A proposal for KPMG and the University of Illinois’s Business Measurement Research Program

Embedded Environmental Metrics

RESEARCH TEAM

- Robert Sroufe – Principle Investigator, Assistant Professor of Operations Management, Boston College, The Wallace E. Carroll School of Management, 140 Commonwealth Avenue, Chestnut Hills, MA 02467, Phone: (617) 552-0469, Fax: (617) 552-0433, Email: sroufe@bc.edu
- Jeffrey Cohen, Professor of Accounting, Boston College, The Wallace E. Carroll School of Management, Chestnut Hills, MA 02467.
- Steve Melnyk, Professor of Production and Operations Management, The Eli Broad College of Business, Michigan State University, East Lansing, MI 48823.
- Frank Montabon, Assistant Professor of Production and Operations Management, Iowa State University, College of Business, Ames, IA 50011.
RESEARCH STATEMENT
The rapid rate of technological change, shortened product life cycles, increasing environmental legislation and international protocols such as the Kyoto protocol, multiple international standards such as, NSF International's 110 Environmental Management Systems (EMS) standard, Environmental Management and Audit Scheme (EMAS) and the International Organization of Standards (ISO) 14001, and increased scrutiny of environmental reporting make environmental metrics increasingly more important. Despite this growing importance, there appears to be a paradox in that environmental metrics and the impacts of these metrics on a firm’s return on investments are not well understood by U.S. manufacturers or auditors.

Previous research by members of the research team suggests that there is a gap between different management levels perceptions of environmental practices and metrics. Additional research has shown that there is also a chasm between firms who are the innovators or early adopters of environmental practices and other firms who may be considered the early majority, late majority, or laggards. For the majority of firms to cross the chasm these firms need more justification before proceeding with resource allocation and the integration of new measurement systems. In this business environment, both manufacturers and suppliers are finding metrics increasingly important. However, an extensive review of the literature reveals a lack of information available to guide firms in developing strategies, practices, and implementation approaches to achieving effective environmental metric integration into measurement systems. In addition, valid explanatory models to guide future academic research and industry understanding are not available.

One of our goals in the proposed research project is to look at several related problems of metrics. First, there is the problem of developing new metrics and overloading existing measurement systems. We want to identify existing metrics and find relationships to improved performance. Second, we want to focus on proactive measurement and not end-of-pipe measures. Third, we need to better understand how good measures are developed and used throughout a firm. Basically, we intend to test to see if environmental performance is improved when we measure and reward environmental practices and when we link the metrics in a cause-and-effect structure to critical processes. Finally, our approach to this project realizes that there are differences in firm’s adoption of environmental metrics (i.e. innovators, early adopters, early majority, late majority, and laggards) and that certain firms will need specific kinds of metrics, or a contingency approach to the assignment of metrics.

Thus, the primary research question addressed by this research proposal includes: what metrics-related strategies and tactics can be identified that facilitate the adoption, acceptance, and use of environmental management practices and how do these strategies and tactics vary according to the specific type of firm, or management level in which the activities are taking place?

Additional Research Questions Include:
1. What environmental measures do firms collect/use? How extensively are they used?
2. Why are some measures not used?
3. What are the impacts of environmental metrics on ROI? These impacts could affect both the expenses and revenue side if a firm used their environmental efforts as a marketing tool.
4. Are green practices really “strategic” and as important as researchers suggest, or are environmental practices and metrics better suited for the tactical and operational levels of the firm?
5. How do managers prevent metrics from causing dysfunctionality?

RESEARCH METHODS
The research will include a combination of literature review, in-dept field research and several web-based surveys within the field study firms. After completing the field research, a large-scale web-based survey will be implemented across manufacturing firms in the United States. In addition, the researchers will convene interdisciplinary industry and academic review teams to enhance the research design, interpretation and results dissemination.

The methodology for the proposed research has two major phases. The first relies on structured in-depth field interviews and surveys (within the firms visited during the field research) to establish what is required for successful environmental metric integration and how implementation takes place, including appropriate analysis of the field data. Perceived industry leadership position will be a primary criterion for selecting companies for field interviews. The research team will identify candidates based on a literature review, recommendations of an Industry Advisory Team and input from firms involved in our research started in 1996 at Michigan State University supported in part by the National Science Foundation Division of Design, Manufacture, and Industrial Innovation (ECM Initiative), Grant No. DMI-9528759, Center for Advanced Purchasing Studies, National Association of Purchasing Managers, and the Education and Research Foundation for APICS The Education Society for Resource Management.

