

Review Essay

Structuring the Information Age: Life Insurance and Technology in the Twentieth Century. *By JoAnne Yates*. Baltimore: Johns Hopkins University Press, 2005. x + 351 pp. Illustrations, figures, tables, bibliography, notes, index. Cloth, \$49.95. ISBN: 0-801-88086-6.

Reviewed by Paul Miranti

JoAnne Yates's brilliant volume deals with the social construction of technological innovation and adaptation in the U.S. insurance industry. Extending earlier research dealing with the impact of consumers on innovation, the study shifts the focus to corporations and evaluates their role in shaping data-processing from the incipency of electromechanical tabulators at the beginning of the twentieth century to the advent of IBM's electronic computer model 360 in the 1970s. Yates generalizes her analysis by drawing on the insights of structuration theory as propounded by sociologist Anthony Giddons, particularly its concept of "duality of structure." This theory emphasizes the importance of individual choice in bringing order to complex phenomena. It holds that while institutional arrangements underlying particular social or technological systems may shape, constrain, or enable human action, they do not ultimately determine outcomes. Thus, the institutional and technological developments that transformed insurance are perceived as being organic, rather than deterministic. They are the product of evolutionary processes that are strongly influenced by the learning and exercise of free will on the part of historical agents. As Yates notes, the goals of such purposeful action often prove difficult to attain when tackling complex tasks, such as automating corporate data-processing. The difficulty stems largely from the uncertainties that constrain decision-makers when confronting the bewildering array of technological and environmental contingencies that impinge on these problems.

Two questions about the nature of technological change unify the study. The first arises from the ongoing dialogue between technology producers and users in defining the direction of innovation. It is concerned with determining to what extent businesses shape

the development of common-purpose technologies, such as tabulators and computers, in satisfying the information requirements of life insurance. The findings of previous research on individual consumers suggest that the influence of business organizations would be high because of their familiarity with “technology in practice,” that is, with how technology is actually used in a firm’s operating activities. The second question relates to how inherited institutional arrangements and technological practices shape the development and adaptation of innovation. Like Gestalt psychology, this aspect of structural analysis holds that learning processes respond to knowledge of past forms. Thus, the corporate adaptation of innovation is facilitated by reducing learning barriers. One way of achieving this is by incorporating familiar routines and functional attributes carried forward from earlier operating regimes into new system designs. In this context, successful science does not necessarily promote the most intellectually advanced initiatives. Instead, the crucial standard is the ease with which new technologies can be mastered and integrated into a corporation’s functional learning base.

Developments during the tabulator era tended to affirm the first thesis that technology is constructed through reciprocal interaction between producers and users. Market leadership passes between several producers largely on the basis of their ability to create capabilities that respond to consumer wants. Although the industry’s first mover, Henry Hollerith’s Tabulating Machinery Company (TMC, predecessor to IBM), eventually came to dominate this market, its leadership initially had to confront the serious design shortcomings of its sorters and printers. These machines were critical to insurance companies because of their potential for reducing labor costs in preparing bills, reports, summaries, and other documents. Dissatisfaction with TMC’s equipment offering, for example, induced the Prudential Life Insurance Company to produce its own sorters designed by one of its executives. New firms founded by J. Royden Peirce and James L. Powers made strong market inroads because of the attractiveness of their printers. The Prudential Assurance Company of London also received a manufacturing boost when it acquired Powers’ British subsidiary in 1919. Yet, in spite of competition and setbacks, IBM was eventually able to retake a decisive lead beginning in the 1920s, bolstered by its strong financial position, experienced management, and strong marketing support. Big Blue took a major step forward in solving its machine-design problems

when it acquired Peirce's company, which had the strongest technology and had continued to strengthen its sales position by committing resources to product design and marketing. This acquisition, and the need for developmental capital, also induced Powers to merge his small enterprise into Remington Rand in 1927.

