# Teaching Real-World Analysis Skills With a Goal-Based Scenario

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**Abstract:** This paper introduces a software architecture useful for teaching a particular class of real-world analysis tasks. It is based on a kind of teaching framework called a goal-based scenario, a "learning by doing" environment in which the student acts in a realistic role and obtains helpful coaching while performing assigned tasks. I describe a fully operational prototype system, Financial Report Analyst (FRA), which was built using this architecture. In FRA, the student learns skills in financial statement analysis by playing the role of a lending officer at a bank. The approach offers several advantages over the traditional business case method. Usability tests of FRA were conducted with students in the Kellogg Graduate School of Management at Northwestern University. It is proposed that the software architecture is applicable to teaching a variety of realistic analysis tasks, both inside and out of the domain of business administration.

## Introduction

Financial Report Analyst (FRA) is a multimedia educational software system that is designed to teach students and professional trainees how to understand and critically analyze financial statements. Its design is based on a teaching framework called a *goal-based scenario*, in which the student becomes an actor in a realistic scenario with an explicit role and an explicit objective [Schank, 1994]. In the course of trying to achieve the objective, the student is provided with intelligent coaching and access to relevant cases, stories, and explanations.

The concept of goal-based scenarios is grounded in cognitive principles including *failure-driven learning*, *cased-based reasoning*, and *learning by doing*. By using FRA, students can acquire knowledge in a way such that in future situations they are able to recognize the conditions of applicability of their knowledge and apply it appropriately. As will be discussed, the approach offers advantages over the traditional business case method. Furthermore, the software architecture may have utility for teaching a wider range of analysis tasks.

The analysis tasks under consideration have a number of characteristics:

1. There is a relatively large amount of information and data that must be factored into the analysis.

2. Knowledge in the domain of interest is uncertain/probabilistic.

3. The nature of the analysis task is such that no single solution path can plausibly be identified as the "correct" one.

4. Performance of the analysis task requires extensive reasoning with background knowledge.

These characteristics make it difficult to provide effective tutoring, for two principal reasons. The first is that, since much of the task consists of reading, reasoning, and mulling, the program has little evidence of what the student is thinking during the interaction. The second is that there typically is not just one correct solution to the problem, making it difficult and risky to criticize the student's actions and conclusions.

## Advanced Business Education

As with other areas of business administration, much of the knowledge in financial statement analysis is not easily captured by facts and rules. Thus it is reasonable to believe (in agreement with many graduate schools of business administration) that the extensive use of the case method in business education is a wiser and more effective approach than various approaches emphasizing general principles.

Although there is not just one form of the business case method [Dooley & Skinner, 1977], the "classic" form of the business case method is aimed at promoting decision-making skills [Hunt, 1951]. Students are given case materials that describe a complex, real-world business situation which has a problem or issue requiring a decision. Before class, they analyze the case and prepare a recommended decision or solution. In class, which may typically have between 20 and 80 students, the instructor leads a discussion in which recommendations from some students are critiqued and debated. Often, students also hand in a write-up which is graded by the instructor or an assistant. However, in practice the principles and ideals of case method administration are often not realized [see Argyris, 1980]; and Smith has pointed out that there has been little research which has closely examined the effectiveness of the business case method [Smith, 1987]. At a close level of scrutiny, several shortcomings of this method can be discerned.

- Students get little or no help while they are working on the case.
- Feedback to the student is limited and comes long after the student performs her analysis.
- The method depends on the availability of a skilled, knowledgeable instructor who at some point can give the students feedback, discussion, or an evaluation of their recommendations.
- Due to time constraints or teacher unwillingness, a concrete, detailed, step-by-step analysis solution is rarely demonstrated to the student.
- Students' motivation for analyzing the case may too often be socially-oriented and "indirect" instead of a direct interest in "participating" in the case scenario. Students' primary motivations often center on getting a good grade, impressing the instructor, and/or protecting their egos during the class discussion.

