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***Abstract*-The advent of the internet is revolutionizing the financial services industry. In the future, electronic banking (EB) will become a strategic factor, evolving from mere transaction banking to the provision of individual, highly customized solutions. For this new way of EB it is essential to have a profound knowledge about the customer. In this paper, we discuss customer modeling as a solution for establishing a central repository, which can provide services for various EB-applications. We show that those generic customer models should include both, knowledge, e.g. about risk-affinity, attitude towards net present value and affinity towards special products, represented as preferences, but also plain information, like age and know-how. Furthermore, we suggest an approach for one-to-one-banking, which, in a first step, completes customer models from given information and thereby lays ground for the ongoing step two, in which user specific actions are inferred.**

## I. INTRODUCTION

The advent of the internet and its consequences on business and society is revolutionizing the financial service industry (FSI) today. The market for electronic banking (EB) has been rising with an astounding pace in recent years. Especially in Europe, direct banks, discount brokers and financial intermediaries heavily populate the internet [1]. Low end customers, which usually do not get full service due to their low profitability, will experience a significant increase in provided service, since EB is mainly driven by fixed costs in contrast to traditional banking. With still drastically falling IT-prices, this effect will be increasingly relevant for higher customer segments as well. With the "net kids" becoming "net adults", EB will evolve to be much more than just a nice feature, but rather the strategic instrument for the financial service market of the future. However, the special chances and risks of EB have only rarely been investigated and incorporated into overall strategies. Based on [2] and [3], for this paper, EB implies all kind of financial services through electronic channels like electronic cash systems, self-service-terminals and especially all different ways of remote banking (i.e. internet, mobile phone, WAP or proprietary electronic markets like T-Online).

At the moment, EB is mainly limited to transaction banking and thus is a commodity product, that is characterized by non-complexity and homogeneity. Search engines and shopping agents (i.e. http://www.aspect.de) provide customers a market overview at their fingertips. This enhances the already existing problem of decreasing client loyalty in the FSI. Banks do not only suffer from the loss of customers but also from increasingly competitive markets and decreasing margins in these markets [4]. Several studies revealed that, especially in the FSI, customer satisfaction and customer loyalty have a strong positive correlation [5], [6]. However, standardized EB products are not customized and usually do not meet the complex financial needs of customers [7]. Such poorly served customers will - not surprisingly - easily substitute these homogeneous products for competitors' products. To summarize, the key factor for a successful EB strategy is to transform EB products into individually, according to the customers' needs and preferences, customized solutions for customers' problems. This notion requires a new understanding of doing business for companies in FSI, especially of doing business electronically.

At the moment, the segment-oriented approach is still prevailing. Based on a comparably small amount of quantitative data, customers are assigned a certain segment, each of which represents one identified model customer type, which each consultation is based on. Since there is heterogeneity within a segment, the consultations do usually not meet the customer's needs and a basic marketing paradigm change is required. The traditional segmentation models in the FSI have to be superseded by the one-to-one-marketing approach.

The one-to-one paradigm is characterized by an entirely different philosophy: the center of interest is not to sell products but to serve the customer. This involves a reorganization of the value chain with the individual customer at the beginning and not at the end of it. Marketing is not done by cluster-analysis in order to assign each customer a segment, but by detection of preferences in order to optimally meet the customer's needs. The underlying data for this approach is not just a small amount of quantitative

| Traditional Banking | | 1-to-1-Banking |
|---|---|---|
| Assign standardized products to customer segments | **Goal** | Satisfy customer needs |
| Products | **Center of interest** | Customers |
| Quanitative | **Data about customers** | Qualitative and quantitative |
| Customer is the end of value chain | **Processes** | Customer is the beginning of value chain |
| Cluster analysis | **Marketing Methods** | Deduction of preferences |

Fig. 1. Paradigm change.

data but all relevant available qualitative and quantitative data [8], [9].

However, one-to-one-marketing is not an invention of marketing experts in recent years. This approach was - probably without even knowing the term - practiced in every grocery shop before mass production and mass marketing was introduced. The owners or sales persons had a personal relationship with their customers. They knew their background, family, profession, needs, and preferences. All this knowledge helped to meet the customer's individual needs perfectly [10]. The reason why most of the grocery stores or small personal banks have been superseded by supermarkets and big national and international retail banks is that one-to-one marketing used to be very (human) resource intensive. The high marginal costs forced banks to offer standardized mass products. However, one of the main characteristics of information technology (IT), its negligible marginal costs per customer, could reduce the marginal costs of the one-to-one approach drastically. Consequently, IT will not only be the enabling technology for individual electronic banking, but also, through channel integration, for individual banking over all channels [11]. Finally, there will be two, one human and one virtual, consultants that will complement each other by the means of their competitive advantages in order to maximize their customers' utility.

