



## BOOK REVIEWS

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### Book Review Essay: Industrial Invention, Electronic Competition—A Review of Three Books on Global Strategic Competition

*Inventing the Electronic Century: The Epic Story of the Consumer Electronics and Computer Industries*, by Alfred D. Chandler, Jr. New York: Free Press, 2001.

*Managing New Industry Creation: Global Knowledge Formation and Entrepreneurship in High Technology*, by Thomas P. Murtha, Stefanie A. Lenway, and Jeffrey A. Hart. Stanford, CA: Stanford University Press, 2001.

*From Global to Metanational: How Companies Win in the Knowledge Economy*, by Yves Doz, Jose Santos, and Peter Williamson. Boston: Harvard Business School Press, 2001.

By Mariann Jelinek, The College of William and Mary, Williamsburg, Virginia.

Three recent books by accomplished scholars constitute a forthright challenge, offer perspectives on some potential resolutions, and goad responsive scholars to reconsider some fundamental theoretical boundaries. Despite the notable differences in their content, purposes, and methods, the implications of these books share the argument for the powerful relevance of business history, multilevel perspectives on strategy, and organization theory.

Alfred D. Chandler's *Inventing the Electronic Century: The Epic Story of the Consumer Electronics and Computer Industries* is a history of the small cluster of firms in these two industries whose managerial decisions drove the evolution of their industries in the United States. In passing, it is also a contrasting study of the evolution of competing national industries—most notably, those of Japan, the United King-

dom, France, and Germany—and of the jockeying for position among these national clusters:

Inventing the infrastructure for the Electronic Century [the twenty-first] became an epic story because some national industries died while others conquered. By the end of the twentieth century, no European-owned and -operated enterprise had the capabilities of commercializing—that is, bringing into widespread public use—major new products of either consumer electronics or computer hardware with their essential software technologies. In the United States, no enterprise had the capability to commercialize new consumer electronics technologies. On the other hand, in Japan, the four leading enterprises in consumer electronics had conquered world markets. And the five leading Japanese computer companies were seriously challenging the U.S. computer industry worldwide (p. 1).

In some senses, Chandler's account is a traditionally rip-roaring tale of momentous decisions, enormous courage and stupidity, and dramatic outcomes. It is also marvelously consistent with contemporary strategic theory—most notably, core competence (Prahalad & Hamel, 1990) and the implications of the resource-based view of the firm (e.g., Peteraf, 1993; Wernerfelt, 1984). Thus, RCA's commitment to its once-stellar Princeton Research Laboratories waned as management pursued misguided diversification through mergers and acquisitions that plunged the company into debt and that dissipated managerial attention and energy in fields far from the company's core competences. Ultimately starved for resources, the lab was dismantled, as RCA fell victim to superior color television technology from Japan, having forsaken its dominant technological lead.

From Chandler's perspective, learning bases—in-depth knowledge, experience, and expertise in a particular area—is perhaps the critical resource for enduring industrial success: "Once first-movers and their immediate followers established their integrated learning bases, the barriers to entry became high enough to

assure continuing dominance (unless they deserted the virtuous path of growth, as did RCA)" (p. 256).

In contrast to RCA, in 1963 IBM bet the company on its System 360, investing enormous sums to change its industry, in a fashion quite parallel to Ford's 1913–1914 investments in standardized jigs, fittings, and gauges for automobile manufacture. Like Ford, IBM was already eight times as large as its nearest competitor and clearly the only firm on Earth with the resources to invest the estimated \$6 to \$7 billion it took to create an articulated family of compatible computers (and their software). Again, like Ford, IBM's investment accelerated the firm (giving IBM a sevenfold increase in revenues between 1963 and 1973).

