A Preliminary Framework for Using Total Cost Assessment in Total Quality Environmental Management

Article *in* International Journal of Environmental · January 2006

DOI: 10.18848/1832-2077/CGP/v01i03/54439

3 authors, including:

Sime Curkovic
Western Michigan University
66 PUBLICATIONS **2,415** CITATIONS

SEE PROFILE

Robert Sroufe
Duquesne University
116 PUBLICATIONS **5,285** CITATIONS

SEE PROFILE

The International JOURNAL of ENVIRONMENTAL, CULTURAL, ECONOMIC & SOCIAL SUSTAINABILITY

A Preliminary Framework for Using Total Cost Assessment in Total Quality Environmental Management

Sime Curkovic
Robert Sroufe
Jim Eckert

COMMON GROUND

www.Sustainability-Journal.com

INTERNATIONAL JOURNAL OF ENVIRONMENTAL, CULTURAL, ECONOMIC AND SOCIAL SUSTAINABILITY
http://www.Sustainability-Journal.com

First published in 2005/2006 in Melbourne, Australia by Common Ground Publishing Pty Ltd
www.CommonGroundPublishing.com.

ISSN: 1832-2077
Publisher Site: http://www.Sustainability-Journal.com

The INTERNATIONAL JOURNAL OF ENVIRONMENTAL, CULTURAL, ECONOMIC AND SOCIAL SUSTAINABILITY is a peer refereed journal. Full papers submitted for publication are refereed by Associate Editors through anonymous referee processes.

Typeset in Common Ground Markup Language using CGCreator multichannel typesetting system
http://www.CommonGroundSoftware.com.

A Preliminary Framework for Using Total Cost Assessment in Total Quality Environmental Management

Sime Curkovic, Haworth College of Business, United States of America
Robert Sroufe, Boston College, United States of America
Jim Eckert, Western Michigan University, United States of America

Abstract: This study addresses one of the major perceived barriers to Total Quality Environmental Management in industry: total costs. The research develops a framework for managers to assess the relative total costs associated with environmental initiatives. A framework is then developed using the Total Quality Management literature and serves as a basis for comparing environmental cost measures for several mid-western manufacturers. The results highlight the extent to which environmental costs are captured and used in industry and present opportunities for future research.

Keywords: Total Quality Management, Total Quality Environmental Management, Environmental Cost Accounting, Full Cost Accounting, Total Cost Analysis, Qualitative Methods

Introduction

AS FIRMS STRIVE to improve their bottom-line, many find that traditional pollution prevention techniques are no longer cost effective. In fact, many manufacturers have found that minimizing or avoiding waste generating activities altogether is a much more cost effective solution than traditional "end-of-pipe" strategies. Replacing these traditional strategies is a new proactive approach known as Total Quality Environmental Management (TQEM) (Bhat 1998). This gradual evolution of quality to include aspects of the environment has been anticipated by several other authors as well (Mizuno 1988; Willig 1994; May and Flannery 1995; Sarkis and Rasheed 1995; Epstein 1996 a,b; Curkovic et al. 2000). The TQEM concept, based on the theories of Deming, Juran, and Crosby to name a few, combines the principals of Total Quality Management (TQM) with the goals of environmental management.

TQEM has been defined as an economically-driven, system-wide and integrated approach to the reduction and elimination of all waste streams associated with the design, manufacture, use and/or disposal of products and materials (Willig 1994; Bhat 1998; Curkovic and Landeros 2000; Handfield, et al. 1997; Melnyk et al. 2001). Fundamental to TQEM is the recognition that pollution, irrespective of its type and form, is waste. Strategies such as Just-In-Time (JIT), Total Quality Management (TQM), and Time-Based Competition (TBC), have defined waste as any activity or product which consumes resources or creates costs without generating any form of offsetting stream of value (Porter 1991; Porter and Van der Linde 1995 a,b). By minimizing waste, the firm can reduce disposal costs and permit requirements, avoid environmental fines, boost profits, discover new business opportunities, rejuvenate employee morale, and protect and improve the state of the environment (Hanna et al. 2000). It would be expected that more managers be interested in the development and use of TQEM based systems. However, for most firms, TQEM has not achieved the same degree of acceptance as have JIT, TQM, and TBC (Angell and Klassen 1999; Epstein 1996 a,b; Makower 1993, 1994).

