

Chapter 1

Analyzing a Case

The major objective in using cases is to apply basic skills learned in doing end-of-chapter problems. This is done in realistic scenarios to foster critical thinking skills and to prepare students for the real world. Thus, cases must be very different from the end-of-chapter problems that typify homework. Thus, at first reading some students react with “What am I supposed to do?” or “There is no question being asked!” This chapter provides students with a starting point and outlines recommended approaches.

Cases lie along a continuum between end-of-chapter problems and the real world. End-of-chapter problems are well defined and generally the solution methodology is clear, even though it may require ingenuity and persistence for success. On the other hand, the real world has been described as a chaotic conglomeration of opinions, facts, and goals. Furthermore, the opinions, the goals, and even the facts may conflict or be contradictory.

Cases may report on a real situation as a newspaper or news magazine would, but more often the names are changed and the situation is simplified. Cases may also be based on a synthesis of multiple situations, set in a fictional description. It is the realism and the complexity of the scenario that defines a case.

Most students are comfortable with the clarity of end-of-chapter problems for homework, but the intrusion of real world complexity into cases causes student dissatisfaction. Cases may not have a clearly specified question or issue. Rarely is there a unique, correct answer. The data may be ambiguous, contradictory, missing, or irrelevant—like the real world. In

addition there are difficulties in note taking and dependence on inefficient class discussion. The instructor may choose neither to direct class discussion nor to present solutions.

This chapter is a starting point in dealing with the messiness inherent in cases. The first step is to compare cases with end-of-chapter problems and the real world. The chapter then describes why cases are useful in learning and how they can be used. The last few sections detail a recommended series of steps for case analysis and for case presentation.

End-of-Chapter Problems vs. Cases

Differences between cases and end-of-chapter problems revolve around the following points:

- Ease of “topic” identification
- Data given and assumptions required
- Treatment of future uncertainty
- Emphasis on methodology vs. recommendation
- Role of non-quantifiable factors
- Complexity and length
- Need to use spreadsheets

Topic Identification. End-of-chapter problems are, by definition, linked with the chapter’s topics. Often the problem order indicates which section covers the topic. On the other hand, cases almost always cover multiple topics from a number of chapters. The “main” topic might be apparent through the assignment’s timing, but other topics can only be identified through careful reading.

Data and Assumptions. The student can expect that an end-of-chapter problem will contain all data required to solve it; and only occasionally will irrelevant information be included. Cases often have data that are incomplete, inconsistent, incorrect, or buried in irrelevant numbers and facts. Sorting out the relevant information depends on identifying the questions to be answered. Selecting the correct data from inconsistent possibilities may depend on perceiving the organizational biases and goals. Filling out the incomplete data requires a feeling for reality and identifying the root problem. Student assumptions may determine the conclusion, so that stimulating class discussions may focus on defending these assumptions. Thus, as in the real world, it is important to identify and document data sources and assumptions.

Uncertainty. Engineering economy focuses on how to base current decision making on future financial impacts. Unlike banking, which includes many fixed financial exchanges, virtually any engineering project involves significant uncertainty. For example, the first cost of a dam may be estimated within 20%, or the market demand for a new product may be estimated within [-50%, +300%].

For end-of-chapter problems with uncertainty, typically probability distributions are given, and expected values can be calculated. For cases, like many real world problems, prudent assumptions about the probability distributions are required. In addition with cases the treatment of uncertainty may require sensitivity analysis or scenarios of the best outcome, the most likely outcome, and the worst outcome. Recommendations will require judgment in evaluating the trade-offs between these possibilities.

Relative Importance of Methodology and Recommendations. Unlike more simple problems, cases emphasize decision making, not correctly choosing and using a formula to get the correct numerical answer. This requires integrating technical writing and presentation skills with analytical skills. The deliverables become a case report and presentation, rather than a worked out application of a formula.

In many cases the problem's definition is unclear and ambiguous, and reasonable objectives must be identified. For example, is it better to maximize the rate of return or to ensure a good rate of return with less risk? Even criteria may be unclear. For example, at what interest rate should the present worth be evaluated? Sometimes the objectives and criteria will be specified, and in other cases assumptions must be made and justified. Selecting objectives and criteria become the first steps in a methodological process that applies the tools of engineering economy.

Non-quantifiable Factors. The recommendations must often consider non-economic factors, such as organizational turf, personalities, or un-quantified growth potential. Some of these non-economic factors underlie the credibility of conflicting data, while others determine the objectives for individual projects, for organizational units, and for the entire organization.

