Combining the interaction styles to display complex data in decision-making system

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ABSTRACT

Analyzing the large amount of complex data is becoming increasingly difficult. This problem impels the interface designers to search for the methods to display such data in a usable way. Combining human computer interaction styles with information visualization techniques provides some solutions. Displaying the relevant data in appropriate level of abstraction can be a good interface design solution. The most important data is focused when the others are accessible but presented in a higher level of abstraction. Presenting the same data in a different manner when multiple views are used also can give good results. The combination of techniques and styles benefits the analyst' decision-making process.

Keywords

Human computer interaction, interaction styles, visualization techniques, focus+context, timeline, fisheye view, multiple views.

1. INTRODUCTION

The interface of credit insurance system should provide an effective way to support the analysis process of relevant information while granting the credit insurance limit. The credit insurer takes into account many interdependent data while making the decision of the possible credit limit for a particular insurant. The analysed data have temporal, structural and logical dependencies. The goal is to provide support for insurer making decision.

Current systems used by our customers lack usability. Users have difficulties viewing the dependencies that were provided by either the structural or linear views.

The first system presents the whole structure of related data in one window that clutters the display (see Figure 1). The analyst hardly finds the useful data.

The second – linear view – shows the related data in one row (see Figure 2). The screen does not contain all data. Some data is accessible by scrolling. Such presentation increases the chances of missing important data.

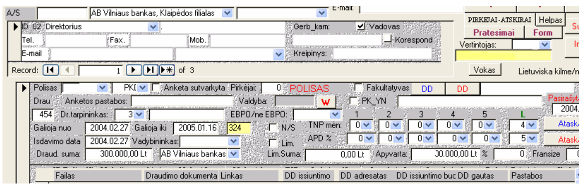
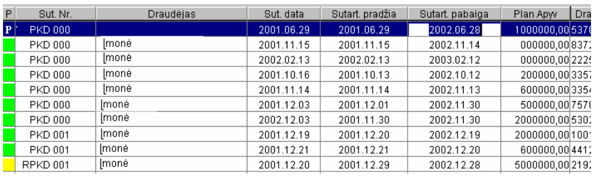


Figure 1. The whole structured record is presented on the one screen



P	Sut. Nr.	Draudėjas	Sut. data	Sutart. pradžia	Sutart. pabaiga	Plan Apyv	Dra
P	PKD 000		2001.06.29	2001.06.29	2002.06.28	1000000,00	537
	PKD 000	Įmonė	2001.11.15	2001.11.15	2002.11.14	000000,00	837
	PKD 000	Įmonė	2002.02.13	2002.02.13	2003.02.12	000000,00	222
	PKD 000	Įmonė	2001.10.16	2001.10.13	2002.10.12	200000,00	335
	PKD 000	Įmonė	2001.11.14	2001.11.14	2002.11.13	600000,00	335
	PKD 000	Įmonė	2001.12.03	2001.12.01	2002.11.30	500000,00	757
	PKD 000	Įmonė	2002.12.03	2001.11.30	2002.11.30	2000000,00	530
	PKD 001	Įmonė	2001.12.19	2001.12.20	2002.12.19	2000000,00	100
	PKD 001	Įmonė	2001.12.21	2001.12.21	2002.12.20	600000,00	441
	RPKD 001	Įmonė	2001.12.20	2001.12.29	2002.12.28	5000000,00	219

Figure 2. Linear view: the record is presented in one line.

In this paper we propose the combination of focus-context and timeline techniques applied in a multiple-view window to facilitate the analyst to make decisions.

2. PROCEDURE OF THE ASSESSMENT OF CREDIT LIMIT INSURANCE

Estimation of the credit limit is essential for the credit insurance service. While making the credit limit insurance decision the analyst gains the information from the internal and external data sources. Internal data bases provide information of the previous insurance operations. External sources include financial indexes, such as status, turnover, sales, buying, the capital, spending, liquidity ratio, the development, and the events from the past contracts. Queries to internal sources are processed immediately. Queries to external sources block the decision-making process until all answers will be received.

Having the required information the analyst decides either to grant the credit limit or to deny the application. While granting the credit insurance and assessing credit limit, error prevention is essential. Errors appear when useful data is not shown and when imported data is not highlighted. Also they appear if relations between data are not clear and important information is mixed with less important.

Error prevention would be more effective when information with higher priority would be highlighted and visible on screen. Because of the large amount, the data should be shown in the different levels of abstraction, such as the overview of the relevant important data and easy accessible detailed view.