Producer-user reciprocity in constructing technology continued during the computer era, especially through the development of software programs that controlled machine applications. Insurance representatives participated on committees that specified the form and structure of basic programming languages, such as Common Business Operating Language (COBOL). The two leading competitors, IBM and Remington Rand, promoted acceptance of their lines by providing application software tailored to the industry. Later, after the imposition of antitrust mandates requiring software unbundling, insurance companies adapted computers to firm-specific purposes by developing systems that integrated operating and accounting software.

The computer era also witnessed events that support the second thesis relating to the carryover effects of past forms in constructing new technology. The experience of Remington Rand suggests that first-mover status and advanced designs do not guarantee market leadership. Its Univac System (derived from earlier wartime models designed to solve complex algorithms) was initially found wanting for insurance purposes because of insufficient data-storage capacity. The firm's innovative development of electronic-tape storage disks ironically created another major problem for insurance users, because it interrupted the visible audit trail that previously had been available through punch-card systems. This unanticipated effect adversely affected financial and managerial control. In contrast, IBM's initial success stemmed from its development of cheaper, simpler units that were more appropriate to the industry's level of computer competency. The incorporation of familiar punch-cards and batch-processing features that had been characteristic of tabulators facilitated the adaptation of IBM's very successful Type 650 to the needs of this industry. Although a small system, its capacities could be readily extended, due to its modular design. This enabled risk-averse managers, who feared loss of control over their information systems, to plan incremental strategies in switching to more complex technologies.

Yates makes effective use of business and professional associational records to explain how these organizations forged links between producers and users in their mutual campaigns to construct a new technology. The American Society of Actuaries, for example, provided a strong inducement for insurance companies to acquire tabulating equipment when it launched its two-year Medico-Actuarial Survey in 1910. The goal of this project was to accumulate more accurate and current information on which to base the revision of mortality tables. It eventually compiled data for 95 percent of the life-insurance policies written in the United States and Canada since 1885. Later, in the 1920s, two new associations created forums for furthering technological discourse. The Life Office Management Association (LOMA) specialized in addressing the more general problem of promoting home-office management efficiency, while the Insurance Accounting and Statistical Association (IASA) focused more narrowly on establishing a better understanding of office-equipment capabilities. The committee reports of these associations communicated information about best practice with respect to automation. The associations also sponsored conventions and other conclaves, where vendors discussed the state of the technology and showcased their products.

While Yates's study weighs the varied impacts of regulation, competition, organization, and associationalism on technological innovation and adaptation, it also emphasizes the importance of two aspects of corporate culture and ideology. The first was a strong public-service ethos that emerged in response to the 1905 insurance investigations and reforms in New York and other states. The second was the industry's commitment to strengthening systematic management as a means of both enhancing corporate efficiency and discharging its public-service responsibilities. In the latter regard, data processing provided information about the details of property rights and obligations that helped to assure probity in dealing with policyholders. Moreover, information-system efficiency affected the cost of insurance and, thus, the affordability of this vital protection. Such systems also increased the transparency of corporate affairs, which was critical for effective governance and oversight. Moreover, to better serve the public interest, competitors routinely shared details about their data-processing practices in associational gatherings.

In evaluating the transition to the computer era, Yates examines the factors contributing to what has been termed the “productivity paradox.” This involves the time lag between the introduction of a new technology and the achievement of improved productivity. Using the renewal expense ratio for ordinary insurance contracts (a calculation that was employed in earlier Bureau of Labor Statistics studies) as a proxy, the author concludes that the insurance industry’s lag in adapting computers amounted to about two decades. Two case studies involving the large, multi-line carrier Aetna Insurance and the medium-sized New England Mutual Insurance detail the difficulties encountered in system revision. While many factors contributed to delay, three were particularly noteworthy:

The first obstacle was the companies’ policy of adopting incremental approaches in order to minimize risk because they were uncertain about the direction of technological evolution and wanted to maintain control over earlier reporting systems. By continuing to use features from the tabulator era, such as punch-cards and slow but careful batch-processing routines, they may have inadvertently sacrificed efficiency for greater system safety. These impediments were only later surmounted through the introduction of systems that integrated telephone-based networks and on-line, real-time communication modalities. Second, the desire to develop firm-specific software also induced many firms to commit substantial resources to the time-consuming tasks of system design and programming. Third, a transitional shortage in the pool of trained personnel made it difficult to optimize computer usage. Initially, this problem was addressed by the establishment of educational programs sponsored by firms, associations, and vendors. However, the quality of trained workers did not improve to any meaningful degree until the introduction of collegiate computer-science programs beginning in the latter half of the 1960s.

