Analysing Web Information Systems with the Abstraction Layer Model and Sitelang

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Abstract

In this article we use the Abstraction Layer Model (ALM) and the related storyboarding language SiteLang to analyse eight Web Information Systems (five banks, two newspapers, one university). We show that ALM and SiteLang are adequate for determining the storyboard behind these WIS, their goals, personalisation and communication aspects, their navigation structure, and the degree of contextual information. With respect to these features we report our findings for the eight selected sites.

Keywords

Conceptual Modelling, Web Information Systems, Storyboarding, Web Site Analysis

INTRODUCTION

The Analysis and Design of Information Systems and in particular Web Information Systems (WIS) is a complex task that should be guided by adequate methodologies. One such methodology is the *Co-Design Methodology* (CDM) presented by Schewe and Thalheim (2000). The methodology is based on an *Abstraction Layer Model* (ALM) for Web Information Systems. The higher layers in this model correspond to a business view of the WIS; the lower layers reflect the design and implementation.

Key activities associated with the business-oriented layers of the ALM address the determination of system goals and intentions, the expected users and their anticipated behaviour, and the definition of adequate navigation paths through the system. The navigation paths correspond to the business processes supported by the system. Setting them up is called *storyboarding,* and SiteLang is a language specifically designed for storyboarding.

ALM and SiteLang were introduced to support developing WIS, but can also be used as a tool to analyse existing systems. System goals and the business processes supporting them are then discovered including data, operations, dialogues and views accessed throughout their course. This is what we do in this article. We analysed eight WIS, the majority of which belong to the banking area (four New Zealand banks and one Swiss bank). Two of these belonged to the news (newspapers) business and one to the education business (our own university). In this paper we report the findings with respect to the storyboard behind these WIS, the identified goals, personalisation and communication aspects, and the navigation structure and the degree of contextual information.

We start with a brief literature review concerning WIS modelling to place the ALM and CDM approach into a context. CDM is not the only suitable methodology, but so far the only one that emphasises a business and user oriented view while not giving up strength on the more technical design and implementation aspects. Then we describe perspectives of WIS in general and the ALM and SiteLang in particular. This defines the context for the findings of our analysis, which will be presented next. We finish with a short conclusion.

APPROACHES TO WEB INFORMATION SYSTEM MODELLING

A few major groups are working on conceptual modelling of web information systems. The ARANEUS framework by Atzeni et al. (1998) emphasises that conceptual modelling of web information systems should

approach a problem triplet consisting of content, navigation and presentation. This leads to modelling databases, hypertext structures and page layout. However, the conceptual modelling approach is not integrated in an overall methodology, e.g. the aspect of storyboarding is neglected. The respective conceptual model therefore is not suitable for adaptation to users, used technology and access channels.

Other authors refer to the ARANEUS framework. The work by Baresi et al. (2000) addresses the integrated design of hypermedia and operations, thus picking up the functionality aspect, but remains on an informal level. Similarly, the work by Bonifati et al. (2000) presents a web modelling language WebML and starts to discuss personalisation of web information systems and adaptivity, but again is very informal. The OOHDM framework by Rossi et al. (2000) emphasises an object layer, hypermedia components, i.e. links, and an interface layer. This is similar to ARANEUS except that OOHDM explicitly refers to an object oriented approach.

The work by Ceri et. al. (2002) emphasises a multi-level architecture for the data-driven generation of web sites, thus takes the view aspect into account. The work addresses the personalisation of web sites by providing user-dependent site views, thus is aware of the problem of adaptivity. Ceri et al. (2002) emphasize structures, derivation and composition, i.e. views, navigation and presentation. These authors thus address the problem triplet targeted at by the ARANEUS framework.

The work on the Co-Design Methodology (CDM) for web-based Information Systems started with the Cottbus*net* project addressing the design and development of a regional information service (see Thalheim (1997) for a detailed description of the project, its approach and the achieved results). This resulted in a methodology oriented at abstraction layers and the co-design of structure, operations and interfaces (see Schewe and Thalheim (2000)). *Storyboarding* (see Feyer et al. (1998)) is central to CDM.