One of the most important problems associated with the development and implementation of TQEM systems is that managers have difficulty assessing the impact of TQEM programs because of the lack of appropriate measures. In order for TQEM to be given serious consideration by a firm, a process is required for evaluating TQEM by appropriately including environmental costs and savings for each investment option (Sarkis and Rasheed 1995; Epstein 1996 a,b). Unfortunately, many projects that pursue pollution prevention and support TQEM are quickly overlooked in traditional capital budgeting processes (Greer and Van Loben Sels 1997). The main reason for this is that very few firms fully recognize environmental costs when performing a cost analysis for each project. A fundamental goal of TQEM is to get companies to recognize environmental costs and incorporate them into the capital budgeting process so that better decisions can be made. By incorporating Total Cost Assessment (TCA) into each project, environmental proposals can successfully compete with

non-environmental alternatives for valuable capital resources within the company.

The purpose of this study was to develop a conceptual framework for managers to identify and assess the relative costs associated with environmental business practices. The objective from the onset was to identify and capture all relevant costs (qualitative and quantitative) using existing costing measures, but evaluating these measures using a newer and more effective approach. This consists of a combination of TQEM and TCA.

The paper is composed of several sections. To start, the background of TQEM and TCA and other relevant accounting methods are used to identify a gap in the literature and establish a need for the research presented. Following the review of the literature, a cost framework is presented, and implications for future research are discussed.

Total Quality Environmental Management

The results of the literature review showed that the move to adoption of environmental business practices and TQEM has been viewed from a perspective heavily influenced by either normative or legal considerations (Friedman 1992; Klassen 2000 a,b; Curkovic 2003). For most companies, compliance is seen as an adequate position to assume (Epstein 1996 a,b). With compliance, the firm does only what is necessary to meet the letter of the law. It is a reactive position that means environmental problems are corrected once they have been created. This is relatively ineffective because it does not attack the causal factors, merely the symptoms (Carpenter 1991; Alm 1992; Allenby 1993; Gupta and Sharma 1996; Klassen and Whybark 1999 a,b). It is also a potentially dangerous position given the retroactive and dynamic nature of many laws. That is, what may be in compliance today may be considered to be out-of-compliance tomorrow. As a result, the firm may find itself always spending to bring itself into compliance with regulations that are continuously becoming more stringent.

The challenge of determining whether it is better for the firm to simply emphasize compliance or whether the firm wants to become recognized as an industrial leader in the development and application of TQEM based systems describes the first of many obstacles and paradoxes surrounding the TQEM literature. In large part, the failure of management to become more environmentally responsible is really a reflection of its inability to address and resolve these paradoxes and problems. The following are some of the most important paradoxes and problems associated with the development and implementation of TQEM systems:

- Top management must be willing to accept and champion corporate-wide developments if TQEM is to become widespread (Hunt and Auster 1990; Epstein 1996 a,b; Hanna et al. 2000). However, when dealing with TQEM, there is a strong bias in favor of ignorance at the highest levels of the firm (Makower 1993, 1994; ReVelle 2000).
- In the short run, implementing TQEM often causes costs to rise (Palmer, Oates, and Portney 1995; Hanna et al. 2000). However, there is a real concern as to whether customers are willing to pay the added costs associated with having something that is environmentally friendly (Rosewicz 1990; Willig 1994; Hanna and Newman 1995).
- It has been argued that being environmentally responsible ultimately makes a company more efficient and more competitive (Klassen and McLaughlin 1993; Klassen 1993; Klassen and Whybark 1994; Willig 1994; Geffen and Rothernberg 2000). However, there are many reported cases of ERM investments which have resulted in negative returns (Makower 1993, 1994; Walley and Whitehead 1994; Klassen and Angell 1998).
- Ideally, the most appropriate place for considering TQEM issues is in the design phase since the amount of waste generated is a direct consequence of decisions made during design (Alm 1992; Fiskel 1993, 1996; Angell and Klassen 1999; Melnyk et al. 2001). However, there is a lack of appropriate measures and tools for capturing the environmental impact of designs (Van Weenen and Eeckles 1989; Allenby 1993; Graedel and Allenby 1995; Sroufe et al. 2000).
- Managers need frameworks or guidelines which they can use to better understand what TQEM is and its components (Bhat 1998; Curkovic et al. 2000; Revelle 2000). However, a great deal of the information surrounding TQEM is either legally based or derived from anecdotal stories and case studies (Willig 1994; Curkovic 2003).
- Finally, and the focus of this research, managers have difficulty assessing the impact of TQEM programs because of the lack of appropriate measures. In order for TQEM to be given serious consideration by a firm, a process is required for evaluating TQEM by appropriately including environmental costs and savings for each investment option (Sarkis and Rasheed 1995; Epstein 1996 a,b; Klassen and McLaughlin 1996; Bhat 1998). There is simply a lack of easy-to-use measures.

