CPBIS: A New Model for Understanding Issues Critical to the Future of the Paper Industry

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ABSTRACT
This paper introduces the Center for Paper Business and Industry Studies (CPBIS) in the context of the paper industry business environment that prevailed at the time of its establishment. The principal objective of CPBIS is to create an academic community that understands the paper industry. In doing so, it aims, through research, to create knowledge that will be of practical benefit to the industry. It will attract highly qualified students in the business, organizational, and social disciplines to study and work for the industry, and it will be a source of educational materials and programs for employees of the paper industry and associated industries. The Center’s current research program is summarized and its educational activities are described.

INTRODUCTION
The Center for Paper Business and Industry Studies (CPBIS) is a joint venture of the Institute of Paper Science and Technology (IPST), the Georgia Institute of Technology (Georgia Tech, GT), the Alfred P. Sloan Foundation, and the paper industry. It is an academic center for the creation and dissemination of the business knowledge that is needed to revitalize this faltering industry. As well, it is a focal point for involvement of business, management, organizational, and social sciences faculty and students in studies that will ultimately benefit the paper industry. In short, it is the nucleus for creation of an academic community that understands the paper industry.

The Alfred P. Sloan Foundation is a philanthropic nonprofit institution based in New York with total assets in excess of $1 billion. It has programs and interests in science and technology, standard of living and economic performance, education, and careers in science and technology. One of Sloan’s initiatives in the second category is the Industry Centers Program. With the Sloan Foundation’s encouragement and funding, nineteen industry centers have been established at fourteen highly regarded universities. They represent industries ranging in character from basic (paper, steel, construction) to technology-centered (semiconductors, information storage, software). In the words of the Foundation, “The objectives of this program are to create an academic community that understands industries and to encourage a direct approach to the companies and people of each industry for data and observations. We believe observation-based work by well-informed academics will, in the long run, lead to practical contributions to the industries studied.”1 CPBIS, the sixteenth Industry Center, was established at IPST and GT in fall 2000.

A CHALLENGED INDUSTRY
Given the many difficult problems confronting the U.S. paper business, the timing of the Center’s creation could not have been more appropriate. The industry, already recognized as being fragmented, capital-intensive, cyclical, and subject to price-based competition, is now simultaneously under siege by its customers, its competitors, and its investors. At the same time, it continues to suffer from a generally poor public image and community relations, and it fails to take full advantage of its human capital.

Customers are turning away for reasons that are partly due to the state of the economy but also partly due to longer-term changes, such as substitution of electronic media for print media and competition from the Internet for advertising and catalog dollars. Boxboard and containerboard shipments are adversely affected by poor performance in the manufacturing and durable goods sectors. Printing and writing papers and newsprint shipments are being weakened by downturns in publishing and office equipment.

Global competition has emerged as a critical issue that has profoundly affected the performance of the North American industry and will continue to do so. The industry added capacity in the 1980’s in anticipation of rapidly growing Asian markets. However, the hoped-for growth did not materialize on schedule, mainly as a result of the downturn in the Asian economies during the 1990’s. At the same time, competition from producers in Asia and Latin America intensified, compounded by government subsidies in Asia, high-quality, fast-growing raw material in Latin America, and relatively low labor costs in both regions. As a result of this competition, combined with the more recent global recession, the industry found itself shipping less product and holding significant capacity in excess of demand, as shown in Figures 1-3.2

![Figure 1. Shipments by the North American paper industry by product category, 1990-2002.](image)
The downturn in the economy, increased offshore competition, and the resulting excess capacity have combined to produce other undesirable consequences. The most obvious of these is perpetuation of the industry’s historically weak pricing performance, as illustrated in Figures 4 and 5. This, in turn, leads to poor corporate financial performance, low shareholder returns, and difficulty in attracting investment. The industry has consistently failed to return the cost of capital. Capital expenditures by the industry are now significantly less than depreciation, raising questions as to the continued viability of some of its production facilities.

TOWARDS A BRIGHTER FUTURE

Given this witches’ brew of looming product substitution, formidable offshore competition, growing excess capacity, and weak pricing, we are tempted to conclude that the future of the industry will be mediocre at best. Before writing it off, however, we should remember that there are fundamental reasons for believing that things are not as bad as they seem and that suitable intervention has a good chance for success.