Yates’s study is especially useful to business historians because of its insights on the theory of the firm. First, unlike much of the literature dealing with corporate evolution (which has tended to emphasize strategic issues), the study demonstrates the vital role that control over internal information resources played in enhancing business efficiency. Innovation in the ways that data were gathered, processed, analyzed, and

redistributed improved decision processes, shaping the lens through which a complex business environment was viewed by corporate managers.

Second, the study indicates that the exploitation of first-mover advantages was not limited solely to leadership in technological innovation. To capitalize on the advantages inherent in innovative technology, providers often had to create complementary services and products that promoted consumer acceptance for new offerings. The new technology motivated some suppliers to establish organizational capabilities for maintaining close customer contact. It also required the development of analysis and planning capabilities to determine how this knowledge of customer wants could be better satisfied through product or market initiatives.

Third, firm size directly affected the ability of technology producers to gather and utilize the customer information that played such an important role in guiding innovation. Small firms, like those owned by Peirce and Powers, could not support the full range of capabilities necessary to fully exploit their knowledge of consumer wants. They were imbalanced firms, with strengths in design, engineering, and production but weaknesses in marketing and finance. These deficiencies seriously constrained their growth. Eventually, they were acquired by larger rivals with sufficient resources to capitalize on their special competencies.

Fourth, while technology adaptation promised greater efficiency, it also imposed new learning requirements on firms, particularly for those dealing with computers but also for companies acquiring tabulators. The learning involved planning for restructuring corporate organization and operating practices to accommodate the new data-processing initiatives. It necessitated the recruitment of new classes of knowledge workers, such as programmers, system analysts, program librarians, computer operators, and data-entry clerks. It created the need to provide for the continuing professional education necessary to maintain employees' technical skills. It also redefined the relationship between the industry and the institutions of higher learning that trained candidates for careers in information processing.

Fifth, the failure of markets to deliver desired technologies induced some users to compensate by internalizing innovation. Three developments evinced this response: Shortcomings in tabulator design, for example, persuaded Prudential Assurance,

Prudential Insurance, and Metropolitan Life to acquire or establish manufacturing capabilities as a base for equipment improvement. In addition, during the computer era, the failure of the national educational system to train a sufficient number of computer scientists motivated many firms to make up for the deficiency by establishing internal employee-training programs. Similarly, restrictions prohibiting the bundling of software and the desire to create more firm-specific operating systems combined to impel many technology users to expand their programming capabilities temporarily.

Sixth, like the Chandlerian firms of the second industrial revolution, insurance companies invested in technology to reduce transaction costs. This, however, proved difficult to do in a service industry, especially during the computer era. Insurance lacked the high, fixed burden that led to dramatic reductions in unit costs with increasing production in manufacturing industries. Instead, the improvements in this service industry were more the product of greater system flexibility than of intensive data processing. After two decades of learning, the industry began to benefit from its creation of more integrative systems and networks that blended the data-processing power of computers and a host of new communication modalities.

In these and other ways, Yates's study of the adaptation of information-processing resources in insurance has greatly widened the horizons of our understanding of the dynamics of technological development in a business setting. This important book makes more comprehensible the role of innovation in an economy driven by information rather than by the production of tangible goods. Yates's ideas and analytical approaches derived from the study of a vital U.S. industry will, in my opinion, influence a growing body of scholarship that seeks to illuminate the forces shaping the world economy as it moves further into the information age.

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