At present, several conceptual frameworks for identifying the various costs associated with waste and pollution have been proposed. These include *Life-Cycle Assessment* (LCA) (Allenby 1993; Bhat

1998), *Environmental Cost Accounting* (ECA) (GEMI 1992, 1993; Willig 1994; White et al. 1993), *Full Cost Accounting* (FCA) (Popoff and Buzzelli 1993; Makower 1994; Savage and White 1995; Epstein 1996 a,b), and *Total Cost Assessment* (TCA) (Epstein 1996 a,b; Kennedy 1994; White et al. 1995). Of these approaches, LCA has been recognized as extremely information intensive, difficult to implement, and somewhat subjective and difficult to defend. With LCA, you must be prepared to show your methodology and open it up to peer review, or public scrutiny. If you are not ready for that scrutiny, then you are not ready for LCA. Examples of this can be found in the clamshell controversy at McDonalds and with the insights gained from scrutinizing LCA predictions for disposable products (Makower 1993 and 1994; Epstein 1996 a,b). Presently, LCA has very limited use in industry.

The other frameworks such as ECA, FCA, and TCA are derived from the same premise that accounting systems need to incorporate environmental information. There is also a limited use of these accounting approaches in industry. Their common call for the inclusion of environmental costs is an overlooked opportunity for managers to better understand the issues presented by these concepts and use this information to make decisions concerning the allocation of scarce resources toward unlimited environmental project needs. Thus, the application of these techniques presents a gap in the literature and an opportunity for research to explore the use of these techniques in the field. This research need not create new tools and measures to capture environmental information; instead existing measures can be used.

Total Cost Assessment

Environmental accounting has been defined as a general term for the identification, compilation, analysis, and reporting of environmental information within the firm (White and Savage 1995). Its applications extend across a variety of business decisions such as the identification of expensive resource inefficiencies, identification and prioritization of TQEM investments, and the financial analysis of such investments. In general, environmental accounting includes both materials accounting and environmental cost accounting (ECA). Materials accounting information provides the foundation for decision-making. However, an understanding of how materials and energy impact a process is essential for identifying potential improvements. Environmental cost accounting (ECA) information translates the business impact of environmental issues into quantifiable measures that can be used in a cost/benefit analysis. ECA provides businesses with the information they need to improve their environmental performance while reducing costs.

One application of ECA is Full Cost Accounting (FCA), which includes environmental costs that accrue to identifiable third parties or to society as a whole (Popoff and Buzzelli 1993; White et al. 1993; Savage and White 1995). Examples would include global warming from carbon dioxide emissions, the depletion of rain forests, or damage from acid rain. FCA in its strictest sense would encompass these costs. While the future of FCA is to extend cost analyses to absorb these external impacts, no firms today are moving in this direction. Most companies do not even have their internal corporate costs in order, let alone an ability to externalize them. However, one application of ECA that has more realistic applications and has evolved in its usage is Total Cost Assessment (TCA).

TCA is concerned only with costs to the company itself. Unlike FCA, TCA does not consider both internal and external (or social costs). TCA is an environmental cost accounting method that allocates both direct and indirect environmental costs to products, processes, and services (White and Savage 1995). This cost allocation begins by analyzing business processes and deciding which competitive priorities of the business to examine. For example, does the company want to concentrate its TCA efforts solely on manufacturing or should they look at the process from research and development to sales? Although this seems like a basic question to ask, many companies overlook a great number of opportunities that are present by examining only one aspect of their business.