The work by Düsterhöft and Thalheim (2001) contains the language SiteLang and recommends its use for storyboarding. In Schewe et al. (2002) storyboarding was applied to electronic banking. For the conceptual level the methodology provides the theory of media types (see Feyer et al. (2000)).

PERSPECTIVES OF WEB INFORMATION SYSTEMS

To a large extent WIS can be designed and developed along the same principles that apply to "normal" information systems. However, such systems are usually closed in that data exchange with systems apart from those anticipated in this role is difficult to achieve and the system users are known before they actually use it. WIS are "open" in that everyone with access to the Internet and able to use a web-browser can act as a system user and exchanging data with these users is easily done. Therefore, we have to pay more attention to a "mission statement" for the system, i.e. taking the important questions "Who will use the system?", "Which user intentions and behaviour shall be supported?", "Which technical devices will be used by the users?", etc. into account.

We will now look at these questions in more detail focussing on five different aspects: intention, usage, content, functionality, and presentation.

Intention

The intention aspect is a very general one centred on a mission statement for the system (see de Troyer (1998) and Schewe and Thalheim (2000)). The primary question is: what is the purpose of the system? For instance, in e-commerce systems the answer may be that the major purpose of the system is to sell certain products. In e-learning systems the purpose may be to provide learning material to students including useful hints and links to supplementary literature. In so-called "information services" the primary purpose may be to provide information about a city, a museum, a country, etc. to a potential visitor. It may also link to virtual tours. In information systems, say for a sports club or a scientific community, the primary purpose may be to provide information about special events to members or to use the system to attract new members.

The second question is this: Is there just one major intention or are there several minor intentions as well? For instance, in an e-commerce system a minor intention may be to promote a certain brand or to bind customers to the selling company. In commercial e-learning systems a minor intention may be to attract students to book further courses — in this case the system would be a mixture of an e-learning and an e-commerce system. In an information service system a minor intention may be to attract visitors and direct them to a booking system — again the system may be combined with an e-commerce system.

A third question concerns the time-scale of intentions. Some of these may be long-term, others short-term. For instance, the minor intention in an e-commerce system to bind customers to the vendor may be a long-term goal, but the selling of particular products is short term. Similarly, a short-term goal in information services may be to advertise the city, region, institution, etc., whereas a long-term goal is to raise bookings by tourists.

A fourth question is a linguistic one, concerning the use of metaphors that may impact the mission. For instance, as a major activity associated with an e-commerce system is "shopping", many e-commerce systems provide a shopping cart as a 'visual metaphor', even if the products are not sold in shops using shopping carts. A museum's information service system might employ the analogue of a guide or a floor plan as useful metaphors.

Usage

Once some clarity with respect to the intentions of the web information system has been obtained, the question arises by whom and how the system will be used. As WIS are open systems, it is important to anticipate the behaviour of the users. Therefore, it is necessary to first obtain an idea of the expected users. Of course, not all these users may be of interest to the system provider, but it is important to identify those users that are to be supported by the system (see Schewe and Thalheim (2000)). For instance, a bank may want to offer a web information system for financial investments. In this case the bank will be interested in users who intend to invest and to provide the necessary information for them. Other users of the system will not be targets of specific aid.

As it cannot be expected that all users act in the same way, the problem of classifying the expected users arises. This may lead to certain user profiles. Such user profiles may be determined by the different goals of the users, their different intentions, their different behaviour, their information needs, their levels of required support, etc.

The activity of *user profiling* will lead to a list of profiles of anticipated users who are to be supported by the system. User profiling may influence the content of the site's pages, their logical organisation, the enabled navigation links between these pages, and their presentation. More abstractly speaking, for each user profile we have to anticipate how the users will navigate through the system. If we denote a possible sequence of pages by the term *story*, then the most challenging problem is to determine these stories and to describe them in an abstract and integrated way. We refer to this problem as *storyboarding* (see Schewe and Thalheim (2001)).

For instance, continuing the example of an investment system, we may have users who do not want to take a big risk, while others behave almost like gamblers. The stories associated with these two profiles will be quite different, as users with the former profile should be directed to investment opportunities with more or less fixed interest rates, whereas users with the latter profile are likely to invest in stocks and shares.

