DTMi – a New Interface for Informed Navigation

Tamara Babaian, Ren Zhang, Wendy Lucas

Bentley University, Waltham, MA 02452, USA
{tbabaian, zhang_ren, wlucas}@bentley.edu

Abstract. We introduce an interactive, dynamic visualization aimed at improving navigation in complex systems, including but not limited to Enterprise Resource Planning (ERP) systems. Users of these types of industrial behemoths are typically presented with a multilayered menu structure for navigating the various task interfaces. The vast number of options and paths tends to overwhelm users rather than encourage system exploration. Experienced users prefer memorizing transaction codes that take them directly to the page for that task, leaving them with a fragmented understanding of how tasks fit together. The Dynamic Task Map with information (DTMi) addresses these issues by providing an interactive, dynamic mapping of the tasks supported by the system and the connections between them. A laboratory evaluation involving an earlier version of this interface, referred to as DTM, revealed that users were at least twice as fast at finding transactions with DTM than with a standard SAP interface and were correct nearly twice as often in their answers to questions concerning those transactions. Outcomes from that study, including feedback from participants, led to improvements that were incorporated into DTMi. In this paper, we present this new interface, describe how it extends the earlier version, compare it to alternative approaches, and discuss our plans for user evaluations and future research in this area.

Keywords: Interactive Visualizations, Dynamic Visualizations, Usability, User Experience, ERP

1 Introduction

One of the most daunting tasks facing users of complex systems is figuring out how to navigate to the desired task interface. This is particularly true for users of large enterprise systems, such as Enterprise Resource Planning systems [1-5]. These systems encompass hundreds of interfaces supporting a wide variety of business tasks (also called transactions) and processes. Difficulties with navigation are mainly due to the fact that the number of interrelated transactions supported by the system is very large, yet each individual organization typically uses only a subset of these transactions. For individual users, the situation is more severe, as they are involved in an even smaller fraction of the total number of supported tasks.

The standard navigational tool for these systems takes the form of nested menus, which offer an overwhelming number of possible paths. Many of the menu options sound the same, and may indeed lead to the same task interface, though that is not always the case. The sheer number of often unfamiliar choices makes it difficult for

the user to proceed with confidence and operate with a sense of competency. User confusion and intimidation are further exacerbated by difficulties with piecing together how transactions are related to the overall process or goals of the individual organizational units. As a result of these issues, novice users often turn to their colleagues for help, while more experienced users memorize the shortcut codes for the transactions they use most frequently. Both types of users rely on notes and other paper-based aides [6] in performing their work with the system. While all of these methods make it possible for users to accomplish what needs to be done, they also serve to limit the potential for system exploration and hinder even experienced people from using the system to its fullest potential.

In this paper, we present a novel interface component for navigating between tasks that is designed to alleviate the problems mentioned above. The *Dynamic Task Map with information*, or *DTMi,* is an extension of the DTM interface, which we presented earlier [7, 8]. DTM is an interactive graph constructed from transaction usage logs containing information about transactions performed with the system. Labeled nodes represent a set of system transactions; this set can be adjusted to include all transactions, or any subset of all transactions. For the version presented here, we chose to include all transactions that were used at least once by at least one user. The transaction that the user is currently engaged in is highlighted and linked to other transactions that users typically perform immediately after or in parallel with it. DTM also allows the user to search for a transaction node by its label. In a laboratory comparison of DTM with a standard SAP menu and search tools, in which users were asked to first locate a transaction and then find a related transaction, users were able to perform the navigation tasks faster and with greater success and accuracy using DTM [8].

DTMi extends the original DTM interface in the following ways:

1. Tasks belonging to the same functional module (e.g. Financial, Human Resources, etc.) are grouped together in distinctly colored convex hulls. The goal of this grouping is to support user exploration and understanding of the different system modules.
2. It includes a dedicated panel on the right side for displaying task information that is not communicated by the graph itself but might be useful in choosing what task needs to be done next. This information may include the names or identifiers of users who have performed the selected task, the date the task was last performed, and additional, pertinent data obtained from the usage logs or other relevant system components.
3. An improved search interface is located in the top bar that, upon request, pans between partially matching transactions and zooms in on each one in turn. This aids in the selection process by enabling the gradual exploration of transactions.