Financial services permeate all aspects of customers' lives, i.e. transaction account, life insurance or investments. In order to provide an individual solution conveniently, the objectives by which the quality of service are measured by the client are to be known. Therefore, individual one-to-one EB requires a set of knowledge as complete and consistent as possible about every single customer present at any interface. A way to represent knowledge about customers sufficiently powerful and generic in order to represent everything of significant importance to the bank is needed.

A repository that is able to deliver a well defined interface to this knowledge has to be designed. This paper aims at developing the first steps to such a repository. We will develop a concept for customer modeling that is founded on work done in the field of user modeling. This model will have to operate both as a universal repository and a user model in internet based self-consultation systems.

## II. WHAT IS CUSTOMER MODELING IN THE FSI?

The concept of user modeling has its origin in AI research and in research done in the USA in the late seventies. Whereas a lot of functioning systems have been designed since, a real breakthrough has not been achieved yet [12]. User modeling traditionally focuses on the development of adaptive software systems. These are systems that adapt looks and functionality according to the needs of users or groups of users [13]. Notice that it is not the main aim of user modeling to develop a generic repository of knowledge about the user. Before going further into customer models some definitions are required.

### A. *State of the Art User Modeling*

Current definitions are either based on defining the nature of user models or on defining the function of user modeling. An example for the latter is Mertens's view. He sees user models as knowledge that enables computers to adapt according to the needs of human beings [14]. An example for the former is Kobsa's view, he states that user models should be made of explicit assumptions on the user's goals, the plans, the user assumes to be able to reach the goals with, and the user's knowledge or beliefs [15]. Today's so called pragmatic approaches focus on the function and argue that a definite distinction between categories of knowledge is neither necessary nor possible [14].

We think that these pragmatic approaches lead to a number of problems that are relevant especially in the FSI domain and render the design of the demanded repository of knowledge about the user not practicable. The main problems are:

1) *Acquisition and verification of knowledge*: Today user modeling approaches collect information about users either by tracking their behavior (usage modeling) or by asking questions [14]. The former are called implicit the latter explicit models. Implicit models have to cope with problems of precision. If, for example, a customer looked for information on a stock implying high risk it then would not necessarily be right to mainly offer similar information or similar products further on. The explicit way of acquiring information by asking questions is limited in two ways. Firstly, the user is required to have a consistent view of how these questions are to be answered. This, especially in the FSI domain, is not guaranteed as users are mostly non-experts. Secondly, the amount and complexity of questions that can be asked is limited by users' patience and openness.

2) *Classification, formalization and storage of knowledge*: It is important to say that no matter how the process of acquiring information about users is organized, the result is an abundance of unsorted information. Certain and uncertain information, unchangeable facts, and momentary sentiments are all mixed up. The result is a wide range of semantics. As described, one of the key points of pragmatic user modeling approaches is not to try to sort this out: Information gets stored as acquired, and no classification or formalization takes place. We consider this as a major problem with respect to our goal of providing a customer model with a clearly defined interface. We believe that we need a structure powerful enough to contain as much semantics as possible.

3) *Usage of knowledge*: The third area of problems of today's approaches concerns the process of deducting actions. As mentioned above, our customer models shall be able to represent the knowledge of the bank about its customers in a wide variety of situations. As described, user models developed by pragmatic approaches do not deliver a

well defined interface. Therefore, a lot of knowledge is necessary to use the stored information correctly. That is an enormous obstacle towards a use as generic repository.

### B. *Content for User Models in the FSI Domain*

Like every model, a user model is a view on reality that reflects what is relevant in order to solve a problem. Whereas information on customers is not scarce even if distributed throughout the bank from central databases to the customers' individual consultant, consultation requires not only information but knowledge. Knowledge today is limited to individual human consultants. Our customer model aims at changing that and thus at enabling modern banking. Knowledge shall be seen as applicable information that is separated from simple information by a higher degree of abstraction and is generated from simple collected information by experience, deduction, or induction.