Chandler's account also makes clear the critical importance of early twentieth-century joint ventures and technical exchanges (primarily with U.S. companies) for the establishment of Japan's early learning bases—a story that is not well known. GE transferred much technology and technical knowledge to its Japanese partner early on, long before the run-up to World War II. Chandler also pinpoints the importance of Japanese firms' copying of IBM designs. Fujitsu acquired priceless knowledge access through its investment in Gene Amdahl's spin-off when Amdahl, an original designer of IBM's System 360, could not raise venture capital in the United States. Hitachi's efforts to steal IBM design information, like Fujitsu's easy entree through Amdahl, clearly depict something less than independent development of learning bases. Surprisingly, despite identifying the Japanese firms as "technological heirs of the U.S. and German first-movers in electronics and telecommunications equipment" (p. 240), Chandler says much less about well-documented, concerted Japanese government support for its industry than does, say, Chalmers Johnson (Johnson, 1983) or study teams examining Japanese expertise in semiconductor packaging (Boulton, et al. 1995).

U.S. financial fads favoring unrelated mergers and acquisitions, conglomerates, and other "pure finance" approaches that ignore running the business have clearly self-destructive effects, according to this account. The consequences of such unrelated activities, in which no effort was made to build on existing expertise or dominant market position, were disastrous for the firms, and ultimately for their in-

dustries. Firms that "deserted the path of virtuous growth" (p. 256) in such fashion died with their national industries.

Whereas Chandler's book is an account of the (recent) past, *Managing New Industry Creation: Global Knowledge Formation and Entrepreneurship in High Technology*, by Thomas P. Murtha, Stefanie A. Lenway, and Jeffrey A. Hart, looks to the future. Its focus on flat panel display (FPD) gives the reader a ringside seat on an emergent industry, now coming into widespread consumer acceptance as prices for large screens drop and production ramps up: by 2005, this is expected to be a \$70 billion per year industry.

Like Chandler's book, this book too is an exciting account of epic struggles. But here the focus is on knowledge needed to subdue one hugely complex and equally expensive set of scientific, technological, and manufacturing problems so large that no single firm possessed the wherewithal to go it alone. Necessarily, according to the authors, a global alliance was required to bring together the expertise and financial resources needed to learn to do flat panels, with U.S., European, and Asian partners all playing critical roles. Given the increasingly complicated nature of technologies—examples would surely include biotechnology and genomics, as well as nanotechnology developments in a number of areas—the future of scientifically and technologically intensive industries promises more of the same: more alliances, more complex relationships around complicated problems, and more nontraditional cooperative competition.

Murtha et al. describe the genesis of this new industry, grounded in very complex and demanding technology—that of FPD—as rooted in the dynamics of global learning—learning from one's own learning base, to use Chandler's term, to be sure, but necessarily also going well beyond it, to marshal the knowledge and developmental capability of others, including competitors. What is especially striking here is that no single party had the requisite knowledge, nor could any single party develop the needed knowledge alone: the problem was simply too big. While the nascent industry's primary cluster is physically located in Japan, reading this as the failure of U.S. and European industry misses the underlying dynamic of collaborative knowledge development. Thus, the authors assert, "The growing knowledge-intensiveness of

global economic activity demands new ways of thinking about industry, competition, and strategic management" (p. xi).

Traditional innovation-based strategies emphasize first-mover advantages to fund the next generation of research and innovation and the next generation of process innovations for cost reduction. In nascent industries "companies face immediate, relentless pressures to reduce costs, while investments in R&D and updating of plant, equipment, materials and processes continue to rise" (p. 9). In traditional thinking about national industries, scholars also have seen industrial clusters, whether national or regional, as exclusionary (cf. Porter, 1990). Good data suggest significant benefits to proximity of individuals and organizations in knowledge transfer (Saxenian, 1994). Yet as industries become both more global and more science based, rapid change foreshortens any potential first-mover advantage. Faced with enormous complexity in the FPD industry, "managers challenged home-country-centric preconceptions of innovation, new business creation, and management processes. . . . In doing so they uncovered new principles for competing in the knowledge-driven, global manufacturing industries of the future" (pp. 6–7).

In the process as well, "companies were destined to face the yield challenge [to produce economically viable production yields from new technology] repeatedly as they added lines to expand output and bring up new generations of production equipment to more efficiently produce larger, better-performing screens" (p. 130). The technology was so complex that each new generation of production equipment, and each new product generation, created genuine challenges to reestablishing manufacturing mastery.

