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An Overview of Diagram Based Idea Organizer: D-ABDUCTOR

Kazuo Misue Kozo Sugiyama

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International Institute for Advanced Study of Social Information Science,
FUJITSU LABORATORIES LTD.

Numazu office
140 Miyamoto, Numazu-shi, Shizuoka 410-03, Japan
Telephone: +81-559-23-2222 Fax: +81-559-24-6180

Tokyo office
9-3 Nakase 1-chome, Mihama-ku, Chiba-shi, Chiba 261, Japan
Telephone: +81-43-299-3211 Fax: +81-43-299-3075

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International Institute for Advanced Study of Social Information Science,
FUJITSU LABORATORIES LTD.

140 Miyamoto, Numazu-shi, Shizuoka 410-03, Japan
{misue,sugi}@iias.flab.fujitsu.co.jp

ABSTRACT

A diagram based idea organizer D-ABDUCTOR has been developed. It can deal with diagrams that have both adjacency relationships and inclusion relationships among cards by a sophisticated use of graph drawing algorithms. Design requirements and features of D-ABDUCTOR are described. An application is shown to explain the process of working with D-ABDUCTOR.

Key words: idea organizers, graphic interfaces, diagrams, compound graphs

1 INTRODUCTION

We have developed D-ABDUCTOR, which is a system to support dynamic thinking processes of humans by sophisticated use of graph drawing algorithms. We aim at to attain an effective integration of human thinking ability and computer information-processing ability. Diagrams are good media to reflect and organize personal thoughts and to communicate with other persons in collaborative works. D-ABDUCTOR provides several new facilities to deal with diagrams that can represent both adjacency relationships and inclusion relationships among cards. Until now, no system has provided the facilities based on automatic drawing of such diagrams.

In this paper we list system design requirements for graphic interfaces of idea organizers. Then we describe the features of D-ABDUCTOR. Next we show an application with actual screen dumps to explain the process of working with D-ABDUCTOR. The techniques described in this paper are also useful for browsers of hypertext[1].

2 SYSTEM DESIGN REQUIREMENTS

We list some of the underlying design requirements that we feel are important for idea organizers dealing with diagrams[8]. The underlying aim of these requirements is to release users from time-consuming chores and to allow users to concentrate on thought.

- **SIMPLE OPERATIONS**

  Complicated operations tend to prevent the users from concentrating thought. Simple operations are easy to learn and useful to make computers known the user's intention.

- **VISUAL RESPONSE**

  Response for users input is important for interactive systems. Visual (or diagrammatical) response is an effective way for the users to know the results of their operations.

- **AUTOMATIC DIAGRAM DRAWING**

  The users often need re-drawing of diagrams on editing process of the diagrams. Automatic drawing releases the users from the time-consuming chores of generating readable diagrams.

- **COMPLYING WITH USERS VARIOUS REQUESTS**

  Users have various requests for styles of displaying diagrams on editing processes of the diagrams. For example, they require to make outline views for global information to detailed views for detailed information, and to emphasize the parts important for them.

- **COMPENSATING FOR HANDICAPS OF COMPUTERS**

  It is difficult to obtain whole and detail views of large diagrams on an ordinary screen because the size and resolution of screens are limited. Thus effective display methods are required[6].

- **PRESERVING THE MENTAL MAP OF DIAGRAMS**

  Automatic drawing may change diagrams totally. Suddenly and drastically changes of diagrams often destroy the user's mental map of the diagrams[2], and make efficiency of works lower.

- **COORDINATING WITH OTHER SYSTEMS AND PERSONS**

  These systems become more powerful when they are used together with other systems or tools. Idea-organizing works with some other persons tend to be able to create good ideas.

3 FEATURES OF D-ABDUCTOR

D-ABDUCTOR provides the following facilities. Figure 1 is a screen dump of D-ABDUCTOR with many sub windows.

- **COMPOUND GRAPHS**

  D-ABDUCTOR provides an environment to deal with diagrams based on compound graphs[9] that have both adjacency edges and inclusion edges (see Figure 2). The environment includes a direct manipulation interface and menus for simple operations.

