

## **Final Report for CPBIS Research Project, “Policy, Organization, and Innovation in American Pulp and Paper since 1914: Historical Perspectives on Contemporary Problems”**

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### **Goals and Objectives**

When we began our project in August 2001, we sought to examine how government policies in the areas of antitrust and intellectual property, trade, and environmental regulation shaped industry organization and innovation during the twentieth century. Such an inquiry would, we thought, provide useful perspective on matters of current importance to the pulp and paper industry.

### **Highlights of Work Performed**

Our team proceeded along three principal lines of inquiry. First, we sought to assemble a comprehensive study of the American paper industry’s central technological and competitive dynamics during the twentieth century. This task, conducted primarily by doctoral student Hannes Toivanen, drew upon a variety of historical materials, including the archives of several paper companies and the papers of key consultants to the industry. Toivanen traveled on multiple occasions to repositories located in several states, processing significant amounts of material in remarkably short order. He also drew heavily upon government documents, including antitrust dockets and patent records, and the vast trade literature held at the Haseltine Library. His research culminated in May 2004 with successful defense of his doctoral dissertation, “Learning and Corporate Strategy: The Dynamic Evolution of the North American Pulp and Paper Industry, 1860-1960.” In the course of completing this major project, Toivanen presented four papers at national academic conferences and one at the semi-annual meeting of TAPPI. He also wrote a lengthy report commissioned by the Sloan Printing Industry Center documenting cases of cooperative innovation involving firms in the paper and printing industries. During summer 2004, Toivanen carried his research forward in time and assisted Usselman in producing a fifth paper for presentation to a national academic audience, the Economic History Association.

Our second major initiative focused upon environmental regulation and innovation. Begun in the second year of the project, this initiative has not progressed so dramatically as the first but has begun to yield substantial results. Doctoral student Philip Unger, now a CPBIS Fellow, is completing a dissertation tentatively entitled “Research and Innovation in Pulp Bleaching Processes and the Expansion of Environmental Regulations, 1935-1985.” Like Toivanen, Unger has drawn primarily upon materials available in the public record, though he has also received some important guidance from our industry liaison, Art Dreshfield. Attempts to gain access to materials held by key firms have ended in frustration, as companies seem quite reluctant to cooperate on matters they consider quite sensitive. The industry environmental trade association,

NCASI, may prove more helpful. Unger has presented preliminary results at a local academic forum and plans to disseminate them more broadly once he has the dissertation in hand.

A third major task, evolving largely out of Toivanen's research on the dynamics of innovation, involves assembling a searchable database of patents pertaining to the pulp and paper industry. During summer 2002, a team of undergraduate researchers assisted Toivanen and the PIs in generating the patent data for the years 1920-1940. Toivanen made extensive use of the results in his dissertation. During summer 2003, we commissioned Professor Bhaven Sampat of Georgia Tech's School of Public Policy to generate a similar database for the years since 1976. Patents for these years are available from the USPTO in electronic form.

### **Significant Findings to Date**

As noted above, our project seeks to provide perspective. By identifying historic patterns of behavior in the industry and delving deeply into some illustrative cases, we hope to give contemporary managers some bearings that may help them deal with analogous situations in our own time. Of course, as academic historians, we also seek to contribute to historical research documenting the role of policy in the American business system.

Perhaps our most important finding to date pertains to the historical patterns of technological innovation in the pulp and paper industry. Most observers have seen the industry as being dominated by incremental improvements in process. Our research points to a much more dynamic story. While recognizing the importance of incremental gains intended to enhance productivity of fairly stable processes, we identify a series of more dramatic technological departures that have periodically punctured the prevailing equilibrium in the industry. These breakthrough innovations have often been associated with strong intellectual property rights, usually in the form of patents covering key components of a new process rather than the fundamental breakthrough itself. These new departures often depended upon collaboration with key customers in emerging markets. Though one firm seldom retained sole control over a breakthrough innovation for long, pioneers did attempt to leverage their innovations, typically through licensing arrangements. On at least some occasions, firms may have pursued innovations because antitrust considerations had cut off alternative forms of competition. Patent licensing arrangements, perceived by some as attempts to stabilize prices, frequently spurred further antitrust activity.

These summary observations point above all to the continuing importance of firm-level technology-based strategy in the pulp and paper industries. Our detailed case studies illustrate many specific examples of such strategies. They range from the formation of an integrated giant such as IP to the emergence of such niche players as Hinde and Dauch, which established a toehold through its introduction of containers of novel design. We cover the converting sector in significant detail while also documenting the essential shift among paper producers toward the sulphate kraft process.

Our studies demonstrate how firms managed cooperative relationships through trade associations, research consortia, and standards-setting bodies while also pursuing proprietary techniques. We describe the role of key intermediaries and also capture the persistent importance of regional differences and strategies. We examine the emergence of critical suppliers such as Babcock and Wilcox and their relations with manufacturers. Our study of machine-coated paper illustrates a classic example of product innovation in which firms such as Westvaco succeeded by cultivating key consumers.