The future of the global industry seems assured. Per capita use in developing countries may be expected to track growth in gross domestic product. The fundamentals remain strong: few other industries can boast products that are both recyclable and based on a renewable raw material. Earlier predictions of the paperless office and the paperless society no longer appear to be realistic. Paper use continues to grow in the longer term and future growth seems assured by paper’s unique attributes and human appeal. It is notable, for example, that in efforts to develop electronic alternatives to print media, paper remains the standard to be emulated.
and understanding that are collectively a prerequisite for addressing those issues.

It was in this context that the Sloan Foundation invited IPST to team with Georgia Tech in developing a proposal for the creation of an Industry Center focused on the business aspects of the paper industry. Together, these two institutions possess the needed resources. IPST is recognized as a leading center for graduate education and research in pulp and paper technology, with strong ties to the industry. Georgia Tech, in addition to being ranked among the nation’s top engineering schools, incorporates Ivan Allen College and the DuPree College of Management, liberal arts and management units that enjoy similarly high rankings. Ivan Allen College encompasses the departments of Economics, History, Technology, and Society, International Affairs, Literature, Communication and Culture, Modern Languages, and Public Policy.

Before accepting the Sloan invitation, IPST undertook to gauge the level of support for the idea, both among industry leaders and within the Georgia Tech community. Dr. James McNutt, a well-known industry expert, was retained to survey industry CEOs. His aim was to ascertain their level of support for the idea, as well as to solicit their views on the priorities such a center should set for itself. At the same time, we surveyed key members of the Georgia Tech community to gauge their interest. The results of the industry survey were unambiguous: support was virtually unanimous and the CEOs had clear ideas about what the research and education objectives of such a center should be. Georgia Tech expressed a similarly high level of interest, with Dr. Sue Rosser, dean of Ivan Allen College, being the chief spokesperson for that community. Armed with these mandates, we assembled a broad-based proposal development team with representatives from IPST, Georgia Tech, and the industry. The proposal was successful and CPBIS was launched in October 2000 with a $2 million grant from Sloan and industry commitments for an additional $1 million in matching funds. These resources were made available on the understanding that CPBIS would seek to create an academic community that understands the paper industry by:

- Studying the industry by direct observation, providing research results that are of high practical value to the industry,
- Creating educational programs that will produce skilled, paper industry-oriented Ph.D. and M.S. graduates in a variety of disciplines, and
- Establishing a diverse set of in-depth continuing education programs tailored to meet explicitly defined needs of the paper industry.

CPBIS thus began with clear research, education, and continuing education objectives.

**RESEARCH**

The CPBIS research program was designed to be consistent with both the Sloan Industry Centers philosophy and the priorities expressed by industry CEOs.

In accordance with the Sloan Foundation mandate, the CPBIS research program emphasizes observation-based research involving fieldwork and direct contact with the industry. It studies the industry itself, not just things important to the industry. The research is primarily business oriented rather than technology oriented, though some projects probe the intersection between business and technology. A further requirement is that the results be disseminated to both academic and industry audiences in terms that are meaningful to each.

In recognition of the needs expressed by industry, the program is built around five research themes. These themes may be briefly defined in terms of questions that the insight gained through research may ultimately help to answer:

- **Globalization:** What strategies should the paper industry pursue to excel as a competitive force in the global economy?
- **Enterprise Effectiveness:** What management structures and operating strategies are needed to make the industry more competitive?
- **Workplace Transformation:** How can the industry make more effective use of its human capital to achieve improved quality and higher productivity?
- **Commercialization:** What paths should be followed to harness scientific and technical knowledge for product and process innovation?
- **Community:** How can the industry understand and develop strategies for managing relationships with its social, cultural, and political environments?

Each of these themes is represented in the current research program, which encompasses eleven projects, briefly described below.

**Globalization**

**Configuration and Management of Globally Efficient Supply Chains**

Many companies in the pulp and paper industry operate globally integrated supply chains involving various facilities and transportation channels in different countries. To remain competitive in today's dynamic global economy, companies must constantly update their global logistics strategies and supply chain configurations. They must make these adjustments within an environment of multiple country-specific tax laws, tariffs, environmental regulations, and exchange rate risks.