In the next section of this paper, we discuss the outcomes of user studies and interviews with users of enterprise systems that motivated the original and updated versions of the DTM interface. We then summarize the results from a user study with the original interface and discuss our approach in light of related work. In section 3, we present the DTMi interface, which was designed to address the issues raised in prior

user studies. We then discuss future plans for evaluating DTMi, followed by our conclusions.

2 Related Work

2.1 Background and motivation

Many recent research studies have pointed out system navigation as being one of the bottlenecks in successful and effective utilization of enterprise systems [2-5]. Figure 1 shows three different approaches to navigation from popular commercial systems. The nested menu structure, exemplified by the *SAP Easy Access Menu* shown on the left in this figure, expands as users drill down through the menu options. While this approach preserves the path taken by the user, it can quickly become overwhelming. New users are intimidated by the massiveness of the menu structure and often do not know where to start looking; experienced users memorize the transaction codes they use most frequently, thereby bypassing this cumbersome menu entirely.

A flat menu structure augmented with a breadcrumb trail is illustrated by the *IBM Cognos* screenshot appearing in the upper right of the figure. While this approach can be less intimidating, it can be even more difficult to find the correct option because only one menu level can be viewed at a time; the user must click back through the breadcrumb trail to view other paths. Lastly, a graphical approach is illustrated by the *Workday* menu in the lower right of Figure 1. While this appears to be the least threatening of the three, it too presents challenges to the user. The user's expectation of where a particular option will be may not be aligned with the icon-with-label depiction. Once the user has selected the appropriate icon, they will again be presented with a list of options. Selecting the Reports icon for the interface instance shown here, for example, reveals a list of over 400 reports.

In our own studies, we have found that users have a difficult time finding desired transactions. A usability study involving 20 novice users performing tasks with SAP revealed that navigation through the main menu was a significant usability issue [9]. It was found to be responsible for 6% of all detected usability incidents and experienced by 65% percent of all study participants.

Users in a field study in which we interviewed employees working with three different enterprise systems reported that finding the functionality that they needed was a difficult, often unsuccessful endeavor, complicated by the transactions being "buried" under layers of nested structures [11]. The complexity and sheer volume of these structures made it difficult to remember the path to take to even common tasks, as noted by these employees:

> *User1: So you could easily wander down some menu path and get lost and never find that again for another month. And not even know how you got there, right?*
>
> *User2: And then things will be buried, you know, under something. You'll think it's an accounting thing but it will be under IS, and then it's another thing they call environment. Some of these menu paths are a little cryptic. And so it's hard to*

sort of get the lay of the land just by looking at it. And it's like if you were brand new to this, it's been so long, but I suspect you could drill down many of these paths wondering, you know, where does this end? And then if you found what you wanted, you know, you might think, "I'm never going to find that ever again."

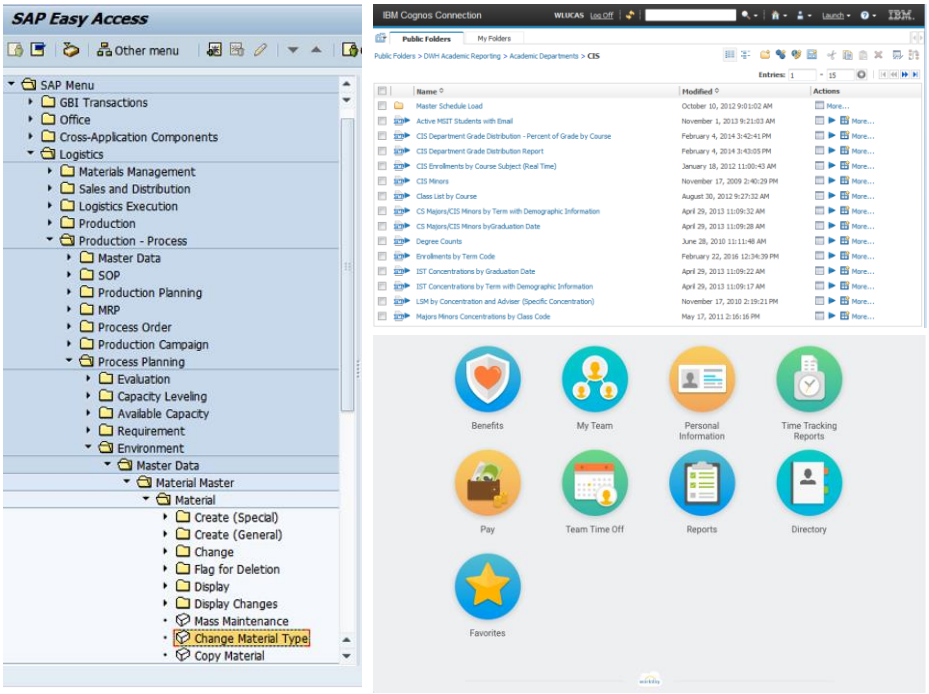

Fig. 1. Three menu structures, with an SAP nested menu structure on the left, an IBM Cognos single-level menu with breadcrumb trail on the upper right, and a Workday graphical menu on the lower left

Given the complexity and number of transactions, it is surprising that the interfaces do not include an easy way to search for a transaction by its name.