Content

The content aspect is central to the development of the system, as it concerns the question: "Which information should be provided?" (see Schewe and Thalheim (2000)). As with most "normal" information systems this is coupled with the problem of designing an adequate database. However, presenting data to the user via a web site follows principles significantly different from the ones followed for storing the data in a database. Organising the data content of the site means to investigate the decomposition, structuring and classification of data in such a way that the stories identified in the storyboard can be adequately supported.

For instance, in a city information service the information about the attractions of a city, the vacancies, the actual events, etc. may be used to set up a database design following well-known principles. For the site it may appear to be useful to combine data about an event, e.g. a conference, with special accommodation offers linked to the event, and information about attractions that are part of the social programme coupled with the event. Thus, modelling the content of a site has to be addressed on at least two levels: an internal level leading to databases, and an external level leading to the content of pages. Both levels have to be linked together. Furthermore, in both cases abstraction concepts should be used. While such abstraction concepts are established in the area of databases, they are still a matter of research for web information systems.

Modelling site content must take into account that information must be presented differently to users who differ significantly from each other. User profiles, the communication channel and the available devices need to be considered. Modelling site content has to provide mechanisms to tailor the content automatically according to these parameters (see Feyer et al. (1998) and Feyer et al. (2000)).

Functionality

The functionality aspect is coupled with the question whether the site should be passive or active (see Ludäscher and Gupta (1999) and Schewe and Thalheim (2000)). A passive site would only allow a user to navigate through the pages without any activity. For instance, a pure information service, e.g. a newspaper service, or an edutainment site, e.g. the site of a popular science journal, may be passive. In these cases the major functionality problem is to set up an adequate navigation structure. In an active site, however, information would also be required from the user. From a conceptual point of view, the main purpose of functionality modelling is to identify functions available at a site to support the activities of anticipated users. Such functions can be system-

specific functions that process user input or general support functions for searching, printing, marking, extraction, etc. For instance, a site may provide just an internal search function to search within the site, provide an interface to write ad-hoc queries to an underlying database, or simply embed a link to a standard external search engine. Sites can be more or less passive, but nevertheless provide some functionality besides navigation links. For instance, the provision of a search facility or the use of a simple login form may not be counted as turning the site into an active site.

Presentation

Finally, the presentation aspect concerns the final realisation by web pages. This depends on the support of technical end-devices such as computer screens, television, mobile phones, etc. and set layout preferences.

THE ABSTRACTION LAYER MODEL

The *abstraction layer model* (ALM) is a general reference model for web information systems. This model is illustrated in Figure 1. The general ideas of this model are as follows:

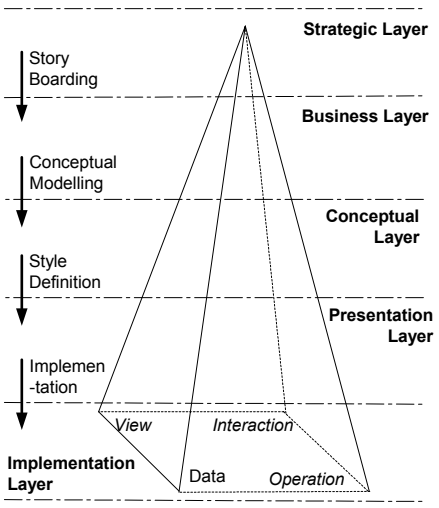

Figure 1: Abstraction Layers in Web-based Information Systems

We identify several layers of abstraction. The top layer is called the *strategic layer*. It is used to describe the system in a general way: What are the intentions? Who are the expected users?

The next lower layer is called the *business layer*, which is used to concretise the ideas gathered on the strategic layer. This means getting a clearer picture of the different kinds of users and their profiles. This may also include the different roles of users and tasks associated with these roles. The major part of this layer, however, deals with the description of the storyboard. Stories identify possible paths through the system and the information that is requested to enable such paths. So the general purpose of the business layer is to anticipate the behaviour of the system's users in order to set up the system in a way that supports the users as much as possible (see Düsterhöft and Thalheim (2001), Feyer and Thalheim (1999) and Schewe et al. (2002)).