A computerized goal-based-scenario (GBS) can be effective in addressing each of these shortcomings. Using a GBS to teach financial statement analysis provides students with individualized tutoring and coaching--typically impossible to provide in a large business class--in a comfortable setting without the time constraints of a class.

## Financial Report Analyst (FRA)

In a goal-based scenario, the student is given a meaningful goal in a realistic scenario; this can enhance motivation and result in greater retention and transfer because students can see what the knowledge is *for* [Schank, Fano, Jona, & Bell, 1994]. In FRA, the student plays the role of a junior lending analyst in the corporate lending department of a bank; the goal is to make a good decision about whether or not to lend money to a company, and to do this the student must carefully analyze the company's financial statements.

The software architecture includes several major components including: an *analysis environment*, containing tools and resources that support the student's efforts; a set of *coaching rules* that determine what advice is given to the student in what circumstances; a *Recommendation Report* that helps the student to structure her analysis and exposes some of the student's thoughts; and an *expert demonstration*, which induces the student to reflect upon her own analysis. Each of these components will be briefly described.

### The analysis environment

The student is given a "company file" containing the financial statements and other relevant data, involving a request for some kind of long-term or short-term debt financing. The student's job is to analyze the set of statements and to produce a report that lists her conclusions about the company and her recommendation concerning the proposed loan.

The student works in an analysis environment which contains: all of the items of the current company file; a simple spreadsheet with capabilities similar to commercially-available spreadsheets; and a *button pad* [Jona et al., 1991] which the student uses to navigate through FRA and to request information or coaching [Figure 1]. The student can easily flip though the items in the company file and use data in the financial statements to perform trend analyses, ratio analyses, projections, and other improvised calculations in her spreadsheet. In addition, the student has access to an embedded hypermedia system containing useful text and video.

