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Transportation Research Forum

Book Review: [Toward More Sustainable Infrastructure: Project Evaluation for Planners and Engineers](#)

Book Author(s): Carl D. Martland

Review Author(s): Michael E. Smith

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Book Review

Martland, Carl D. Toward More Sustainable Infrastructure: Project Evaluation for Planners and Engineers. Hoboken, NJ: John Wiley & Sons, Inc., 2012. ISBN 9780470448762.

Toward More Sustainable Infrastructure

by **Michael E. Smith**

Carl Martland has introduced an excellent textbook designed to provide undergraduate students in civil engineering with a high-level understanding of where projects come from, how they should be evaluated, what we should expect to consider when selecting a project or project variant, how projects fit within an overall program, and what the characteristics are of projects that are more likely to be chosen and are more likely to be successful. Each of the 16 chapters in the textbook begins with a superb list of concepts to be covered followed by detailed discussion of the topics, including exemplary illustrative problems. Each chapter is followed by a well thought out summary of topics discussed in the chapter. Following each chapter summary is a set of exercises for the student; these include essays and problems. Students working their way through the essays and problems will find the summaries, topics lists, and example problems to be exactly the kind of resources that they require to quickly locate the specific material needed to assist them in creating first-class essays and answers. The student will find those items very useful when studying for exams.

The example problems contained in each chapter are well explained and illustrate important concepts. In Chapter 2 we see a well-constructed example illustrating how investment in a canal in the nineteenth century could be justified based on the fact that moving goods via water would be considerably less expensive than moving goods using horses and wagons. But the investment in creating the canal is considerable and the reach of the canal is not anywhere near as complete as the reach of roadways and paths that can be traversed by the horses. The result is a classic tradeoff between large investments, lower operating costs, and a less complete level of service that we see today in an untold number of instances.

In a number of cases, the text could be improved by presenting more balanced economic information that would help the nascent engineer avoid a few pitfalls. First, there are a number of engineers who view the world in terms of linear cost functions. That is, they see the provider of a good or service that faces total costs consisting of a fixed start-up cost and a linear cost per unit. The reality, though, is that all providers of goods and services in a free market will continue to create their product until the marginal costs of that product are an increasing function of the number of units. Were they not to do this, then we would have horizontal supply curves and would be blessed with infinite quantities of things. As we are not so blessed, we know that supply curves are not horizontal. I think that a useful addition would be to provide an understanding of cost curves that are non-linear, having a rising marginal cost of production.

The book also contains some references to economic issues that are currently in dispute. These include the multiplier effect (many economists dispute its existence) and the belief that monopolists will always charge excessive prices that can only be held in check by appropriate government regulation. Studies of electric utilities have found that regulation generally fails to hold down prices in that manner. Also, although the text covers benefit-cost analysis very well, there could be usefulness in introducing the concept of Pareto optimality. With that approach, a solution can be searched for that helps everybody instead of the majority. One of the useful things about private-

sector solutions is that they tend to approach Pareto optimality while government-based solutions work toward improvements for the majority.

Problem 4.5 discusses the tragedy of the commons. This concept is a very useful one for engineers to understand. One of the best examples of this tragedy that I know of is the urban freeway. Examining how to solve the problem of the over-crowded freeway without burdening government would make for an excellent additional problem.

The lesson of Section 5.5 is excellently stated and is quite true. Since decisions and investments that are undertaken by a government body involve all the complications of the political process in addition to financial and economic evaluation, decisionmaking for such projects can become quite belabored. While private companies still need to evaluate the financial aspects of a project, they do not concern themselves with some of the more arcane political aspects except to the extent required by law. At this point in the text, it could be useful to suggest that moving as many decisions as possible into the private sector, while retaining appropriate regulatory oversight, could be superior to having governments invest in such projects themselves.

Chapter 6 provides a marvelous history of constructing the Panama Canal. At first, the Canal was largely not a commercial success. Instead, the military found it very useful. I think that a great opportunity exists here to compare and contrast how the government pursued the investment and how a private company would handle it.

