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Albert Churella. *From Steam to Diesel: Managerial Customs and Organizational Capabilities in the Twentieth-Century American Locomotive Industry.* Princeton: Princeton University Press, 1998. viii + 215 pp. $45.00 (cloth), ISBN 978-0-691-02776-0.

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Innovation or Ossification?

In 1929 three large firms dominated the American locomotive industry, and steam ruled the rails, as it had for nearly a century. By 1949, steam only ruled in the scrap yard, dethroned by diesels. And the big three steam builders–Alco, Baldwin, and Lima–were heading to America's corporate graveyard. A newcomer, the Electro-Motive Division of General Motors, had made off with the locomotive industry and revolutionized the intensely conservative world of railroading with its diesel-electric locomotives. How this radical innovation remade the American locomotive industry is the subject of this book.

The steam-to-diesel transition is one of the more dramatic episodes in American business history, yet few historians have ventured into this rich and multi-faceted story. Therefore this book by Albert Churella is a welcome addition. Churella provides a sharply focused account of how the managers of six firms (the three major steam builders and three new entrants) "responded–or failed to respond–to technological change" in this industry from 1920 to 1970 (p. 3). His book is an important contribution to the literatures on managerial cultures, organizational capacities, and corporate responses to technological change. Focusing on these issues, it does not seek to provide a comprehensive portrait of the steam-to-diesel transition.

The primacy given to individual firms and management choices and cultures roots the book in traditional business history. Churella delineates how the Electro-Motive Company (EMC), a General Motors subsidiary, broke into the locomotive industry in the late 1930s, a feat emulated by General Electric in the 1960s. These moves confirm that Chandlerian firms garnered real competitive advantages from their triad capacities in innovation, management, and marketing. (The book argues that the third new entrant, Fairbanks-Morse, failed in its short-lived venture of making diesel locomotives largely because of marketing and managerial weaknesses.)

Churella also details the impact of organizational capacities, both in the executive suite and on the factory floor, on the rise or fall of the locomotive builders. For many decades the old steam builders–Alco, Baldwin, and Lima–had honed their organizational cultures and capacities around the batch production of customized capital goods, largely designed by customers. Precisely this heritage, argues Churella, prevented managers at the established locomotive builders from comprehending the new possibilities and realities of the diesel age. Executives at EMC and GM pushed the diesel as a radical innovation that would replace steamers, while their counterparts at Alco and Baldwin would only concede a supplementary role for the new technology. Lima's decisionmakers would not even go that far. Events proved the EMC/GM team correct (in 1941 EMC became GM's Electro-Motive Division, or EMD).

Moving outside the firm, Churella considers how governmental actions in peace and war affected the locomotive builders' efforts to build and market diesels, a technological revolution that received a direct hit from World War II. He rejects the notion, advanced in earlier work by Thomas Marx, that restrictions established by the War Production Board (WPB) favored EMD. Churella takes the opposite stance, arguing that WPB mandates delayed the demise of steam, thus causing EMD "to lose market share throughout the war" while giving Alco and Baldwin "the opportunity, although unrealized, to advance their own R and D and manufacturing techniques" (p. 75). While Churella's latter point is certainly true, his projections on market share seem to arise from a shaky counterfactual: that given the war, but no WPB restrictions, EMD would have sold more locomotives than it did under those restrictions (p. 79).

Churella also recounts the government's 1963 antitrust suit against GM/EMD. While his research uncov-

ers evidence supporting the government's case, his summary judgment is that EMD achieved its dominant market position because it offered "both a better product and better service than any of its competitors" (p. 131). A third area where federal policy arguably had an important impact on the locomotive industry generally and the diesel transition specifically, ICC rate regulation and service mandates over the railroads, receives very little attention here. In sum, Churella's narrative and analytical framework offers only bit parts to governmental actors, leaving individual locomotive makers essentially free to respond to technological changes and market opportunities.

This account also notes the importance of contingency, historical accident, and simple luck in the success or failure of firms, thus denying any historically-inevitable path arising from organizational capacities alone. For example, Churella recounts the accidents that led General Motors in December 1930 to absorb EMC, a small firm that marketed diesel railcars. Rather than the product of corporate strategy, this takeover resulted largely from a friendship between GM's research head, Charles Kettering, and EMC's founder, Harold Hamilton. While GM's president, Alfred Sloan, did not divine the potential of diesel power for mainline locomotives (p. 46), Hamilton certainly did. He "was determined to use GM as a source of capital but "capital that wouldn't control, so that we could still manage the business and carry the project that we were shooting for…" (p. 42, quoting Hamilton).