The central layer is the *conceptual layer*. Whilst the business layer did not pay much attention to technical issues, they come into play on the conceptual layer. The various scenes appearing in the storyboard have to be analysed and integrated, so that each scene can be supported by a unit combining some site content with some functionality. This will lead to designing abstract "media types" (see Feyer et al. (2000)). To design the structure of an underlying database the information content of the introduced media types must be combined.

The next lower layer is the *presentation layer*, which is devoted to the problem of associating presentation options to the media types. This can be seen as a step towards system implementation.

Finally, the lowest layer is the *implementation layer*. All the aspects of the physical implementation have to be addressed on this layer. This includes setting up the logical and physical database schemata, the page layout, the realisation of functionality using scripting languages, etc. As far as possible, components on the implementation layer, especially web pages, should be generated from the description on the higher layers.

On each layer, except the strategic layer, we identify two dimensions for the description of the system. The first dimension distinguishes between local and global components; the second dimension distinguishes between static and dynamic components. As this leads to four combinations, we distinguish between the following components:

- global and static components, which are addressed by a *data specification*,
- global and dynamic components, which are addressed by a *function specification*,
- local and static components, which are addressed by a *view specification*, and
- local and dynamic components, which are addressed by a *dialogue specification*.

Each layer is associated with layer specific modelling tasks. The transition from the strategic to the business layer is associated with the activities of storyboarding and user profiling. The transition from the business layer to the conceptual layer is associated with conceptual modelling, which addresses database modelling, operations modelling, view modelling, and media type modelling. The transition to the presentation layer is associated with the definition of presentation styles. Finally, the transition to the implementation layer is associated with all implementation tasks. The fact that these layers exist in the model and that the methodology is based on transitions between these layers does not imply that a development project must first finish the work associated with one layer before it can proceed to the next lower one.

THE STORYBOARDING LANGUAGE SITELANG

Düsterhöft and Thalheim (2001) introduced the language SiteLang. It offers the following modelling notions:

- *Storyboard*, i.e. a directed graph being contained in the (graph of the) information space created by the information system. Its vertices are called scenes. Its arrows are called transitions.
- *Scenario*, i.e., a subgraph of the storyboard.
- *Story*, i.e., a path in the storyboard.
- *Scene*, i.e. a vertex of the storyboard. Scenes may be labelled with the user types having access to the scene. The operations that may be accessed that may be associated to the scene.
- *Actor*, i.e., a user role.
- *Content*, i.e. data, information.

Kaschek et al. (2003) classified the activities for which users require particular support as being related to:

- *Information*, i.e., identifying data and operations to be used best.
- *Navigation*, i.e., positioning at a target location in the information space.
- *Processing*, i.e., applying operations to data to obtain and export desired results in a particular format.
- *Handling*, i.e., using the system to achieve the actual goal efficiently, including the use of representation functionality, composition of business functions, and tailoring the user interface to suit the user's working style.
- *Search*, i.e., locating operations and data in information space.

Operations available at a scene thus can be expected to fit into one of these operation classes. Carrying out such operations is what makes customers move through the information space.

As a means of separation of concern it is recommended to personalize WIS, i.e. to introduce user types and for each user type a profile, i.e., a couple of characteristics which are established with scales, i.e., totally ordered sets allowing the definition of user types as certain, e.g. convex, regions in the space generated by the characteristics. Personalization may significantly reduce complexity of modelling WIS usage. The price for it of course is the required integration of the functionality supporting the various users as well as the necessity for each of the user types to derive suitable views. This is pretty much the situation known from schema integration and view derivation in database design.