1) *General knowledge about the domain*: As mentioned, a consultation in terms of modern banking is based on the customers' needs. The necessity to model customers' needs also constitutes a minor difference to Kobsa's perspective described above: he focuses on goals. As we are designing a customer model adequate for consultation purposes, we cannot rely on the assumption of general correctness of customers' goals. We have to model the customers' needs that may vary from the goals. That happens if a customer went wrong when defining his goals. In order to know where the customer should go, we need knowledge about the domain. For example, if a customer states that he plans to invest in real estate and wants to finance by credit partly, the need could be that the customer is informed on those topics but also that alternative actions considering investment or financing should be evaluated.

2) *Preferences as knowledge about individual customers*: As shown, the customer model has to be able to express the customer's needs. Statements that express closeness or distance towards problems or products shall be called preferences. This definition may sound unusual at first, but a closer look reveals that this only means a minor extension of the traditional definition. We consider this augmented definition to be appropriate to represent the knowledge about needs exclusively by preferences (and do not have to address, for example, dislikes separately). From the needs addressed in the example above a preference towards long time investment could be deducted. We consider a few categories of preferences relevant for describing the customers' needs. The main focus is on basic attitudes like risk affinity or the tendency to convenient or financially optimized solutions[1], the affinity towards problems like investment or risk coverage and the affinity towards products like certain stocks. Individual preferences are not permanent but change over time. A change is triggered by new information and on the base of general knowledge.

3) *Information*: Knowledge should play the dominant role in the consultation process. Nevertheless, we believe a usable customer model for the FSI domain is also required to include information about the customer. As mentioned, a wide range of information about customers is present in every bank. We regard some categories as especially relevant. These are personal data like age and earnings, the customer's interaction history on traditional and electronic ways and the customer's know how on different FSI topics.

## III. A Process for Customer Modeling in the FSI

Now we have seen what content a user model adequate for financial services consultations should have.

But not only the contents of the customer model are different. Also the inference process, from getting to know the customer up to inferring the appropriate actions - these actions may vary from mere providing of information to consultation in selection and combination of complex financial products, has to be adapted to the specialties of financial services in order to achieve acceptable results.

Let us first have a look on the state of the art process as it is now widely used within consulting support systems.

### A. *The state of the art process*

As figure 2 shows, starting from the user model which is filled with information provided firstly by the user him-/herself (at the beginning of the consultation process) and optionally, secondly by customer databases. The inference process uses the formally represented information within the user model together with a domain specific and a domain independent database and deducts, depending on the implemented inference method, the most appropriate action.

Having described the standard process very briefly, let us now have a look at the shortcomings of this approach, which will serve as the starting point for our suggested enhancements:

The main weakness is that the inference process cannot rely on a profound knowledge about the customer's preferences. This is true because lots of knowledge remains implicit, i.e. not formally represented. The more one knows about the customer, the more one will be able to generate individualized actions. Therefore, one of the key factors of effective automated consultations is to deduct as much knowledge as possible about a customer's preferences from the information which is either entered by the customer/consultant themselves or has been recorded in former sessions. Although this is only common sense when it comes to customer modeling, the awareness of the

[1] By modeling such attitudes we want to take into account what is done in the field of behavioral finance. We think that nevertheless the problem remains that no general statement is possible whether a consultant should mainly follow the will of his customer or should try to educate.