The second phase involves the development and confirmatory testing of a measurement model that will be used to test the validity of the explanatory model which will describe the integration and role of environmental metrics in measurement systems. Once the researchers identify measurement model scales that demonstrate a high degree of reliability, internal consistency, and parallelism between factors, then final survey development and administration will occur. Randomly selected manufacturing within the United States firms will receive a web-based survey for completion and analysis. Final model and hypotheses testing, research result interpretation and integration, and research finding dissemination will complete the requirements of the second thrust.

DESCRIPTION OF PROPOSED RESEARCH ACTIVITY
The proposed project will focuses on environmental metric integration within measurement systems and concentrate on continuous improvement and environmental management strategies over the post-development stages of a measurement system. The proposed project will also identify future environmental strategies/practices and trends affecting environmental metric integration and extend this information throughout the value chain.

Research objectives include developing an explanatory model for the integration of environmental metrics into measurement systems as well as developing an understanding of successful and unsuccessful integration strategies and practices that will support the
development of a comprehensive set of metrics and implementation guidelines for a firm to follow.

Specifically, the results of should:

1. Provide a comprehensive model for understanding the variables impacting successful environmental metric integration and possible interaction of the variables. This model can lead to a better understanding of metric integration and provide the basis for further scientific testing and model enhancement.

2. Provide a comprehensive set of implementation guidelines/frameworks for firms to follow to improve integration of environmental metrics into existing systems so as to improve quality, reduce costs, assess the role of technology, improve product and process features, and enhance external reporting.

3. Provide for the development of case situations materials for traditional classroom and executive education.

4. Empirically test explanatory models using several competing theories with data from respondents in U.S. manufacturing firms.

Overall, the proposed research will determine, in a structured fashion, (1) what variables directly and indirectly relate to successful environmental performance and metric integration, (2) determine which strategies and practices work best in achieving supplier integration resulting in competitive improvements, and (3) the circumstances or environments in which the strategies and practices work best. The research will attempt to develop integrative models and implementation frameworks for putting the strategies and practices to work while testing several relationships between variables and constructs linking environmental metrics and performance.

LITERATURE REVIEW AND PLACEMENT

Researchers outside the field of operations management have considered the role of culture (Wehrmeyer and Parker 1996), training and education (Dechant and Altman 1994) and the importance of measurement systems (Brown and Dray 1996) for encouraging environmental activities in the workforce. However, outside of Chinander (2001) little research has been reported that has studied the role of measurement, monitoring, and managing environmental processes. This gap in the literature provides an opportunity to examine contextual variables such as organizational structure to determine the relative effectiveness of managing environmental processes. A vast majority of studies examining environmental issues are conceptual and tend to be based on anecdotal evidence. Empirical studies examining corporate environmentalism are now beginning to appear in the literature. These studies have concluded that adopting environmental management does bring certain advantages for businesses.

The objective of this research is to build upon this growing body of literature and empirically test several infrastructural operations management issues that surround environmental management. While most of the research team members are involved in operations management research, we would like to extend the bounds of our previous research to include relevant accounting issues and applications. Thus, included in these infrastructural issues is the impact of environmental metrics on ROI and the role of nonfinancial measures in measurement systems. While KPMG has pioneered a Strategic Audit System, and Key Performance Indicators (KPI), this system has yet to address performance indicators involving environmental metrics. The environmental metrics developed within this research project could be new KPIs for auditors to evaluate.
Additionally, new metrics uncovered in the proposed research has the potential for researchers and practitioners to take another look at a missing element of the balanced scorecard approach to management (Kaplan and Norton, 1992, 1996, 2001). This approach uses both financial and nonfinancial measures.

Nonfinancial measures can play an important role in measurement systems. The potential value of nonfinancial measures for predicting and interpreting financial performance has also prompted the Financial Accounting Standards Board to consider the disclosure of these measures to investors in financial statements (FASB, 2000). Results of experiments by (Luft and Shields, 2002) suggest that “accounting choices – the provision of nonfinancial information …as well as well as the summary statistical information about performance measure data in reports – can make the process of learning from performance measurement systems more effective and improve judgment and decision making.” Basically, nonfinancial environmental metrics can help auditors understand the risks of the client and make an audit less likely to run the risk of litigation in case of a client’s failure due to environmental mismanagement. Just how environmental metrics can reduce risk is not clear due to a dearth of information of frameworks or models for these metrics.