The essays and problems themselves cover all of the topics in their respective chapters quite well. And some of the characters in the problems have rather clever names. In Chapter 9 we are introduced to the developer Canwy Bildem, who suggests that construction on a new skyscraper should proceed immediately. Perhaps Mr. Bildem is represented by Dewey, Cheatham & Howe! Also, one of the problems in Chapter 8 introduces us to Bonnie and Clyde, who consider bank robbery as a possible way to finance their dream of pursuing a particularly risky investment in South America.

I was particularly impressed with the example problem on page 233 where Martland introduces the concept of incremental investment. Engineers will frequently look at a problem based on totals and averages, ignoring the fact that an incremental investment of I will provide a marginal return of R . Thus, the rate of return for that increment is R/I , which may be much too low, even if the rate of return for the total investment is quite acceptable. That is how we can tell that we should, perhaps, stop with a smaller project.

The chapter on Public Private Partnerships is very impressive. I note that the analyses were all based on well-defined cash flows that resulted in each case. That is, the analysis proceeded as though the government were simply another corporation seeking to maximize its return. The case of the Kansas City flyover project is an excellent example of this. The text discusses the private benefits of reducing delays to the freight trains and the public benefits of reducing delays to travelers on the public roadways. Martland does not discuss how this problem would look were the highways to be privately owned. But if we consider that possibility for a moment, we could see that the entire project, if it were analyzed in the same manner as presented in the text, could be considered entirely from a private-sector view.

At the end of Chapter 12, the student is presented with a case study on Positive Train Control (PTC). The railroads have considered many incarnations of PTC over the years and have concluded that the technology is one in which they do not wish to invest. The government has suggested that the safety benefits of PTC are sufficient that the public should require the railroads to make that investment. The PTC case helps to illustrate quite graphically the public-private tradeoffs and considerable array of approaches that project advocates can use to ensure implementation of a particular investment plan.

The chapter on risk does a thorough job of enumerating the risks that are faced in the pursuit of any project. I might add that project promoters will very likely underestimate the risks, underestimate the costs, and overestimate the benefits. That is the reason why hurdle rates can significantly exceed

minimum acceptable rate of return. It is this risk of poor estimation that may be the largest of all risks.

One way to address the risks of poor estimation of cash flows is to estimate them better. And the discussion of using simulation to estimate cash flows is on target. I was particularly impressed with the detailed discussion of how spreadsheets can be used for that process. Computer programming languages, such as FORTRAN, have been used for such purposes for decades. But that approach is difficult to understand and takes a very long time to get right. Spreadsheets are intuitive and easy to understand, making them a good tool for many kinds of analysis. And Martland shows us how the ability to generate random numbers in a spreadsheet adds to the capability of the tool.

Overall, I find the textbook to be an excellent one for instructing undergraduates who want to know how projects should be conceived, analyzed, selected, and managed. Most engineering textbooks look at only the very detailed concepts of project design. As Martland's text points out, though, there is a real need for engineers to go beyond such a narrow perspective. Indeed, I find that this textbook does a great job of answering many of the questions posed by a textbook in engineering economics that formed the basis of a course I took many years ago. In that text, the authors suggested that while engineers focus on project design, it is at times far more important to be able to answer such basic questions as, "Why do the project now?" or "Why do the project in this way?" or even "Why do this project at all?" Much of the time engineers are focused on doing things just because it is technically feasible. But it is just as important that any proposed project be politically and economically feasible as well. Martland's text provides the nascent engineer a marvelous grounding in how to make sure that all the bases are covered.

Michael E. Smith is an economist for the United States Surface Transportation Board, providing insights into railroad operations based on the Board's annual waybill sample and serving on teams that investigate complaints about railroad rates and services. He received a B.S.(1974) and an M.S.(1975) in civil engineering from Ohio State University and an M.B.A. (1981) from the University of Maryland. He began work in 1975 with the Federal Highway Administration as a transportation planner; then served at the Federal Railroad Administration, assisting with the analysis of the benefits and costs of subsidizing small rail branch lines. Next, at the Association of American Railroads, he led the development of models to understand the economics of introducing technology improvements in the railroad industry. Burlington Northern then hired him to perform a business case analysis for their Advanced Railroad Electronics System, now more widely recognized in the railroad industry as Positive Train Control. After that, he served as manager at Reebie Associates. He is author of more than a dozen published papers in the field of transportation and is pursuing a Ph.D. in economics at George Mason University. He is a registered professional engineer in the District of Columbia.