Information Technology and Business Processes in the 20th Century Insurance Industry

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Historians studying predecessors of the computer often provide brief discussions of Hollerith's tabulating equipment, especially in the context of his Census work [e.g., 9]. A decade ago Geoffrey D. Austrian's *Herman Hollerith: Forgotten Giant of Information Processing* [1] drew attention to the technology and its inventor, providing many details of its early evolution in response to government and then business needs. Recently this technology has received more attention [19, 3, 5]. These treatments have begun to explore the role of tabulating equipment in American business before World War II, as well as the role of the business market in the development of the tabulating equipment industry.

This paper takes a single industry, life insurance, and looks at the role tabulating machinery and early computers have played in its business processes, as well as the role of the insurance industry in the evolution of tabulating technology. The insurance industry is a particularly interesting one for these purposes because of its information-intensive nature. In one of the few studies recognizing the non-mechanical roots of information technology, Campbell-Kelly [4] has studied the emergence of manual methods of large scale data processing in the British Prudential Assurance Company, Ltd., during the Victorian era. He notes that "the insurance business is perhaps the purest example of an 'information-based' industry - that is, an industry whose sole activity consists of gathering, processing, and distributing information" [4, p. 2]. Thus, as one industry commentator during the computerization era noted, "What the production line is to a manufacturer, the data processing system is to an insurer" [6, p. 3].

After briefly describing some of the salient features of the U.S. life insurance business and its information needs, I will discuss the industry's initial adoption of basic tabulating systems to mechanize existing and primarily manual processes of sorting, counting, and adding; and its evolving use of tabulating technology and its incremental improvements to integrate some of

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its key business processes. Finally, I will briefly suggest the reciprocal influence of the insurance industry on tabulating technology.

American Life Insurance and Its Information Processing Needs

By 1900, life insurance was big business in the U.S. The largest firms handled over $1 billion worth of insurance policies and had assets over $250 million. There were two principal branches to this industry [14, p. 1]: ordinary insurance, the older branch, in which policies were relatively large and premiums were generally paid yearly, by mail or in person at the insurance office; and industrial insurance, a late nineteenth century innovation, which dealt with small policies on the lives of primarily industrial workers and their families, and in which very small premiums (e.g., a nickel or a dime) were collected weekly at the worker's home by sales agents assigned to a particular area or debit.[2] Mutual Life Insurance Company, New York Life Insurance Company, and Equitable Life Assurance Society were the largest companies dealing solely with ordinary insurance, and the Metropolitan Life Insurance Company and Prudential Insurance Company (unrelated to the British Prudential) were the largest companies handling industrial insurance, though both also developed ordinary insurance departments. While both segments of the industry were based on the same actuarial principles, the operating aspects of the two segments differed significantly. Industrial insurance involved many more transactions for much smaller amounts, making it inherently more costly to provide and thus more expensive (per dollar of insurance) to the buyer. From the beginning, controlling costs was especially important for providers of industrial insurance.

As Morton Keller [14] has described, the Armstrong Commission Hearings of 1905, conducted by a joint committee of the New York Legislature, were the culmination of late nineteenth century trends in the industry and a watershed event in the history of insurance in America. They exposed the widespread abuses in insurance finance and top management's lack of proper attention to operating matters unrelated to investment. In the wake of the investigation, state regulators passed legislation strictly limiting the investment activities of the firms and mandating stricter controls over products and operations. New generations of management came into many of the large firms to clean house and to establish in earnest the quasi-public status the firms had often claimed. Many companies (e.g., the Equitable and Metropolitan Life) also mutualized, ending a potential conflict between public service and profits. Thus for many large insurance companies, unlike railroads and manufacturing firms, a crisis of profitability *per se* did not drive the adoption of new methods of management and supporting techniques and technologies of information [24]. Nevertheless, the firms felt the need to keep costs down both to fulfill their public service mandate and to remain

[2]During the first half of the twentieth century, these two branches were joined by group insurance and the demarcation between them was muddied by the introduction of intermediate types of insurance.

competitive in their pricing so they could continue to grow. Competition for market share (generally expressed in terms of value of insurance in force) was stiff, and firms were acutely aware of competitive rankings [e.g., 12, p. 168].

Insurance, as Campbell-Kelly [4, p. 2] has observed, "is perhaps the ultimate information product." Insurance firms at the turn of the century (and since) were highly information-intensive, managing a variety of different types and forms of information for an enormous number (and variety) of policies. One insurance executive has stated that "the outstanding characteristic of the life insurance office . . . is, the repetition of the same data and same transactions in the various records and statistics. From the very moment a policy is issued this repetition stays with it until the ultimate termination of the policy" [7]. This characteristic is combined with the accuracy necessary to give individuals good service over the lifetime of the policy--a much higher level of accuracy than required in Census statistics, for example. These factors play an important role in company decisions about information technology, as well as in the industry's overall approach to information technology.

