

Case-based Reasoning for the Case Method

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Abstract

Eighty-five years ago, Harvard created a business school to train the leaders of industry and commerce. Within a decade, Harvard had institutionalized case study as its primary teaching method in the business school.

Today, the case method is a fixture at most business schools. An average MBA student prepares (or is supposed to prepare) up to 600 cases during his or her two years in graduate school.

The contrasts between the case method and traditional teaching methods are similar to those between case-based reasoning and rule-based systems. In this paper, we discuss the case method and compare it with the paradigm of case-based reasoning. We describe a computer system designed to extend the case method with the application of case-based reasoning. The implementation of this system requires the development of an indexing scheme and content theory of the goals, strategies, and explanations of business decision making.

The Case Method

In 1908, Harvard decided to open a business school. The University of Pennsylvania and Dartmouth already had such schools, but Harvard soon set the standard through the use of the case method.

According to Gragg (1954) a business case is:

a record of a business issue which actually has been faced by business executives, together with surrounding facts, opinions, and prejudices upon which executive decisions had to depend. These real and particularized cases are presented to students for considered analysis, open discussion and final decision as to the type of action which should be taken.

The case method had ardent proponents in its early days, including the president of Harvard.

The case method of business training is deemed the best preparation for business life, because the

discussion of questions by the banker, the manufacturer, the merchant, or the transporter consists of discerning the essential elements in a situation and applying to them the principles of organization and trade. His most important work consists of solving problems and for this he must have the faculty of rapid analysis and synthesis. (President A. Lawrence Lowell of Harvard, circa 1920, reprinted in [Christensen, 1987].)

Given that there were no libraries of cases upon which to draw, Harvard started collecting and writing its own cases – a process which continues to this day. Harvard hired its own MBA graduates to write cases.

Early Harvard cases were simple. Here is one in its entirety (reported in [Christensen, 1987]).

Ajax Manufacturing Company: Filing Receiving Clerks' Copy of Purchase Order

The Ajax Manufacturing Company has, for the past five years, sent a copy of each purchase order to the receiving clerk. The receiving clerk places these copies on a spindle and when the shipment is received, if it is complete, he attaches his copy of the purchase order to the detailed notification of material received report which he makes out.

When this method of placing the copy of the purchase order on a spindle was started this company was producing approximately eight hundred pairs of men's goodyear welt work shoes per day. During the years 1916-1918, however, it expanded its output to over 3500 pairs per day. This expansion has necessitated the filing of the copies of the purchase orders in the receiving department, in accordance with some systematic scheme.

Mr. Carney, the receiving clerk, has visited several factories and has found that some receiving clerks file their copy of the purchase order by the date the shipment is due; others file them by the name of the commodity or by the name of the vendor.

What method of filing the copy of the purchase order should Mr. Carney establish in his department?

This minimal example illustrates some key aspects of cases.

- **Real situation.** The case is based on an actual problem faced by a real person in a real company.
- **Human protagonist.** Here, the focus is on "Mr. Carney," not the Ajax Manufacturing Company. People make decisions. Companies do not.
- **Specific problem.** The question is not how to maximize profits, but how to file a purchase order.
- **Implicit goals.** The case does not state that the company is interested in cutting overhead, improving productivity, reducing errors, or decreasing the time required to process an order. These goals are axiomatic in business and implicit in this case.

In addition to exposing business students to real problems faced by real companies, the case method requires students to explain their decisions and justify them in front of their classmates and instructors. There is evidence that the requirement to justify a decision is one of the more valuable aspects of the case method. The following student reports are taken from [Christensen, 1987].

- I didn't realize there were so many different ways of dealing with this "situation," and there are lots of "situations" in every case. I'm going to get away from "single-track" thinking.
- I went into class with one point of view; it came under attack! In the old days I would have dropped my idea immediately, but I stuck in there, gave ground where I saw I was weak, and came away having convinced most of my section that our plan was right. I can do it!
- I sure goofed! My plan was a good one and I had spent hours working it through. Yeah – but I ignored the key element: how was I going to convince others that doing it was the best plan?

We may then add another key feature to the case method of instruction.

- **Explanation.** In preparing a case, a student must not only arrive at a decision, but also must be able to justify that decision as being preferable to the alternatives.

Cases come in a variety of forms. A case may be included in a textbook. A case may merely be a collection of articles from magazines or newspapers. A case may be based on the personal experience of the instructor or students.

