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Improving the Quality of Model Reviews with Computer Hypertext Technology

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IMPROVING THE QUALITY OF MODEL REVIEWS WITH COMPUTER HYPERTEXT TECHNOLOGY

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Abstract

A graphic, hypertext computer application approach to facilitate the reviews of function or data models and feedback is reported. Computer modeling tools were employed, and the models transferred into hypertext for review as an alternative to the traditional manual "kit" method of documentation developed in the 1970's. This new approach has been designed and deployed to achieve consensus in the review cycle of function-decomposition modeling projects. Results are described, indicating that the benefits of employing hypertext can be realized by watching for situations appropriate to the use of hypertext in a project. Changes in the accessibility to hypertext applications, and the improvement in the ability to couple the modeling tools to hypertext model "readers" will allow a full exploration of possible benefits. This paper will describe two very different projects which use hypertext kits, one within industry, the other within an evolving standards organization.

Introduction

The use of computer aided modeling in the function model[1] or data model life cycle will be described. The hypertext paradigm, and its relation to model kits is described. Some examples of the way the paradigm was experimentally applied is also presented in this section.

Present use of Tools

The Integrated Computer Aided Integration Definition (IDEF) methods includes the "kit" and the "Reader/Author Cycle" used by a team during model development. Computer modeling tools have come into common use by modelers. These tools effectively assist the modeler, providing both powerful editing and modeling language rule enforcement. However, these modeling tools are not designed to assist the reader of a model nor help a modeling team conduct its review. Thus the modeling community is left to cope with two complex environments as depicted in Figure 1. If the team should decide to keep the model in the tool environment for use in

[1]Function models, often referenced as "activity models" are a hierarchical decomposition of the actions needed to complete a defined task or achieve a specified goal.

the review process (or beyond) procedures must be established by the team which replace most of the steps of the defined kit process. The usual practice is for each of the modelers to have a copy of the same tool (software). The model files are then passed to the next team member who can fill the dual role of both reader and author. That member is recognized as having "custody" of the current version. Others who have a model version copy may "read" the files, but must identify and communicate proposed changes to the owner of the current version to insure that changes are made only to the active copy. Such exchanges of copies of the tool's native format files raise difficult problems of configuration control.

