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To: Center for Paper Business and Industry Studies

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CPBIS Project Integrated Environmental and Economic Performance Assessments for
Strategic Planning and Policy Analysis in Paper Manufacturing

Research Strategies: Understanding and Measuring “Performance” in the Paper Industry

Background

From a sustainability perspective, we would define “performance” in the pulp and paper industry by the relative effectiveness of a mill or enterprise in transforming its capital resources—financial, technological, natural, and social—into value-added products and processes. Such an assessment would encompass the entire product life-cycle and its associated financial, environmental and social effects. It would extend beyond the production of a particular product to include the extraction and beneficiation of raw materials, the production processes, distribution of the product to customers, use of the product by the customers, and recycling or remanufacture of the product or its constituents into new products.

The focus of our CPBIS project is narrower than the sustainability perspective, but is intended to provide a foundation for more complex assessments in the future. Our initial focus is on a particular enterprise, a manufacturing facility and its products, and the relevant measures of financial, technological and natural capital resource effectiveness. We will explore ways in which resource data (mass, energy, water, etc.) from steady-state and dynamic models of a production facility can be combined with financial data from an existing financial model used by the firm. For comparison, we will also develop an activity-based cost (ABC) model that integrates financial data with data on other resources used by the manufacturing site. Future studies will address the product life-cycle perspective on effectiveness (with respect to environmental and financial performance) and the relationship between performance measures of a facility and the enterprise. Our goal is to develop a tool to support both operational and strategic decision making by providing simultaneous views of the facility/enterprise from manufacturing process, financial, and environmental perspectives.

Our partners in this project are Dr. Paul Stuart, the NSERC chair in process integration at the Ecole Polytechnique in Montreal, Quebec, Canada, his students, and the representatives from a paper mill in northern Ontario. The Ecole Polytechnique team will develop the steady-state and dynamic process models of the facility as well as provide an initial study on the existing financial model used by the firm. The CPBIS/Georgia Tech team will develop the enhanced ABC model of the facility. The Georgia Tech/Ecole Polytechnique team will explore performance metrics and other data interpretation schemes that combine financial data with material/energy data and take into consideration contextual factors associated with environmental effects.

Overview of Current Environmental Metrics in the Pulp and Paper Industry

The first part of this project involves evaluating the metrics that the pulp and paper industry currently uses to measure its environmental progress as well as postulating the direction that we believe these metrics need to head in order to be effective in the sustainable world of tomorrow.

“Regulation has been the dominant driver of environmental performance improvements in the pulp and paper sector.” —Committee on Industrial Environmental Performance Metrics, 1999

Not surprisingly, the pulp and paper industry has focused its attention on reducing environmental releases and effects in response to a variety of government regulations. The resulting environmental performance metrics primarily measure the release of regulated substances to air and water sources, or the management and disposal of solid and hazardous wastes. The public’s growing awareness of environmental issues has also served as a stimulus for creating new environmental metrics. Industry representatives, in response to either community pressure or litigation, have attempted to quantify the extent to which they have contributed to, or are responsible for, environmental effects in the context of a particular community or ecosystem. Many pulp and paper companies consider another system-level effect: the entire life-cycle of its product. Life-cycle considerations require a new, more complicated set of environmental performance metrics involving the environmental performance of multiple firms operating in a geographically-dispersed supply chain (Brown, 1998; Graedel and Allenby, 1998). These issues are significant to the pulp and paper industry as a supply side producer and need to be factored into the accounting structure of these companies. In sum, advances in environmental science and increases in environmental awareness have expanded the environmental performance metrics used by the pulp and paper industry to include measures of social, economic, and ecological effects.

Representatives of the pulp and paper industry, as in many other industry sectors, recognize the high cost of environmental regulation and, implicitly, the bottom line costs associated with inefficient production processes. Interest in better understanding the impact of environmental performance on core business operations has resulted in better accounting practices and more informative metrics. Such metrics go beyond simply measuring toxic output by attempting to translate environmental costs into economic costs factored into the accounting schemes traditionally used in the firm. Many companies have found that these metrics reveal the capability to run a leaner and more cost effective business (Epstein, 1996; Ditz et al., 1995; U.S. E.P.A., 1995). Such insight has allowed corporations to view environmental performance proactively, as a means for improving their competitiveness and advancing towards a more sustainable society.

There are two primary categories of metrics used in the pulp and paper industry. Perhaps the most well-known metrics are related to the harvesting of trees to supply the mills. These metrics measure the forest management and sustainability practices of these companies. Though important, these metrics are outside the scope of our investigation. Our interest lies in those metrics related to the production, recycling and disposal of pulp and paper. These metrics

measure the impacts of the paper making process from the time the raw materials arrive at the mill until the point these products are either recycled or sent to landfills as waste.

We classify the metrics we use according to the system laid out by the International Organization for Standardization (ISO) 14031. According to this system metrics can be grouped into three areas: operational, management, and economic (Industrial Environmental Performance Metrics, 1999). These three groups are defined as:

Operational Metrics— “. . . generally measure potential environmental burden in terms of inputs and outputs of materials and energy.”

Management Metrics— “. . . metrics designed to inform management and support decision making on the expenditure of time, money, an manpower required to maintain or improve a company’s environmental performance.”

Economic Metrics— “. . . metrics designed to measure the economic performance of a company.”