This research investigates the current state of global supply chain configuration and management in the container sector of the industry and identifies factors inhibiting and enabling global trade in the sector. It seeks to identify drivers and objectives for globalization and the critical areas where value is added to the products in the global supply chain, as well as factors such as tariffs, other trade barriers, and government policies that impact the location, efficiency, and flexibility of the supply chain. A comprehensive survey instrument has been designed to
collect the data needed to achieve these objectives, and plans are in place to initiate the survey.

**Enterprise Effectiveness**

The Value of Forest Biotechnology to Vertically Integrated Pulp and Paper Producers

Exploiting biotechnology to decrease the cost of paper production appears to hold considerable promise for the future. One potential application is tree improvement by clonal forestry, breeding, or genetic engineering. In principle, this is a way to decrease costs by increasing land area-based wood yield (through specific gravity increases), pulp yield (through decreased lignin content), and/or paper yield (through improved fiber quality). The variety of potential benefits poses the problem of deciding where research efforts should be concentrated. This project combines a forest cost model with a mill cost model to identify those traits that, if successfully altered, would lead to the greatest improvement in profitability of a vertically integrated producer of kraft linerboard in the southern U.S.A. Extensive modeling involving a variety of scenarios is providing a wealth of information to guide future biotechnology research. One example of results to date is shown in the figure below, where it is seen that increasing wood specific gravity from 0.45 to 0.65 would lead to a greater reduction in operating costs than either reducing the lignin content to 20% or increasing the growth rate by 50%.

A simplified representation of the manufacturing process in ABCEM terms is shown in the figure below. The general structure of the ABCEM model has been developed for use within the facility, interfaces with the process simulation model have been developed, and all the necessary links have been made to the accounting data files, but the needed WinGEMS process simulation model is still under construction. Tasks remaining prior to completion the ABCEM model are to make the necessary links to the WinGEMS model and mill process information system files.

**Figure 6.** Reductions in annual operating cost realized by a 50% increase in growth rate (GR+50%), a reduction in lignin content to 20% (LC-20%), or an increase in specific gravity from 0.45 to 0.65 (SG 0.65).

**Figure 7.** Schematic of the manufacturing process in enhanced activity-based cost model (ABCEM) terms.

Supply chain management (SCM) in the pulp and paper industry is a critical business issue that offers tremendous potential for improving customer satisfaction, lowering operating costs, reducing inventory investments, and improving fixed asset utilization. Moreover, there is evidence that current SCM approaches and initiatives in the pulp and paper industry have significant gaps in the areas of demand planning, production planning, scheduling, inventory management, and transportation and distribution planning.

The paper industry’s commitment to sustainability expands the definition of corporate “performance” by considering the effectiveness of the firm in transforming all forms of capital—financial, technological, natural, and social—into value-added products and, subsequently, shareholder value. The performance assessment would extend to the entire product life cycle and its associated financial, environmental, and social effects. In this project, the investigators are focusing on a particular newsprint manufacturing facility. In partnership with mill operating personnel and Montreal’s Ecole Polytechnique, the Georgia Tech team is developing an enhanced activity-based cost model (ABCEM) that integrates financial data with mass and energy flow data from process simulation models of the production facility and the mill’s process information system. The team’s ultimate goal is to develop a tool to support both operational and strategic decision-making by providing simultaneous views of the facility and the enterprise from manufacturing process, financial, and environmental perspectives.
improvement initiatives. Such supplier actions may have a devastating impact on the long-term performance of the pulp and paper industry.

This research focuses on the non-fiber, maintenance, repair, and operations (MRO) supply chain, a critical area impacting firm performance and one in which very limited research has been done. The primary objective of the current study is to understand and document opportunities for creating value among supply chain partners in the pulp and paper industry. The framework shown in the figure below has been developed to guide the study.

![Conceptual framework of MRO supply chain](image)

**Figure 8. Conceptual framework of MRO supply chain.**

*Price Behavior in the Pulp and Paper Industry*¹⁰

Information on prices is essential for capacity planning, inventory management, production planning, budgeting, project financial assessment, and contract negotiations. Significant and unpredictable paper and pulp price movements have had a number of serious consequences for the pulp and paper industry, including excess capacity, unintended inventory buildup, and financial losses. In the long term, unanticipated price behavior could threaten the economic viability of the industry.