The great majority of cases are small pamphlets of 10 to 20 pages published by the Harvard Business School. Like the Ajax case above, these cases follow a formula. They focus on a specific decision facing a real person. The case narrative presents a brief background or history of the business or industry, and a discussion of the alternatives. There are usually appendices

containing exhibits of financial information and other supporting documents. Professors and researchers at Harvard expend considerable time and money preparing these cases for use at Harvard and other schools. Publishing cases is a profitable enterprise.

At the other end of the food chain, the student faces the complementary task of preparing the case. That is, the student, alone or in a group, reads the case and determines what decision the protagonist should make. Unlike a math problem, there is no one right answer. (However, there can be wrong answers.) The student's job is to identify the major issues in the case and to develop a rationale that addresses those issues.

A case serves many purposes. Taken by itself, it may illustrate a theoretical principle, or stimulate class discussion. However, given their real-world origins, cases rarely provide exact matches for theories.

Most MBA programs comprise two years of study with courses including finance, marketing, accounting, statistics, organizational behavior, and information systems. While there is wide-spread use of cases within each of these fields, cases also provide a realistic way of spanning disciplines. A single case may have implications for accounting, finance, and marketing. Such a case provides students an opportunity to integrate a variety of knowledge.

In many courses, students may prepare 3 or 4 cases each week. Over two years, a student has probably read up to 600 cases.

CBR and the Case Method

The case method developed as a more realistic and practical alternative to lectures and textbooks. Case-based reasoning developed as a psychologically more realistic alternative to rule-based systems.

The obvious point of comparison between the case method and case-based reasoning is that they each focus on a real episode, rather than abstract principles or rules. The case method is based on the idea that students learn better from concrete cases than from abstract principles. Case-based reasoning asserts that learning cases is more natural and compelling than learning rules, for both computers and people.

The other major features of case method cases are consistent with CBR systems: agent perspective, specific problem, implicit goals, and the role of explanation. The real cases are more memorable and have a richer set of consequences and inferences than abstract principles or rules.

Given the considerable overlap in the fundamental nature of CBR and the case method, an obvious question is: how can we apply case-based reasoning to support the case method?

Before we address that question, we shall briefly describe recent work which uses interactive multimedia for case development, delivery, and student tutoring.

The Living Case

In spite of the requirement that cases represent real episodes, some critics have complained that case materials themselves are artificial and suffer significant shortcomings [Turner and Kumar, 1991]. In particular, stereotypical cases have the following properties.

- **Sequential presentation.** The narrative usually follows a simple chronological development of one story.
- **Selective information.** The material is focused and reasonably consistent – providing a coherence not found in real-life situations.
- **Static representation.** The case is not dynamic. The student is unable to affect events or to reveal any new information, beyond analyzing the existing data.
- **Single medium.** While there are occasional videotapes or other materials, the typical case is print text with black and white graphics.

Turner and Kumar (1991) describe a system developed at New York University called *The Living Case*, “which flexibly and interactively presents cases along with dynamic, ongoing feedback to students while they work.”

The Living Case is a multimedia system for case authoring, case delivery, and student tutoring, in which cases are presented using text, graphics, full-motion digital video, spreadsheets, and other interactive software.

The Living Case was designed to address the problems stated above with the traditional printed case. In reasoning from cases, there is a spectrum of experience ranging from the first-hand experience of the participant, to the second-hand relationship of the writers of the case, down to the third-hand episode of the student reading about the case. Presumably the first or second hand experience is more vivid, accurate, and memorable than the third hand experience.

The Living Case is an attempt to use multimedia to make the student’s experience more like a first or second hand experience. The interactive computer simulation in fact creates a first hand experience for the student.

Case Exploration

The Living Case represents one way to expand the case method by making cases richer and more memorable. Another approach is to provide the student with tools for exploring a library of previous cases, making explicit the paradigm of case-based reasoning. With Ken Laudon at New York University, we are developing a case-based reasoning tool to be used by MBA students preparing business cases.

Most case preparation focusses on a given business problem in isolation. That is, the case looks at com-

pany X and its history with little regard to the choices made by other companies in similar situations.

We are applying case-based reasoning to the case method by providing a case explorer tool that will serve as a repository of business cases with a rich set of indices. The student analyzing the problems of company X could use the case explorer tool to find other companies, perhaps in other industries, which faced similar decisions.

The tool could help the student develop explicit case-based reasoning skills. It would make it easier for students to argue from cases, rather than simply analyzing cases. Most case analysis is focused on issues in a single case, not on making connections with issues from other cases. In the real world, decisions often hinge on the degree to which one can find the best precedent or previous case on which to base a new decision. This is a fundamental premise of case-based reasoning [Simpson, 1985; Hammond, 1986; Slade, 1991a]. The initial set of cases for the case explorer is drawn from a textbook on information systems [Laudon and Laudon, 1991].