3. USABILITY DIMENSIONS

The definition of usability states that usability is effectiveness (accuracy and completeness with which users achieved task goals), efficiency (the task time users expended to achieve task goals) and subjective satisfaction (positive attitude to the use of the visualization) with which a specified set of users can achieve a specified set of tasks in a particular environment [ISO97a]. In order to promote usability three categories of usability principles are proposed: learnability, flexibility, and robustness [Dix03a].

These categories are subdivided into more specific principles. Insurer should see the data hierarchy relation according to relevant priorities. The points of interest should be visible in detailed view, related aspects only visible, but not detailed, until the user chooses them. Events should be organised in succession. So, the *timing scale* is important.

The large amount of data and complex relations requires effective usage the screen area. Therefore, *visibility* of the whole available information is significant. Essential subcategory of robustness is *error handling*. This action prevents users from committing a mistake or slip, or allow user to recover from erroneous path.

The task should be less time consuming comparing with the current system. So, the *efficiency* goal should also be raised for decision-support system.

4. VISUALIZATION AND INTERACTION APPROACHES

Visual data analysis requires both angles: overview and details-on-demand. First, insurer needs to overview the list of answered queries. In the overview user focuses on important aspects of the analyzed case. Then, user accesses details of the data.

Focus-context techniques allow having context information with the detail at the focus of attention. Focus-context approach allows easy move between views at different scales. The overviews of the four focus-context techniques – distortion, rapid zooming, elision and multiple windows – among others are given in [Spe00a]. The eight design guidelines [Bal00a] facilitate the solution of displaying information in multiple views.

Time and visualization can be considered from two sides: visualizing temporal values (such as data, periods, etc.) and ordering the other data on the time axis (such as monthly spending, weekly sales, etc.) [Dix00a]. Timeline is a technology that could be applied to visualize events in a time axis. Event, tasks and other information can be placed in parallel bars each with own objective. Bars are divided using colours or lines. This method both reduces the chances of missing information and streamlines access to details while remaining tailorable and easy transferable between tasks [Pla96a].

5. VISUALISATION OF COMPLEX INFORMATION

Complex information means the set of undivided objects that cannot be expressed by other single object. Complex relations set unambiguous relations between complex and single information objects. The case of credit limit insurance concerns several structured objects such as insurer, policy, claims and so on. All of them have relations between each other.

Decision making requires that complex data should be properly organised. Furthermore, analyzed data should be available in different views and scales.

Multiple-view approach is proposed because user needs to deal with related data in different levels of abstraction. The need for different views accords with the rule of diversity from [Bal00a]. This bifocal technique allows displaying the whole information space in one screen.

Rule of parsimony suggests using multiple views minimally [Bal00a]. The number of used visualisations is reduced to three. By the concept a screen is divided into three vertical parts. The biggest one displays detailed view of the chosen data, another two are for relating sets of the data. One of them contains the basic data of information user currently studying. Another one is for displaying the results of the search.

The visualisations are synchronised. Selection in the left pane immediately updates the middle and right panes. Selection in the right pane adapts the middle pane view. These points are in harmony with the rules of self-evidence and consistency [Bal00a]. Such display's division allows using the whole workspace and shows the dependencies between the objects. Also some standard means (prints, colour, etc.) can be used to highlight the most important data.

Both parts that display the set of data may contain large amount of data. The fisheye view technique provides better visibility in case the large amount of the data is presented (see Figure 3). This method accords with the rule of space/time resources optimization that indicates to balance the spatial and temporal costs of presenting multiple views with spatial and temporal benefits of using the views [Bal00a].

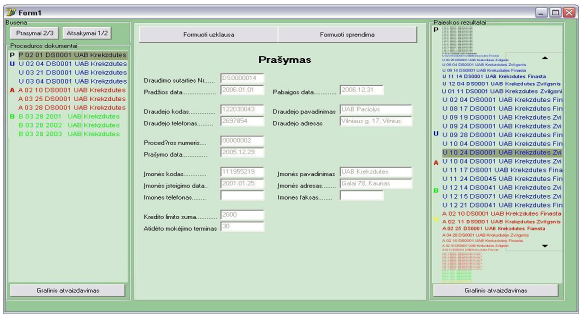


Figure 3. Viewing the application and relevant documents: the combination of multiple-window and fisheye view techniques.

To analyse the time relations between the data timeline style is proposed. The biggest part of the screen displays the set of data using this technique (see Figure 4). This method accords with the rule of complementarity that states that multiple views can be used when different views bring out correlations and disparities [Bal00a].