Interviewer: So what would you do if you can't find something that you really had to do?
User3: Just keep clicking around.

Furthermore, despite transactions being grouped under common headings and within the same set of pages, transactions that are related to a specific user's work process often appear in different groups, are placed far apart, or are mixed in with unrelated transactions. As a result, users have a very hard time understanding the flow of the process within the system. This leads to difficulties in identifying and navigating to a transaction that is related to or must follow the one they are currently working on, as noted by the following user:

User4: There's a transaction for `A', transaction for `B' and a transaction for `C' and nothing links them…

To overcome this difficulty, users create notes that range in complexity from simple lists of transaction codes on a post-it to elaborate flowcharts supporting them and their colleagues in their work [6]. Figure 2 depicts one example of informal notes created within an organization; the flowchart in the figure presents a process, which is annotated with references to specific transaction codes. These kinds of notes, along with other observations from field studies, motivated our innovative approaches to supporting users of complex enterprise systems.

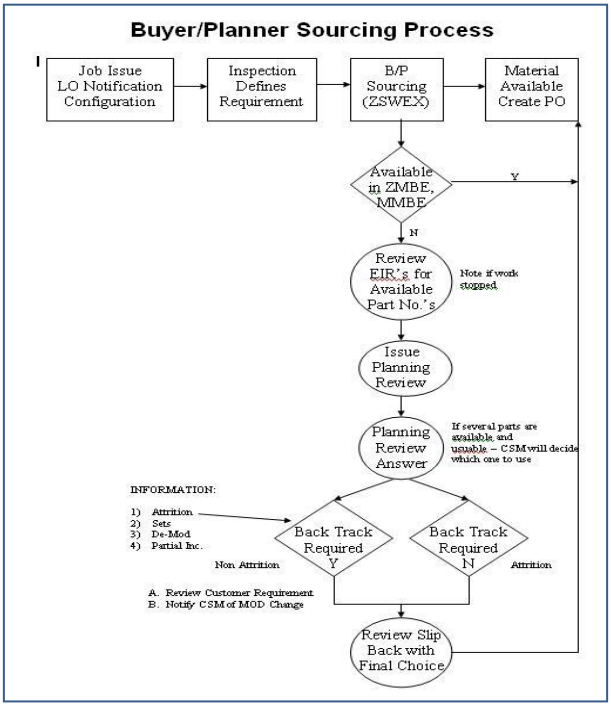

Fig. 2. A flow chart created by users of an enterprise system, depicting the flow of a business process with references to the corresponding transactions referenced by transaction codes

2.2 Adaptive Menus and Visual Approaches to Navigation

In our previous work, we developed and evaluated a dynamic visualization-based approach to navigation in enterprise systems called DTM [7-8]. When compared in a user study to the transaction search and navigation facilities within SAP, users overwhelmingly preferred DTM, noting its ease of use and its appealing and more informative nature [8]. In terms of performance measures, users who were asked to locate transactions by name were, on average, three times faster and 1.6 times more accurate with DTM compared to SAP. Users' suggestions for improving DTM in-

cluded adding groupings of transactions and refining the visual layout of the graph and labels for improving the readability of the transaction nodes.

DTM, along with its successor DTMi that is presented here, can both be viewed as a type of adaptive menu because they are constructed from usage logs, making the composition of the graph dependent on the use of the system within an organization. User evaluations of adaptive menus have yielded mixed results in the published literature [11-12]. Most studies, however, have been focused on the effectiveness of adaptive approaches to creating toolbars and split menus in personal productivity software. Adaptation accuracy, stability, and predictability of adaptive interface features have been cited [12] as important factors in achieving user efficiency gains with such adaptations. Compared to the context of *personal* software, in which the adaptation (whether done automatically or user-driven) occurs based on the preferences and history of a single user, the enterprise system context implies that the relevant transaction history must come from a set of users with similar goals. Users of enterprise systesms cite their colleagues as their primary source of training and support. It follows that the usage histories from which the central navigational component of the system is composed should not be limited to the individual employee's workgroup or even department, as employees sometimes need to cross role boundaries to achieve the maximum impact from having enterprise data at their disposal.