Evidence from Arthur D. Little (1989), Greeno (1989), Kleiner (1991) and Smart (1992) suggests that a focal point of a firm’s ability to manage operations is the system by which these processes and practices are measured and monitored. Environmental management systems (EMS) involve infrastructural investments that affect the way manufacturing is measured, monitored, and managed. These types of systems include efforts to formalize procedures and processes for evaluating environmental impacts during capital decision budgeting, facilitate stakeholder involvement in managing operations, increase employee training for waste reduction, establish an environmental department, help develop procedures for cross-functional coordination, and monitor internal and external reporting (Arthur D. Little 1989; Hunt and Auster 1990; Marguglio 1991; Klassen and Whybark 1999b). For the sake of this research an EMS involves (Sroufe 2000): “[T]he formal system and database which integrates procedures and processes for the training of personnel, monitoring, summarizing, and reporting of specialized environmental performance information to internal and external stakeholders of the firm. The documentation of this “environmental” information is primarily internally focused on design, pollution control and waste minimization, training, reporting to top management, and the setting of goals. The use of this information for external stakeholders is primarily found in annual reports, focuses on the outputs of the firm, and is used to enhance firm image.”

Companies are realizing that proactive environmental management can prevent problems and result in a more effective organization. The best managed companies have clearly demonstrated that implementing a sound environmental management system can produce significant increases in productivity and profitability (Soh 1998).

Environmental Metric Adoption
The infrastructural operating issues surrounding environmental metrics, either formally or informally are subsumed within a measurement system. The system specifically addressed in this research proposal involves the Environmental Management System and implications when these systems are viewed from an innovation adoption framework (Moore, 1991). The adoption
of organizational innovations due to such factors as regulatory pressure and performance has been well documented (Baron Dobbin, and Jennings, 1986; Davis, 1991; Palmer, Jennings, and Zhou, 1993). In a generalizable framework, Moore (1991) identified five major groups of new technology adopters: innovators, early adopters, early majority, late majority, and laggards. One can argue that the first three categories of adopters are the most likely to adopt environmental metrics and systems. Each of these three groups approach the decision of whether or not pursuing development and integration of new practices is appropriate using very different types of criteria. The difference between innovators and others is that the leaders see environmental initiatives as good for the environment and good for the company. The firms on the other side of the chasm are risk adverse and need compelling quantitative impacts. Here we find the firms that are in the greatest need of metrics and an understanding of the impacts of these metrics to both processes and outcomes (Melnyk and Stewart, 2002). To get a firm to cross the chasm management needs metrics that focus on processes and not on outcomes. Process metrics are more highly correlated with acceptance, usage, and impact. Once a firm has crossed the chasm and measured process level activities, the managers are more likely to understand processes and find more extensive relationships with performance. Metrics are the key! The interesting research questions become how do we measure, report, and disseminate environmental metrics? Additionally, what types of metrics are needed to reach a larger audience and convince firms to cross the chasm?

NOVELTY OF TOPIC
Metrics research and especially embedded environmental metrics are new to Operations Management and environmental business research. While a majority of green business research focuses on the performance indicators and strategic environmental theory (Sroufe, Montabon, Narasimhan and Wang, forthcoming), few if any studies actually identify tactical and operational attributes of environmental metrics and business processes. The concept of embedded environmental metrics has the ability to extend traditional cost accounting bounds to include total environmental costs of a product or process. To date, we have seen a lack of environmental metrics in business research. This presents a unique opportunity to develop research and identify new variables and constructs impacting environmental performance, while simultaneously developing theory based on industry practices.

EXPECTED CONTRIBUTION AND BENEFITS TO RESEARCHERS
A competing theories approach will cause people to rethink some existing approaches to environmental management practices and has the potential to resolve paradoxical findings. We should be able to better explain and predict why firms do and do not pursue environmental practices using existing theory. We also have the ability to further develop a new set of constructs and test longitudinal relationships since ISO 14001 was introduced to US firms.