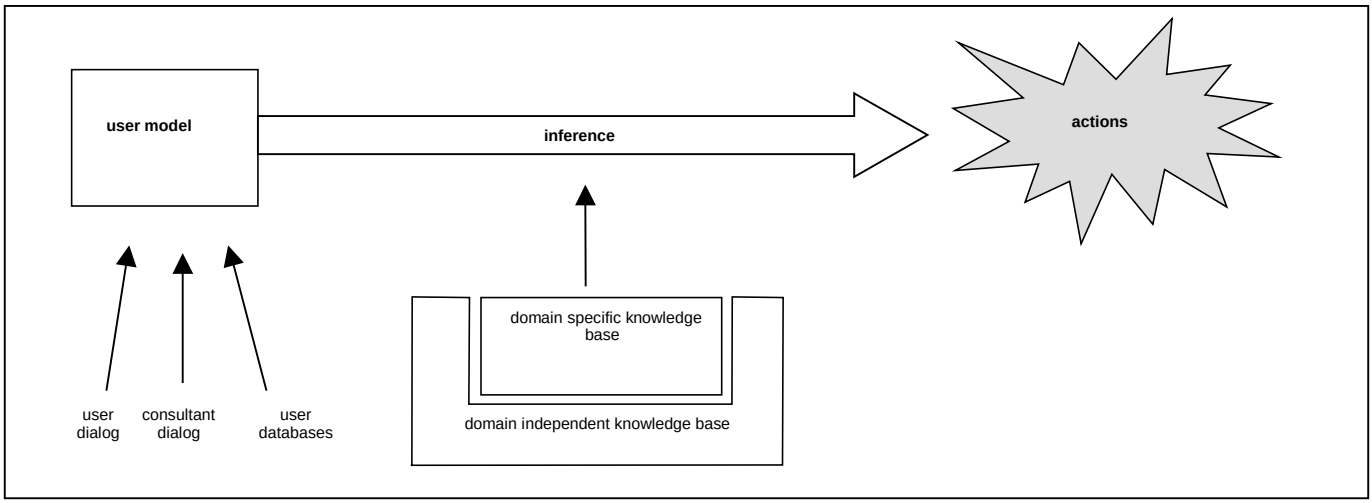


Fig. 2. State-of-the-art process of individualized banking based on customer models.

importance for an explicit representation of this knowledge is not. As long as this originally implicit knowledge is not formally represented within the user model, one encounters two problems: Firstly, the generation of deducted knowledge (the customer's preferences) is done somewhat arbitrary, as it is part of the consulting itself. If there are rules in the knowledge bases about deducting preferences, these may be used during the consultation, but the knowledge engineer is not forced to provide such rules when configuring the system. Therefore, the generation of preferences is likely to be neglected, i.e. the potential of high quality consulting by knowing about the customer's needs is not used. And secondly, the generation of this knowledge has to be done for each consultation again.

Resuming, we state that the traditional process is not adequate for the FSI, as it does not necessarily work on the customer's preferences which we identified to be vital for high-quality, individualized consulting.

In the next chapter we suggest an improved process and show how it helps to overcome the weaknesses described above.

### *B. An improved approach*

The main feature of our method is that it enables to establish a customer model as it was outlined in chapter II. This is done by a two-step-inference approach. Instead of putting all inferences into one monolithic process, we split up between the process of generating knowledge about the customer and the consultation process itself. Therefore, the complete process can be described as follows: (see fig. 3)

a) Customer and consultant interaction and references to customer databases fill the customer model with explicit information.

b) The information about the customer will be completed. This can be done e.g. by a process based on stereotypes where a bundle of properties is assigned to the customer, , by the help of triggers [16].

c) The inference process $I_1$ deducts the customer's preferences, corresponding to his/her needs, from the customer information base built up in a) and b). This deduction is done by using domain specific and domain independent knowledge about building customer models. $I_1$ is also called pre-process, because its goal is to prepare the customer model for the next step

d) $I_2$ is the actual consulting process, which determines - starting from an instance of the customer model - the adequate individualised action. This process is supported by a domain specific and domain independent knowledge base built up for consulting processes as well. $I_2$ refers mainly to the preference base which was built up in c), but especially in the FSI, it may be necessary to include plain user information as well, e.g. for parameterizing selected product offers.

During a session, a customer or his/her consultant can enter new information at any time and thereby override information stored in the customer model, made available by stereotypes. The new information may indicate a change in the customer's needs, which triggers the inference process $I_1$ to start again and usually results in a new consultation process $I_2$. As it is useful to store the generated knowledge about the customer longer than for just one session, the customer model will be completely preserved in a customer specific knowledge base and can be restored at the beginning of the next session. This process, addressing implementation and efficiency considerations, is not shown in figure 3 for simplicity of illustration.

Instead of describing each single step of our suggested approach in more detail, we will go on and discuss the features by outlining the advantages which especially apply to our focus, the consulting in the FSI.

1) *The 2-step inference process reduces complexity*: Splitting up the process of knowledge generation into two clearly separable sub-processes enables the knowledge engineers to concentrate on different sub-goals when specifying the methods for knowledge generation. The aim of the pre-process ($I_1$) is to represent adequately the customer within the system. This representation is, from a technical point of view, an instance of the customer model. The aim of step two ($I_2$) is quite different, namely to deduct from the knowledge about the customer adequate individualised actions. Both processes ($I_1$ and $I_2$) are supported by knowledge bases which are – again for reasons of reducing complexity - separated as well.