Learning about and detecting trends present in the visualized data are potential advantages from using visualizations [13], and DTMi certainly may lead to employees learning about the transaction usage trends across the organization. This and other user experience goals, such as engagement and enjoyment, may prove to be very beneficial to enterprise system users, who generally perceive the system as being overly complex, intimidating, and unforgiving [5-6, 10].

3 DTMi

DTMi aims to address the difficulties inherent in providing users with effective, intuitive means for navigating complex systems. Like its predecessor, DTMi is an interactive graph that is constructed dynamically from transaction usage logs. When first loaded, all of the transactions available from the system are displayed as labeled nodes, as shown in Figure 3. Tasks are grouped by functional module in differently colored convex hulls. The darker green grouping, for example, represents the Sales and Distribution (SD) module, while the Financial (FI) module is depicted in dark pink. These groupings help the users understand which tasks constitute the different modules in the system. To reduce congestion, links between tasks are not shown in this view.

To assist in user exploration of tasks within modules, both zooming and panning actions are supported: moving two fingers towards each other/away from each other on the mouse pad will cause the mapping to zoom out/zoom in; panning is enabled by pressing one finger on the mouse pad while moving another along the pad. The user can also hover the mouse over a particular task; additional details concerning that task

are then displayed in a dedicated panel located on the right side of the DTMi. These details are provided by the usage logs and other relevant components of the system.

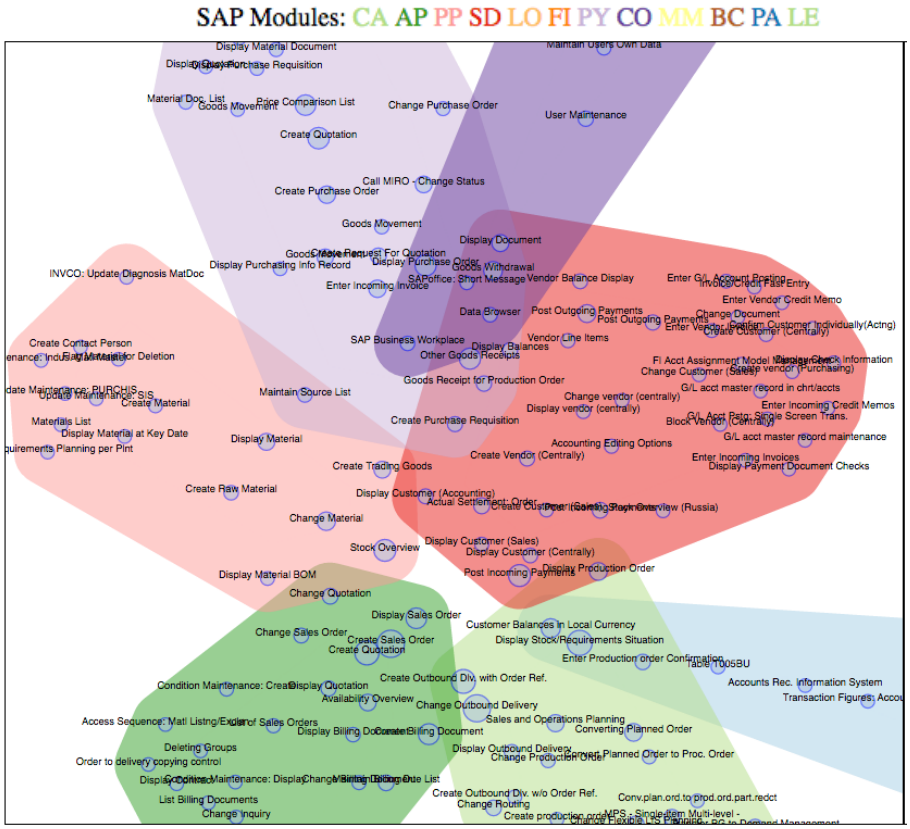

Fig. 3. A partial snapshot of the initial Dynamic Task Map with information (DTMi) showing all transactions available in the system. Tasks belonging to the same module are grouped together in colored hulls, identified by the legend at the top of the screenshot.