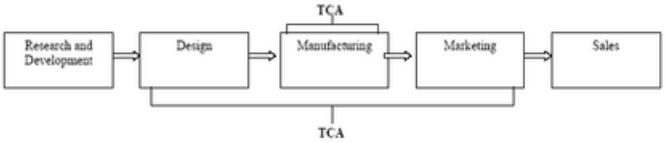

Figure 1: Total Cost Assessment Can Encompass Any Combination of Business Activities, Source: Finding Cost Effective Pollution Prevention Initiatives (Global Environmental Management Initiative)

Next, a company must examine all of the costs that go into a process. The reason for this is that many of today's inefficient allocation decisions can be attributed directly to the fact that most environmental costs are hidden in general overhead categories. These costs are usually grouped in two ways. The first set is manufacturing, which deal primarily with product costs. The second set, sales and general ad-

ministrative overhead, deal with period costs. Although they may seem similar, product costs are those costs the firm has incurred to make the product while period costs are those the firm considers to be part of operating the business itself. Both categories can include items from production equipment and materials to human resources and research and development costs.

Table 1: Typical Costs Included in Overhead

Manufacturing OH [1]	*General Administrative OH*
Disposal Costs	Research and Development
Maintenance	Human Resources
Waste Treatment	Legal Affairs
Safety Equipment	Environmental Compliance
Supplies	Marketi

[1] Source: Accounting and Capital Budgeting for Environmental Costs Workshop (Environmental Protection Agency)

According to current accounting standards, companies are supposed to take costs not directly measurable or assignable and place them in a general overhead category (Savage and White 1995). However, by doing this managers are unable to recognize certain costs as environmental costs. This is where the most important phase of TCA begins. A comprehensive cost/benefit inventory is an essential part of any financial analysis, particularly for environmental projects. Identifying all costs and savings associated with a TQEM program is the first and most important step in TCA. One way for companies to accurately account for environmental costs is by breaking all of the processes down into what is known as the "Four Tiers". By doing this, managers will create categories that will encompass all the environmental costs. This will allow companies to recognize these costs as environmental costs and guide them to better capital budgeting decisions. These categories consist of direct costs, hidden costs, contingent liability costs, and less tangible costs. Each is described below.

Direct Costs *: those costs that are directly linked to the product, process, or service. Out of all FCA components direct costs are the easiest to identify and quantify. These can be typically found in traditional data sources that most companies employ and can include items such as: capital expenditures, equipment installation, project engineering, material, labor and waste management.*

Hidden Costs *: those costs that are typically hidden in general overhead categories. There are two important steps to identify and quantify them. First, the company must identify those environmental laws and regulations that are applicable to their business. Then the company must estimate the current costs of complying with those regulations both now and in the future. In most cases this data is also easily obtainable under current accounting systems and includes such items as compliance reporting, education and training, legal support, sampling, and testing.*

Contingent Liability Costs *: those costs usually associated with liabilities that result from waste and materials management. These costs are divided into two main categories. First, the costs associated with accidental releases, and second, those costs that result from legal damages or personal injury. Unlike the other categories discussed so far, contingent liability costs are not easily attained. These costs usually have to be estimated and there are various ways to go about this process. Many companies rely on past experience while others study similar businesses within the industry. Both have about the same accuracy and are used equally.*

Less Tangible Costs *: these costs are considered to be the benefits obtained by an improved corporate image. Out of the "three tiers", less tangible costs are the most subjective and controversial of those listed so far. Like contingent liability costs, they are very difficult to attain and also very troublesome to estimate. Most companies that account for less tangible costs measure them according to increased revenues or decreased expenses due to improved corporate image. These costs can include goodwill, community acceptance, and an improved image. Other examples include lower product acceptance by consumers, strained employee/union relationships, negative corporate image, and strained customer/supplier relationships.*

Table 2: Four Tiers of Costs "Four Tiers"

Direct Costs[1]	Hidden Costs
Buildings	Regulatory Compliance
Equipment Installation	Environmental Monitoring
Project Engineering	Legal Support
Material	Sampling and Testing
Labor	Education and Training
Waste Management	Utilities
Contingent Liability Costs	Less Tangible Costs
Accidental Releases	Corporate Image
Legal Damages	Community Goodwill
Settlement for Remedial Actions	Customer Acceptance

[1] Source: Finding Cost Effective Pollution Prevention Initiatives (Global Environmental Management Initiative)