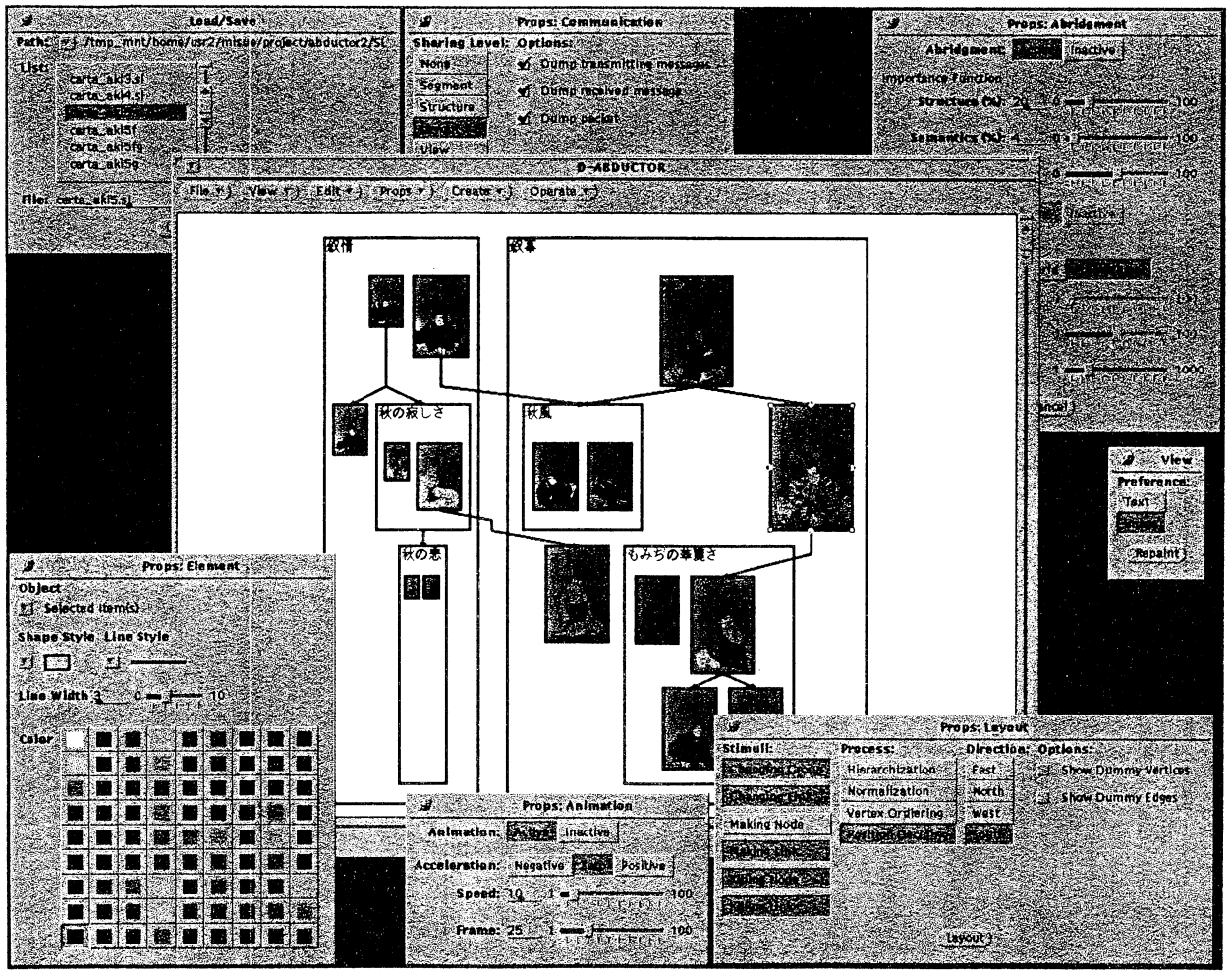


Figure 1: Screen dump of D-ABDUCTOR with subwindows

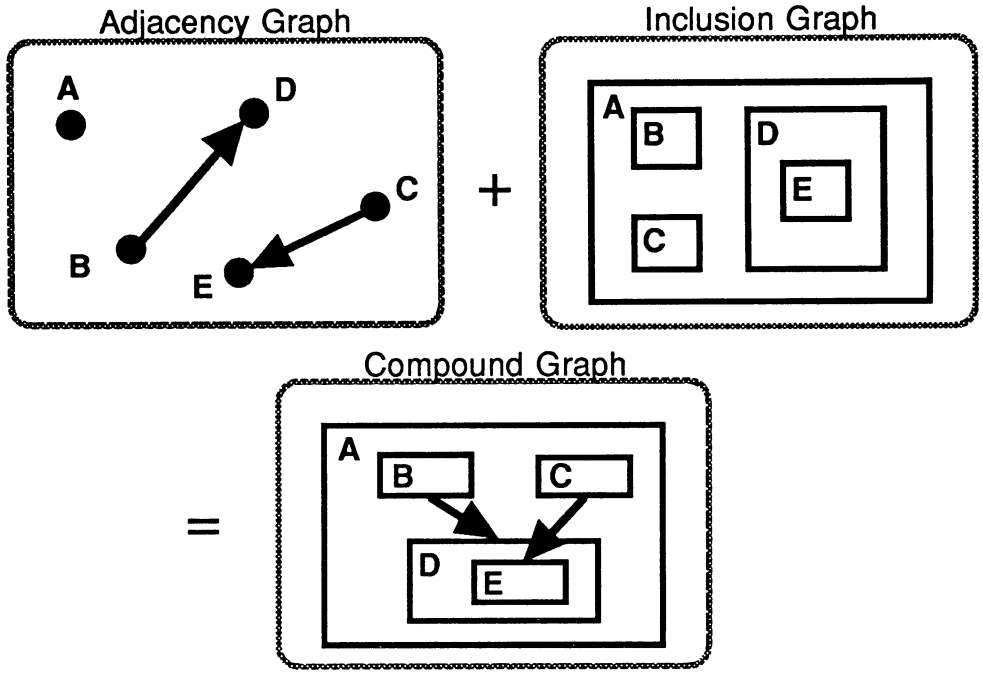


Figure 2: Adjacency Graph + Inclusion Graph = Compound Graph.

- **AUTOMATIC DIAGRAM DRAWING**

  D-ABDUCTOR provides an automatic drawing facility for compound graphs, using an algorithm based on cognitive criteria[9]. Certain operations selected by the users can trigger the invocation of this facility for visual response. This facility also supports many of other facilities mentioned below.

- **COLLAPSE AND EXPAND OPERATION**

  The **collapse** operation collapses a group of vertices into a vertex to make an outline of a diagram. The **expand** operation expands a vertex that has been collapsed to a group to make return the detail to the diagram. The users can make diagrams more abstract or more detail by using these operations.

- **ABRIDGMENT**

  Abridgment changes visibility and size of vertices according to their importance. More important vertices become larger, and less important vertices become smaller or omitted. Structure of diagrams, semantics of vertices and the specific user's viewpoint influence importance of vertices[3, 5, 7].

- **DISPLAY WITH ANIMATION**

  D-ABDUCTOR provides display of changes with animation. The animation reduces the instantaneous visual change so that the changes preserve the user's mental map. The users can change the number of frames and speed of animation.

- **COMMUNICATION WITH OTHER SYSTEMS**

  D-ABDUCTOR can communicate with other systems by drag and drop operations. For example, D-ABDUCTOR can get pictures from "*Picture Library*," and draw pictures in vertices. D-ABDUCTOR can also communicate with "*Card Base*," which manages a database of cards with text and images. D-ABDUCTOR invokes Card Base with some keyword expressions, and draws some retrieved cards.

- **COMMUNICATION WITH OTHER WORKSTATIONS**

  A process of D-ABDUCTOR can communicate with processes of D-ABDUCTOR on some other workstations to share information. The users can choose one of several sharing levels: **nothing**, **segments**, **structure**, **layout**, **views** and **operations**.

- **LANGUAGE "SIMPLE"**

  D-ABDUCTOR has language "*Simple*" for data description, communication and others. The language Simple can describe all operations and commands of D-ABDUCTOR. We also offer a tool "*Message Transmitter*," which transmit messages in Simple to D-ABDUCTOR. Other systems can control D-ABDUCTOR easily by using the language Simple and Message Transmitter.

4 WORKING EXAMPLE WITH D-ABDUCTOR

The following sequence of procedures to organize ideas is just one example. D-ABDUCTOR does not restrict the users to this sequence.

