

Odyssey - A Web-Based Design System

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Abstract

A web-based design system has been developed for capturing, sharing, and deliberating on design information. The system is based on a process-based design model and a traditional project management model.

The process model is based on a matrix of activities and issues. The activities include Generate, Evaluate, and Select. Many issues are considered in design, e.g. problem definition, requirements, functions, alternatives and layout design. The web-based design system also includes a traditional project management model for defining and assigning tasks. The project management model has a hierarchical structure from a Milestone, to an Objective, to a Goal, to a Task. The task is linked to a matrix and issue. Support systems are included for asking questions, making comments, assigning tasks, entering status reports, and making team decisions.

The students found the combination of the process-based and project-based system easy to use. Future plans include integrating web-based instructions/help with the design system and incorporation of distance meetings.

I. Background

Previous Efforts - The process-based approach to the engineering design of products is based on a design matrix that models the design process and a deliberation model that captures the design rationale¹.

Design Matrix - The Design Matrix combines the features of design methodology and a design process model. The Design Matrix is a way of organizing the design issues and activities². A schematic for a simplified Design Matrix is shown below. The process-based model provides a flexible framework to address the complexities of design. In an actual design many matrices would be included for different functional areas (including marketing, manufacturing, maintenance, etc.) and for different levels of detail (subassemblies and components). The format remains the same, only the issues vary.

	Generate	Evaluate	Select
Problems			
Requirements			
Functions			
Design Concepts			
Design Layout			

Figure 1: Simplified representation of Design Matrix

The rows represent the issues to be addressed. In this example the issues are the Problem, Requirements, Functions, Design Concepts, and Design Layout. These issues are addressed by the activities in the columns labeled Generate, Evaluate, and Select. Many issues are considered in design, e.g. problem definition, requirements, functions, alternatives and layout design.

Deliberation Model - The evaluate and select activities in the design matrix provide a framework for the deliberation model based on IBIS³. The IBIS model is based on the principle that the design process is fundamentally a conversation among the designers, customers, builders, etc. in which they bring their viewpoints and expertise to resolve design issues. The model focuses on the key *Issues* of the design problem. Each Issue can have many *Positions*. (A Position is a statement that resolves the Issue). Each Position on an Issue may have one or more *Argument*, which support or objects to the position. The system is shown schematically below.

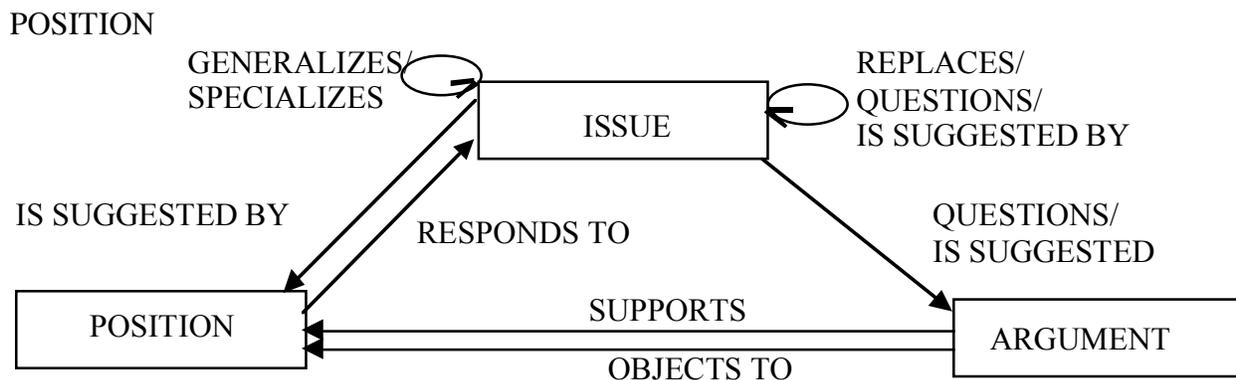


Figure 2: Schematic diagram of IBIS

A Position responds to an Issue. Arguments either support or object to a position. Issues may generalize or specialize other issues and may also question or be suggested by other positions

and arguments. A discussion may begin with a design concept of how to solve a problem. A person may suggest a position on the concept with supporting arguments. Another person may make arguments supporting or objecting to the position and propose a second concept.

Results - The results of the initial implementation of the system on a small cluster of microcomputers using a multi-user database suggested that the process-based model could be applied to a wide range of issues at different level of detail. Several benefit were identified by the users including simultaneous processing of information, equality of input, documentation of decision rationale, a common structure for various functional areas, and the availability of information for review.

One problem with the implementation of the model on a cluster of computers was that the students, in a night class that met once a week, only had access to the system during class time. To make the system available to all students at any time this process-based model was implemented on the web

II. Odyssey

Odyssey is the web-based implementation of the multi-user design system described above. The home page is shown below. The user must have a user ID and password to enter the system.