Complexity and Length. Due to the details required for the previous points, a case is lengthier and more complex than an end-of-chapter problem. This difference means that cases are often approached differently than end-of-chapter problems. This chapter's final sections discuss a recommended approach.

Need to Use Spreadsheets. In engineering economy most end-of-chapter problems can be solved using formulas and the tables of engineering economy factors. Cases are almost always better solved using spreadsheets. Uncertainties in the data and the case's complexity usually require that the model be solved repeatedly as it is developed. Ensuring a model is correct is easier if you start with a simple model and add detail and complexity. Once it is developed, sensitivity analysis often requires multiple solutions. In addition, graphs are often needed to effectively support the recommendations. Thus spreadsheets are usually the best tool for case analysis—and for economic analysis in the real world.

It is recommended that these spreadsheets contain a data block where each element in the case is entered—once! It is also recommended that spreadsheet formulas make use of relative and absolute addresses to efficiently use the copy command for cash flow tables and for sensitivity analysis.

Cases vs. the Real World

These key points summarize the comparison of cases and reality:

- Reality accentuates the differences between cases and end-of-chapter problems.
- Reality presents the problem in more complex terms than do cases.
- Reality often requires iterative data gathering and investigation vs. fixed assumptions for cases.
- Reality increases the need for people skills.
- In the real world, analysis can threaten favorite projects or even jobs.

Reality vs. Cases vs. End-of-Chapter Problems. Cases and reality can be compared on the same seven points that were used to contrast cases with end-of-chapter problems. In these comparisons we find that reality simply is “somewhat more so” than cases. Just as cases are longer and more complex than end-of-chapter problems, reality is more complex than cases. The boundaries of real-world problems are less well defined than cases, partly because different problems overlap. Reality involves more uncertainty, a greater emphasis on the recommended decision, and a greater role for non-quantifiable factors. Reality is also far better addressed with spreadsheet models that are easy to modify and update.

Problem Presentation. The major difference between cases and reality is that cases present the problem to the student. In reality, the data must often be searched for, the objectives and

constraints must be identified, and the alternatives must be defined and perhaps designed. Then the economic evaluation can begin.

Iterative Data Gathering vs. Assumptions. Most of the time, real-world analysis permits repeated interaction. For example, the head of the design department may supply a view of the problem along with important data. Later, the analyst may find that these data conflict with facts supplied by another department. Rather than simply choosing a set of “facts” to believe, the step of asking for the data can be repeated. This process also allows the analyst to learn and to ask better questions on each visit. Cases do not allow this interaction, thus the student must instead substitute assumptions. This usually includes explaining why the assumptions were needed and justifying the particular choices that were made.

Documenting data sources for assumptions or adding a name/date block for data supplied by a person increases the credibility of the final recommendations. We’d like to thank the person who first advocated this to us: Karen Schmahl who used this approach to build trusted models in industry before she authored Cases 1 and 2.

People Skills. Interacting with others depends on people and communication skills. Coworkers, superiors, and subordinates contribute, clarify, and critique; so, good analytical skills are not enough. Group work with classmates on cases requires and develops similar skills, except that reality requires sensitive, active listening to ferret out and define the problem and the data. Finally, both case analysis and the real world do involve the communication of findings, and thus they depend on and develop presentation skills. In the real world multiple people from different parts of the organization will review the analysis and recommendations—not just the instructor.

Jeopardy. One of the most significant differences between case analysis and the real world is that classmates are not severely threatened by questions and analysis. On the other hand, employees are often influenced by the career implications of management decisions on which projects should be accepted and which should be rejected. Superiors, coworkers, subordinates, and even the analyst will see favorite projects or even their jobs threatened by recommendations based on economic analysis. Dealing with these situations requires both care and highly developed people skills.

Despite all of these differences, cases are clearly several steps closer to reality than end-of-chapter problems. The value of this closer approximation of reality is the subject of the next section.

Cases and Learning

The objectives for case analysis flow naturally from the previous comparisons of cases with end-of-chapter problems and with reality. The analysis, discussion, and presentation of cases relate to student learning in at least four ways:

- Development of intellectual skills
- Promotion of attitudinal change
- Broadening the student's knowledge of the world
- Motivation

Intellectual Skills. The goal of case analysis is learning how to apply textbook knowledge to real-world situations. This learning requires that students be *actively* involved, which the reading, listening, and lecturing of traditional classroom methods cannot accomplish. Lectures can effectively explain theory and principles, but cases are far better at developing judgment, insight, and critical thinking.