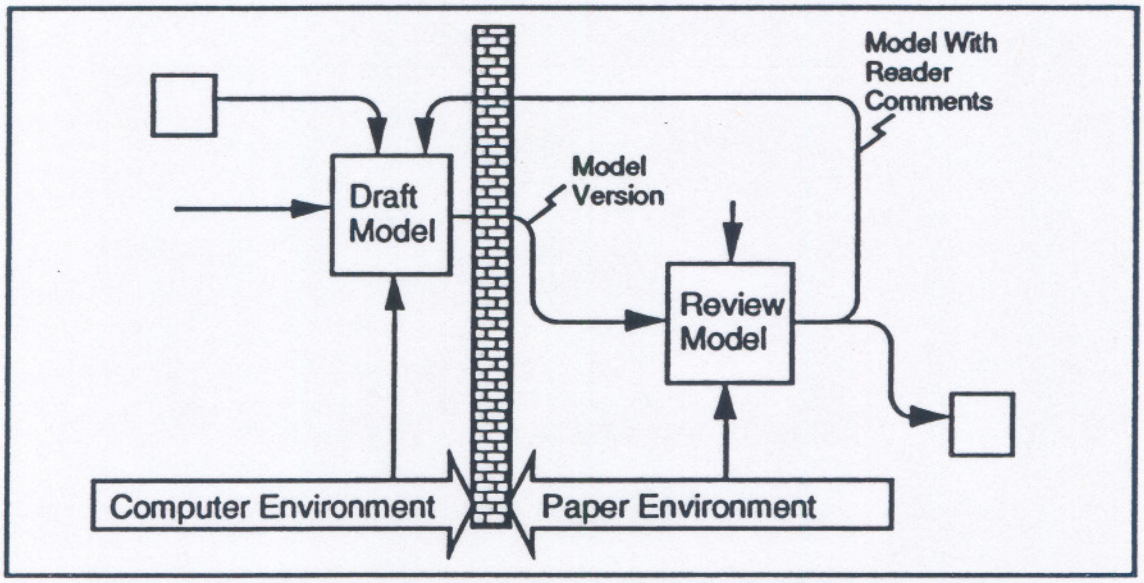


Figure 1. Problem: Two Dissimilar Mechanisms in the Model Life Cycle

The printed output from the modeling tools is the more common means of team review. When comments are solicited from reviewers, they are asked to return a copy with their penciled comments. The modeler—and the team—are effectively following the kit method as defined in the IDEF manuals [1][2]. For a team member who usually works on a computer, such *paper work* may be found burdensome because the work is seen as manual and less interesting.

The graphic nature of the modeling methods adds another level of difficulty to the possible use of "electronic" kits. The situation in which a formal model grammar can be easily exchanged as a computer file usually occurs if the file is text. For example, internet is quite commonly used to achieve agreement on material in readable text form; however graphics must be converted into a text form, then back to graphics when received. Often the file must be sent to a printer to be able to view the graphics being sent. There is little opportunity to electronically communicate the graphic marked with the reader's comments back to the author.

Developing Hypertext Kits

Hypertext offers the reader the ability to browse a computer document which may contain graphics, and which has been authored so that a minimum effort is required to navigate through the material. The hypertext paradigm is characterized by multiple "pages" as manifested through a series of windows, screens, or cards. Most hypertext applications accommodate graphics as readily as text. Navigation is facilitated through the use a graphic region of "hot text" or "buttons" which are activated when a screen's cursor is positioned over such a region and the mouse button pressed. This action will cause the screen image to move to a different window or trigger any of a number of computer actions as designed by the author [3]. For example, the author may have selected words in the main body of a document that exist in a glossary section—or screen—to be linked to their glossary entry. Another button can be provided to return the reader to a previous place.

One of the advantages of hypertext is that navigation links can be made to traverse the graphic images hierarchically. Navagation links are accomplished by placing a button on each of the functions shown on the sheet. The button changes the contents of the window to the sheet that contains the decomposition for that function. Other buttons may be added to provide access to the text that is meant to accompany each function.

The remaining significant feature of hypertext is that the files can be made interactive. This feature allows the reader to make choices or to be prompted to enter text into a designated area. The interactive feature is key to the use of hypertext in a team situation. The team readers can enter their responses into the model hypertext file—or a companion file—and return the kit (file) to the author. Using the computer, the author can also easily electronically copy the comments into a project document file.

The following section describes how the hypertext features were beneficially employed to produce and distribute model kits in a unique medium.

Deployment, and Comment Return

The graphic editing tools provided by the hypertext application can be used to "re-originate" models when the model consists of only a few pages of graphics. At present, transferring model pages into a hypertext application is limited to the computer system's copy-and-paste capability for graphics. Most hypertext applications will also provide a means to ask the reader to "log-in" upon opening the model file so that a reader's name can be related to any comments entered. Once the model graphics exist in the hypertext environment, the author must add the navigation buttons and the fields for the model text sections.

Figure 2 is an example from the IGES configuration control process authored in hypertext at NIST. It presents the top diagram of the IDEF0-authored document to the reader. When the "Information" button is clicked, the navigation information graphic shown in Figure 3 is accessed. For the model illustrated, only the lowest level function boxes are explained with a text description. When the "A#" of such a box is "clicked," the explanation appears in a "pop-up" text field as shown in Figure 4.