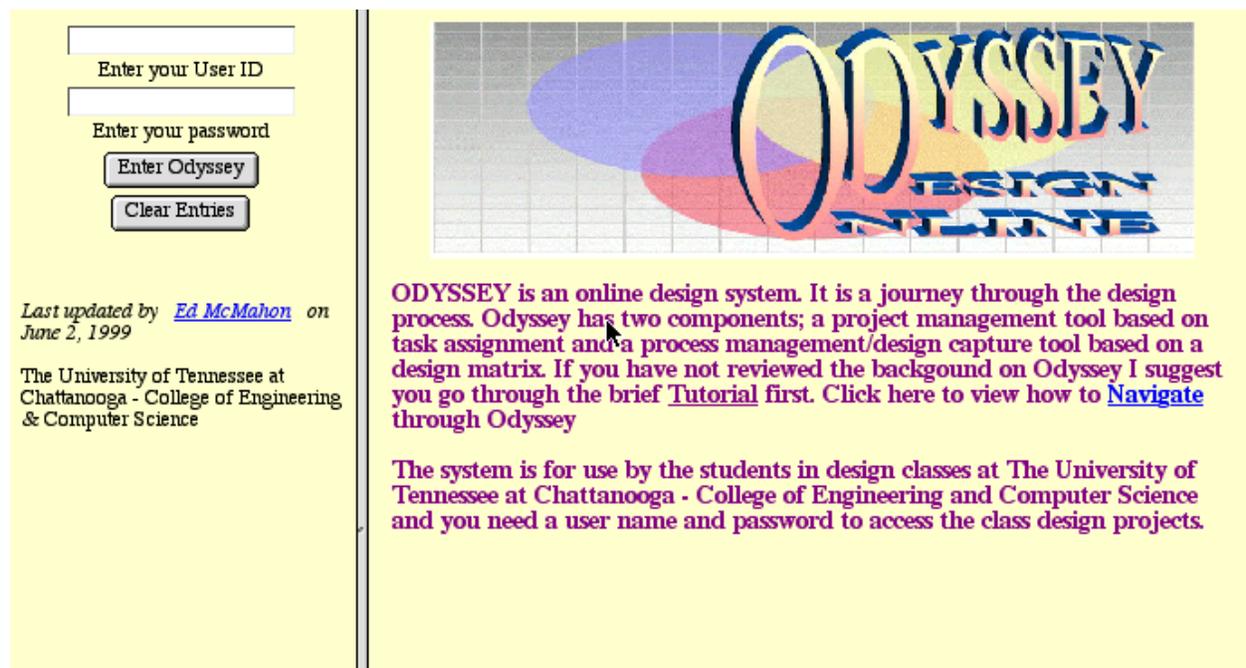


Figure 3: Home page for Odyssey

Once the User ID and password are entered the left frame changes to a Tree Applet that defines the project planning module for the particular project. The team members Tree Applet is shown below. Note: Netscape Communicator 4.0 Microsoft Internet Explorer 4.0 or any browser that supports JavaScript is required. Netscape Communicator 4.0 is recommended.

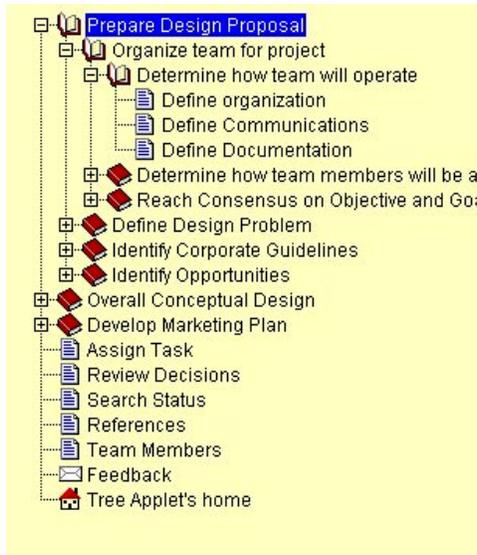


Figure 4: Team Members Tree Applet for Odyssey

At the first level of the Tree Applet is the Milestone (Prepare Design Proposal), the second level is the Objective (Organized Team for Project), and the third level the Goal (Determine how team will operate). Clicking on one of these will provide a summary of all of the information that has been entered for the particular level of activity. The fourth level is the task.

REVIEW INFORMATION FOR THE MATRIX/ISSUE	
Matrix =	Opportunities
Issue =	Industry products
#Entries for Current Matrix/Issue =	22
<p>Nomic Station Website; Adjustable Computer Desk VariTask adjustable work centers The VariTask E-Series family of adjustable work biomorph-desk INTERACTIVE PERSONAL DESK Designed for Users in Professional and H Artwright. The ultimate computer furniture The Incliner Computer Table adjusts infinitely within a 40 degree range of trave Laid-Back Computing your work station or your home office is dependent on the</p>	
<input type="button" value="Evaluate Generate Activity"/>	
GENERATE NEW INFORMATION FOR THE MATRIX/ ISSUE	
<div style="border: 1px solid black; width: 100%; height: 100%;"></div>	
Use the Browse button to select a file to attach a file:	
File:	<input type="text"/> <input type="button" value="Browse..."/>
Add Web Link: <input type="text"/>	
<input type="button" value="Enter"/> <input type="button" value="Clear"/>	

Figure 5: Generate Information for Odyssey

Clicking on the task will bring up a screen to enter information and review information for the task. This information is stored in a particular matrix and issue. This entry form is shown above. The top section is a view of the contents of the Matrix/Issue/Generate cell; all of the generated information for this matrix and issue is listed here. In the bottom part of the form new information can be entered, including attached files or other web links.