(1) BRAINSTORMING

We collect segments of ideas by brainstorming and write them down on cards (vertices of compound graphs) by text editors. D-ABDUCTOR spreads cards in its window initially. Figure 3(a) shows a situation that all cards are on default initial positions.

(2) ORGANIZING

We organize cards manually by making groups of some cards with common ideas and drawing links between related cards or groups. We can perform **move** and **link** operations directly by using a mouse. Figure 3(b) shows a situation that some groups have been made and some links have been drawn.

(3) REARRANGING

We rearrange diagrams that have fallen into disorder to make them readable. An automatic drawing facility is available. It is also possible to rearrange diagrams while organizing cards. Figure 3(c) shows a situation that automatic re-drawing has been done.

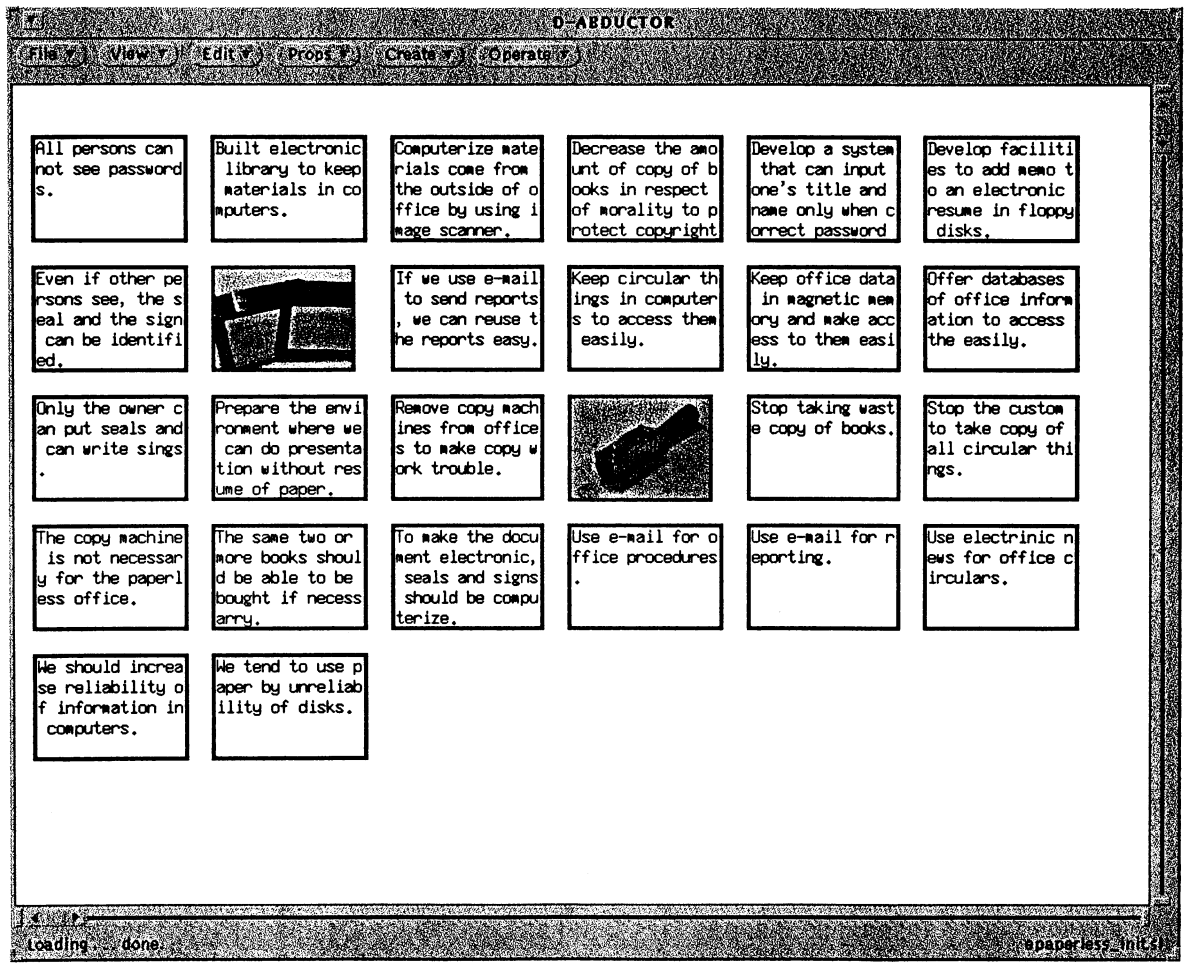
(4) OBSERVING

We observe the diagrams from different points of view. Changes of viewpoints may cause automatic re-drawing of diagrams by the facility of abridgment. Figure 3(d) shows a situation that the user puts two viewpoints on the diagram.