That project was developing the mainline diesel locomotive. In 1935, Kettering secured Sloan's support for developmental work. Within five years EMC had its own manufacturing plant at La Grange, Illinois, and it was marketing diesel locomotives in all three mainline market segments: switchers, fast passenger engines, and heavy freight haulers. Churella ably delineates how GM and EMC accomplished this bold and rapid R&D program. He also shows how historical fate, in the form of World War II, provided EMD with the opportunity to rationalize production thanks to huge demand for its diesel prime movers for maritime applications. EMD had a great war; in those years, the division first turned a profit, and it laid foundations in production and technical support for its postwar rout of the locomotive industry.

In his most original and important contribution, however, Churella reaches back to earlier decades to give the steam-to-diesel transition its proper foundation. That story does not begin with a locomotive at all, i.e.: a power unit that hauled unpowered cars. Rather, the diesel revolution originated circa 1905 with self-propelled railcars. Passengers rode in these cars, which had internal-combustion prime movers that drove electric generators that in turn powered electric motors down in the swiveling trucks. Experience gained in the 1910s and 1920s in this basic technological paradigm established this drivetrain as the model later used in diesel locomotives, contributed to organizational capacities at EMC and GE, created a cadre of engineering talent that sang the diesel/electric gospel, and offered railroads their first taste of the economies that beckoned if they would only look beyond steam.

Churella makes his points in a cleanly-written account of seven chapters. The research is strong, although not one of his six companies has either left or opened a sizeable and coherent body of internal records. He largely surmounted the limits on sources by consulting all the scattered internal business papers available, supplementing them with a thorough review of the railway and financial press, government documents, and some material from railway archives. The book is targeted at business historians, and its brevity and focus on firm behavior particularly commend its use in business history classes. But many scholars in that sub-field will wish for better grounding in the data. Despite its focus on individual firms, the book lacks any tables or graphs on steam and diesel locomotive output, market shares, capitalization, revenues, or profits. No tabular data are given for railway profits, bankruptcy incidence, or capital investment rates, yet these matters must have affected decisionmaking at the locomotive builders–particularly in the 1930s. Some of this information does appear at points in the text, but tabular presentations would certainly have helped build the portrait of sweeping turnover in this industry.

Understanding Churella's desire to write a business history of locomotive makers, I still wish he had provided a broader treatment in two areas–although breadth is admittedly difficult to achieve in a 153-page account that already incorporates well-crafted case studies of six firms. Nonetheless, the book opens with a rather ahistorical and deterministic chapter that juxtaposes steam and diesel technologies, arguing that "these technological differences mandated radically different production and marketing techniques" (p. 10). Ample evidence supports the argument that steam and diesel locomotives did require or elicit divergent approaches in production and marketing. But Churella then overextends this deterministic view in arguing that standard designs for diesels were nearly essential in amortizing the builder's R&D costs (pp. 19-20). While Electro-Motive did use such

standards to its benefit in the 1940s, during the 1970s GE offered fourteen different locomotive models with over 550 product options available for railroads seeking to customize their motive power (p. 137). In other words, GE apparently broke into the mainline locomotive market through customization, not standardization, suggesting the absence of any deterministic mandate in diesel locomotive technology.

The second topic that could have received expanded treatment in this account is the role of historical accident or fate. Churella certainly acknowledges its importance at points. But his penchant for trenchant retrospective judgments on firms' strategic choices tends to oversimplify. For example, he lauds Fairbanks-Morse's choice to enter the diesel locomotive industry, while faulting that 1944 decision because it "did not take fully into account the oversaturation of the postwar diesel locomotive market" (p. 93). Without a crystal ball in the boardroom, that is tough to do. In a world of imperfect information and the disruptions arising from depression and war, we get little sense here of how difficult it was for managers at Alco, Baldwin, Electro-Motive, Fairbanks-Morse, General Electric, and Lima to establish any clear paths and policies, let alone divine the correct ones.

In Churella's view, by 1940 EMC had taken control of the locomotive industry (p. 56). This fine specialized study concisely shows how the GM/Electro-Motive team vanquished the established industry leaders. Building on this original and significant monograph, other scholars can now take up further questions in the steam-to-diesel transition: why this change occurred so quickly (the pace both aided and surprised EMD), what roles the railways played in establishing this new technological paradigm, the rationale for such revolutionary innovation in a declining industry, the effect that regulatory controls on the carriers played in the transition, and its results for railway labor and operations.

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