WEB SITE ANALYSIS

We analysed the following eight WIS:

Organization	URL
ANZ New Zealand	http://www.anz.com/nz/
ASB Bank	http://www.asbbank.co.nz/
Kiwibank	http://www.kiwibank.co.nz/
The National Bank	http://www.nationalbank.co.nz/default.asp
UBS AG	http://www.ubs.com/e/

Aachener Nachrichten	http://www.an-online.de/
Neue Zürcher Zeitung[1]	http://www.nzz.ch/
Massey University	http://www.massey.ac.nz/

Four of these WIS were New Zealand banks ('ANZ New Zealand', 'The National Bank', 'ASB Bank', 'Kiwibank'), one was a major international bank ('UBS AG'), two were newspaper sites (the Germany-based 'Aachener Nachrichten' and the Switzerland-based 'Neue Zürcher Zeitung') and one of them was a university WIS ('Massey University'). Our prime interest was the bank WIS due to current involvement in a related project, and more specifically home loans. Non-banking WIS and the UBS WIS were included as a comparison sample with respect to our findings. We did the WIS investigation according to two classification points: 'page structure' and 'usage'. We do not want to criticize the organizations running a WIS, therefore we do not refer to the WIS by name.

Scene structure

The scene (or Web page) structure was quite uniform over all investigated WIS. Individual scenes contained some of the following:

- a content area,
- a navigation area including search and help functionality,
- a welcome area,
- an advertisement area,
- a legal information area.

The navigation area matches information, search, and handling in the above sense. The content area together with welcome area, advertisement area, and legal information area matches processing in the sense in which the term was used above. Consequently practice supports the analysis performed by Kaschek et al. (2003) concerning the support customers require. Since one is restricted to the customer's point of view and cost aspects were neglected advertisements were not considered.

The mentioned areas sometimes were connected regions on the screen. Sometimes they were not. Not all scenes had all these areas. But no scene had an area not fitting into these classifications. It might be interesting to note that within one storyboard the placement of the areas on the screen was changing while navigating through the board. This clearly violates the quality aspect of conformity of screen layouts and if given too much freedom in implementation or design could increase the time span required to gain awareness of where areas are and thus decrease efficiency of the WIS. The non-conformity of web page layout occasionally was due to a link (belonging to the navigation area) moving, after being clicked to be displayed at the bottom of the screen instead of at the top where it was before. Thus it is reasonable to believe that insufficient enforcement of coding standards or even the absence of such standards caused the mentioned deviation from conformity.

The content area items generally were small headline centred text chunks. The welcome area mostly did not contain active regions on screen, i.e. regions allowing users to trigger operations. However, as is the case with the advertisement area, the welcome area items may change size, shape, colour, filling, brightness or location. Clearly too much modification of the format of the advertisement area is likely to distract attention away from the other areas. A good screen layout is required to meet usability requirements from the content point of view and from the sales promotion point of view. However, for purely advertising sites that might exist or evolve but weren't investigated there might be no such trade off. Of course the advertisement area items in general are links. Content area items and advertisement area items often were equipped with an eye-catching picture and a link.

The finding here shows that the storyboard metaphor does suit well as a base for the content related part of WIS. However, content (for general applicability of the approach) has to be understood in a wider sense such that advertisements etc. are included.

WIS goals

One can in fact identify different goals for the four investigated banking WIS as far as home loans are concerned. All investigated bank WIS offered a home loan sub space of their information space. But this sub space for some banks is quite different than it is for others. This indicates a different purpose of the WIS. In the majority of WIS one finds a set of calculators allowing one to determine 'borrowing power' (the amount able to

[1] After this study was prepared, this site changed to a pay per access system and the site was rearranged.

be borrowed) or the monthly obligations in the event of a loan being granted or similar. However, the data used in the respective calculations is quite different. One of the New Zealand banks, e.g., asked for the marital status, the number of dependents, other loans, flat rental, living expenses, including transportation and similar. Another New Zealand bank neglected most of this data at the stage of customer-WIS interaction. For a final decision on whether to grant a loan it, however, is beneficial to consider the mentioned data among others. It thus is reasonable to conclude that the respective sites (with respect to home loans) serve different purposes. The one, involving much more significant detail in the calculation, actually tries to move the business model to a stage where substantial parts of the business are done in a customer-computer interaction mode. The other one, which involved much less significant detail, tries to get users interested in the business deal and interested in talking with staff about it. The New Zealand bank with the most sophisticated borrowing power calculator also offered the most far reaching support to gain understanding of the most important steps in the online home loan application.