Applying Tqem Principles to Tca

Much the same as any other tool for developing Total Quality Management, measurement is important. If processes are not measured then it becomes increasingly difficult to effectively and efficiently manage and have accountability for the processes. Many corporations have found it very beneficial to us a Plan-Do-Check-Act (PDCA) system for developing their commitment to TQEM. The PDCA system is a method for continuous process improvement based on the concept that a process must be fully understood before it can be improved. Thus, this same approach is recommended for the TCA approach since there is still a need to better understand these approaches and provide useful information for managers. A corporation that makes use of a PDCA system would look like this:

Plan *: Decision-makers identify a gap between the current situation and the desired situation. This could be due to a lack of necessary cost information or some other type of dilemma. It is during this stage that management seeks to identify ways to close this gap or improve the situation.*

Do *: Once a plan has been developed a company needs to put it into practice. This plan is usually acted out on a smaller scale first to avoid large financial consequences. These Kaizen Events are typically acted upon quickly and results are almost immediately evident.*

Check *: After the plan has been placed into action it then becomes necessary to see if the gap identified in the planning stage is actually closing.*

Act *: In this final stage management examines and communicates the results of the project. They then decide whether all of the necessary information is present and whether it assisted them in their decision-making process.*

The PDCA system is frequently used in evaluating TCA and TQEM. Other approaches that have been used can include cause and effect diagrams, check sheets, model building, and the Pareto criterion analysis. All attempt to accomplish a better understanding of processes. Thus, new and unique tools do not have to be developed. TCA can be accomplished using existing tools and problem solving methods that managers and accountants are already familiar with, but have overlooked. Thus, there is a potentially short learning curve for implementing FCA in management if frameworks such as the one proposed in Figure 2 are applied.

Directions for Future Research

After reviewing the background of TQEM and frameworks for capturing environmental costs, there is an apparent opportunity for research involving the use of TQEM and TCA. An initial conceptual framework based on a four-tiered approach to identifying the costs of environmental projects was introduced. The first step in future research would be to develop interview protocol and a survey instrument based on this preliminary four-tiered framework. It should be used on a select few firms recognized as being at the leading edge in the implementation and use of TQEM practices. Two major outputs yielded by this exploratory case-based research would be 1) a catalog of the various cost measures and procedures used to implement and carry out a TQEM cost analysis, and 2) an empirically refined TQEM cost framework. This cataloging activity would not only describe the tools and measures but also indicate how these measures can be used, types of expected outcomes, and conditions most conducive to their use. This framework and catalog would consolidate information from a field that is currently considered to be very fragmented. The final outcome

would be a demonstration of the framework. This demonstration would identify the ease of use, extent of data requirements, and the types of decisions facilitated by the data provided by the framework.

The significance of this type of research can be evaluated along several important dimensions. First, it would help to close several critical gaps (primarily involving the gaps between strategy and TQEM and the gap between firm-specific tools and general procedures). Second, it would provide alternative measures to the commonly used but complex (and time consuming) life cycle assessment. Third, and lastly, it would meet a definite need – that of providing a catalog of available cost tools and measures.

References

Allenby, B.R. (1993). *Industrial Ecology*. New York, NY: Prentice-Hall.

Alm, A.L. (1992). "Pollution Prevention and TQM," *Environmental Science Technology*, 26, 452.

Angell, L.C., and Klassen, R.D. (1999), "Integrating environmental issues into the mainstream: an agenda for research in operations management", *Journal of operations Management*, 17(5), 575-598.

Bhat, V.N. (1998). Total quality management – An ISO 14000 Approach, Qurom Books, Greenwood Publishing Group, P.O. Box 5007, Westport, Conn.

Curkovic, S., and Landeros, R. (2000). "An Environmental Baldrige?" Mid-American Journal of Business, 15(2), 63-76.

Curkovic, S., Melnyk, S.A., Handfield, R.B., and Calantone, R.J. (2000). "Investigating the linkage between total quality management and environmentally responsible manufacturing," IEEE Transactions on Engineering Management, 47(4), 444-464.

Curkovic, S. "Environmentally Responsible Manufacturing: The Development and Validation of a Measurement Model." European Journal of Operational Research, 146(1), 130-155.