This is not the benign world that Chandler's first-mover companies enjoyed—able to anticipate continued dominance as long as they did not stray from the virtue of their learning base. Instead, again and again, FPD companies struggled to achieve commercially viable yields—together, and with their networks of suppliers and customers—to eke out another round of progress. Speed mattered: "Chronological time expended in these endeavors related inversely to profit" (pp. 130–131). And speed was typically a function of individuals: experienced, knowledgeable individuals who knew how to set up the high-volume lines so essential to success:

Companies that lacked or failed to seek access to sufficient stocks of first-hand knowledge embodied in individuals and teams fell out of synch with the economics of industry advance . . . suffered in the short-term or eventually fell by the wayside because they could not ramp up production at sufficient speed to drive display sizes up and costs down as quickly as their competitors (p. 131).

What is going on here is an interesting shift from a technological regime characterized by intermittent, discrete technological advances like those Chandler notes that establish a first-mover's advantage—perhaps for decades—and the much more protracted saga of repeated iterations of product-process challenges: "Competitive advantage in new, knowledge-driven industries depends on companies' capabilities to lead generational transitions that simultaneously increase product functionality and lower costs" (p. 166), pushing an overall decline in even new products' introductory prices and exacerbating the cost of being late to the party, since the window of superior margins becomes narrower with each new entrant. Moreover, the old distinctions between product innovation and process innovation have broken down as well: in the FPD industry substantial challenges intervened between each product and each process generation, yet each company also needed sufficient potential market to warrant its substantial investments.

Despite the prior successes of MITI and Korean government interventions in industrial development, Murtha and his colleagues note, "The industry evolved consistently ahead of governmental conceptions. . . . Political processes do not run on Internet time" (p. 167). In the United States, the Advanced Display Manufacturers of America, founded by companies that had earlier received DARPA funding, filed an antidumping petition (initially successful) against incoming screens, and thereby drove much assembly offshore: "U.S. Customs officials had ruled that the duties could not be levied on screens already incorporated into assembled goods" (p. 177). Some U.S. firms—not involved with the multinational alliance of producers—formulated their problem as one of foreign government subsidy and market penetration. Consortium members saw the issue as knowledge flow management—and had little time for government intervention.

Furthermore, given the "torrid pace of industry evolution" (p. 168) and stiff price competition, no company could afford to rely, for critical equipment or supplies, on unproven newcomers recommended by its government. Knowledge and performance expertise and experience with the latest, best, current, or next-generation technology were simply too critical, and the stakes too high. Rather than rely on government consortia, members of the FPD industry turned to one another, to their networked suppliers, and to close contacts with customers to develop both the expertise to build each new generation of product and the markets to sell them. Both tasks were suffused with tacit knowledge, embodied in people, as was much of the critical knowledge feeding into new equipment design, as well as knowledge needed to manage speedy transition to new generation production lines and their rapid ramp-up.

Speed matters here, and not just speed in a single technology or dominant design, as in the past, but at jumping ahead of the curve:

Path dependence makes a poor assumption for strategy in new industry creation. It relieves management of too many important choices too soon. . . . In knowledge-driven competition . . . multiple designs overlap and rapidly succeed one another. Dominance can prove fleeting and potentially illusory for managers who assume their companies have achieved it. The most successful companies build learning capabilities that enable them to lead rapid change, transcending old advantages in the process of building new ones (p. 186).

As a result, later firms—like Korea's Samsung and, subsequently, Taiwanese producers, eventually followed by Chinese firms and repatriated Chinese Americans in the FPD industry—can acquire proven older-technology equipment, form learning networks and alliances, and transcend the initial dominance of the first movers in knowledge-driven industries. Such latecomers can take over the lead in subsequent generations, leading the migration to the new process technology and the new dominant product—but only by establishing networks to draw in the needed *tacit* knowledge that serves to bridge to the next generation of product and process: "Investments in knowledge creation, including product innovation, manufacturing process innovation, and manufacturing line integration [rather than significant capital investments per se], made the difference" (p. 187).