When case analysis successfully meets this objective, students are better able to: (1) diagnose problems, (2) evaluate data, (3) analyze complex situations, and (4) make convincing oral and written recommendations. The evaluation of data and the subsequent analysis depend heavily on the student's textbook knowledge of engineering economy. Cases then establish the importance of justifying assumptions, validating the model, and checking and modifying the results.

Attitudinal Change. Case analysis can support changes in student's attitudes. For example, students are forced to become more self-reliant rather than depending on the instructor or the back of the book. Cases also focus attention on the situation and a recommendation rather than on the analytical tools. Finally, the focus on the recommendations and the time pressure to meet deadlines ensure that quick-and-dirty techniques and solutions must sometime be accepted for cases—just as in the real world.

Real-World Knowledge. Cases describe situations that increase student awareness. The role-playing that results can assist in the transition from textbook problem solver to analyst to

decision maker. For students this exposure to a variety of situations can even help to guide career choices.

Motivation. Many students are motivated to extraordinary efforts and learning in case exercises. For some it is interest in a real-world problem that seems less of an academic exercise. For others, the motivation comes from the competitiveness of inter-group rivalry or from the team spirit of a small group.

We believe that the importance of these objectives is high and increasing. More analytical techniques are being used in the economic justification of projects. Spreadsheets are used every day for economic analyses. This implies an ever-greater need to sharpen students' diagnostic skills for problem identification and technique selection.

Preparing a Case

How should **you** prepare a case? Case analysis is a process that involves identifiable stages and activities:

- Reading
- Identifying and modeling the problem
- Creating or identifying alternatives
- Evaluating the alternatives
- Fitting the model to the real world to support a recommendation

Reading. Gathering information to analyze a case must clearly be based on reading, as the case is presented in a written format. But, how is it done? We recommend that you read the case four times: (1) skim, (2) carefully with notes, (3) iteratively to clarify points, and (4) read to double-check.

The first time through establishes a framework to organize your thoughts. The second time is a careful reading with notes and highlighting for significant facts. After this reading you should be able to identify the issues, the alternatives, and the objectives. The third reading is piecemeal and iterative as you build your model (typically with a spreadsheet) and develop your recommendations. The fourth and final reading should be careful and complete. After you have done your analysis and developed your recommendations, you should double-check for a fact, opinion, or number that you overlooked or forgot about.

Identifying and Modeling the Problem. This chapter has stressed the fuzziness of case analysis and the need to identify the problem to be solved. This diagnostic stage is often approached through one of the following four “modeling” processes:

- A historical model compares the situation with the past. For example, should the company invest in this project when previous projects have averaged a 14% rate of return?
- A model based on analogy compares the situation with an example from the environment. For example, should our agency prioritize projects by ranking on benefit/cost ratios as other agencies do?
- A planning model may rely on comparisons with an ideal. For example, many textbooks suggest opportunity cost as a basis for selection of a minimum attractive rate of return.
- Finally we all have models of financial decision making from our “personal” experiences. For example, grandma has stressed the need to be frugal and to build a financial cushion for contingencies.

First, the overall objectives and the pieces of the problem must be identified—then the context that defines *who* you are in the case and *who* the audience is for *what* deliverables. Obviously different models will emphasize different features of the same situation. So, multiple views should be used rather than applying a single model.

Other dangers at the stage of problem identification include: (1) confusing symptoms with problems, (2) making premature evaluations, and (3) accepting everything as fact. The end result should be an explicit problem statement that identifies the significance of each piece of the problem—both short-run and long-run.

Creating or Identifying Alternatives. Finding alternative solutions is closely linked to defining the problem. Without alternatives, there is no choice and no decision to be made. The future may be terrible, but that alone does not define a problem to be solved. Sometimes the alternatives are clearly stated in the case, and sometimes alternatives must be developed with creativity and insight.

One of the most costly and common errors is to miss good potential alternatives. Often these rely on a “larger” view of the problem. For example, rather than improving packaging or inspection, quality might be improved through redesigning the product. Other times, the best alternative is to use the most cost effective elements of an alternative and omit what

might be “gold-plating.” A new factory layout might be able to cost effectively re-use some existing equipment, rather than replacing all of it.

Another common error is to assume that the identified problem has a single objective or a single cause. If there are multiple goals or multiple causes, then alternative solutions must deal with each, not with just one. For example, a public works project might be intended to provide a service, to alleviate unemployment, and to stimulate further development. Each of these objectives is related to a “problem,” and these “problems” may have multiple causes. Designing and selecting the best alternative must consider all of these.

The cash flows for each alternative will be based on data or assumptions. Together with identification of their basis, they become part of our documented model.