CORPORATE MEASURES	Georgia Pacific	Kimberly-Clark	Boise-Cascade	International Paper
Environmental Capital Spending	x	x	x	x
Environmental Training Hours	x			x
Environmental Audits	x	x	x	x
Toxics Release Inventory (TRI) Emissions and Discharges	x		x	x
Notices of Violation (Environmental Compliance)	x	x	x	x
Water Quality	x	x	x	x
Efficiency of Energy Use		x	x	x

Figure 1. Operational and Economic Metrics Cited in Environmental Health and Safety Reports

We surveyed the annual environmental reports of four major companies in the pulp and paper industry to illustrate the metrics currently used in the industry. These companies include Georgia-Pacific, Kimberly-Clark, Boise-Cascade, and International Paper. Figure 1 shows the management and economic metrics cited by these companies in their reports. It is interesting to note the apparent motivation for choosing these particular metrics. The capital spending, efficiency of energy use, and compliance metrics relate information of interest to stockholders as well as the general public. The toxic release inventory (TRI) and water quality issues speak directly to the environmental impact of the mill. The remaining metrics, environmental training hours and (independent) environmental audits indirectly measure the corporation’s commitment to environmental issues. These metrics are interesting in that they measure actions that are auxiliary to the direct environmental efforts that these companies are undertaking. These metrics are indicative of the industry’s need to present direct and indirect effects of their environmental efforts.

ENVIRONMENTAL MEASURES	Georgia Pacific	Kimberly-Clark	Boise-Cascade	International Paper
Wood Waste Reused /Decrease in Wastes to Landfill	x	x	x	
Recycling	x		x	x
Solid Waste Reduction		x		x
Hazarduous Wastes	x			x
Total Reduced Sulfur (TRS) Emissions from Pulp and Paper Mills	x		x	x
Sulfur Dioxide Emissions from Pulp and Paper Mills	x			x
Nitrogen Oxide Compounds (Nox) Emitted from Pulp and Paper and Building Products Facilities	x		x	x
Pulp and Paper Mill Water Use	x	x	x	
Dioxin Emissions/Chemical Reduction Standard		x		x
Pulp and Paper Mill BOD and TSS Discharges	x		x	x

Figure 2. Operational Metrics

The operational metrics shown in Figure 2 largely measure a company’s compliance with government regulations. It is interesting to note that not one single metric has been reported by all four companies. This variation in reporting may reflect differences in the production processes used by each corporation, differences in raw materials or their products, or differences in the relative importance of various environmental issues in the ecological contexts in which they operate. In fact, in reading the environmental impact statements of these four companies it was difficult in many cases to categorize some of these metrics into these common categories. The selection of corporation-specific metrics makes comparisons, or benchmarking, among industries in the sector difficult. For example Georgia-Pacific quantifies its recycling efforts in terms of “Recovered Paper Consumption” (tons/year). This metric is scale dependant and is only meaningful in relation to a company of similar size to Georgia-Pacific, or when normalized by production levels. Similarly, the environmental report for Kimberly-Clark largely related its environmental progress only to its own “Vision 2000” objectives.

Conclusions

The National Academy of Engineering appointed a committee to study industrial environmental performance metrics, drawing upon representatives from a variety of industry sectors and academia. The Committee made ten recommendations for improving industrial environmental performance metrics and we have summarized four key points related to the direction of future developments in metrics (National Academy of Engineering, Committee on Environmental Performance Metrics, 1999):

- ❑ Standardize metrics based on clearly defined industry-wide goals.
- ❑ Determine the relative importance of these metrics in order to rank priorities (we believe that this will have to be done at the local level).
- ❑ Integrate metrics throughout the product life cycle.

- Develop metrics that measure sustainability, including integration of socioeconomic criteria into sustainability measures.

The pulp and paper industry has made significant investments in technologies to improve the operation of their production processes and their understanding of inefficiencies and their associated environmental effects. These process information (and integration) technologies allow for modeling and simulation of production processes, enabling facility and corporate decision makers to improve the effectiveness of capital investments for both economic and environmental performance goals. In addition, several firms have engaged in life-cycle assessments of their products and processes, generating new information and data on the environmental effects from timber harvesting to paper recycling. Finally, new cost accounting approaches, such as enhanced ABC, allow for alignment of financial data with relevant material/energy/resource data. Our goal is to advance the use of these individual tools through the development of an integrated toolbox using standard and novel metrics that reflect economic and environmental performance.

In the end, our work is intended to help the pulp and paper industry promote the creation of a more prosperous and sustainable society. Sustainability has been defined as, “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987). At this time, the state of sustainability defies specific, absolute metrics. It is relative and is most commonly defined as *more* eco-efficient and profitable companies than before. Implicit in this “definition” is the assumption that more eco-efficient and profitable companies provide for greater societal welfare (cleaner production and products, more jobs, tax revenues, etc.). For these incremental improvements to accumulate from an individual to a societal level, the industries will have to engage in some form of benchmarking—within one’s own company and among competing companies. Benchmarking requires a uniform set of metrics (some may integrate a variety of performance metrics) that are applied systematically by the participating industries. Such benchmarks would allow stakeholders, investors, and management to make informed decisions within the context of what the industry is currently capable of doing. Since sustainability is inherently a local phenomenon, environmental performance standards for manufacturing facilities, and thus those metrics most highly regarded, will often be set at a local level. Finally, we believe that in the future companies will want to measure not only their economic and environmental performance, but also their contribution to developments in society. Such sophisticated metrics involve considerations of economic, ecological, and social effects across varying spatial and temporal scales.

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