Figure 4 shows the results of the user panning to the lower left corner of the display, zooming in on the Accounts Payable (AP) module, and hovering the mouse on the "Display Sales Order" node. Among the information displayed in the right panel is the identity of the person who last performed this task, when it was performed, and that person's department. This information could be helpful to the current user if they have questions concerning this task. Any data from the logs could potentially be displayed in this panel; ideally the contents would be configured to best meet the needs of the particular organization.

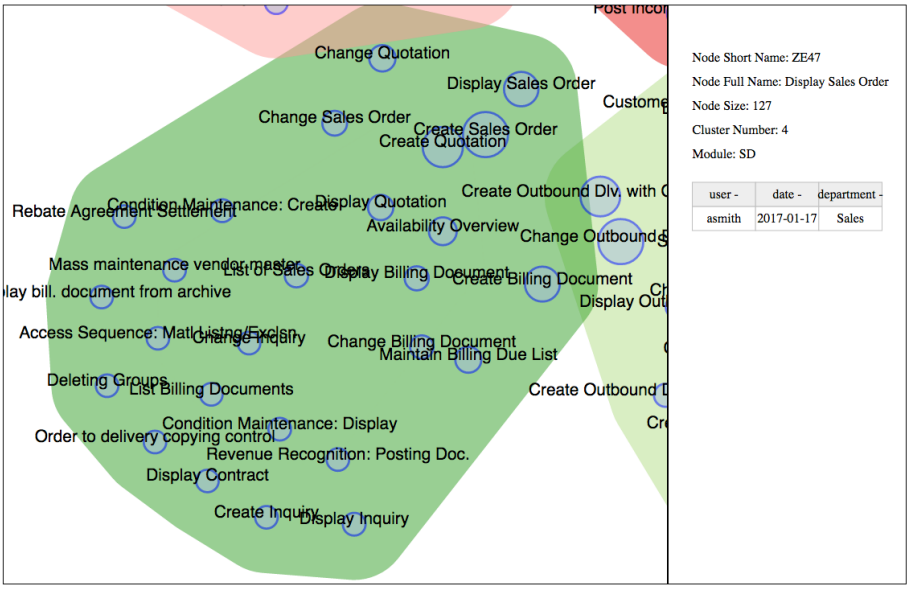

Fig. 4. DTMi display after the user has panned to and zoomed in on the Accounts Payable (AP) module, depicted as a green, convex hull. The side panel displays information on the Display Sales Order node, where the user has hovered the mouse.

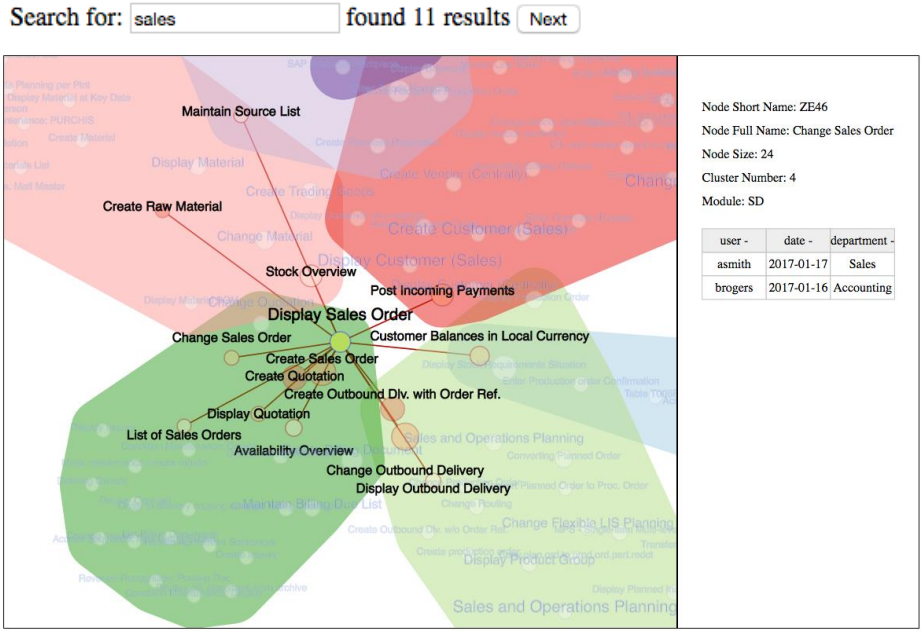

Fig. 5. A snapshot of DTMi including the search interface, in which the user has entered the keyword "sales." The side panel displays information on the Change Sales Order node.