The case explorer implements the CBR paradigm explicitly as a decision making paradigm. Students would be taught the following.

1. Identify indices for the new case.
2. Retrieve similar cases from case library.
3. Modify the previous cases for the new problem.
4. Test the new solution.
5. If success, add to case library.
6. If failure, explain failure and cycle again.

By decomposing the process, we can teach students to be more critical and objective in their analysis.

We shall also integrate the VOTE program [Slade, 1992b; Slade, 1992a; Slade, 1993] with the case explorer to permit VOTE to simulate the decision making problem posed in the case. In the domain of Congressional roll call voting, VOTE is given a member of Congress and a specific bill. VOTE then determines how that member would vote and produces a natural language explanation of the resulting decision in English or French.

Below is an example of the VOTE program simulating Congressman Morris Udall voting on a bill banning the desecration of the American flag.

```
> (vote 'udall 'hr-2978)
```

```
* Member:      Morris K. Udall
* Bill:         Flag Desecration
* Bill banning the desecration of the flag.
— OMITTING INTERMEDIATE OUTPUT —
```

```
* English rationale:
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Morris K. Udall votes against bill HR-2978, the flag desecration bill. After weighing the implications, he believes that provisions of this bill are not

constitutional. He completely supports the United States Constitution and the Bill of Rights. Udall readily endorses the right of freedom of speech. Even so, Udall realizes that members of the Democratic party oppose the right of burning the American flag in protest.

*** French rationale:**

Morris K. Udall s'oppose au projet de loi HR-2978, la loi de la profanation du drapeau. Après une considération approfondie, il croit que les dispositions de ce projet de loi ne sont pas constitutionnelles. Il est un champion de la Constitution américaine et de la déclaration des Droits. Udall désire vivement appuyer le droit de libre expression. Cependant, Udall comprend que les membres du parti Démocratique s'opposent au fait de brûler le drapeau américain lors d'une manifestation.

In the business case domain, the program will start with the initial facts of the case from the perspective of the decision maker who may have relationships with other agents. The student's task is to make explicit the goals of the case for the decision maker and the other agents. The program will then simulate the decision, and provide a natural language justification or explanation of the decision.