Tabulating Technology in the Insurance Industry

It was possible to handle the information tasks required by large insurance firms without much in the way of mechanical aids, as Campbell-Kelly's [4] description of the methods used by the British Prudential (then the largest life insurance firm in the world and the inventor of industrial insurance) starting in the 1870s demonstrates. Its system centered on replacing many bound ledgers with sets of cards, each with the details of a single policy, to facilitate sorting and processing. This approach was widely adopted in U.S. firms as well, with the Metropolitan and American Prudential attempting to duplicate its procedures when they started their industrial businesses [12, pp. 71-79]. Initially, U.S. firms adopted tabulating machinery to mechanize and thus speed up these repetitive card handling processes.

Tabulating systems, which were initially developed by Herman Hollerith for use in the 1890 U.S. Census, quickly came to include separate devices for punching, sorting, and tabulating cards [1, 2, 3, 5, 19]. The initial census system used cards divided into irregular fields with letter or number codes in each punching position. By the early twentieth century, however, Hollerith had developed a more flexible but standardized format with up to 45 columns (each having numbers from 0 to 9 plus two additional punching locations) that could be grouped into fields in many different ways. The electromechanical sorting and tabulating equipment, initially hand fed but soon incorporating automatic feeding mechanisms, could sort and then count cards with a particular hole or combination of holes punched, showing the total on a register from which the operator copied it down. In his work for his first commercial customer, the New York Central Railroad, he developed accumulators for adding totals within designated columns, increasing the potential uses of the equipment by giving it adding machine capabilities. Hollerith saw potential in commercial customers from very early, but he only

turned to this market in earnest after he was frozen out of the Census market around the turn of the century [1].

Initial Adoption for Faster Sorting, Counting, and Adding

The insurance industry was one of the very first private industries to show interest in Hollerith's system, seeing it as a way to speed up its card-based manual sorting and counting systems. At Hollerith's invitation, 25 members of the (one-year-old) Actuarial Society of America attended a demonstration of his equipment in April of 1890 and discussed its prospective actuarial uses with him [18, p. 337; 1, p. 83]. At that point, the Prudential already had plans to try the system, and within a year Hollerith had installed some machines there. By 1895, the Prudential's actuary, John K. Gore had invented and installed his own card punch and sorter [18, p. 338; 8]. His sorting device, which used a radial configuration quite different from any contemporary or subsequent punch card equipment, was faster than Hollerith's earliest sorter,[3] but his system lacked any form of tabulator, thus requiring some other manual or mechanized process for counting cards or adding quantities. The company used it, however, in much the same way that other firms used early Hollerith systems--to mechanize and thus speed up some aspects of the manual sorting and processing of cards. As early as 1902, the Actuarial Society of America undertook a multi-company mortality study to be punched and sorted on the Prudential's equipment, thus exposing more firms to the potential uses of punch card machinery.

Within a few years, other companies were beginning to experiment with Hollerith's punch card equipment for mechanizing manual sorting, counting, and adding operations. Just before the turn of the century, several of the smaller insurance firms contracted with the service arm of Library Bureau, a library and office supply firm that had an agreement with Hollerith, to undertake studies for them using Hollerith equipment [1, p. 134]. By 1909, a pair of papers in the *Transactions of the Actuarial Society of America* [10, 11] revealed, New York Life had converted its method of conducting internal mortality studies from a manual card system to a Hollerith system. Arthur Hunter, the New York Life actuary who wrote these papers, noted the value of these systems to an insurance firm: "While there is considerable expense involved in making a change from written to punched cards, the cost of installing the new system should be offset by the saving in clerk hire in from three to five years. In addition to the saving in money the saving in time and

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[3]In a May 23, 1901, letter from Gore to Hollerith concerning the actuarial study, Gore made the following comparison between the two systems: "In sorting vast numbers of cards, even including the counting, my system is much quicker than yours. When, however, by sorting, the numbers of cards in the various groups are reduced to the hundreds your system is the quicker" (Library of Congress, Hollerith Collection, Container #10). The Gore sorter's speed was 15,000 cards per hour or 250 cards per minute [18]. However, the Hollerith sorter achieved that speed when it was re-engineered for the agricultural census in the same year of this letter [5], and subsequent improvements continued to speed it up. Nevertheless, the Gore sorters continued in use at the Prudential until the 1930s [18, p. 338; 15, p. 308].

facility for making investigations in greater detail have induced many companies to look with favor on the new system" [10, pp. 268-9]. Moreover, he announced that the Actuarial Society had decided to adapt New York Life's new Hollerith methods to the multi-company joint Medico-Actuarial Mortality study currently being undertaken, because "There were so many companies who desired to use the Hollerith machines in supplying the data for the Committee" [10, pp. 252-3]. The Medico-Actuarial study was the means for introducing Hollerith machinery into some firms or segments of firms, including into Metropolitan Life's Ordinary Insurance Section [17, p. 70].

