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W. Mark Fruin. *Knowledge Works: Managing Intellectual Capital at Toshiba.* New York: Oxford University Press, 1997. ix + 267 pp. $39.95 (cloth), ISBN 978-0-19-508195-4.

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Awash in a sea of high quality, meticulously engineered electronic and mechanical products bearing the label "Made in Japan", Americans–both inside and outside academia–continue to wonder, despite Japan's recent economic troubles, "How does Japanese industry do it?" In *Knowledge Works: Managing Intellectual Capital at Toshiba*, Mark Fruin addresses this perennial question through a factory organization at Toshiba's Yanagicho factory. At irregular intervals from 1986 through 1992, Fruin entered Toshiba's workforce to observe the complicated social patterns that generate change at Toshiba. Because Toshiba devolves most of its resources related to product and process development to the factory level, working in the various sections responsible for bringing new products on line permitted Fruin to study at firsthand the technical, social, and cultural relations that structure Toshiba's larger technology strategy. In *Knowledge Works*, Fruin argues persuasively that Toshiba's success during the 1980s in responding to rapid shifts in market preference, to the quickly strengthening yen, and to the establishment–sometimes voluntary, sometimes not–of international trade quotas, stemmed directly from the development of a new form of factory organization, a form beyond simple mass production, a form Fruin terms the "Knowledge Works."

Briefly, this book is a useful and thought provoking study of how a single factory is organized to support rapid innovation in both process and production technology. Fruin presents a useful model–that is, the knowledge works–for analysis of this industrial form and supports his claims with detailed descriptions of the technical systems, social organization, institutional values, and individual attitudes that underpin this form. The book is not, however, without its flaws, most prominent being Fruin's desire to generalize this form as a source and explanation of Japan's national rather than Toshiba's corporate comparative advantage.

In the term "knowledge works," Fruin playfully emphasizes the central point of the book: "Knowledge works" are places where "knowledge works." Put a little more elegantly and emphatically, "Knowledge works are a force for a new age, a postproduction age, of intellectual capitalism. Instead of making things, a production problem pure and simple, making the right things, in the right amounts, at the right times and prices, is the postproduction problem. And because nothing stands still, making *righter* thing, in *righter* amounts, at *righter* prices and times, must be the goal. Post production, or intellectual capitalism, presumes information processing abilities of a high order, on-site differentiation and integration of functions, a customer-is-always-right point of view, and quite emphatically, an environmentally conscious mode of operations" (p. 24).

Knowledge works permit a higher degree of responsiveness to changes in markets by permitting higher levels of differentiation in a factory's product lines and simultaneously higher levels of integration technically, socially, and culturally across the different groups managing, designing, and producing these products. While management remains well attuned to the short-term exigencies of the market, still more important to the continued vitality of both the factories as knowledge works and Toshiba as a corporation is management's strategic commitment to factories as sites for not only the production of better products but also the production of better skilled, more knowledgeable, better motivated workers on better organized, better managed lines. Knowledge works prosper not by the traditional mass production strategies of de-skilling and the division of labor; instead, at Yanagicho, the factory provides the site where technicians, engineers, and managers from not only Yanagicho but also other Toshiba plants, group companies, suppliers, and even outsiders cooperate to attain the "physical, spatial, and functional integration of labor and information" (p. 17).

Understanding the characteristics of the manufacturing processes undertaken in knowledge works as being profoundly determined by the particulars of a given site's

history provides Fruin a useful explanation to understand how Toshiba innovates so quickly. It does so because on the factory floor, the whole organizational panoply of managers, engineers, technicians, suppliers, assembly personnel, inspection personnel and such are synchronized by a common set of values, practices, and goals. Technical knowledge, social contracts, and cultural intuitions combine seamlessly to create the basis for rapid process and product innovation. Continuous and ongoing renegotiation of these compacts is the norm which permits flexible response by management and engineering in the deployment of Yanagicho's intellectual, financial, and labor resources.

While it is the social and cultural dynamism and cohesiveness of "knowledge works" that power technical development at Toshiba, it is the technologies themselves that create value for the company. Which technologies–and consequently which complementary skills and what forms of organizational knowledge–to develop is central in determining which markets any given knowledge works can and will be able to service. Fruin notes the presence in each of Toshiba's knowledge works of what he terms "Champion Lines," families of products that provide not only considerable revenue flows but also considerable and ongoing innovation in both product and process development. "They lay a threshold of organizational knowledge on which related products can thrive, one that ultimately justifies the high risk and cost of creating multifunctional capabilities in particular product departments [of, that is, a knowledge works]" (p. 47). Yanagicho's "Champion Line"–plain paper copiers–has defined the trajectory of technical, product, and market development for the whole factory complex since the mid-1980s. While the knowledge works form enables Toshiba to participate in the crowded and highly competitive domestic copier market, at the same time, in developing the technical know-how necessary to compete in this market, Toshiba augments, complements, and improves the basic technical and organizational knowledge present at Yanagicho and thus drives change in the other product families produced there. Indeed, of the thirteen product lines produced in the Yanagicho plant, fully two-third are "historically and technically linked" to its plain paper copier line (p. 48).

