The Number Factory: Punched-Card Machines at the Dutch Central Bureau of Statistics

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This article describes the application of punched-card machinery for data processing at the Dutch Central Bureau of Statistics (DCBS) between 1899 and the mid-1960s. It demonstrates that the increasing replacement of manual data processing by these machines was not stimulated primarily by their technical improvement, but by specific changes in the bureau's statistical program. Attention is paid to the influence of the labor market, organization of labor in data processing, and the establishment of a special data processing department, paving the way for the introduction of the digital computer. The development of the statistical program of the DCBS is related to its wider social context.

Punched-card machines represent an important development in the history of data processing. Invented by Herman Hollerith to deal with the American census of 1890, their use thereafter spread rapidly. Within decades they were being used on a large scale for statistical and administrative purposes and to a lesser degree for scientific calculations. Many business concerns and institutions owned or leased their own extensive machinery. The punched-card technology formed an important part of the emerging information society.

Although there is considerable literature on the technology itself and on the industry to which it gave rise, the reasons for the use of the punched-card system have received rather little attention. Insight into these reasons is necessary if we wish to understand the success of the technology. Which social developments created such favorable conditions? James Beniger is one of the few to have formulated an answer to this question. In his book *The Control Revolution* he postulates that the demand for information technologies grew out of a crisis in the control of production, transport, and distribution of goods in industrial society. It is nevertheless worth asking if there might not also have been other reasons.

Another reason for examining the use of punched-card machines is the fact that the organization of labor in today's computer departments is strongly influenced by those that arose in the era of the punched-card machine. As we shall see, data preparation rooms, and forms of systems analysis and rudimentary programming all existed before the computer age.

This article examines the use of punched-card machines within one organization, the Dutch Central Bureau of Statistics (DCBS). In 1916 this institution was the first Dutch organization to install card processing machines, and by the Second World War it operated one of the largest punched-card machine systems in the Netherlands. The machines superseded the manual counting that had originally been the only method of data processing (and which remained the method for certain statistical work right up to the 1970s). The questions to be asked are, For which reasons did the DCBS increasingly prefer the punched-card method above manual processing, and how did working methods and the organization of labor evolve around these machines? At the end of the article, I briefly discuss the introduction of the digital computer.

Keeping count

The Dutch Central Bureau of Statistics dates from 1899, although the government had carried out statistical research before this date; for example, a decennial census had been carried out since 1829. The need for statistical information had been growing from the middle of the nineteenth century. Parliamentary democracy meant that both governments and citizens needed information on the state of the nation. Moreover, the industrialization that took place in Holland toward the end of the nineteenth century was characterized by growing conflicts between employees and their employers, and a corresponding demand for information on the conditions of the former.

The government set up the DCBS as an independent office with the intention of enhancing its objectivity. The DCBS's work revolved around social statistics: wages and working hours, unemployment, unions, collective settlements, and strikes. The bureau also prepared statistics on the observance of labor and safety legislation and on prices, care of the poor, criminality, government expenses, and elections. The DCBS also carried out the decennial census.
The Number Factory

The DCBS always had a great deal of counting work. This was originally carried out manually, by keeping tally and counting by hand. For the census the bureau temporarily hired a large number of sorting and counting clerks, divided into a day shift and an evening shift. They repeatedly sorted and counted the forms according to different characteristics (housing, date of birth, marital status, and so on). The counting was performed by two clerks who compared results afterward. Special checking clerks made sure that the others had sorted and counted the forms correctly.

In the early years, DCBS employees working in its Population Statistics Department also used buttons and boxes. For each form with a particular characteristic, a button was thrown into a corresponding box. For calculations, the DCBS bought simple calculating machines; the first, made by Burroughs, was purchased in 1901.

The Hollerith method

In 1916 the DCBS introduced a revolutionary innovation in counting methods: punched-card machines, at that time referred to as Hollerith machines. The DCBS was the first Dutch organization to take this step. The machines were acquired to deal with the statistics of foreign trade, giving an overview that consisted of tables of imports and exports, storage in goods depots, the method of transport, and the throughput at harbor. In 1916 the DCBS had taken over responsibility for these statistics from the Ministry of Finance, where they had fallen into decline. World War I was to be the impetus in a move toward better statistics. Shortages of raw materials meant that the government had to take emergency measures.