One New Zealand bank, with respect to their approach to online computing of borrowing power, was classified as being situated between these two banks. Thus with respect to the WIS goals determined here no clear conclusion could be drawn. The fourth New Zealand bank did not attempt to offer customer-computer interaction for online loan applications. It merely offered a form that could be printed and used as a base for discussion with staff. This bank is relatively new on the market. It thus might be the case that respective decisions concerning online loan processing are still ongoing or will be reconsidered soon, as it might be the case that limitations concerning market share or required technology impacted the decision on the WIS goal. Concerning the attempt to substitute staff consultation with software the customers can work with, UBS seems to be a step ahead of the New Zealand banks in that they not only offer calculator like devices but guarantee they will notify the applicant by phone within three days after the electronic application has been submitted and the required evidence that true statements were made in the electronic form have arrived at the respective UBS branch. This concerns the UBS home market Switzerland which is the market best compared to New Zealand the home market of the banks running the other investigated bank WIS. Note further that the UBS calculator signifies to the customer by displaying appropriate messages the assessment of the loan application based on the data actually provided.

The mentioned distinction of WIS goals can be pointed out more clearly by paraphrasing the approach with effective online loan support information including calculators as attempting to do business cases online and thus substitute some of the customer-staff interaction by customer-computer interaction. This of course has far reaching consequences if implemented since it is likely to change the job profile of staff interacting with customers and requires more sophisticated Web IS design and implementation in particular with respect to safety and security issues. On the other hand the business model with less support for customers doing business online can best be understood as a contribution to customer relationship management in particular customer binding.

Though this was not at the heart of the investigation it also appears to be the case that the newspaper WIS dealt with were created to meet different goals. The observation suggesting this conclusion is that the one paper generally offers to display a print form version and email facility to mail articles to someone for information items. On the other hand the other newspaper not only does not support emailing of articles or a print form presentation of them, and explicitly points out that dissemination of articles to third parties is not permitted. It also offers much less self blended articles than the other newspaper but relies heavily on raw material, i.e., unedited messages from a national news agency. It appears that this newspaper perceives its WIS more as an add-on rather than a substitute of a physical newspaper. From a traditional understanding of the news business one could expect that newspapers much more than banks rely on broadcasting, i.e., one-way mass communication. In fact contact information in the bank WIS is much more elaborate and present than it is for the newspaper WIS.

Persolalization

Personalization generally was only supported marginally. Only the university WIS offered a respective password protected facility, which therefore is not discussed in more detail here. One New Zealand bank already denotes a radio button personalization with which a predefined view on the storyboard can be selected. Consequently, lacking respective dedicated facilities does not prevent the bank WIS completely from personalizing their WIS. The personalization they use is chiefly determined by the known different kinds of doing business. But some more advanced customer related data is used. E.g., banks tend to distinguish between 'first home buyers' and 'buyers and sellers'. Obviously this makes sense since the former might reasonably be expected to be a novice in the business while the latter ones can be presupposed to be experts in it. One New Zealand bank offered specific support for under 25s and one additionally for retired. Customers are expected to use the respective navigation area items to enter the sub space dealing with the particular part of the business.

We conclude that none of the banks except UBS AG practiced advanced user profiling for WIS development. This is remarkable: From interviews we did in the course of the above mentioned project with some of the New Zealand banks investigated here we know that they practice user profiling for system testing. For each of their user types they have a virtual customer with complete biography. This virtual user then is simulated in a role play for system validation. Neither did the bank sites attempt to deal with the customer giving faked data. All banks rely on supplied paper documents as evidence for true electronic statements. Business background except for the distinction between first homebuyers, dealers and individuals or companies in general is neglected.

UBS offers a relatively sophisticated system of user types. They classify customers according to individual conditions as under 12s, under 20s, over 60s, students, or affluent. They even up to some degree take into account cultural background in that they allow the customer to specify the country in which he wants to buy a home. This country can be classified as Switzerland, Europe, North America, Central and South America, Asia/Pacific, and Middle East/Africa. They seem to presuppose that someone targeting one of the mentioned regions is familiar with the application conditions. They further distinguish between individual customers, companies, government and public sector, financial sector and financial intermediaries.

