solution is a mixture of assigning a certain role to each customer on the basis of "hard facts" (eg legal status, income) while at the same time bearing in mind his risk-awareness and other "soft facts". Based on this information an individualized portfolio is designed and through a recommender agent anonymous requests result in actual product suggestions. The key to success is to be individualized information as well as a connection to actual products and portfolios throughout the whole consultation process, providing customers with the knowledge they need for a competent decision on their retirement provision.

Further work aims to extending our user model as well as improving the matching and retrieval methods to allow not only exact fits but also best fits for the user's needs. The application itself will be extended step by step to other areas of the financial domain

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