A recurrent theme of these studies is that innovation-based strategies often required very close management of relationships among a network of firms. Innovation was, in a sense, a network phenomenon. Yet the network consisted of distinct firms pursuing their own unique strategies. While at times the industry seemed characterized by a community of undifferentiated units pursuing largely similar incremental improvements, the reality was much different. Individual units always had distinctive qualities, and innovation involved considerable strategic jockeying as well as incremental learning.

These features of the pulp and paper industry were largely obscured by the consolidations of the 1960s. The resulting conglomerates characteristically possessed a full range of capabilities across the spectrum of paper products and markets. Antitrust had a great deal to do with this. With paper companies blocked from leveraging patent rights and forming horizontal combinations within a given market segment, they instead combined operations aimed at each market segment. Now a few large firms of roughly equal strength competed in each niche.

In these conditions, innovation assumed a less strategic character. It appeared largely as an incremental, non-proprietary effort that occurred on a sustained basis but was not expected to generate sharp discontinuities in business practice. Perhaps as a consequence, most pulp and paper firms came to rely on purchased technology. The critical knowledge base of the industry shifted to suppliers, who increasingly located outside the United States. Technical departments at the paper companies themselves, typically headed by engineers, relentlessly pursued marginal improvements in efficiency. Management came to see plant-level practices as keys to maintaining competitive advantage in what was considered a “mature” or “stable” industry.

The focus upon plant-level efficiency greatly complicated our second major story: the response of the paper industry to environmental regulation, particularly that regarding clean water. With our research still ongoing, we cannot yet speak with confidence about this topic. It seems clear, however, that a major difficulty in meeting the call for decreased effluents and improved water quality was that virtually all mills faced distinct conditions. No single blanket remedy came close to fitting all situations. The variation resulted from the subtly distinct technologies and work processes deployed at each site, from the vagaries of local geography, and from differences in state and local regulations. Efforts to address the effluent issue consequently played out quite differently from place-to-place. Certain facilities could meet the pressure for reform with significantly less cost to efficiency than others. Environmental remediation thus became a critical variable in

determining the plant-level efficiencies that had become a key component of industry competition.

This situation helps explain why the industry found the issue of water quality so difficult and disruptive. In effect, technological innovation aimed at improving water quality took on a highly strategic character. Technical remedies for the water problem had significant implications for firm (and plant) profitability. This is one reason why many within the industry perceive that environmental remediation came to dominate technological innovation in the industry during the nineteen seventies and beyond.

As with other cases of technological innovation discussed above, firms facing the challenges of achieving environmental compliance had to make critical choices. They made trade-offs between off-the-shelf remedies and customized solutions tailored to individual plants. They needed to decide when to cooperate with industry-wide efforts and when to go it alone. The latter choice was particularly complicated because firms and the industry were operating in a politically sensitive climate in which parties could suffer repercussions if they appeared callous or uncooperative. Our current research aims to document how key players handled such extraordinarily difficult challenges.

## **Papers, Presentations, and Other Work Products**

### Papers Presented

Hannes Toivanen, "Policy, Organization, and Innovation in U.S. Pulp and Paper Industry, 1910-1950, Business History Conference, Wilmington, DE, April 2002.

Hannes Toivanen, "Shaping Markets: The Political Economy of Paper Standardization, 1880-1940," Annual Meeting of the Society for the History of Technology, Toronto, Canada, October 2002.

Hannes Toivanen, "'Visual Harvest': Ambiguity in U.S. Forestry Science at Home and in the Tropics, 1890-1925," Annual Meeting of the History of Science Society, Milwaukee, WI, November 2002.

Philip Unger, "EPA's 'Cluster Rule' and the U.S. Bleached Kraft Pulp Industry: A Potential Case Study of Environmental Regulations on Technological Innovation and Diffusion," School of History, Technology, and Society Graduate Student Forum, Georgia Tech, April 2003.

Hannes Toivanen, "Historical Perspectives on Contemporary Problems: Organizational Capabilities and the Structure of Large Pulp and Paper Firms, 1950-1980," TAPPI, Atlanta, GA, September 2003.

Hannes Toivanen, "Innovation, Intellectual Property Rights, and Concentration in a Nascent Industry: U.S. Newsprint Industry, 1889-1913," Consortium on Competition and Cooperation Doctoral Research Colloquium, Emory University, April 2004.

Steven W. Usselman, “Antitrust and Innovation Policy for the American Century”  
Annual Meeting of the Economic History Association, San Jose, CA, September 2004.

Steven W. Usselman, “Antitrust and Innovation in the Paper Industry: Historical Perspectives,” TAPPI, Atlanta, GA, November 2004.

#### Papers Submitted for Publication

Hannes Toivanen, “Innovation, Intellectual Property Rights, and Concentration in a Nascent Industry: U.S. Newsprint Industry, 1889-1913,” revise and resubmit for Business History Review.

#### Doctoral Dissertations

Hannes Toivanen, “Learning and Corporate Strategy: The Dynamic Evolution of the North American Pulp and Paper Industry, 1860-1960.” Defended April 2004.

Philip Unger, “Research and Innovation in Pulp Bleaching Processes and the Expansion of Environmental Regulations: 1935-1985.” In progress.