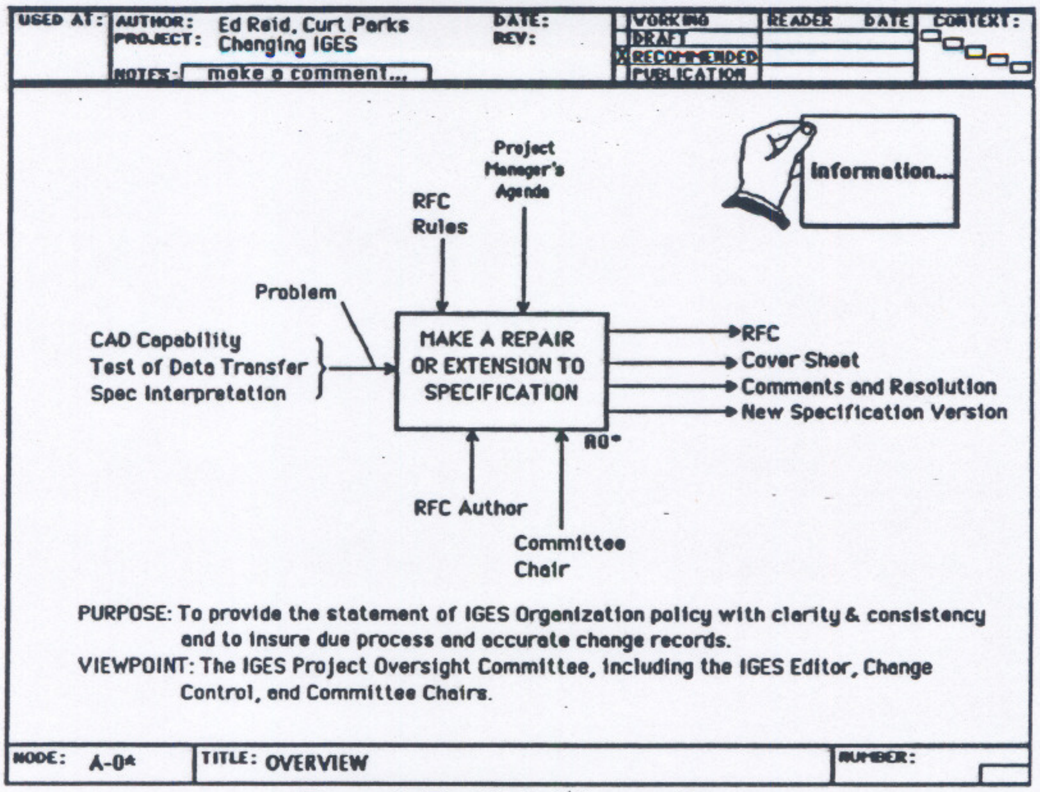


Figure 2. The Model Context Page

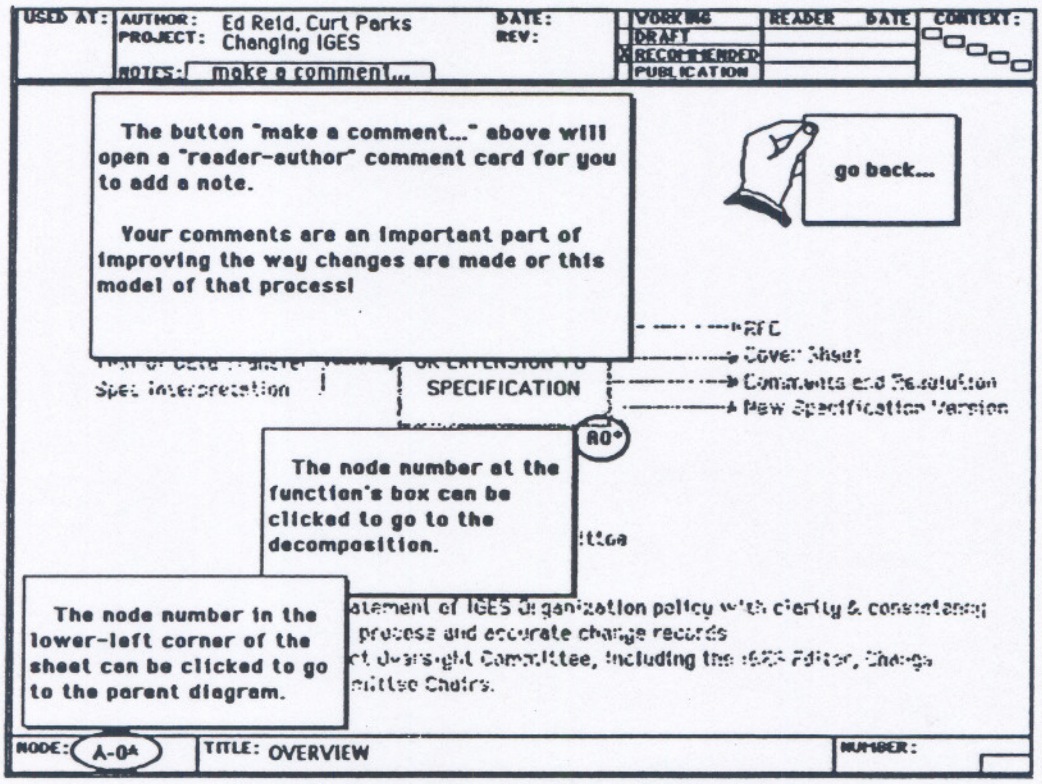


Figure 3. Instructions For Browsing the Model

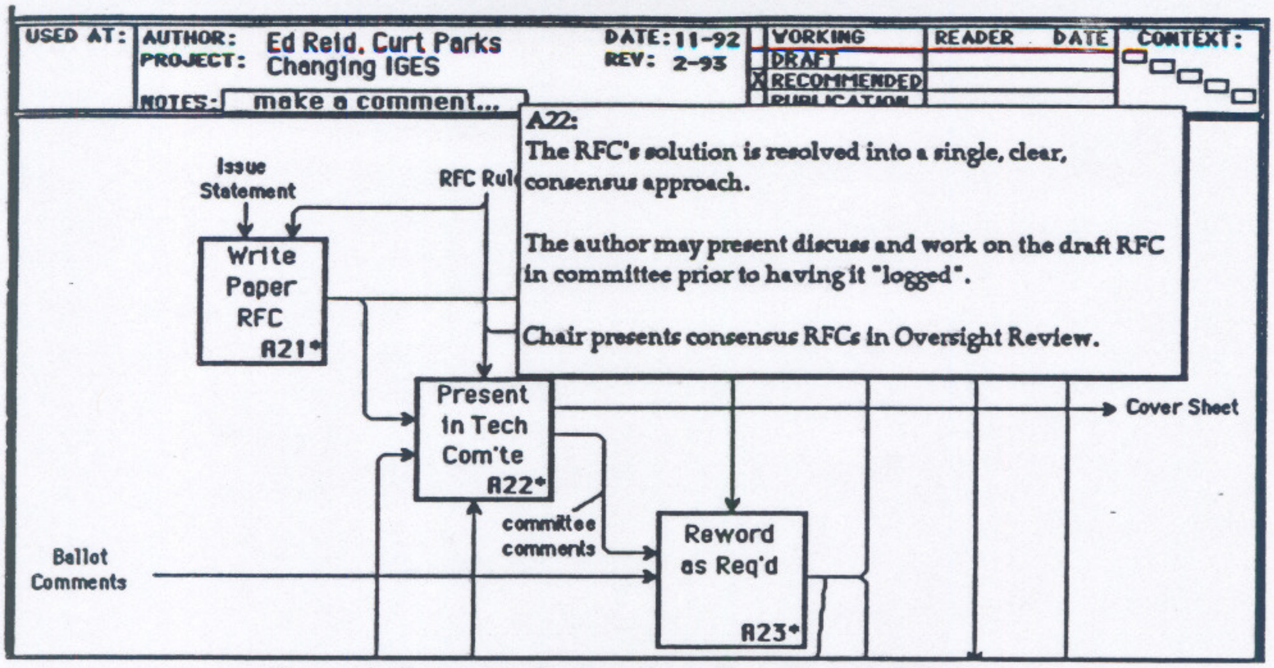


Figure 4. Example of a Function's Text "Pop-Up" Field

Additional files may be added which can be displayed as computer screen windows. One example is Figure 5, an interactive file for the reader to record comments. As a window, these files may be moved off from the model's window if the screen is relatively large. This allows simultaneous viewing of part or all of the model while entering comments into one of the additional files. A "pop-up" field could also have been used to collect comments. The separate reader's comments file (which could be returned to the author independent of the model file) offers advantages for this particular model distribution.

The addition of the interactive comment provisions was found to be critical to the success of the hypertext kits: The author could save the comments as a collection of comments for each model cycle. The author could also transfer the comments to a document which can be published for the purpose of describing the modeling effort. In an entirely computer-facilitated kit series of review cycles, the comment text could be transferred to another hypertext file—together with the author's disposition—then re-distributed to the team. In this situation the kit consists of a computer directory of files labeled to identify the model and its version, phase, or cycle.

Consider: a disk (with more well-labeled files than the reader is expected to open) is much more desirable than receipt of an overly thick paper document kit.