Hunter's account revealed that to ensure accuracy, New York Life had two cards independently punched for each policy, then visually compared to check for errors. While the extra card punching and comparing took time, he made a virtue out of necessity, arguing that "This constitutes one of the greatest advantages of the perforated card over the written card" [10, p. 265], since it results in two complete sets of cards, one of which can be kept in numerical order and one in mortality investigation order, thus saving time in updating cards and in conducting further investigations as desired. This technique, however, increased the repetition inherent in insurance work.

While New York Life's system was used primarily for compiling actuarial statistics, by 1909, another article in the same issue of the *Transactions* [13] revealed, Hollerith machines were also being adopted to speed up a broader set of insurance functions in some firms. Henry Kaufman described his unidentified firm's fairly complicated system of Hollerith cards, which included for each policy a new business card, a dividend card, a deferred premium card, and so on, each card designed differently (some including sections for handwritten entries as well as columns for punched entries) and punched in duplicate for verification. He accepted this repetition, explaining that for such extensive use of punch cards, "It is necessary of course to have a number of different cards, as all the information cannot be punched on one card; and furthermore, it will facilitate matters if one card is not used for too many purposes, especially as the punching of the cards is a very small matter" [13, p. 279]. Unlike in the actuarial uses described above, where sorting and counting cards were the main functions, in these uses some fields had quantities that needed to be summed. Because the tabulators of this era did not provide accumulators for each field, the tabulating device "must be ordered especially to meet the requirements of each particular office," requiring firms "to carefully ascertain in advance what fields are desired to be added, because when once such fields are established they cannot be changed" [13, p. 278].

In this final application of Hollerith tabulating equipment, we can see the strengths and weaknesses of the technology's initial uses in the insurance industry. Neither the tabulating machines themselves nor the cards the insurance firms custom-designed were very flexible at this stage. These cards, like those used in actuarial studies, basically translated non-punch-card records to punch cards, increasing rather than decreasing the repetition inherent in insurance processes. Kaufman commented "It may occur to some that as a good deal of this data is common to all the cards, one card could be planned that would cover everything, but of course the different uses to which these

cards are put must be taken into consideration and also the manner of using them" [13, p. 295]. At this stage, the author, and probably most other insurance firms using the cards, were content with the increased speed the system provided at each stage of the repetitive process (even punching, he pointed out, is seven times faster than handwriting), not trying to reduce repetition by consolidation of records or of steps.

Incremental Improvements in Technology and Use

In subsequent decades, developments in tabulating technology opened the way for new uses in the insurance industry. The technical developments, spurred by the competition between Hollerith and his Tabulating Machine Company (subsequently acquired by the Computing-Tabulating-Recording Corporation, which then changed its name to International Business Machines, Inc.), on the one hand, and James Powers and his Powers Accounting Machine Company (later acquired by Remington Rand), on the other, have been well documented by others [1, 2, 3, 5, 19]. In the life insurance industry, another inventor, J. Royden Peirce, worked closely with Metropolitan Life and less closely with a few other firms in attempting to develop his own tabulating system with many of the same features [16].[4] While many of the incremental innovations aided in speeding up the tabulating technology, the advent of the printing tabulator allowed the first major change in the nature of those processes, and that of the alphabetical tabulator the second.

The printing tabulator was first commercially introduced by the Powers Accounting Machine Company around 1914, by which year Peirce had also contracted with at least two life insurance companies to custom build printing tabulators [20]. The Tabulating Machine Company followed with its own improved version, an automatic printing tabulator, in 1920. Initially, printing tabulators printed out the totals previously simply displayed on a register to be copied down. Soon they could list data on a whole set of cards and print subtotals as well as totals.

The interest of the insurance companies in the printing tabulator was based on the new possibilities it opened up for consolidating steps as well as speeding up previous processes. In a paper presented at the Life Office Management Association around 1926 [7], the author noted the impact of this innovation on life insurance practices:

> Because the original Hollerith tabulator was a non-listing machine, the punched cards were seldom used for direct preparation of records and their use was more or less limited to the various analysis work. This condition was changed when the Powers, and a few years later the Hollerith printing tabulator,

[4]There is not space here to relate the story of his efforts, but papers in the Metropolitan Life Archives [16] reveal that he anticipated in concept (though not in reliable working equipment, since he was never very good at constructing the equipment he designed) several of the developments of the other two firms.

> made their appearance on the market. These tabulators opened a new field for the use of punch cards. The practice of tabulating original records directly from punch cards is gradually becoming more common and is taking the place of former analysis of records after they were made by hand.