This account poses difficult questions from the perspective of traditional strategic theory: Why would dominant companies allow proprietary knowledge to be licensed to new entrants and rivals? It poses them as well from the perspective of traditionally national-oriented paradigms: Why would "Japan" license to "Korea" or "China," or sell them state-of-the-art equipment to foster their competitive prowess? (And didn't the clustering of FPD development and production in Japan constitute a failure for U.S. firms?) Given the very different viewpoint the book discerns in the FPD industry, the questions are worth answering.

Murtha et al.'s short answer is that no company (and no nation) was—or is—sufficiently knowledgeable to go it alone in FPD. Development initially centered in Japan for convenience but included American and European companies as critical partners from the beginning. Moreover, initial Japanese dominance in production has rapidly eroded as next-generation facilities have been set up elsewhere. Because knowledge continues to evolve in many different places, FPD companies and their suppliers continue to need to be wired into the global network. Companies license their (older-generation) proprietary process knowledge to extend the window of profitability for the older generation—while moving on to use what they learned in subsequent generations themselves. Especially as "national" clustering was moot to begin with, "cross-national, intercompany collaboration to expand the industry helped to restore the health of the manufacturing equipment sector" (p. 190)—a critical supplier industry for FPD companies, who depended on these firms for help in developing next-generation capabilities. Not only did they, too, have to prosper, but the industry as a whole needed additional scale, and expanding the participants helped to create it.

These perspectives underline a far more collaborative form of competition in this industry, uniting the fates of original equipment manufacturer customers and suppliers with the FPD firms. Further, it is apparent that this collaboration does not, as simplistic economic analysis might suggest, lead to collusion to hold up customers. And, finally, in their account Murtha et al. also argue powerfully that knowledge-driven companies exist in a world of expanding pies—larger markets that can be created by such co-

operation, even in the teeth of simultaneous, constant competition to lower prices and ramp up yield. Success comes from leveraging knowledge to achieve the next generation of product and processes, while keeping a weather eye on alternative technologies developed in the wings—potentially to supplant the current thin film transistor (TFT) display technology. Speed remains critical, as do development, lowering costs by advancing product performance and process in tandem, as “dual strategic imperatives” (p. 192), and globally leveraging both technology and market knowledge.

In *From Global to Metanational: How Companies Win in the Knowledge Economy*, Yves Doz, Jose Santos, and Peter Williamson seek to theorize broadly about the next evolutionary step in competition: the move to transnational organizations. Whereas Chandler outlines establishment of the infrastructure of the consumer electronics and computer industries, and whereas Murtha et al. focus on the emergence of FPD, Doz et al. move across industries to generalize about how to manage the new knowledge-based competition. Drawing on a wealth of vignettes, they lay out a case that traditional multinational firms tend to relatively powerful centralized generative activities, the results of which are then projected worldwide. Occasionally, firms establish multiple centers to project different products, processes, or methods. Yet these firms are ill equipped for the new demands of “metanational” competition: seeking out, melding, and sharing new knowledge globally, simultaneously generating new knowledge and efficiently utilizing older knowledge, exploring, and exploiting.

“Today the challenge is to innovate by *learning from the world*” (p. 1). The problem is the proliferation of new knowledge, together with the constant need for innovation. No matter how good a firm is at its past expertise, relevant new knowledge will spring up elsewhere, in unexpected places—and nobody in today’s global firms has the skills, budget, or mandate to capture that new knowledge: firms understandably are too busy running the shop, they don’t know where to look, and they wouldn’t know how to bring new knowledge global anyhow. The authors make effective use of the distinction James March identifies between “exploration” and “exploitation” (March, 1990), although they do not mention it. Instead, Doz et al. identify three lev-

els of competition in the global knowledge economy, centering on *sensing* new competencies and lead market knowledge; *mobilizing* that knowledge by integrating scattered capabilities and opportunities to pioneer new products and services; and managing *operations* for efficiency, flexibility, and financial discipline (p. 6).