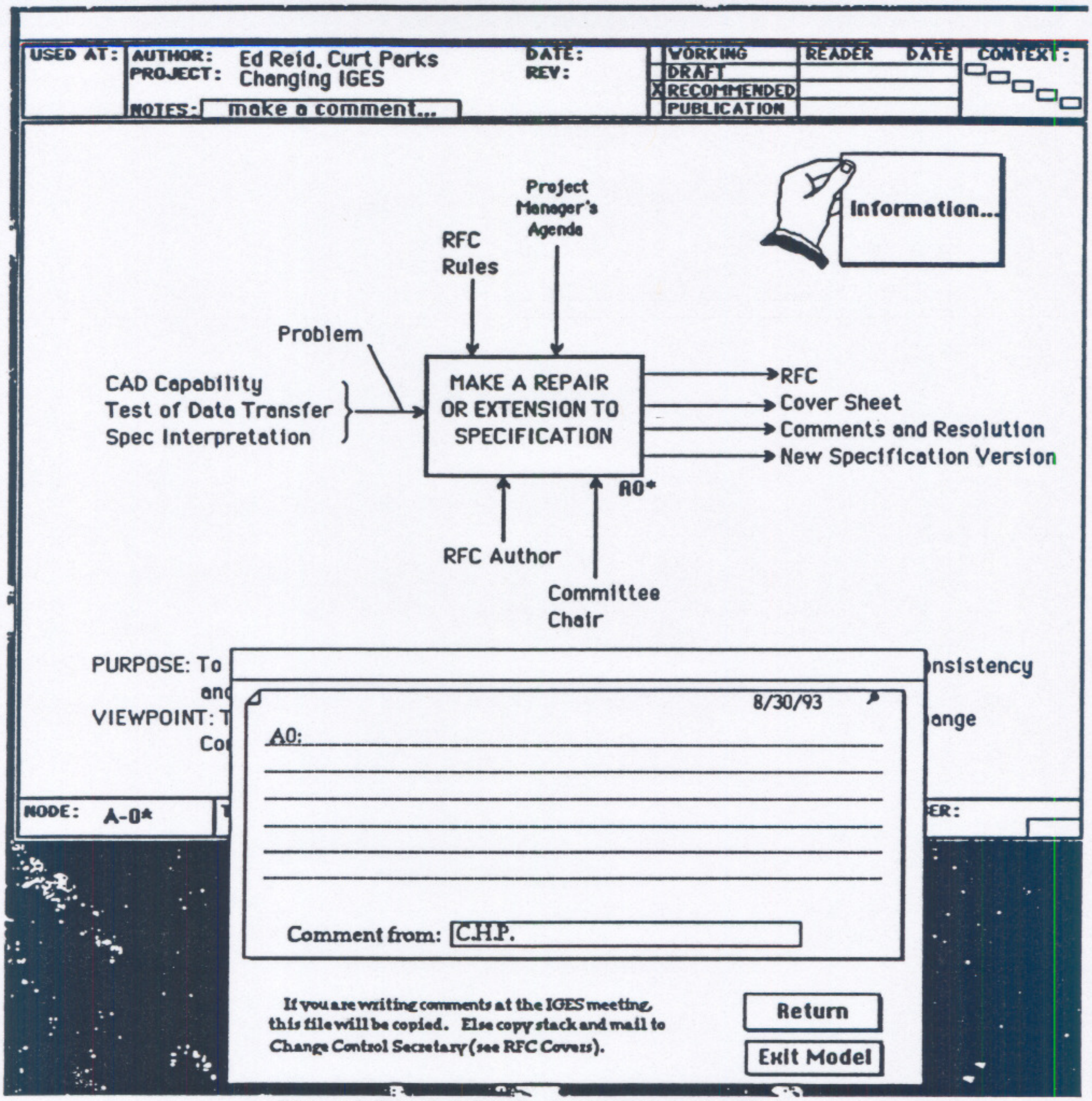


Figure 5. The Reader-Comment Interactive File

Two Projects Which Re-engineer the Modeling Life Cycle

First, the evolution of function modeling to include the development of the hypertext model in an industrial environment is described. This project produced a set of reusable modeling "templates" and a means of keeping computer records about a modeling project. Next, the use of the hypertext model templates in a voluntary standards community modeling task is described. These two projects are very different from each other in terms of the teams and the team goals. The medium and the construction of the models, however, were similar—affording a good basis for evaluating the utility of hypertext documents. (The figures in this paper were taken from the second of the two function modeling projects.)

Teams and Hypertext Models in an Industry Environment

In industry in the late 1980s, IDEF was viewed as a method to improve and refine production and design procedures. Early utilization of modeling involved the use of CAD tools to develop the model graphics, and other software tools to manage the underlying information. Hard copy kit versions were then generated for the creation and review cycle.

Acceptance of the method was lukewarm. Process "experts" and managers found it difficult to find the information of interest. The model developer was constantly generating new versions of the model kit, and trying to control comments and descriptions as they related to the graphics. Commercial packages became available which aided in creating the graphics of the model kits, but did not provide for the control of related data. Despite it's potential, unless something could be done to overcome these problems, IDEF would not continue to be used. As time went on and the use of the IDEF methods became more familiar to and accepted by those in industry, much of the reluctance toward becoming involved in the modeling teams vanished. There remained, however, the problem of disruption when including new employees as new members in the team efforts.

Upon review with individuals involved in using modeling tools, a Hypertext kit approach was recommended to overcome the problems of the hardcopy kit. Key elements of the tool would be: (1) a flexible interactive graphics creation package with a friendly method of navigating through the model (geared to individuals that are not computer or model literate); (2) controlled association between model graphics and the underlying definitions; and (3) a means of linking comments and refinements to the model structure, while maintaining the security of a prior version. The tool should be capable of providing a printed kit version when desired and should provide easy access to specific detail using a simple model walk-through process.

The key to designing an acceptable model review tool in industry is simplicity. Visualization of the decomposition of an activity using graphic "buttons" to pull up lower level detail aids in understanding. The tool must provide several capabilities such as the ability to attach explanatory text in paragraph form, to call up or hide text as desired, and to selectively print it in a report is essential. The tool must also provide capability to overlay an "as is" portion of the model with a "to be" replacement for visualization. This would require adequate program control of the arrows between the functions (ICOMs) throughout the model structure.