2) *The consultation process ($I_2$) can be specified more precisely*: The main process can rely on a customer model in which the customer is specified as exactly as possible. Each consultation process can refer to the same structure within the representation of the customer, the only difference being the values of the instance within the customer model, and, depending on the chosen representation method, additional information expressing uncertainty. This allows the specification of the inference process $I_2$ to be based mainly on customer's preferences which can be considered as a prerequisite for effective consulting on financial services.

3) *The two inference (sub-)processes can follow different paradigms*: The pre-process can be categorized as a diagnosis problem, i.e. answering the question what are the customer's preferences although they are not told explicitly. The consultation process tackles configuration and search problems, its task being to find an optimal match between the features of one or a bundle of product's and a customer's preferences [17]. As a result of the separation, it is easy to implement different inference mechanisms as problem solvers for the single steps.

4) *The 2-step approach provides flexibility*: From an architectural view, splitting up the inference mechanism allows for building component based systems. Step 1 implements the generation of the FSI-adequate customer model (our process $I_1$) and offers its services via an interface to layer-2 components, incorporating the consultation process ($I_2$). The relationship between step-1 and step-2 components can be regarded as client-server scheme. The flexibility is based on the possibility to combine different $I_2$-components with the same repository. Therefore, we are not only able to select between different $I_1$- and $I_2$-implementations as we pointed out in 3), but we are as well able to select between different implementations within the consultation process $I_2$ (illustrated by shaded elements). Although we already have limited our scope to the FSI-domain, it may be useful to further specialize the $I_2$-process, depending on the objective. This could be e.g. consultation on financing opportunities or advice on strategies for minimizing succession tax, or, quite different, directing one-to-one-promotions. By implementing