None of the sites offers particular support for disabled customers. It is worth pointing out that it would be easy to cope with some disabilities such as red/green blindness, or disabilities of the hands in that voice input and output could be supported. There might be a need for installing specific equipment before a particular supporting function could be used. However, respective notes on the entry page of the site should point out the availability of such support. Some forms of weak eyesight could be supported by particular screen layout and zooming functionality.

Customer cultural background except from the UBS WIS was neglected. Though New Zealand has two official languages, i.e., English and Maori, all the New Zealand WIS are available only in English. UBS does not support all four official Switzerland languages, but offer French, German, and Italian as well as English. However, UBS also deals with cultural background only in rudimentary form. Awareness of education issues only in the limited form of student targeting could be identified. All sites neglect gender, computer literacy or similar.

Communication

Wallace and Matthews (2002) called communication 'key to success on the Web'. However, none of the investigated WIS can be ascribed attempting to take communication aspects seriously in the sense of proactively attempting to identify communication barriers and offering help to master them. For newspapers, e.g., offering dictionaries (or links to them) of technical terms or foreign words would be an easy thing to do. Clearly this would help some customers to better understand the content of the offered articles. The university WIS neither supports other languages than English nor customers with non-European cultural backgrounds. It might be worth noting that the University has a lot of Asian students the majority of whom are not native English speakers. Furthermore dictionaries could not be found at prominent places in this WIS. No attempt to support these users could be found. Clearly a dictionary of banking terms at least for novices in the banking area cannot be avoided and was available in one form or another at most of the bank WIS. Availability of such a dictionary of terms thus was not counted as attempting to improve communication. The UBS service finder in a limited way uses metaphors to help customers make more efficient use of the WIS. While determining the result of an inquiry the tool displays the message 'thinking' to make the customer understand that he has to wait.

Navigation support & context

All but two WIS (i.e., the German newspaper and UBS AG) actively support only a depth first search (DFS) style of storyboard exploration, i.e., they do not provide a back button. In respect to this they rely on the browser functionality, which might be a dependency that could cause trouble if the respective browser functionality is modified or implemented differently. The DFS mode of navigation in the information space might be the first choice from the point of view that someone quickly wants to position at a particular location. However someone looking for the right thing is not necessarily well supported with it.

Navigation support is done mainly by provision of the navigation area and its items. These index the information space and thus allow for a content-based search. More sophisticated navigation support such as localization abstraction, personalized navigation tools, etc. (see Schewe et al. (2002)) than searching the navigation items is not given by any of the investigated WIS. There are, however, different options available to assist the user in this search. These are, e.g. full text search combined with search focus restriction leading to the whole storyboard or a subspace being searched for scenes matching it; search menu, where a list of keywords is offered and information according to the chosen one then is going to be displayed. There may be an 'index' also called 'site map' giving (presupposing a particular level of granularity) a complete overview of the storyboard.

Achieving this is not necessarily the case with the totality of the other navigation area items. Clicking on one of them (situated at a certain height in the index structure) often leads to the item being refined by the next lower level items and the others unchanged. Clearly for an index of non trivial height and fan out at each level this representation technique soon leads to losing orientation since one cannot, on the available screen area represent sufficiently well the index structure.

For larger information spaces the index as a tree like structure gets too difficult to grasp. UBS therefore offers the so-called service finder, i.e., a customer type parameterised smart index which if customer data is updated displays the subspace best matching the customer type. The service finder offers a 'Back' button and thus allows for a breadth first search style of space exploration. The content best matching the customer type is displayed in a new browser window. Since some of these contain encrypted data the browser 'Back' button does not always work but leads to invalidated pages (without content) displayed to the customer.

None of the investigated WIS aids sufficiently in preventing customers from the 'getting lost in hyperspace' syndrome. The most they do is prefixing navigation area items with an arrow like symbol or highlight them to indicate that the customer is located within the respective subspace. A relatively simple approach for it would be to display a view on the path that the customer has travelled in the information space since he entered it. Similarly usability of WIS could be increased by simple means such as a portfolio in which favourite locations in information space could be book marked. Generalizing this idea an even more efficient aid would be a view definition facility (involving search machines) with the help of which users could create virtual subspaces. This would significantly increase usability and would be easy to implement.