This program will comprise a content theory for business domains, providing explicit case indices, goals, relationships, and explanations. There are many important types of surface features that may be used as indices for cases.

- **Industry type:** manufacturing, transportation, financial services, information technology.
- **Sector:** public, private, non-profit.
- **Level of decision maker:** CEO, division head, manager, consultant.
- **Players:** employees, customers, competitors, vendors, distributors, regulators.
- **Functional unit:** headquarters, manufacturing, marketing, sales, finance, accounting.
- **Type of decision:** investment, technology, marketing, human resources, product design.
- **Industry position:** market share leader, niche player, low price producer, technology leader, start-up.
- **Strategies:** right sizing, customer driven, total quality, reduce cycle time, global expansion.
- **Economic goals:** net present value, return on investment, stock price, earnings.

Part of the analysis is determining which features are salient in a given case. In turn, that will influence what prior cases are retrieved from the case library.

Based on our work on VOTE, we believe that a more important set of features is the implicit set of goals

that are part of a business case. For example, in the Ajax case above, these goals included cutting overhead, improving productivity, reducing errors, and decreasing the time required to process an order. As demonstrated by VOTE, these goals not only serve as indices to prior cases, but also play a part in determining a decision strategy and providing an appropriate explanation [Slade, 1991b].

With Henry Lucas and Michael Fish, we are looking at simulating the decision of whether to undertake an information technology acquisition.

Traditional capital budgeting paradigms, such as net present value, pay-back period, or return on investment, often prove inadequate when used to evaluate investment in new technology. This is in part due to the difficulty in identifying all the costs and benefits associated with new technology.

When a manufacturer builds a new plant, he has a good idea what costs he will incur for construction, financing, new equipment, and training because he or his company has likely gone through this experience before. Similarly, he can identify the benefits in terms of increased production efficiency, lower marginal costs, and increased product quality.