Thus the printing tabulator made insurance processes more efficient by eliminating steps from the old manual methods and going straight from cards to reports and records. For example, cards could be sorted by district and then agent, and, with appropriate printed forms in the printing section of the tabulator, directly create printed lists of all the policies serviced by a specific agent (the Metropolitan Life Archives [16] contain an early example of such a report). Previously such a listing would have had to be prepared by hand or typewriter from the cards that had been sorted. With this development, tabulating equipment ceased to be a glorified adding machine and became a tool for creating needed management reports from raw data in card form.

A further major innovation in tabulating technology, the alphabetic tabulator, opened the way for a further reorganization and consolidation of insurance processes to allow firms to generate external documents such as premium notices, receipts, and even policies, as well as internal reports, directly from punch cards. Up until the mid-1920s, commercially available tabulators could only sort, count, and print numerical data. Alphabetic information such as the policyholder's name had to be handwritten or typed, or applied in a separate step with an Addressograph (a device which used embossed metal plates to print alphabetic or numeric material). As early as 1913, dated drawings reveal [16], Peirce had conceived the idea of tabulating and printing alphabetic characters as well as numbers. Used in conjunction with forms, such equipment would be able to produce external documents such as notices without the use of an Addressograph. In a Dec. 18, 1916 letter to Metropolitan Life's actuary, J.M. Craig, Peirce presented to a vision of how such equipment could transform insurance processes, saying that it would be

> . . . a great step in advance of anything which has heretofore been done in this line. . . . Once the primary card has been made all the reports and notices from the beginning of the policy's career to its end will be made by machinery. From the production of the card to the final reports in the actuarial Division is one continuous automatic mechanical cycle" [16].

By 1918, the Metropolitan had signed a contract with Peirce covering such equipment. This vision took a long time to realize, however. Peirce's own developmental efforts became bogged down, and in August of 1926 the Metropolitan had to get IBM to take over the contract [16]. Meanwhile, in 1924 Powers introduced an alphabetic tabulator which made it possible to punch, sort, and print letters as well as numbers [2, p. 14]. With the limited capacity of cards, however, a name plus basic policy information was about all that could be coded on a card. The 80-column card introduced by IBM in

1928, followed shortly by IBM's own alphabetic tabulator, made it possible to put both numeric fields and a significant number of alphabetic characters on a single card.

This new configuration had the potential to allow the direct generation of external documents such as premium notices and receipts directly from cards, but it still could not print an address on several lines. It was not until the early 1940s that the *Life Office Management Association Bulletin* announced to its members the imminent appearance of an IBM system that "makes it possible to list as many as three lines of alphabetic printing from a single card" and thus "is applicable to the writing of premium notices" [22]. Until that point, Addressographs were still used by most large firms in preparing and addressing such external documents. In 1948 a card-driven system, in this case producing notices and checks, was still rare enough to deserve comment in a Supplement to that publication [21]; ironically, this same issue announced some of IBM's earliest electronic equipment. Thus the vision of a fully integrated process conceived by Peirce was not realized for many decades, and then only when a new, more powerful technology was on the horizon.

Conclusion

Insurance firms initially used tabulating machinery simply to speed up existing manual methods of sorting, counting, and adding by mechanizing them. As they gained experience and as equipment improved incrementally, they strove to use each card in more ways. They used new printing and alphabetic listing devices to create internal reports and eventually external notice, receipts, and even checks directly from the tabulated cards, rather than copying down the numbers from the tabulator registers and then incorporating those numbers into other documents. This required rethinking work organization and the central production processes within this information-intensive business in which documents--broadly defined to include everything from a report to a policy to a check--are the only physical products.

While developments in tabulating technology shaped the life insurance industry in the first half of the twentieth century, that industry also influenced the tabulating industry. Space constraints preclude developing this half of the interaction, but it may be suggested briefly. The insurance industry's needs in tabulating technology were certainly made clear to the leader in tabulating technology through Gore's development of early sorting technology, through Metropolitan Life's sponsorship of Peirce's ideas for printing and alphabetic tabulating, and through insurance enthusiasm for the Powers printing tabulator. In a 1914 letter from Gershom Smith, general Manager of Tabulating Machine Company after Hollerith retired, to Thomas J. Watson, president of the Computing-Tabulating-Recording Corporation to which TMC belonged, Smith warned Watson of the danger posed to their insurance industry business by the developments of Powers and Peirce [1, p. 332-3]. He cited rental fees and card sales for the insurance industry adding up to almost $140,000 a year, a significant chunk of total income given that 1913 revenues were around $950,000 [23]. With that at stake, the tabulating industry certainly had to pay attention to the insurance industry and its needs, making

the relationship been information technology and business uses of that technology a reciprocal one.

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