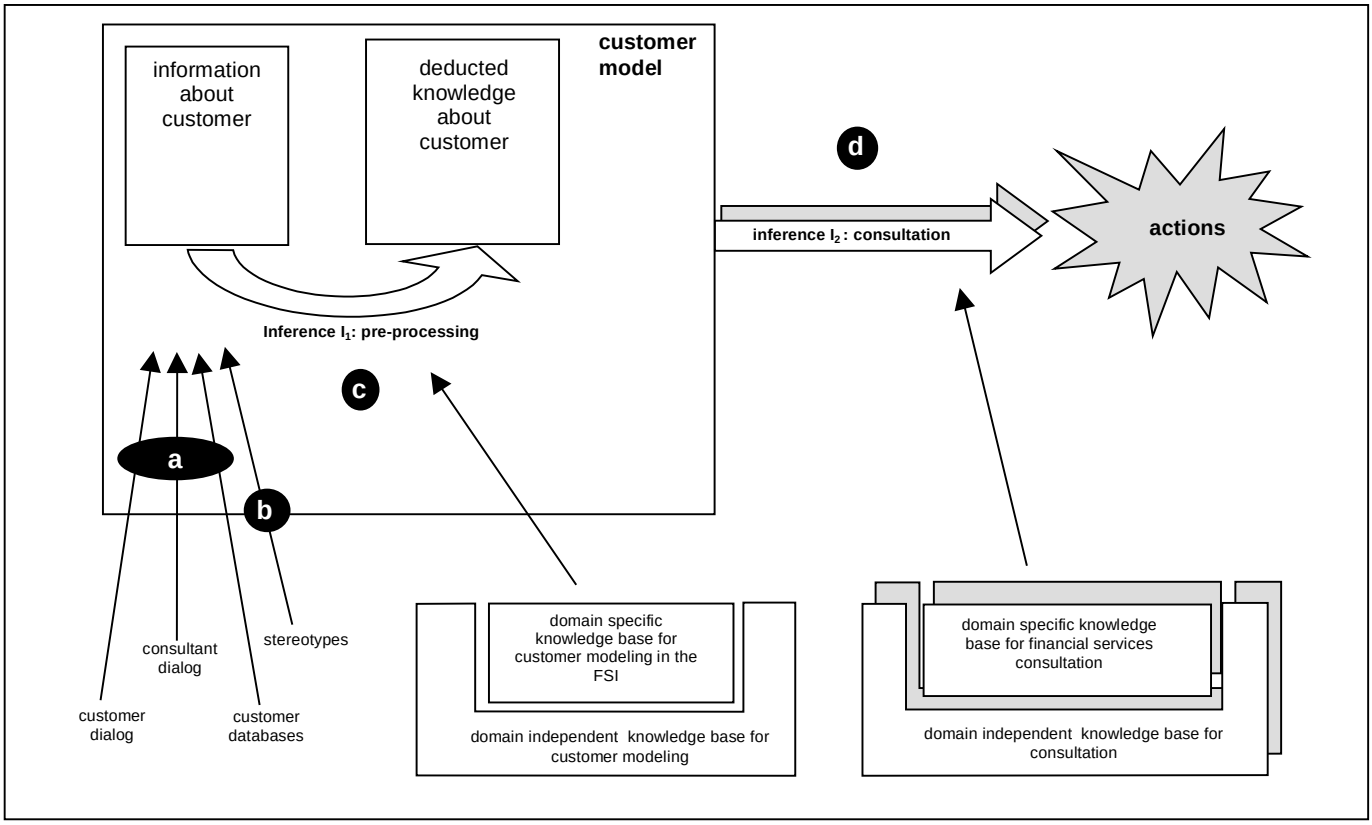


Fig. 3. Process of establishing customer models and deducting user-specific actions.

the two steps in different software components we are able to achieve the goals coming along with component based architectures, the most important being extendibility, scalability and interoperability.

5) *The processes of knowledge generation can be traced more easily*: In most expert systems, the quality of an explanation component plays an important role for user (i.e. customer and/or consultant) acceptance. As we have two clearly defined sub-goals, it is comparably easy to track the process from plain customer input via customer preferences to the final customer-specific action. It is also easier to verify the different knowledge bases and to trace errors occurring while generating knowledge. As a final advantage both inference processes can be improved independently from each other.

## IV. Discussion

As we have seen, one of the main differences of our approach towards the state of the art is that our customer models are designed to be standalone repositories of knowledge and offer a well defined interface. It is obvious that it requires more effort to design such models than to design rather small so called pragmatic models that are integrated parts of single applications.

The higher amount of required effort results mainly from two reasons. The first reason being our more general claim. Whereas pragmatic models concentrate on aspects relevant to rather small and well defined problems, for our concept all aspects relevant to the domain of the FSI are to be modeled. This is of special importance, since we do not only want to model expressed goals or beliefs of users but needs that shall be generated on the base of profound domain knowledge. Therefore, we consider it absolutely necessary to design the knowledge bases in intensive cooperation with experts. On the other hand, we believe that this task is easier and cheaper in the long run, as explicit knowledge is easier to administrate than the knowledge of pragmatic models. Taking into account that similar goals could only be reached by dozens of pragmatic models with probably inconsistent knowledge bases, the additional efforts of our approach seem to be even more acceptable. Additionally, we do not plan to model all relevant aspects in advance, but we will first establish a solid base that evolves step by step. Nevertheless, it is true that additional effort is required to design the interface by deciding what knowledge should be included in the first knowledge base. This is the second reason for higher effort.

Another even more relevant aspect than effort is the problem to design a consistent model with the required scope at all. Some authors doubt that models of human beings' behavior with practical use can be designed at all [12]. They state that the human decision processes were to complex and that resulting errors were enormous. Although, we accept that risks like lack of precision and misinterpretation might lead to errors, we do not regard the scope of the model as too wide to be able to generate valuable results. On the one hand, we do not model behavior, but instead we want to deduct needs from information. On the other hand, although the domain may look big compared to many existing systems, it is still limited compared to man's scope. After all, almost every action in the FSI concentrates on investment, finance or insurance or a combination of those.

## V. Outlook

So far, we have completed the design of the components of customer models and defined an appropriate process and a way to represent preferences that is not part of this article. Our current task is to introduce customer models based on the described concepts into EB at a major German bank. At the time of the presentation of this article at the ECIS, we would include further information on the discussed subjects and would present our experiences after having put them into practice.

The current concept is developed mainly for EB and is implemented in an EB environment. In the future, EB will be one of many channels by which banking customers will be addressed. Every channel needs sufficient knowledge about the customers in order to meet the needs of modern banking. The knowledge at all channels shall be consistent and information acquired via one channel shall be available for the others, too. Consequently, we plan to develop an architecture capable of supporting every channel of modern banking ranging from EB to automated mailing.

Another dimension we plan to extend our modeling to, is the field of products. This article showed how customers can be modeled so that we get well defined interfaces to that models. We mentioned that these interfaces can be used by different inference processes of different applications. We think that we could reach further improved consultation processes, if we designed a concept for modeling products and thus the components of solutions to customers' problems in the FSI domain. If this step is reached, the second inference process $I_2$ would be a process of matching customer models with product models. This can be applied to any of the modern banking channels.

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