Scenarios

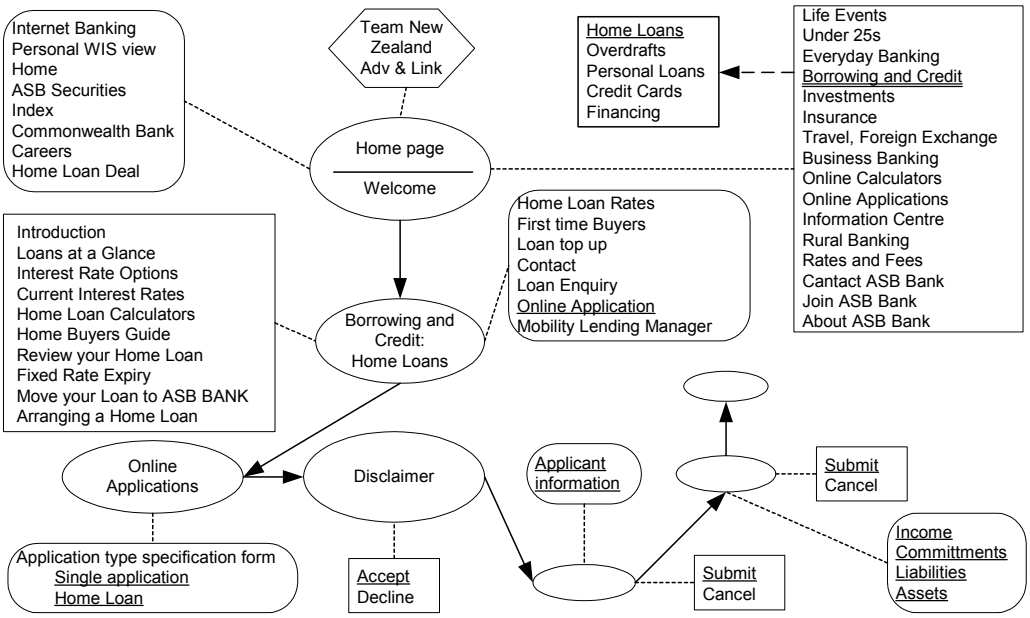

Figure 2: On-line home loan application story

Figure 2 shows it is relatively easy to describe usage processes of real WIS with SiteLang. The story models the online home loan application using a New Zealand bank's WIS. Scenes are represented as ovals, navigation functionality as rectangles, data and operations as rounded boxes, and advertisements by hexagons. The chosen link in the navigation area is underlined, and in the same way we indicate the chosen data or operation. If clicking on a navigation area item leads to a refinement of it being displayed this refinement is displayed in a rectangle and an arrow points to it starting at the navigation area. The arrows between scenes represent scene transitions. The dotted lines associate navigation functionality or data and operations to scenes. The depicted scenario is available for all users. The scene label indicating this is omitted. SiteLang obviously allows a clear statement of the content and navigation functionality accessible for a given type of user at a scene. A SiteLang usage model thus may help in design and implementation of WIS. In particular such a model might aid in boosting performance due to improved concurrency of resource consumption of customers.

CONCLUSION

In this article we used ALM and SiteLang to analyse eight Web Information Systems. The objective was to determine the storyboard behind these WIS, their goals, personalisation and communication aspects, their navigation structure, and the degree of contextual information. Though the appearance of the sites was quite similar, some differences were obvious:

- The banking sites' aim of making contact with customers was apparent in the five bank systems, whereas for the newspaper sites contact did not play a big role.
- The navigation structure and the underlying business processes became quite obvious at most sites, especially one bank site.
- It seems that reflection about personalisation and customer-staff communication has not been used, when the systems were set up.

We conclude that ALM and SiteLang are not only suitable for developing WIS, they can also be used as an instrument to analyse existing systems in order to determine goals, supported business processes, strengths and weaknesses.

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