To review a particular entry for the Matrix/Issue, the entry is selected and the user clicks on the Evaluate Generate Activity button. The form shown below allows the user to Evaluate the information or Select the information according to activities described in the process-based model. Progress is made when a decision is made using the Select activity. The user may also modify existing information, make comments on entries, or ask questions about entries. Questions are directed to the person who entered the information for a reply.

GENERATE ACTIVITY AND RELATED INFORMATION		
Entry #	Matrix	Issue
10272	Opportunities	Industry products
<div style="border: 1px solid black; padding: 5px;"> biomorph-desk INTERACTIVE PERSONAL DESK Designed for Users in Professional and Home-Office Environments Who Want Mobility and Flexibility </div>		
VIEW WEB SITE		
<input type="button" value="Evaluate"/>	<input type="button" value="Select"/>	<input type="button" value="Modify"/>
<input type="button" value="Comment"/>		<input type="button" value="Question"/>
Return		

Figure 6: Review Information for Odyssey

A team decision making tool is also included. The team members are asked by the task manager to rank each alternative in a selected Matrix/Issue and provide a rationale for each ranking. The information is compiled using the rank-sum rule and the manager reviews the information to make a final group selection. The manager can review both the sums of the ranking and the rationale for the rankings.

The bottom of the Tree Applet includes other management and communication activities for Odyssey. Each user can assign tasks, review decisions, review status reports, review references, of find contact information for other team members. The manager has additional entries in the Tree Applet to initiate decision making and to create new elements of the Tree Applet (Milestones, Objectives, Goals, and Tasks).

III. Results

The web-based system tested in two classes during the 1998-99 academic year without the Tree Applet and in two classes in the 1999-2000 academic year with the Tree Applet. The students were instructed in the use of the process-based model and the use of the web-based implementation of the model.

During the 1998-99 academic year the Tree Applet was not implemented. The student had to decide which Matrix/Issue to choose for entering data. The students indicated that it was too complex and they did not know which matrix and issue to use.

In the fall of 1999 the project management approach, in the form of a Tree Applet, was added. One group of students used both versions of the web-based design tool in a yearlong senior design project. These students thought the addition of the tasked-based Tree Applet was a significant improvement over the matrix/issue-based selection process.

Another significant improvement was the ability to access lists of information for a particular Milestone, Objective, or Goal. All of the students appreciated the ability to get an overview of the contents of Odyssey. Each entry in the summary was linked to the Generate Information form. This made it convenient to Evaluate, Select, Modify, make comments, or ask questions about a particular activity.

The students liked the decision making tool and had a high level of confidence in the decision (80%). At the same time they expressed a preference for face-to-face discussions on decisions. This might suggest that the decision making tool in Odyssey is a good tool for screening and discussing alternative but it is easier to reach the final decision in face-to-face meetings. The students also suggested that they should be able to modify their decisions after reviewing the rationale by other students.

The students were concerned with the slowness of the system at times and the lack of availability at others (server down). They would like more formal training in the methodology behind Odyssey and on the mechanics of using the system.

IV. Conclusions and Recommendations

The web-based Odyssey based on the Design Matrix and a task structured Tree Applet was a successful system for organizing product development information from a variety of functional areas and at different levels of detail. The task structured Tree Applet was a significant improvement. The deliberation model, used in the Evaluate, Select, and ranking activities, captured the rationale used in the decision making.

The use of summary tables based on the Milestones, Objectives, and Goals, with links back to the data entry, was important in enabling members of the team to view and make comments on information generated by other members of the design team.

The perceived lack of efficiency of the web-based system is an important issue. One part of the slow response was the campus computer network. The lines leading into the campus were slow do to the rapid growth of computer networks on campus. This problem has been corrected. The problem with the server being unavailable was mostly caused by debugging and ongoing modifications to the system in response students' comments. A faster server and fewer changes in the system should address these issues.

The addition of an online tutorial and case sensitive help will be addressed in response to the students' concerns about the training on the methodology and the mechanics of the system.

The issue of online decision making versus face-to-face meetings will also be addressed. Web-based meeting support is available and will be considered in conjunction with Odyssey.

Many of the issues presented by the students deal with the mechanics of the system not the basic structure. . This initial study on Odyssey was successful in demonstrating the effectiveness of the basic structure, a combination of the process-based model and the project management tool. The system successfully maintained the benefits of the earlier multi-computer system while extending the use to the larger web-based community.

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