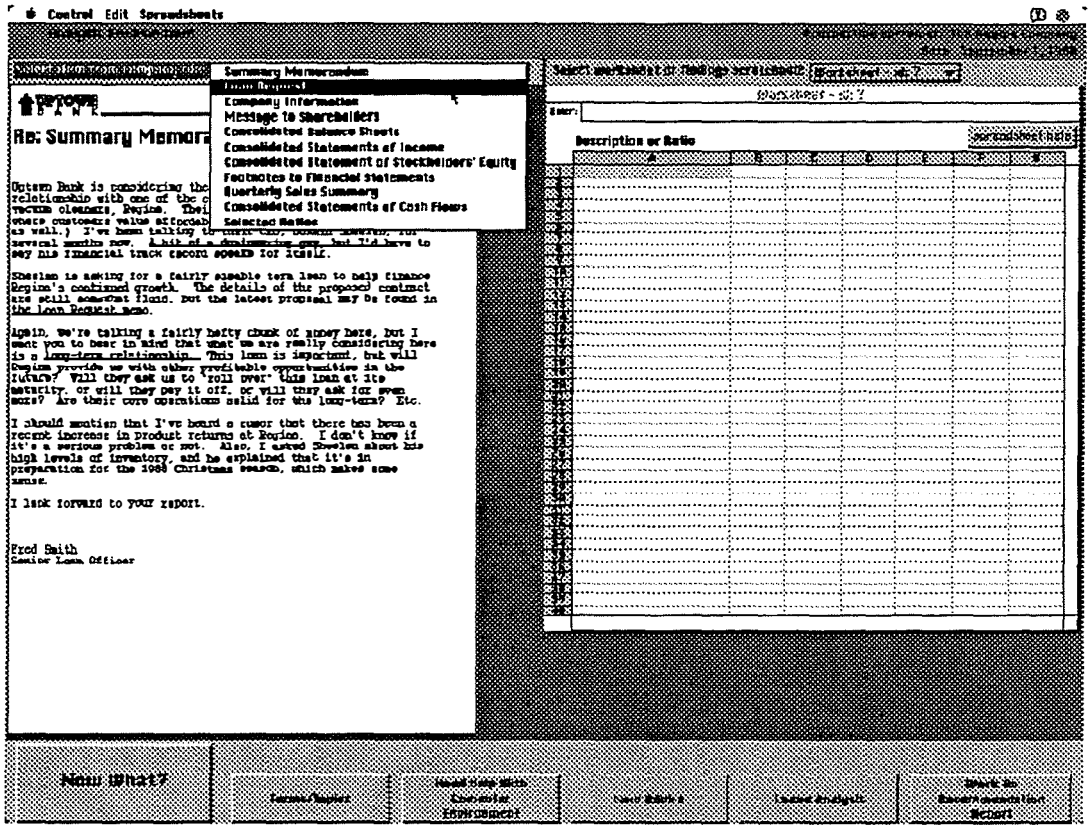


**Figure 1:** The analysis environment. On the left side is the company file and the company file item selector, which in this case contains eleven items. On the right is a general purpose spreadsheet, and at the bottom is the button pad.

### Coaching rules

Coaching is an important aspect of the system. To increase students' interest and to provide them with memorable stories and perspectives on the task of financial statement analysis, we have gathered videotaped interviews with a number of experienced analysts in the banking industry as well as an accounting professor at the Kellogg Graduate School of Management at Northwestern University. Upon the student's request, brief video clips containing relevant war stories and analysis techniques are shown to the student while she is working in the analysis environment.

Coaching in FRA is analogous to the situation where an apprentice has been working on an involved, complex activity with a human mentor nearby, and then realizes that she wants help and calls the mentor over. Sometimes, with a quick look at the apprentice's progress, the mentor can give a terse piece of advice which immediately satisfies the apprentice. On the other hand, often the apprentice has some responsibility for communicating to the mentor what her specific problem is, since there are a large number of paths the apprentice could have taken and the mentor does not have a detailed model of the apprentice's mental state. After the mentor has selected and delivered the most appropriate piece of advice, the apprentice often will

have follow-up questions that request clarifications, examples, the big picture, or more detail. She will often want to ask several questions in succession, perhaps sometimes backing up to previous topics.

The mentor, knowing well the issues and details of the problem that the apprentice is working on in this instructional setting, will sometimes notice an aspect which the apprentice has overlooked, or some technique which it would benefit the apprentice to try. The mentor will seldom interrupt immediately, but instead will wait to see if the apprentice discovers it himself, because he knows the satisfaction the apprentice will get if she does discover by himself, and realizes that she will learn it more permanently that way. However, at some point the mentor will make the apprentice aware that he has a piece of advice if the apprentice is interested; if the apprentice assents, the advice is given and then follow-up questions are answered.

FRA is designed to have the coaching capabilities that this mentor has. The foregoing description is an idealization, of course, but it aptly depicts the motivations and design rationale for FRA's "Coach". Coaching is adaptive and context-sensitive: exactly what kind of advice is given at a particular time is dependent on what actions the student has done so far, what conclusions she has drawn, and what advice has already been given. These tests are codified in a set of coaching rules. The student may request advice at any time by clicking on a "Now What?" button, and occasionally advice may be preemptively offered by the Coach by lighting up a "New Advice" button.

In general, the coaching rules are designed to address all *detectable failures* the student may have while working on the task. The advice provided is not insistent on a particular solution, but can alert the student to unrecognized opportunities and warn the student about indefensible conclusions.

**The Recommendation Report**

During the analysis the student fills out a Recommendation Report, in which he indicates his conclusions and the reasons for them [Figure 2].