Having introduced the concept and architecture of the Knowledge Works in the first two chapters, Fruin spends the majority of the book studying how Toshiba management maintains, extends, and reproduces the structures that define a knowledge works. The third chapter describes how management promotes the education, socialization and acculturation of its workforce to the needs and values of a knowledge works through a continual process termed organizational campaigning. The fourth describes how Toshiba–or more accurately the Yanagicho factory–manages its relations with suppliers, encouraging excellence and cooperativeness through the strategic exchange of knowledge, expertise, and personnel. In the fifth chapter, Fruin uses a case study of the development of the SuperSmart card–a credit card sized computer–to demonstrate the potency of knowledge works to develop rapidly (in only 22 months) a product embodying multiple technological innovations. In the sixth chapter, Fruin examines how Toshiba responded to the problems encountered in exporting both the knowledge works concept and plain paper copier manufacture to a plant in Irvine, California. Not surprisingly, the seventh and concluding chapter reprises the basic argument of the book, pointing to Toshiba's potential for flexible and speedy innovation that results from the presence of a corporate factory system organized around knowledge works.

As noted above, this is a useful and interesting book. Having worked in the Yanagicho factory as an employee, Fruin writes with an authority born of experience. At the same time, the book is more than simply a diary of production line experience. His experience is structured by new readings of old arguments in a variety of literatures in management and economics. Moreover, his method is not limited by overly fastidious attention to disciplinary boundaries. In trying to understand what motivates workers to participate, Fruin bravely enters the problematic realm of individual values, culture, and inevitably history. *Knowledge Works* persuasively demonstrates the importance of these less quantifiable and more local aspects of human experience in Toshiba's development of a factory-based capability to respond to and generate rapid change.

Using this multidisciplinary approach combined with a fine detail derived from careful field research, Fruin has formulated an argument that emphasizes the importance of a particular cluster of factors–some cultural, some social, some institutional, some political, some market, and some technical–in enabling the creation of knowledge works at Toshiba. By so tightly and persuasively linking the factors of the knowledge works' creation to the particulars of Toshiba's products, market, organization, and culture, Fruin renders any generalization of the knowledge works concept problematic. After making a good case for knowledge works being the source of Toshiba's comparative advantage, Fruin–too boldly in my view–continues, making much the same claim regarding the sources of Japan's national comparative advantage. For

example, in his conclusion Fruin writes:

The widespread existence of Knowledge Works in Japan but the relative scarcity (or nonexistence) elsewhere suggests the powerful impact of national competition on manufacturing organization at home, the competitive edge enjoyed by Japan's industrial firms in established product markets, and their ability to respond quickly, even preemptively, to new domestic and overseas markets. (p. 210)

Since no company has experienced exactly what Toshiba has experienced and since only a few even come close in terms of market, product lines, and such, it is difficult to believe that the knowledge work per se is widespread even in Japan.

This is not idle philosophizing. Over the course of the book, we do in fact learn that many of the most prominent Japanese companies are not configured in a knowledge works-like style of production. For example, serving as they do radically different markets, Toshiba and Toyoda do not, indeed could not, operate using the same production models (p. 206); for Hitachi, Mitsubishi, and NEC, R&D deployment is mostly focused–contrary to knowledge works best practice–at laboratories that are neither physically nor institutionally linked to specific factory sites (pp. 57-59); and the competitive cooperation found in Yanagicho's dynamic and responsive supplier network derives from the shared intangible assets fostered under the knowledge works approach rather than the formal, more static, and more widely spread fiscal and organizational relations defining traditional keiretsu and kiygo shodan business groupings (p. 99). These are not inconsequential differences. In the knowledge works model, the structure of the supplier network, the factory level allocation of R&D, and the organization of production are key structuring elements. By and large, it seems that knowledge works–in the mode in which they are implemented at Yanagicho and described by Fruin–could be as rare in Japan as they are abroad. By making an argument that ties knowledge works so tightly to the specific technical, institutional, and corporate history of Toshiba and its Yanagicho plant, Fruin renders the imitation of knowledge works by Toshiba's domestic competitors only slightly less problematic than their transplantation from Toshiba's plants in Japan to new factories in the United States.

Another way to estimate the influence of knowledge works on Japanese industrial development would be to ask when they first came into being. In terms of knowledge works influencing larger issues of national comparative advantage, earlier would be better to allow time for dispersal. Indeed, Fruin argues,

Knowledge Works are not a recent, postwar invention. They appeared during the interwar period as focal factories: multifunction and occasionally multiproduct factories that bore administrative responsibility for serving regional markets at a time when national markets were not well integrated." (p. 31)

Here and elsewhere in the book, Fruin times the advent of knowledge works as during the interwar period. I do not wish to suggest that Fruin is wrong in drawing links to this period; however, these must be termed only the barest beginnings of certain aspects of the knowledge works structure. They should not be mistaken for the structure itself. Given that certain knowledge works structures at Yanagicho such as total productivity organizational campaigning (p. 69), the establishment of factory oriented R&D structures (p. 191), and the creation of an active and responsive Supplier Association (p. 97) all stem from institutional changes undertaken in the period between the late 1970s and mid-1980s, the development of the knowledge works form should be seen as a product of the slow down in Toshiba's corporate growth engendered by "Oil Shocks" and the ending of Japan's period of high economic growth.

Thus, to my way of thinking, the organization defined as knowledge works is both more recent and less widely spread in Japan than is suggested by Fruin's otherwise well constructed and excellently researched book.

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