Evaluating. Evaluation begins with “number crunching” the data and the model. Often this will require a feedback loop through earlier steps to find missing data or to improve an alternative. This iterative process is one reason that most cases are analyzed using spreadsheets.

One error is to depend on a single analytical tool or measure to evaluate the probable and possible outcomes of alternatives. These outcomes will almost always be multidimensional. Specifically, any recommendation must be *financially feasible in the short run* and *financially rewarding in the long run*. This focuses on a cash-flow analysis, by period and over the alternative’s horizon. Even the question of long-run financial reward depends on selecting an objective. Possibilities include maximizing present worth, minimizing risk while meeting reasonable standards, maximizing the internal rate of return, or maximizing product diversification and market growth.

Other qualitative criteria include links to the organization’s strategic goals, any differential market advantage, and ease of implementation. Implementation may depend on the limitations of personnel and control systems, the impact of motivation and morale, and the presence of contingency plans.

Checking the Model Against Reality. Engineering economy is based on mathematics and theory, but the real world is not. Moreover, any model is a simplification of reality. Just as the model is a “fit” to the real world, the model’s recommendations often must in turn be adjusted. Besides assumptions that were not perfectly satisfied, there may be policy considerations that were simply omitted from the model. These differences are a key part of case analysis. What are the limits of the case analysis that was done?

Conclusion. All of these stages and activities are designed to produce a specific recommendation, along with the careful analysis and logical argument that support it. Part of the foundation will often be assumptions or inferences that must be justified. These assumptions should be made instead of recommending further analysis or further data gathering. These are feasible recommendations *only* when there is a multistage decision, or when a flexible alternative can be designed to allow future shifts in direction.

The process outlined above is work, but with the right attitude it can be fun as well. Pretend the case is real and play it like a game. It has a lot more possibilities than a homework problem with one right answer and only one approved method for finding it.

Case Discussions

Case discussions require more from you than does a lecture. You must listen much more closely, as points that are missed or not understood cannot be found later in the text. When the case is covered over more than one class period, the discussion may explain or define key assumptions that will be part of later analyses and presentations. Other elements that will improve the class discussions include:

- Allowing for special needs
- Preparing for class
- Managing the discussion
- Choosing what to say

Allowing for Special Needs. Discussing a case can be as simple as answering the instructor's questions or as involved as a one-hour team presentation. But, the active involvement of the entire class means that students must tell the instructor about any special needs. Students can stand and speak loudly for the hearing-impaired, and the instructor can make allowances for those who cannot speak easily.

Preparing for Class. To benefit from the discussion, be sure to fully prepare before class. This includes mastering the facts and analyzing each case before class. Students must attend the class regularly, because you cannot gain from a discussion you do not hear. Reading the text can sometimes make up for a missed lecture, but there is no substitute for the case discussion.

Managing the Discussion. Case discussions can degenerate into unproductive arguments if the students and the instructor do not maintain a constructive tone. The instructor's efforts to guide the case discussion must be tolerated, and classmates must be treated with respect—even during vehement disagreements. Sticking to the topic is essential. The discussion will flow more smoothly and be easier to follow without sudden topic changes, without rehashing, and without repeating previous comments—especially your own!

Choosing What to Say. The discussion will be more interesting if provocative, unconventional, or creative ideas are advanced. It will be more fun with appropriate humor. And it will be more productive if comments are brief and constructive. Even while you push your own ideas, you must listen to others, and you must be ready and willing to change your mind.

The case discussion should be based on the principles gleaned from the textbook and the facts of the case. Other sources include personal experiences, comparisons with previous cases, material from other courses, and library research. But whatever the source of the comments, themes should not be overplayed. Vary contributions and do not make the same points on each case. When the case describes a historical situation, hindsight may be unfair. Unforeseen events can cause the best decisions to have horrible consequences.

Oral Presentations

Mastering the art of case analysis requires effective oral and written presentations. The skills that you have honed in your English classes and in discussions with friends and family are the foundation for successful presentations. This short section cannot wave a magic wand to improve your presentations. This section can only remind you of what you already know about making a formal presentation.

When You Are the Presenter. You should not prepare and read a written text. Brief notes are better at balancing interest and liveliness with the need to stay on track. It may be worthwhile to memorize an attention-getting first sentence, but rehearsal is better than reading for the rest of your talk. Everyone is nervous before speaking. Yet, simply acting more confident can reduce the butterflies. Your audience wants you to succeed.