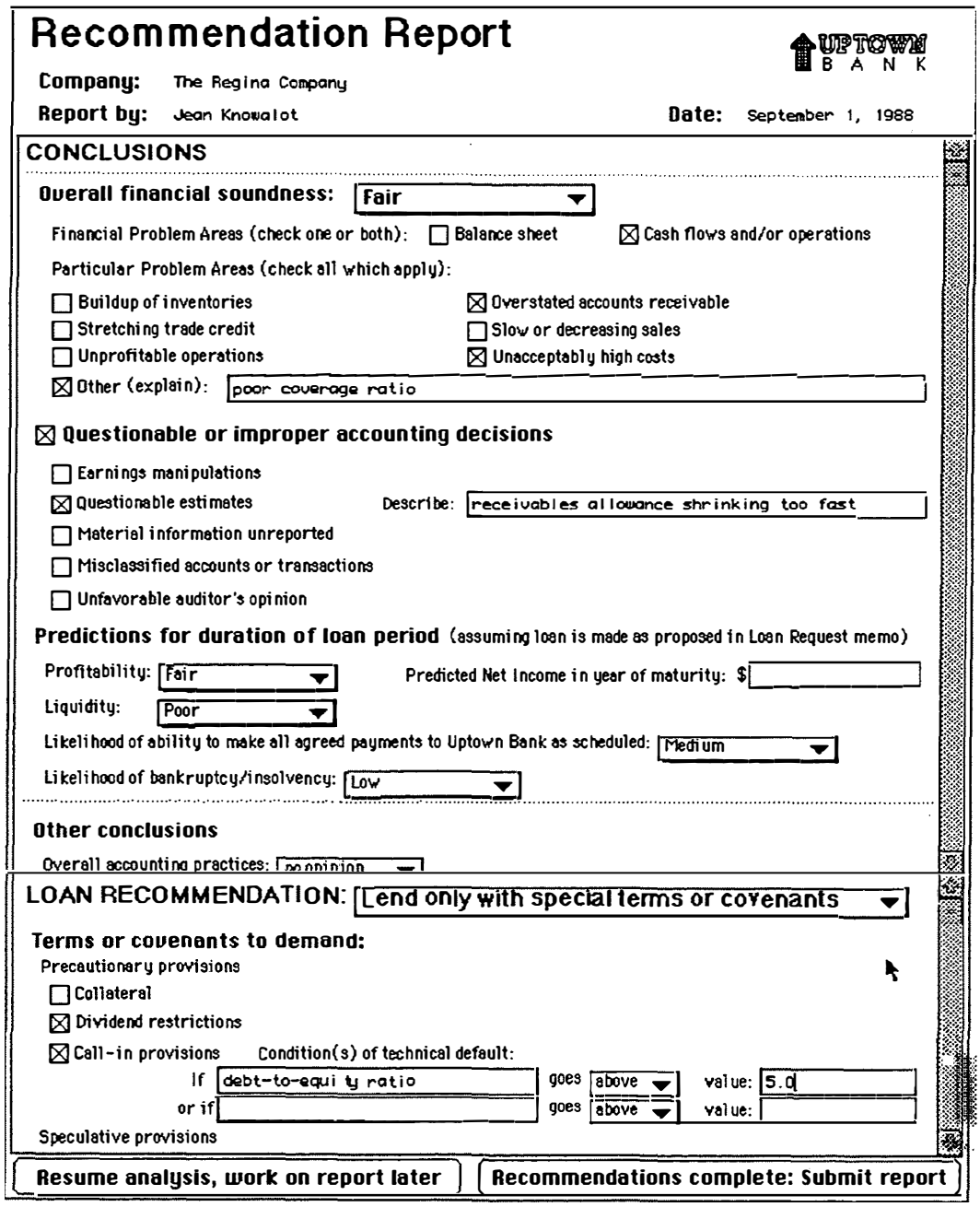


**Figure 2**: A Recommendation Report that has been completed. The top portion indicates the student's conclusions and some of their supporting justifications and evidence, and the bottom portion indicates the student's specific recommendation.