These activities and the criteria for managing them are sufficiently different that they cannot simply be “shoehorned” into a traditional firm structure. Moreover, as the world’s economy becomes more truly global, both the challenges and the opportunities require new responses: global scope is no longer sufficient to guarantee advantage, no single market or technology source can dominate in most industries, and valuable knowledge is scattered. The nature of knowledge also creates difficulties, since the most valuable knowledge is often “sticky” and difficult to comprehend outside its context—“you have to be there,” creating an obvious problem for firms used to thinking of presence in terms of bricks and mortar commitment.

Just as Murtha et al. note the simultaneous dispersion of knowledge and the proliferation of its sources in FPD, Doz et al. provide numerous examples of unexpected innovation sources and novel means of sensing, mobilizing, and melding them into usable knowledge. PolyGram, the music company, learned how to create international hits from locally successful performers, blending enough experience to know global tastes and tolerances with sufficient links to the local market to identify the likely candidates among up-and-coming acts. Nokia blended market knowledge from Japan, Europe, and North America in its U.K. lab to develop its first breakthrough global phone. ST prospected for customers around the world and repeatedly bumped against the limits of standard semiconductors in satisfying customer needs, so the company created a structure to mobilize specialist knowledge from its customers about their unique needs and used its knowledge to develop a design for a world-leading customer that could be adapted for others.

*From Global to Metanational* lays out alternatives to traditional multinational and global structures and practices for the new tasks of sensing, melding, and operationalizing a constant flow of innovative knowledge. Informative chapters on sensing, melding, and harvesting the metanational innovations offer abundant

advice for managers, who are the central target of the book. However, the underlying rationale is also appealing to scholars, and while there is some underlying research and theory reported, the book aims at a relatively high level of abstraction. Thus, there may be numerous opportunities to test these ideas more formally (Barabasi, 2002).

All three of these books propose that knowledge is the lever for strategic success and that bringing it to bear in the marketplace is the critical task. In all three, the authors argue, from different perspectives, that evolving the knowledge base of the firm is a critical and very complex task of increasing importance. And all three books are well worth the time needed to read them. I might quibble that Chandler's book, written "with the assistance of Takashi Hikino and Andrew von Nordenflycht," is not quite up to the magisterial level of *The Visible Hand* (Chandler, 1977), but that would be carping: this is a fine book. Doz et al. are less theoretical and less massively documented than either of the other two books, and their book is clearly aimed at managers. Still, the abundant caselets, well-crafted logic, and (mostly) helpful diagrams are compelling. Murtha et al. focus on a single case, so perhaps we might argue that their conclusions are not generalizable. But a more useful perspective is to reflect on how closely these very different books support one another in documenting the increasingly central role of knowledge in business; the difficulty of creating, capturing, and evolving it; and the importance of collaboration and alliances in using it.

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## Book Review Essay: New Perspectives on Global Industrial Dynamics

*Managing New Industry Creation: Global Knowledge Formation and Entrepreneurship in High Technology*, by Thomas P. Murtha, Stefanie A. Lenway, and Jeffrey A. Hart. Stanford, CA: Stanford University Press, 2001.

*From Silicon Valley to Singapore: Location and Competitive Advantage in the Hard Disk Drive Industry*, by David G. Kendrick, Richard F. Doner, and Stephan Haggard. Stanford, CA: Stanford University Press, 2000.

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The study of globalization through specific industries and their evolution, focusing on the strategies employed by firms and countries in these industries, is a grossly underdeveloped aspect of our discipline. As anyone who has talked to practicing managers in such sectors as integrated circuits and IT products will testify, managers and the firms they represent see their tasks in terms of complex processes of industrial dynamics—industry cycles, product cycles, value chain dynamics—that are rarely captured in the mainstream frameworks of strategy. Moreover, we will comprehend globalization poorly if we tackle it only at the macro level, where industry specifics are dispensed with. Hence, books that bring these issues into focus are especially welcome.

Two new books from Stanford University Press—*Managing New Industry Creation: Global Knowledge Formation and Entrepreneur-*

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