The goal of this study is to analyze the pricing behavior of pulp and paper products, focusing primarily on the containerboard sector. Modern econometric techniques are being used to identify the underlying process that governs containerboard price movements and to construct structural models of market demand and supply in order to study the causative factors of price movements and to estimate various price elasticities.

Project activity to date has focused primarily on price forecasting and forecast assessment, construction of demand models, survey instrument design, and background data collection. The figure below compares linerboard price forecasting models implemented by the CPBIS investigators with a published forecast. The former had an average error approximately 40% less than that of the latter.

![One-Step Ahead Forecast Performance](image)

**Figure 9. Comparison of linerboard price forecasts.**

*Profiling Best Practices: A Cross-Center and Cross-Industry Exploratory Analysis of Box-Plant Trucking-Logistics in the Paper Industry*¹¹

Although trucking logistics operations in the pulp and paper industry can be complicated and costly, the literature contains very little information on the relative costs and benefits of alternative logistics operations, including outsourcing, long-term contracts, and private carriage. The industry’s logistics planning, primarily involving the scheduling of trucks and labor, appears to be largely accomplished locally and seems to lack the efficient coordination necessary to achieve supply chain management excellence.

This project, now in its beginning phases, integrates the skill and knowledge of researchers in two Sloan Foundation Industry Centers – CPBIS and the Trucking Industry Program – and two university settings – Georgia Tech and the University of Michigan. Focusing on production and shipment of corrugated boxes, the investigators will identify business models that corrugated box plants currently employ to meet their trucking logistics needs, create benchmarks for evaluating existing trucking logistics practices in this segment of the pulp and paper industry, and develop a set of criteria that reflect best practices in truck transportation logistics operations for materials going to corrugated box plants and finished goods transported via truck to end-users. Representative corrugated box plants will be identified for an in-depth analysis of their trucking transport logistics.

The case studies will entail creation of a detailed profile of the transport logistics operations in each of the selected plants. Information will be obtained through personal meetings and telephone conversations with logistics managers and the collection and analysis of relevant profiling data. Identification of measurable indicators to describe and evaluate the logistics operations environments of box plants will then enable an investigation of factors leading to successful logistics. Additionally, the team plans to identify best trucking transport logistics practices in representative box plants. Finally, one of the deliverables from the project will be the development of a Web-based questionnaire for conducting an industry-wide survey of transport logistics in the overall pulp and paper industry. This would form the basis of a second-year proposal to significantly broaden the analysis and develop a deeper understanding of logistics practices industry-wide.
Workplace Transformation

Workplace Transformation and Human Resource Management in the Pulp and Paper Industry

It is generally agreed that mills that enjoy high levels of commitment among hourly employees are best positioned to take full advantage of today’s advanced pulp and paper production technologies. This is the motivation for adopting high-performance work systems. Such systems depend on the intense involvement and commitment of production workers who are selected, trained, and motivated to take full responsibility for their work unit and its relationships with other departments in the mill. The best-known examples of such advanced work systems are usually found in greenfield mills, but the great majority of the industry’s operating facilities are older, brownfield sites – unionized plants whose workforces have a long history of running their machines under traditional forms of work organization. Clearly, we need a better understanding of the conditions that facilitate workplace change and the benefits it can provide to both mills and employees.

This research aims to achieve such an improved understanding by studying the workplace practices of paper mills in the U.S.A. and linking these practices to organizational effectiveness. Survey instruments have been developed with different types of respondents in mind: production managers, human resources managers, and local union presidents (where applicable). Surveys will be addressed to all three types of respondents at each of the participating mills. Pilot testing of the instruments is in progress and data collection will begin with formal endorsement of the Paper Industry Management Association, pending the execution of legal agreements protecting the rights of the participating mills. Analysis of the resulting data will provide a broad view of trends in the industry, patterns of practice adoption, linkages to performance, and factors affecting adoption, implementation, and effectiveness of these practices. Subsequently, the investigators will identify a smaller number of particularly relevant practices for on-site studies of the dynamics of different workforce management practices.