5 CONCLUSIONS

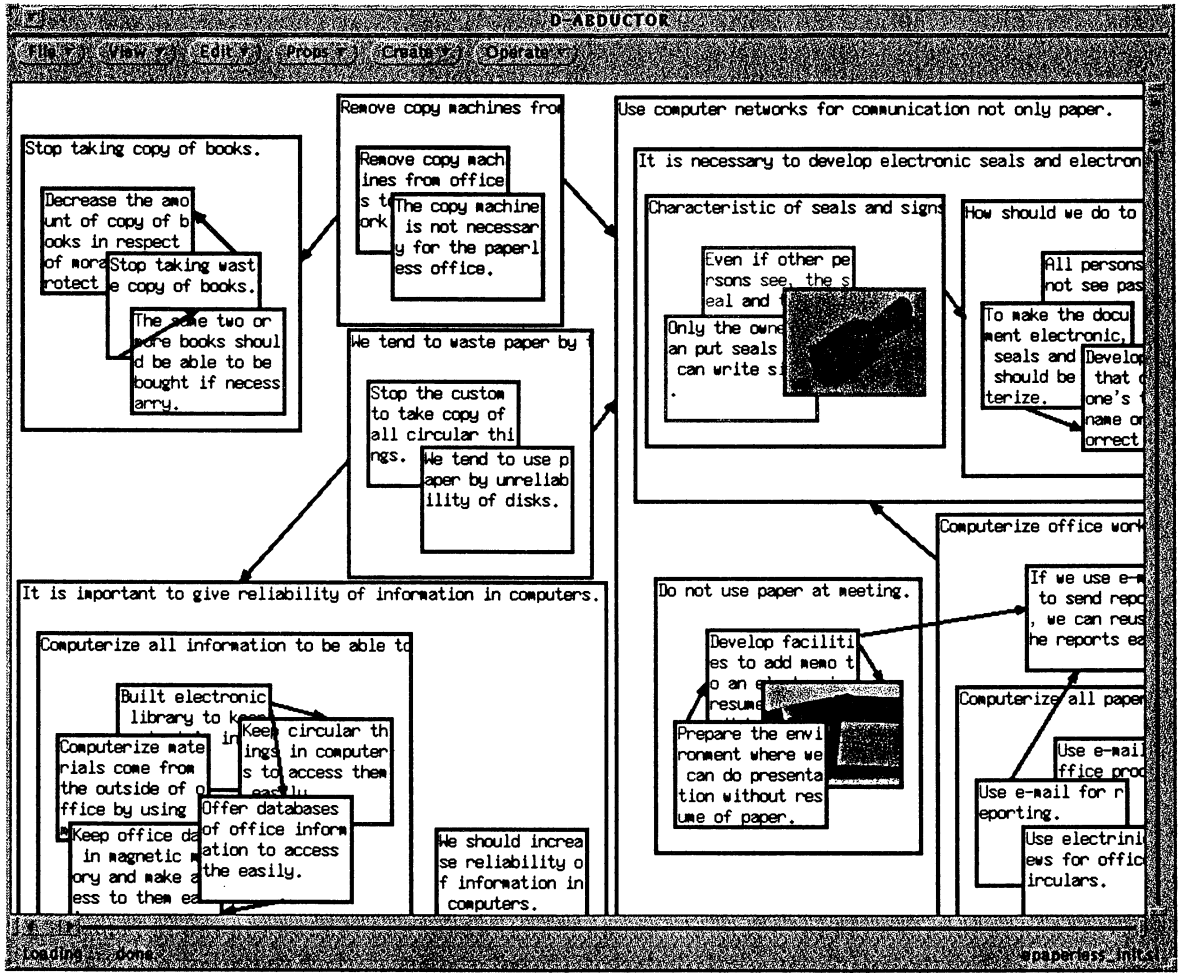
We have implemented a prototype of D-ABDUCTOR on a SPARCstation 2 workstation. In the future we will try to apply it to practical fields. We expect that the applications guide us toward other requirements to integrate human and computer abilities.