Environmental Protection Agency (EPA). (1994). *Workshop Proceedings: Accounting and Capital Budgeting for Environmental Costs Workshop*. Washington D.C. May.

Environmental Protection Agency. (1989). *Pollution Prevention Benefits Manual*. Washington D.C. October.

Epstein, M.J. (1996a) "Improving Environmental Management with Full Environmental Cost Accounting," *Environmental Quality Management*, 6(1), 11-22.

Epstein, M.J. (1996b). *Measuring Corporate Environmental Performance: Best Practices for Costing and Managing an Effective Environmental Strategy*. Montvale, NJ: The IMA Foundation for Applied Research, Inc.

Fiskel, J. (1993). "Quality Metrics in Design for Environment," *Total Quality Environmental Management*, 3, 181-192.

Fiskel, J. (1996). *Design for Environment: Creating Eco-Efficient Products and Processes*. New York: McGraw-Hill.

Friedman, F.B. (1992). "The Changing Role of Environmental Management," *Business Horizons*, 35(2), 28.

Geffen, C.A., and Rothenberg, S. (2000). Suppliers and environmental innovation: the automotive paint process. *International Journal of Operations and Production Management*, 20(2), 166-186.

Glaser, B. & Strauss, A. (1967), *The discovery of grounded theory: Strategies for Qualitative Research*, Aldine, Chicago.

Global Environmental Management Initiative (GEMI). (1992). *Finding Cost Effective Pollution Prevention Initiatives: Incorporating Environmental Costs Into Business Decision Making.* Washington D.C.

Graedel, T., and Allenby, B.R. (1995). *Industrial Ecology*. Englewood Cliffs, NJ: Prentice Hall.

Greer, L. and Van Loben Sels, C. (1997). "When Pollution Prevention Meets the Bottom Line," *Environmental Science and Technology*, 31(9), 418 – 422.

Gupta, M., and Sharma, K. (1996). Environmental operations management: An opportunity for improvement. *Production and Inventory Management Journal,* 37(3), 40-46.

Handfield, R.B., Walton, S.V., Seegers, L.K., and Melnyk, S.A. (1997). Green value chain practices in the furniture industry. *Journal of Operations Management*, 15(4), 293-315.

Hanna, M.D., and Newman, R.W. (1995). Operations and environment: An expanded focus for TQM. *International Journal of Quality & Reliability Management*, 12(5), 38-53.

Hanna, M.D., Newman, R.W., and Johnson, P. (2000). Linking operational improvement through employee involvement. *International Journal of Operations & Production Management,* 20(2), 148-165.

Hunt, C.B., and Auster, E.R. (1990). "Proactive Environmental Management: Avoiding the Toxic Trap," *Sloan Management Review*, 31(2), 7-18.

Kennedy, M.L. (1994). "Getting to the Bottom Line: How TCA Shows the Real Cost of Solvent Substitution." Pollution Prevention Review, 4(2), 17-27.

Klassen, R.D., and McLaughlin, C.P. (1993). "TQM and Environmental Excellence in Manufacturing," *Industrial Management and Data Systems*, 93(6), 14-22.

Klassen, R.D., (1993). The integration of environmental issues into manufacturing: Toward an interactive open-systems model. *Production and Inventory Management Journal*, 34(1), 82-88.

Klassen, R.D., and Whybark, D.C. (1994). Barriers to the management of international operations. *Journal of Oper a tions Management,* 11(4), 385-396.

Klassen, R.D., and McLaughlin, C.P. (1996). The impact of environmental management on firm performance. *Manag e ment Science,* 42(8), 1199-1214.