Change Management Effectiveness within the Paper Industry: A Multilevel Investigation

As pointed out by Thorp, “The U.S. paper industry is at a crossroads. It has reached a point in history when the forces of change will cause it to set off in directions unlike any it has previously taken.” As a result of these changes, senior managements have had to make many far-reaching decisions that translate into myriad operational-level adjustments, while seeking to minimize the problems associated with the transition and maximize the gains that motivated the change in the first place. In such an environment, we need to understand how organizational members’ reactions to a given change are affected by numerous factors.

This research, which will begin in summer 2003, will seek to better understand how individual paper-industry employees cope with and respond to organizational changes. To achieve this objective, the investigators will seek to develop an understanding of how individuals’ reactions to any one specific change are affected by the particular change being implemented (“What”), the other changes taking place (“What else”), how the change is managed (“How”), and personalities of the individuals affected (“Who”).

To achieve their goals, the investigators will work with three paper industry organizations and their unions that have gone through significant organizational changes (e.g., merger, acquisition, downsizing, new technology) that meet defined criteria. In preparation for a subsequent program of empirical data collection through surveys and interviews, direct observation and semistructured interviews will be used to better understand each organization’s culture and business practices.

The results will be combined with those of earlier work by the same researchers to provide a more complete model of the change process, detailing how the multiple influences function together to affect change success. The study will lead to recommendations to paper industry firms for improving change implementation strategies and monitoring of change efforts to ensure success.

Commercialization

Revitalizing the U.S. Market Pulp Business: Viability of Specialty Pulps

There appears to be considerable potential for the market pulp industry to improve its financial performance. One possible avenue is to take advantage of species differences to tailor its products to the needs of producers of existing paper products and to those who wish to develop specialty products based on unique combinations of pulp properties. Similarly, there is potential for paper producers to achieve product differentiation by taking advantage of the unique properties of specific market pulps, either currently available ones or pulps that might be developed through species control. This project has both technical and economic objectives that will help both the producers and users of market pulp to realize the potential for specialization in the market. The technical objectives encompass the creation of a database containing the properties of the majority of the pulps available worldwide and its publication in the form of a book. At the same time, the investigators will assess the economic viability of specialization.

Community

Policy, Organization, and Innovation in American Pulp and Paper since 1914: Historical Perspectives on Contemporary Problems

This research exploits the power of historical analysis to provide concrete lessons from past experience to help formulate future policy. An improved understanding of the competitive structure of the pulp and paper industry and its relations with state, local, and federal government will better position the industry to adapt and integrate its
Black liquor gasification combined cycle (BLGCC) technology is a key element in the pulp and paper industry’s vision of competitiveness and fossil fuel independence. To date, there is considerable research effort into BLGCC as both industry and DOE have increased commitments to realize its promise. Techno-economic and feasibility studies have led to a consensus that the capital costs of BLGCC operation are not much higher than a conventional recovery boiler, yet electric power generation more than doubles. Since more than 125 recovery boilers in North America will exceed their useful life in the next 10-15 years, these boilers can be replaced with more profitable gasifiers if well-identified technical hurdles can be overcome in the interim.

It is expected that a fully developed BLGCC process is profitable on its own. In spite of this, there exists enough technical risk in the research needed to bring the technology to fruition that private industry itself is unwilling to finance the entire effort. On the other hand, if enough other societal impacts can be identified and found to be comparable in magnitude to the internal economic benefits, then the completion of BLGCC research through public channels becomes economically efficient. There are compelling reasons to suspect a priori that social returns from BLGCC can be large enough to motivate public funding for the research. With this background, CPBIS undertook the funding of research to investigate several attractive features of BLGCC on the environment, on human health and safety, on employment security, and on community development. Reduced transportation costs of alternative fuels and abatement of greenhouse gasses are examples of environmental benefits that society can enjoy from a fully operational BLGCC technology. Beyond such direct benefits, BLGCC might also generate such benefits as improvements in worker safety and retention of jobs in “at-risk” communities.