The Recommendation Report serves several important purposes. One is to focus the student's attention on what the specific *goals* of the analysis are; she thus is made aware of what issues are relevant for the task and domain, and has an implicit model for the analysis task. Another is that the report serves as a limited but needed window into the student's mind; as the student draws specific conclusions and so indicates on the Recommendation Report, the program uses this evidence to assess (via the coaching rule mechanism) how well she is grasping the significant issues in the case and what problems or misconceptions she might have. The format of the Recommendation Report is designed to structure the argument being constructed by the student.

**Expert demonstration**

After the student has submitted her recommendation, she finds out how the company subsequently performed. She then has the opportunity to see a demonstration of how an expert analyzed the financial statements of the company. The expert demonstration is performed in the same kind of analysis environment as that used by the student in her own analysis. Step by step, the expert types formulas into the spreadsheets, flips back and forth between the different financial statements, and points at particular numbers. Each step is annotated with a description of what the expert analyst is thinking: what his current action is, why he is doing it, the hypotheses or conjectures he is pursuing, and/or the conclusions he is drawing. The student, having studied the same case in the same analysis environment, gets a clear and concrete picture of the sorts of things one must *do* during an analysis, as well as a valuable point of reference on the actions and conjectures she tried during her own analysis. The progress of the expert analysis is controlled by the student. At any time, she can stop it to ask questions via the hypermedia system, or to temporarily retrieve her own previous analysis for comparison.

This approach is useful because, as stated earlier, there typically will not be just one correct solution to the analysis problem. The expert demonstration does not analyze the student's solution for her, but it induces her to reflect on her own solution.

## Usability Test

Although there are logical arguments for the appropriateness of FRA's architecture, the pedagogical effectiveness of the approach in FRA will require empirical validation. A prerequisite hurdle, however, is ensuring that the program is usable and understandable to students. Accordingly, a usability study on the system was conducted.

Twenty-one students in Northwestern University's Kellogg Graduate School of Management used FRA as a required assignment in a course entitled Corporate Reporting and Analysis, taught by Professor K. Ramesh. All students had previously had an introductory course in Financial Accounting. Students analyzed a detailed case involving a medium-sized manufacturer. The goal of the test was to expose any problems with the user interface, to see whether the problem scenario and analysis environment were comprehensible to students, and to obtain students' reactions to the program. Each student spent approximately four hours working on FRA (including case analysis, submission of a Recommendation Report, and demonstration of the expert analysis.) Three types of data were collected: while the program was used, all student actions were automatically recorded and saved for later review; students filled out a questionnaire after use; and students were informally interviewed during and after use.

Overall, the results were very encouraging. To a large extent, success can be judged by the lack of negative feedback given by students: when the coaching, interface, and so forth work effectively, users tend not to notice them and assume that "of course that's how it should work." Students generally found FRA to be understandable, helpful, and "user friendly", and uniformly claimed to enjoy using it. Several of them singled out the expert analysis as being particularly effective. However, a number of the students complained that the spreadsheets lacked features that they expected and wanted. And many of the students wished they could have had more time to explore the system, which was not possible during this test due to scheduling constraints. A review of the recorded action-transcripts yielded few surprises. In general, the spreadsheets were heavily used, and the Recommendation Reports completed by students were generally sensible and not far off from the "intended" analysis.

## Summary

The software architecture that has been described--including the analysis environment, the report, the coaching rules, and the expert demonstration--may be applicable to a category of analysis tasks that is wider than just business administration. These same techniques could be used whenever the student is expected to analyze a case having a large amount of information and to make some kind of reasoned judgment or decision about the case situation. For example, there are a variety of administrative decision-making tasks in public-

sector administration (e.g. health and welfare agencies, the military) and in the various professions (e.g. medicine, law) which fit this mold. The idea is that, whenever the task revolves around making sense of a situation or entity, analyzing alternatives, and making a decision, the same kind of environment can be used: a domain-specific Recommendation Report can be designed, coaching rules formulated, and an expert demonstration scripted. Details of the architecture are given in Foster [Foster, 1996].

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