However, investment in high technology differs from traditional capital budgeting problems in that there is often little relevant prior experience. When a company buys a local area network or replaces its mainframe with a client-server architecture, chances are, this is a first-time venture. Thus, it is impossible to evaluate this option based on a previous case, since there is no previous case. Furthermore, given the rapid pace of technological development, investment in new technology may *never* be based explicitly on prior experience.

Typically, investment in information technology is justified based on tangible assessments, such as head-count reduction, and intangible estimates, such as increased productivity or product quality. We have identified dozens of standard justifications, some of which are listed below.

- keep up with the competition.
- lower marginal product cost.
- leverage previous technology investments.
- increase capacity and flexibility.
- reduce future costs of not investing.
- change organizational structure.
- meet customers' requirements.
- comply with regulatory requirements.
- centralize decision making.
- decentralize decision making.
- enhance coordination.
- reduce uncertainty and risk.

These are the types of goals and explanations that the case exploration tool will incorporate. We plan on demonstrating the case explorer at the workshop.

Implementation

We have developed a prototype system in HyperCard on the Mac. Figure 1 shows a sample screen displaying a case concerning the United Parcel Service. Figure 2 displays a screen image of the "Increase market share" card from Issue database.

This prototype system allows users to add new cases, and index them with issues, industries, relations, and technologies. Users may also create new features, and link features together in a network. This alpha system permits us to develop our indexing taxonomy.

The next step is to integrate these databases with the VOTE program. We are currently porting VOTE to Common LISP on the Mac, and will merge the two systems. We shall then be able to use VOTE to simulate the particular business decisions relating to specific cases.

We plan on testing the systems with MBA students in the coming year.

Conclusion

We observe that the case method is a pervasive part of business school education. The case method shares many features with case-based reasoning. We are developing an automated tool that will support the use of the case method by (a) providing the student access to a richly indexed library of business cases, and (b) a decision making simulation that takes into account not only the previous cases, but also the goals and relationships of the decision maker, and provides a natural language justification for the choice.

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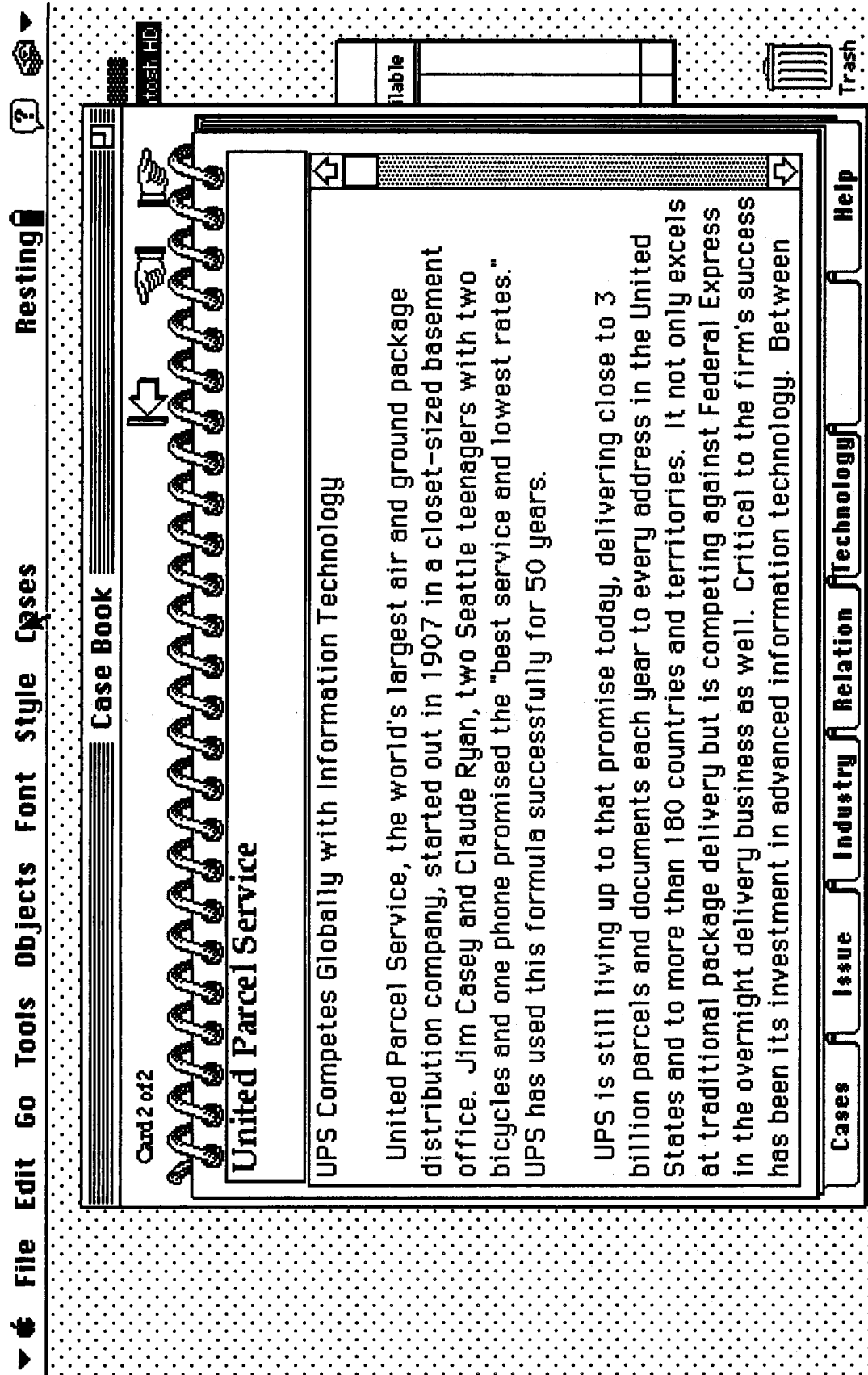


Figure 1.

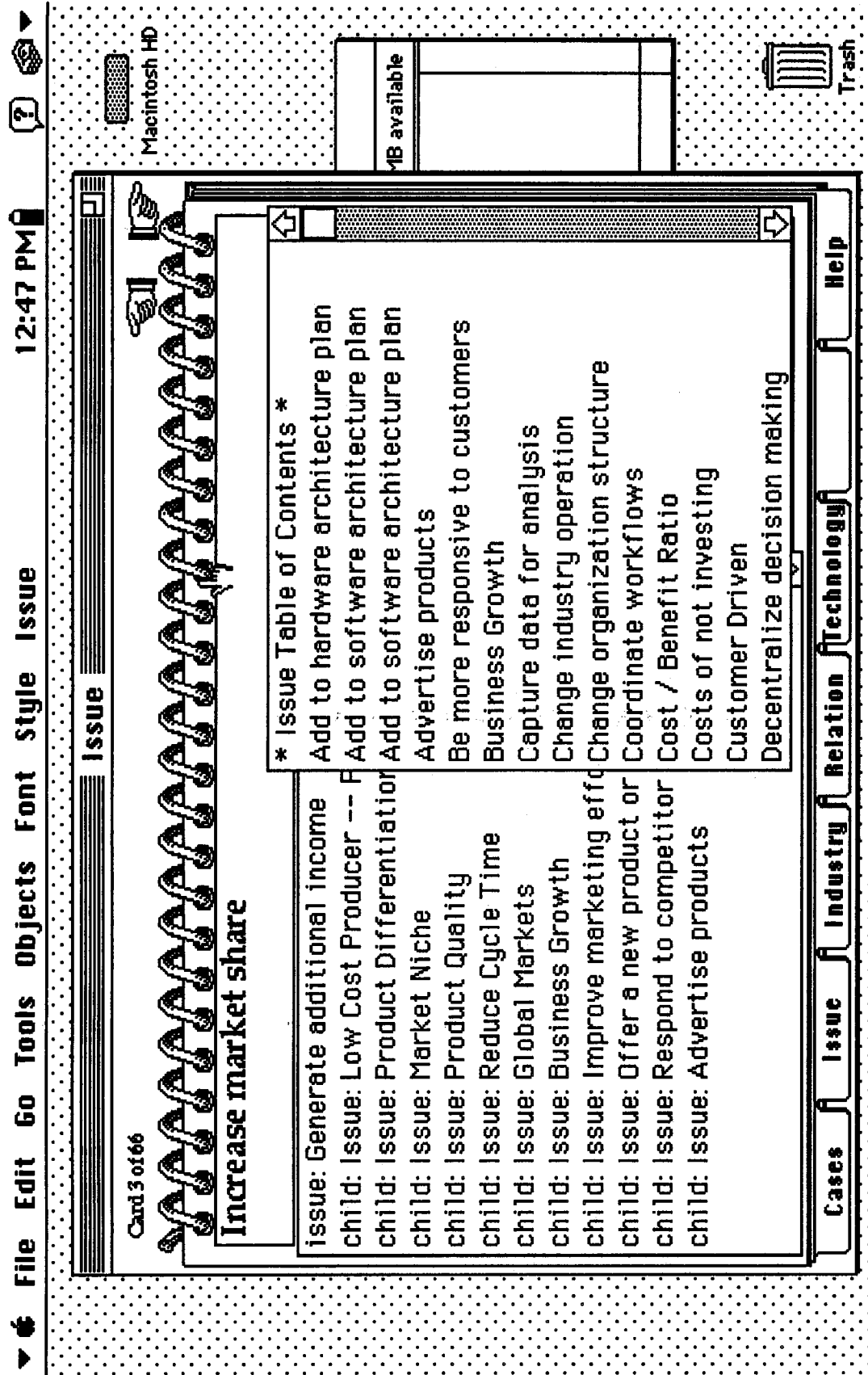


Figure 2.