A demonstration hypertext package including these key elements was developed and shown to potential IDEF users in the organization, and it met with a high degree of enthusiasm. There were discussions of how to improve the utility of this concept. Among the desired improvements discussed were interactive links to other related software packages (such as data modeling programs), timing analysis, and programs for generating reports. Another future possibility would be the extension of explanatory attachments to include drawings, photographs and movies of an activity or ICOM for further clarification.

The hypertext "templates" from the demonstration package described above were made available to standards organizations where the use of the contributed (i.e., public domain) software had a very different impact.

What is important to note is that industry is not receptive to the ongoing responsibility of fully developing and maintaining internally a computer application which is specifically designed for use in function or data modeling. It is generally felt that if the desired and needed model-reviewing software should become commercially available, that it would have wide acceptance in industry.

Hypertext Models and Model Review in a Voluntary Standards Organization

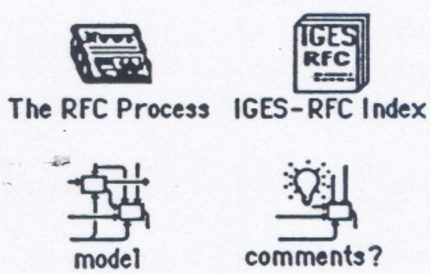
Considerable efforts have been made to document standards in hypertext format [4]. The hypertext standards and other computer material [5][6] have made hypertext concepts sufficiently well accepted for its application to function and data modeling. The model graphics (such as pages with 3 to 6 empty boxes) and the navigation buttons developed for the above project were introduced to one of the committees in the Initial Graphics Exchange Specification (IGES) [7] Organization. This committee had been using function and data modeling to develop extensions for the new versions of the specification. The Organization's change control process was being formally documented [8] and hypertext files were being created to record change decisions and status changes [9]. A function model of the process was desired to accompany the document. It was felt that the use of the hypertext model templates could result in a shorter model review cycle and the final models could accompany the active change information files in addition to being published in the change process document.

The change process model (parts of this model are shown in Figures 2–5) was authored directly in the hypertext application, although it was also entered into a modeling application to check for syntax accuracy later in the review cycle.

The model's first review cycle was completed using a notebook computer as the "kit": the author requesting each reader in turn to spend some time using the computer and the model file. The need for a companion file for entering comments was quickly apparent—and developed. After the readers had all entered comments, the comment file was printed. Comments addressing the same problem were grouped, and the model revised.

A second review cycle was completed in a similar manner, with the comments and author responses printed and mailed to commenters.

The "publish" version of the model was printed for the organization, and the hypertext file was included with the change control files. The model/file was linked to its node tree as shown in Figure 6 of the general information hypertext document. The files are placed on a computer that is made accessible to all the members during each meeting of the IGES Organization. The comment file is checked at the end of the meeting, and any comment records copied to disk.



The two reviews, facilitated by the models in hypertext, have been observed to result in rapid model evolution: Over the past two meetings no additional comments have been received, from readers of either the published document or the change file directory.