Besides the facilities that we have described above, we have also developed free-hand-like curve generation[4], multi-viewpoint perspective display methods[6] for early version of D-ABDUCTOR. They also play important roles to provide good user-interfaces.

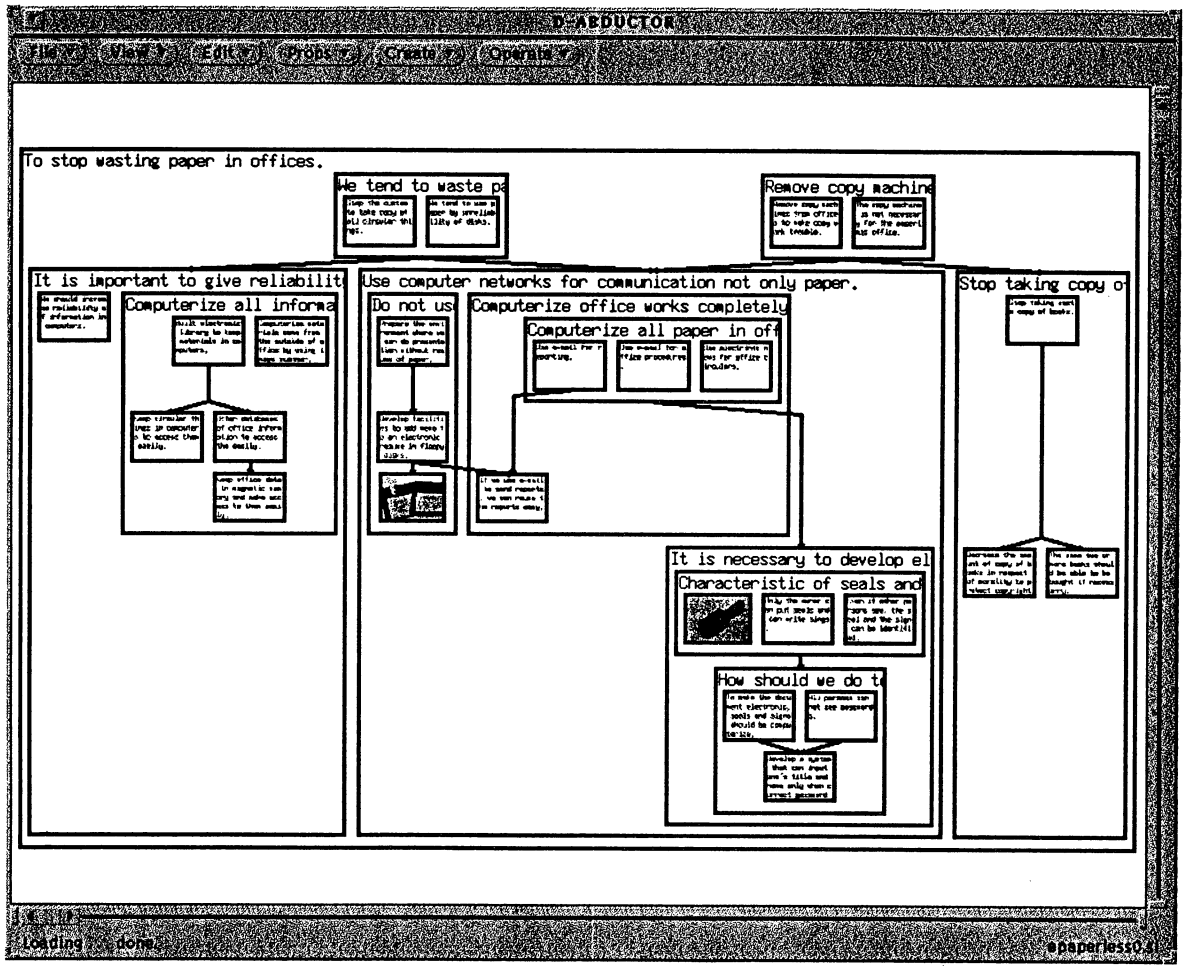


(a) Spread cards

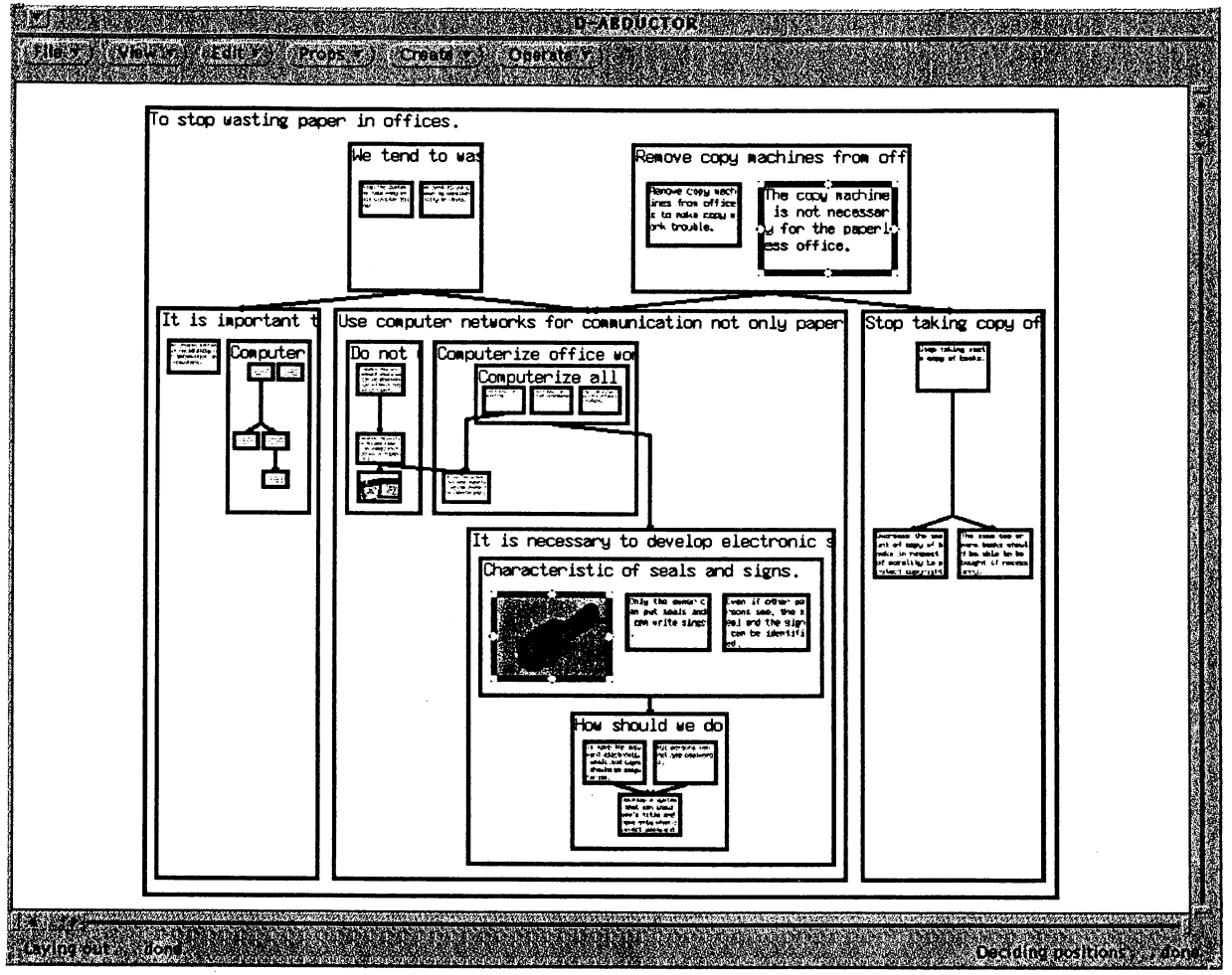
Figure 3: Working example with D-ABDUCTOR



(b) Organized cards
Figure 3: Working example with D-ABDUCTOR



(c) Automatically rearranged diagram
Figure 3: Working example with D-ABDUCTOR



(d) Diagram with two viewpoints
Figure 3: Working example with D-ABDUCTOR

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