DTMi also includes a search interface. After the user enters a search term, the display updates to highlight a transaction whose label is at least a partial match with that term. Connections are shown between that node and any nodes depicting transactions that are performed concurrently or immediately after it. The color intensity of each transaction node indicates the frequency with which transitions are made to it from the highlighted transaction, as determined from the usage logs collected by the system. Each time the user clicks the "next" button, the display will pan to and zoom in on the next match that is found. This aids in the selection process by enabling the gradual exploration of transactions.

In Figure 5, the user has entered the keyword "sales." In response, the DTMi interface has highlighted one of the 11 matching transactions, "Display Sales Order," which appears in the center of the screen. This transaction is shown as being connected to several other transactions. The nodes with the strongest color intensity include "Create Sales Order," "Create Quotation," and "Create Outbound Div. with Order Ref.," indicating that these transactions are performed most frequently in parallel or immediately following the "Display Sales Order" task. The user has hovered the mouse over the "Change Sales Order" transaction, revealing additional information about it in the right panel that may be useful in determining which transaction to perform next.

4 Discussion

We have designed and developed DTMi based on our understanding of the needs and work practices of users of enterprise systems, which we gained through field studies and analysis of ERP usability literature. While the original design of DTM as an interactive, searchable graph based on the SAP system log proved effective and well-liked by novice users in a laboratory study [8], the new design must be validated with real users of enterprise systems in the field.

As we discussed in Section 2.2, DTMi fits into the paradigm of adaptive user interfaces, as it presents transactions connected to those that follow them, based on the usage logs that record sequences of transactions as they are executed by users. Brusilovsky et al. [14] have demonstrated that, since interface adaptation is performed by combining a user model with interaction features augmented by this model, results of an "as-a-whole" evaluation of an adaptive interface may not reveal the real value of adaptation. This is because an end-result-focused evaluation does not distinguish between the effects of choosing the right model and choosing the appropriate presentation and interaction techniques to go with it. Instead, the authors argue for a *layered* approach to evaluation, in which the usefulness and accuracy of the model underlying the adaptation is evaluated separately from the way the model is employed in the interface. These arguments are corroborated by the experimental results reported by Gajos et al. [11], who have tested three different adaptive menu designs, all based on the same usage model. In their study, they found significant differences in user preferences regarding different versions of the interfaces, as well as significant differences in the average time it took users to locate menu items using those interfaces.

These considerations point to the necessity of investigating specific design choices within DTMi, such as whether the model of transaction "relatedness" that connects a transaction to the ones following it in a user's history is the right model for enterprise system users. Alternatives include linking two transactions if they are related in a document flow.

In terms of the chosen presentation and interaction characteristics, we need to assess if, for example, the grouping of transactions should be based on the system-defined characteristics or on specific organizational practices. That is, should the colored blocks separate transactions by system modules or by the organizational unit that employs them? Another important question concerns the selection of the usage threshold for the displayed transactions: should infrequently or never used transactions be hidden and only revealed when they are explicitly searched for? Lastly, since the DTMi informational side panel can be configured to present different kinds of information, what would be most useful to include here? These aspects of the interface can be assessed by demonstrating and discussing DTMi in focus groups with real users.

Along with evaluating user performance and satisfaction with DTMi, it would be interesting to find out if the visualization will help organizational users detect trends, promote the understanding of the organizational practices and processes, and improve users' attitudes toward using the system by reducing their perceptions of its complexity. Since users in our previous study were very enthusiastic about the interactive nature of DTM, employing the DTMi interface may aid in the successful adoption of complex industrial systems by some of the more reluctant users.

5 Conclusions

In this paper, we have presented DTMi – a visual interactive interface for transaction search and navigation in enterprise systems. DTMi extends a previous version (DTM) with features that include the grouping of transactions, iterative search based on a partial keyword match, and a panel for displaying task- and navigation-related information. DTMi presents a new approach to navigation, which can be configured to present a variety of detailed information that can aid in task selection. We plan to interview enterprise system users regarding:

- the usefulness of our chosen model of connecting transactions based on usage history, and
- the informational content that should accompany each transaction in the side panel.

We expect that the visual nature of DTMi will contribute to an enhanced user experience through greater enjoyment, increased engagement with the system, and the potential for greater learning and trends discovery. These expectations will need to be verified in practice.

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