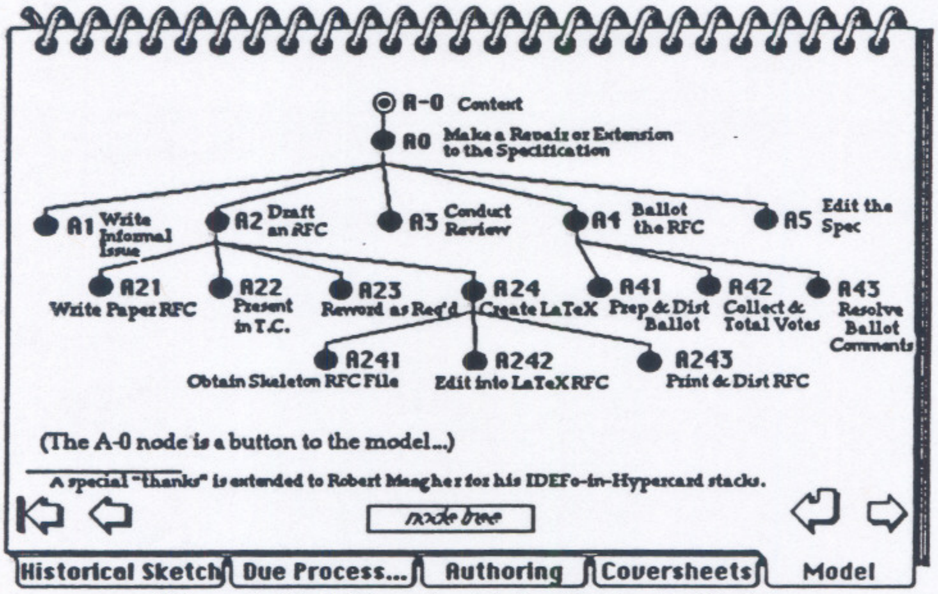


Figure 6. Node Tree Containing Button to Model

Lessons Learned and Other Observations

During both of the models' kit cycles, the authors expended an extra amount of time on a computer. An automated software tool was employed in addition to the hypertext application. This is due to the creation of the hypertext kits which are not facilitated with an "automated" tool developed for modeling. Following the deployment of the hypertext kits, much of the initial time was regained by the greatly improved means of handling the comments. Many of the readers noted that they were more comfortable typing their comments into the "little notebook" files developed for the kits.

The link between the model and the functions being modeled is missing in most applications. One of the most significant benefits gained was the ability to couple the model to other related application documents. For example, in the IGES project the finished model in a hypertext reader was linked to the configuration management hypertext files. Where there are other industrial applications, the model can be an effective complement, and can be linked to the functions of the application. An example of such an application is the "Manufacturing Producibility Analysis Coordination Tool," which is also a hypertext application[10]. Such linking has additional potential where the model is to be the "controlling document" for the process defined. These potential benefits were not evaluated by the authors, however such model-to-process linking is felt to be a primary requirement for developing a situation where the model truly (and dynamically) controls the functions that were modeled.

As described, the use of hypertext can be adapted to other modeling methods. Both of the modeling situations described involved function modeling using IDEF0 methods. A data model is a planned addition for the IGES system, and the development of the data model may also utilize the same hypertext kit cycles. For such data models, the authors expect to develop small, topical entity sub-models on each screen (page), with an "overview" model screen included with the kit cover. Each entity in the overview would be linked to its sub-model, or view.

The authors also suggest that adding the hypertext as a kit alternative should not be done without a paper printout of the kit for any potential reader who is not a regular computer user. Fortunately, the hypertext application as well as the modeling tools can be used to print the pages needed .

The selection of the hypertext reader computer application was fortunate, as the second project described required a "freely available" reader in the final phase. Here, there is no desire to restrict people from reviewing the model electronically. A model in a "licensed-for-fee" application would result in many requests for the printed version.

In both situations described, almost all of the model's readers were computer users, however only a few had the author's modeling tool available on their computer. The authors also feel that the hypertext kits require minimal instruction, whereas the modeling tools—even when provided only for model reviewing—require either special training or manuals. Additionally, it is felt that there would be no way for a reader to "comment" on the model without directly editing the model should the reader use the modeling tool. To date, these tools only accommodate the model author and publisher.

Conclusions

The deployment of model kits in hypertext filled the gap left when modeling became "computer aided," and provides the model "reading" assistance needed by the reader. There is a need for "coupling" software so that the author can create a hypertext reader's kit from the modeling tool. This coupling-software could firmly establish an all-electronic model life cycle.

The hypertext kits significantly shortened the kit cycle time. Where the hypertext application facilitated the ability to browse the model and the related text, the improved reader response appears to be similar to the improved response time found when electronic media (e.g., internet e-mail) is employed.

These model-development experiences have been enjoyable, interesting, and rewarding for both authors. The IGES hypertext model is public domain and is available at IGES meetings or from Mr. Parks.

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