Some of us may be dull or awkward speakers, but if we are prepared we can still be effective and, with practice, we can improve. The simple steps of making eye contact, observing the group for feedback, varying our voice rate and tone, and moving and gesturing

in moderation can increase our effectiveness. We may never be on television, but all of us will make presentations to our coworkers, our bosses, and our subordinates. These presentations will all have deadlines, they will all have limited time, they will all be simpler than a written report on the same subject, and they will benefit from simple visual aids. Thus, cases again prepare us for the real world.

Targeting Your Presentation. What is the purpose and context of your presentation? Are you presenting a factual analysis or “selling” your project? Has the audience read the case, prepared their own analysis, or read your report? Is each presentation of a different case or are several presentations on the same case (and are you the first or last of the several)? Answers to these questions allow you to focus your presentation so that you provide enough background and development to support your recommendations without boring your audience with what they already know.

The Written Case Report

Technical writing may be focused on presenting details, on convincing the reader that the choice is correct, or on motivating personnel to follow through. Effectiveness in every case requires a clear purpose, an identified audience, and an understanding of “who” is writing. Whether the report is a proposal, a memo with attachments, a technical report, or a completed form, a common process is used for:

- Structuring the report
- Writing vs. speaking
- Writing and attention to detail
- Outlining and writing the report

Structure the Report. The written report will identify issues and problems, it will analyze and evaluate the alternatives, and it will present specific recommendations. However, the structure of the report will often present these steps in a different order.

Case reports, like job-related reports, will be read by others who are familiar with the topic and who are focused on the decision to be made. These reports should begin with a summary of recommendations, so that readers can quickly find the most important points. Often these points will be included in a table or bulleted list, and then supported by a key chart.

The report's body should describe the background, problem statement, key assumptions, etc. Depending on the report's length and your instructor's preferences, the order and format may change. Possible additions include a letter of transmittal, a table of contents, a list of figures, and supporting appendixes for data and assumptions, detailed calculations, and sources of information.

Writing vs. Speaking. Like any other writing, you must balance belaboring the obvious against providing insufficient detail. This balance relies on an understanding of what your reader can be expected to know. But for any reader, their understanding will be enhanced by your use of simpler words and sentences. Writing does allow and requires more complexity than speaking. Speaking can rely on visual cues, on tone and intonation, and on interaction. Writing must rely on selection of words with precise nuances and on subordination and joining of ideas through more complex sentence structures. While fiction often uses a narrative style, technical reports generally should not.

Writing and Attention to Detail. The greater attention to vocabulary and structure that comes with writing is extended to concern with grammatical correctness, spelling, and clarity. Many readers will equate careless writing with careless work. A report with misspelled words, sentence fragments, overly long paragraphs, exaggerated conclusions, or an unclear style will simply be dismissed as confusing or unreliable. Similarly a report that is too short may be dismissed as shallow, or one that is too long as padded.

Outlining and Writing the Report. The foundation for a solid report is laid with the initial outline. This is the stage where you identify descriptive headings and the logical flow of ideas for paragraphs. Then deciding where to use and carefully designing figures, bulleted lists, and tables can dramatically improve the effectiveness of your writing. Then as you write, you can concentrate on clarity and appropriateness of tone (word selection, sentence structure, and transitions). This approach will minimize—but it cannot eliminate—the need for a cut-and-paste redrafting and for a revision of unclear sentences. All writing must be proofread multiple times. Finally, the image of professionalism can be enhanced with appropriate binding of the final report.

Conclusion

Case discussions stimulate thought and provide practice at communicating ideas. They will also make it clear that no one has all of the answers. In the classroom and as a manager it is wise not to assume a rigid position until a full range of views and information has been assembled.

Except for the most technique-oriented cases, even your instructor will not have all of the answers. Thus the case discussion will be more democratic and less prescriptive than typical lectures. Instead there will be a range of answers, often depending on the viewpoint and objectives of those involved. The choice will be between workable and non-workable solutions, rather than aiming for a single optimal solution.

Since there is not a single answer, the evaluation of your work will be based on:

- Care in use of facts and background knowledge
- Demonstrated ability to identify and state problems and issues clearly
- Use of appropriate analytical techniques and sound logical argument
- Consistency of analysis and recommendations
- The ability to formulate reasonable and feasible final recommendations

Cases represent learning by doing. By creating live and effective practice situations, cases extend the doing of homework problems that underlies engineering education. The learning is not a set of facts, but rather skill acquisition and development. Thus the learning is harder to “see” and to measure, but it is still very real. It is also fun.

For Further Reading

Edge, Alfred G. and Denis R. Coleman, *The Guide to Case Analysis and Reporting 4th*, System Logistics, 1986