Klassen, R.D., and Angell, L.C. (1998). An international comparison of environmental management in operations: The impact of manufacturing flexibility in the U.S. and Germany. *Journal of Operations Ma n agement,* 16(2/3), 177-194.
Klassen, R.D., and Whybark, D.C. (1999a). Environmental management in operations: The selection of environmental technologies. *Decision Sciences,* 30(3), 601-631.
Klassen, R.D., and Whybark, D.C. (1999b). The impact of environmental technologies on manufacturing performance. *Academy of Management Journal,* 42(6), 599-615.
Klassen, R.D. (2000a). Exploring the linkage between investment in manufacturing and environmental technologies. *International Journal of Production and Operations Management,* 20(2), 127-147.
Klassen, R.D. (2000b). Just-In-Time manufacturing and pollution prevention generate mutual benefits in the Furniture Industry. *Interfaces,* 30(3), 95-106.
Makower, J. (1993). *The E-Factor: The Bottom-Line Approach to Environmentally Responsible Business.* New York: Tiden Press, Inc.
Makower, J. (1994). *Beyond the Bottom Line: Business for Social Responsibility*. New York: Tiden Press, Inc.
May, D.R., and Flannery, B.L. (1995). "Cutting Waste with Employee Involvement Teams," *Business Horizons*, 38, 28-38.
McInerney, F. and White, S. (1995). *The Total Quality Corporation: How 10 Major Companies Turned Quality and Environmental Challenges to Competitive Advantage in the 1990s*, Penguin Books USA Inc. New York, N.Y.
Melnyk, S.A., Handfield, R.B., Calantone, R.J., and Curkovic, S. (2001) "Integrating Environmental Concerns into the Design Process: The Gap between Theory and Practice." IEEE Transactions on Engineering Management. 48(2), 189-208.
Mizuno, S. (1988). *Management for Quality Improvement: The Seven New QC Tools*. Cambridge, MA: Productivity Press.
Palmer, K., Oates, and Portney, P.R. (1995). "Tightening Environmental Standards: The Benefit-Cost or No-Cost Paradigm?" *Journal of Economic Perspectives*, 9(4), 119-132.
Popoff, F., and Buzzelli, D. (1993). "Full Cost Accounting." Chemical and Engineering News, 71(2), 8-10.
M. Porter and C. Van der Linde. (1995a). "Green and Competitive: Ending the Stalemate," *Harvard Business Review,* 73(5), pp. 120-134, 1995.
Porter, M. and Van der Linde, C. (1995b), "Toward a new concept of the environment-competitive relationship", *Journal of Economic Perspectives*, 9(4), pp. 97-118.
ReVelle, C. (2000). Research challenges in environmental management. *European Journal of Operational Research,* 121(2), 218-231.
Rosewicz, B. (1990). "Americans are Willing to Sacrifice to Reduce Pollution, They Say," *Wall Street Journal,* April 20, A1.
Sarkis, J., and Rasheed, A. (1995). "Greening the Manufacturing Function," *Business Horizons*, 38(5), 17-27.
Savage, D.E, and White, A.L. (1995). "New Applications of Total Cost Assessment". Pollution Prevention Review, Winter, 7-15.
Sroufe, R., Curkovic, S., Montabon, F., and Melnyk, S.A. "The New Product Design Process and Design for Environment: Crossing the Chasm." *International Journal of Operations and Production Management*, vol. 20, no. 2, 2000, p. 267-291.
Van Weenen, S.C., and Eeckles, J. (1989). "Design and Waste Prevention." *The Environmental Professional*, 11, 231-235.
Walley, N., and Whitehead, B. (1994). "It's Not Easy Being Green." *Harvard Business Review*, 72(3), 46-52.
Wheeler, W.A. (1992). "The Revival in Reverse Manufacturing," *Journal of Business Strategy,* 13(4), 8-13.
White, A.L., Becker, M., and Savage, D.E. (1993). "Environmentally Smart Accounting: Using Total Cost Assessment to Advance Pollution Prevention." Pollution Prevention Review, 3(3), 23-35.
White, A.L., and Savage D.E. (1995). "Budgeting for Environmental Projects: A Survey." Management Accounting, October, 48-54.
Willig, J. (1994). *Environmental TQM*. New York: McGraw-Hill, Inc.

About the Authors

Dr. Sime Curkovic
Dr. Sime Curkovic is an Associate Professor of Supply Chain Management at Western Michigan University. His research interests include environmentally responsible manufacturing, quality management, supply chain management, and global strategic sourcing.

Robert Sroufe
Dr. Robert Sroufe Robert Sroufe is an Assistant Professor of Operations Management at Boston College. His teaching and research interests include environmentally responsible manufacturing and supply chain management.

Jim Eckert
Jim Eckert, Western Michigan University,Haworth College of Business,Marketing Department.

THE INTERNATIONAL JOURNAL OF ENVIRONMENTAL, CULTURAL, ECONOMIC AND SOCIAL SUSTAINABILITY