The research, just now beginning, will encompass several tasks. The first is the creation of a global environmental impact statement that will quantify the aggregate benefit of implementation of BLGCC at the many sites where it is likely to be adopted. Secondly, the investigators will employ nonmarket valuation methods to develop estimates of the net economic benefits of the nonmarketed goods the technology produces. The third study is a community economic development appraisal in which the investigators will locate the counties where BLGCC is likely to be adopted over the next two decades and identify those that perform below the national income and employment average. At the same time other benefits will be sought, such as the possibility that a community may be able to cover peak daily energy demands, thus reducing its vulnerability to volatile spot-market grid prices.

**EDUCATION**

The Center’s educational mission is fulfilled in several ways: through the creation and delivery of courses and course modules within the curriculum of Georgia Tech, through involvement of graduate students in research and internships, and through continuing education programs tailored to the needs of employees of the paper industry and associated industries.

**Courses and Course Modules**

To date, CPBIS has sponsored the development of two graduate courses for delivery on the Georgia Tech campus.
The first, offered during the 2002 Spring Semester, was entitled “Studies in American Manufacturing: The Paper Industry” and was taught by a team of instructors, both academics and industry practitioners, led by Professor August Giebelhaus of the School of History, Technology, and Society. It was designed to incorporate business, social science, and technical approaches toward a more holistic understanding of the nature of the pulp and paper industry and current challenges facing it. The second course, taught by Dr. George Manners of Kennesaw State University, was entitled “Process Management in Paper and Processing Industries.” Its central theme was how contemporary process modeling can add significantly to management understanding and capability. Additional courses are currently under consideration, as is the possible creation of a certificate program in paper industry studies. Such a program would have the beneficial effect of creating demand for CPBIS courses. Also planned is an effort to package the results of our research into modules, each consisting of sufficient material for several lectures, that would be made available to instructors of existing Georgia Tech courses.

**Student Research**

A requirement for funding of research by CPBIS is that the proposed project must have significant graduate student participation. In addition, a new initiative will fund fellowships to attract highly qualified students to embark on paper industry research of their own choosing. To date, twenty-two graduate students have been or are conducting CPBIS research. Such research experience does much to contribute to the students’ understanding of paper industry issues. Furthermore, it increases the likelihood that the students involved will contribute to the industry in the future, perhaps by entering academia themselves and propagating interest in paper industry studies.

**Continuing Education**

The term “continuing education,” as used here, embraces varied types of knowledge dissemination activities and discussion forums. An early example of the latter type was Dr. McNutt’s initiative to establish a series of forums to encourage discussion of critical industry issues and to stimulate the kind of thinking that is needed for resolution of current problems. Three such sessions of the series, named “Rethink and Discovery,” have been held. All three have received good reviews, and recorded Webcasts of all three sessions may be seen and heard at the CPBIS Web site. A fourth Rethink and Discovery session is planned for the 2003 Annual Meeting of the Paper Industry Management Association in San Francisco in June.

In partnership with PIMA, CPBIS has completed a highly successful online offering of a course entitled “Defining and Achieving a Reliability Culture,” developed specifically for maintenance, production, and reliability personnel at all levels. In a joint effort with Kepner-Tregoe, Inc., PIMA and CPBIS will continue the popular and successful on-line training program with a new two-part series, “Problem Solving at the Speed of Business.” Programs will also be offered in classroom settings, beginning with “Management Development for Enhanced Performance,” a four-day program to be offered at IPST during the first week of June 2003.

CPBIS has also sponsored a variety of seminars by visiting speakers, recently concluding the first season of its Distinguished Lecture Series, which featured well-known and highly regarded speakers at intervals of one month throughout the academic year. Like the Rethink sessions, all of these were Webcast live and recordings are available on the CPBIS Web site.

**CONCLUSION**

Through research, education, and continuing education, the Center for Paper Business and Industry Studies has embarked on a new course toward the creation of an academic community that has a deep understanding of the paper industry. We anticipate that insight gained as a by-product of that understanding will be of high practical value to paper industry managers as they seek ways to ensure the future prosperity of the industry. As one editorial writer recently put it, “CPBIS surely qualifies as one of those new thoughts the paper industry ought to be thinking.”

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This paper is dedicated to the memory of a good friend and colleague, Dr. Barry Crouse, dean, Academic Affairs, Institute of Paper Science and Technology.

REFERENCES AND NOTES


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