Complex view can be cognitively overwhelming to the user. The rule of decomposition [Bal00] recommends partitioning to create manageable chunks. In the proposed prototype decomposition is accomplished for the analysis stage. While choosing the request for insurance, on the left pane users can see suspended and new requests. When insurer chooses new request, the header of chosen request is kept to the left pane, the replies to the queries are placed in the right pane. In the middle a detailed view of the chosen reply is shown. When analysis process is completed, the main window with new and suspended requests is shown.

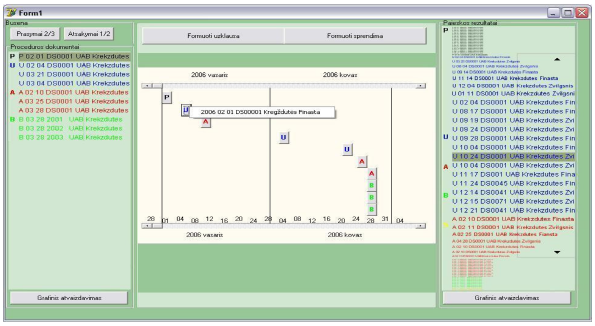


Figure 4. The relevant documents are placed at the timelines: multiply view with timelines

6. EARLY EVALUATION OF THE PROPOSED PROTOTYPE

We claim that combination of multiple views with fisheye and timelines enhances usability of our analysed decision-support system. Usability aspect is manifold. In this paper we measure the advantage of using of the combination of multiple views with timelines and fish-eye. We evaluate the added value using these visualisations in terms of effectiveness and efficiency.

The project is in the initial stage and we propose the prototype of an interface. In order to avoid expensive mistakes, the first evaluation is performed before any implementation. Early usability evaluation often does not involve users directly. Formal expert reviews have proven to be far more effective than informal demos with user testers [Nie94a]. Measuring effectiveness we compare the decision-making process of the current interface with the usage scenario of our prototype. From the variety review methods the cognitive walkthrough and model-based evaluations are based on evaluation of usage procedure. That is the reason why we choose these methods for the early evaluation.

Cognitive walkthrough (CW) was proposed by Polson et el. [Pol92a] and later revised [Wha94a]. This evaluation requires the fairly detailed prototype, description of tasks, list of performed actions and user characteristics. The evaluator steps through the action sequence to critique a system and then tells about the system's usability.

The cognitive walkthrough of the current interface emphasises the five problems. First, it is not visible which field has additional information. Second, the additional information is presented in separate windows and user may feel flustered. It is hard to associate what windows relate with specific request. Third, user experiences the difficulties managing many separate windows. Fourth, when insurer analyses the additional information, the request document is overlapped. It will be accessible, when the additional statistics windows will be closed. Fifth, once began to evaluate the requests insurer cannot analyse the other requests though analysis of specific request is suspended.

The evaluation of the proposed interface endorsed that multiple-window view allowed solving these problems. The whole information space is visible for the chosen request. For each insurance request only related documents are shown and difficulties managing the plenty of windows are avoided. After beginning the analysis in the left pane the header of the chosen document is shown. For suspended request the replied documents that already have been analysed are shown in the left pane. Showing the time relations in timelines facilitate the analysis.

Each document type is associated with specific colours that facilitate distinguishing the documents.

Model-based evaluation

Predictions about user task performance can be made using model-based evaluation, i.e. GOMS model [Car83a]. *Keystroke-level model* (KLM) is lower-level modelling technique that simplifies GOMS assumptions and provides predictions of the time users will take to perform the task with a given prototype [Joh96a]. The advantage of the KLM techniques that it allows a rapid estimate of execution time and can be used *to compare* designs [Car80a].

We compared the existing and proposed designs, using this technique. The evaluation of the existing prototype showed that operations take about 23 seconds to complete the task. In addition to lower-level operations, task performance procedure includes 6 system responses and 6 data analysis steps.

The evaluation of the proposed prototype endorsed that the essential steps take about 16 seconds. Besides these operations the proposed procedure involves 4 system responses and 4 data analysis actions. CW evaluation of data analysis step has shown that problems of existing interfaces are solved.

So we can state that proposed interface is more efficient than the current one because requires less lower-level operations. Evaluation of data analysis step confirmed that proposed interface has solved usability problems caused by existing interface.

7. CONCLUSIONS

Even though the existing decision-support software was created as a means of improving decision-making process and insurance outcomes, the usability evaluation detected many defects. The latter not only frustrate the users, but also influence the effectiveness and efficiency of decision-making process. The combination of multiple views with fisheye and timelines proposed in this paper improves the usability of the analysed system by enabling the user to view the whole information space in different abstract levels and styles. Early evaluations using cognitive walkthrough and keystroke-level model endorsed the benefits of the proposed prototype comparing with the existing system.

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