The DCBS considered the Hollerith method the cheapest way to process the figures. Visits were made to Berlin, where the German National Bureau of Statistics (Kaiserliche Statistische Amt) was trying out the machines with export statistics. At that time Germany was at war, but Holland had adopted a neutral stance. In 1916 DCBS signed a contract with Dehomaag (Deutsche Hollerith Maschinen Gesellschaft) Hollerith's agency in Germany, for two tabulating machines, four sorting machines, and 26 card-punching machines. A third tabulating machine soon followed. The DCBS chose a 34-column card, sufficient for the demands made by the trade statistics, and the cards were printed specially. The rent payable on the machines was DM 1149.10 per month (not including the third tabulating machine).

It is worth noting that Dehomaag was able to supply machines in 1916, because at that time the agency was suffering a shortage of machines. Supplies from the US had stagnated because of the war, while demand for the machines had grown for the same reason. Perhaps the answer lies in the fact that just before the US joined the war in 1917, the American parent company C-T-R (Computing Tabulating Recording Co., the result of a merger that had included the Hollerith company and which would later become IBM) had sent a batch of machines to Dehomaag. Dehomaag also began manufacturing punched-card machines. The DCBS did, however, pay a 15 percent “war duty” on the punch cards.

The war may incidentally also have been responsible for the fact that James Connolly's History of Computing in Europe incorrectly cites 1919 as being the year in which the DCBS bought punched-card machines. His information is probably based on American archives in which the wartime transactions with Dehomaag do not appear.

Counting step by step. Data processing took place in three subdepartments: the control room, the punch room, and the machine room. Each department had about 20 personnel. In the control room the incoming data was checked and encoded; in the punch room the cards were punched; and in the machine room they were sorted and counted. Much of the work, such as the card punching and the operation of the tabulating machines, was carried out by women. The head of the female staff was also a woman. At this time an increasing amount of administrative work generally was being performed by women. At the DCBS the sorting machines were operated by men. The reason for this is probably that one stood at these machines and had to bend down to remove the sorted cards from the card pockets; the machine was even nicknamed the “backbreaker.” Both standing and bending down were considered unsuitable for women, bending being
hampered by tight corytary. It was also a man who repaired the machines and instructed the new operators.

The data on trade statistics came in as returned customs documents. These statistics were prepared monthly, and it was important that the figures were made available as quickly as possible. For each goods load the keypunch operators prepared a card recording the harbor name, method of transport, the country of origin or of destination, the type of goods, their weight, their worth, and their number. The code for the type of goods had four figures, as the DCBS, according to international standards, distinguished among more than a thousand different kinds of goods. The keypunch operators visually verified the data entered on the cards with the original documents.

In the machine room the cards were sorted according to type of goods and country. This too took place a step at a time, in a "multicolumn sort," with the cards being repeatedly fed through the sorting machine. First the operators would sort the cards according to the last number of the goods figure, then according to the last but one, and so on, until all the cards were in the correct order. The women at the tabulating machines then counted the volumes and the values of the goods by type and by country.

Two women sat at each machine (see Figure 1). One woman read the amount of goods per country off the counters and typed these numbers into an adding machine to calculate the grand total. The cards were then passed through again, this time to count warehouse goods movements, the method of transport, and the transit ports. So far as can be seen in the DCBS archives, the department processed nearly two million cards per year. The most important part of the monthly trade statistics was prepared during the first half of the following month, using overtime, with the results appearing around the 15th of the month.

The DCBS continued to produce trade statistics after World War I. Although the bureau reduced statistical activities in other areas, the government needed trade statistics for the preparation of trading treaties with other countries. Moreover, the figures were also important to trade, industry, and transport firms; these sectors expanded considerably in the years after World War I.

Around 1920 complaints began to be voiced about the punched-card machines, complaints about poor-quality card material, the lack of spare parts, and the age of the machines. It is possible that Dehovagh had been using older machines because of license problems with the American parent company, C.T.R. In 1921 the DCBS signed a direct contract for the delivery of new machines with the parent company in New York. In 1922 a special machine was delivered, at no charge, which checked whether the cards were the correct thickness and whether they were contaminated by carbon deposits or metal fragments that could cause problems during processing.

The archives do not make clear how working with the machines was experienced by the operators themselves. The DCBS annual report of 1925 does, however, make mention of the din that the operators had to suffer: "the health of the officers at work in this room was not benefited by the constant commotion engendered by the machines." Following this comment, the DCBS divided the room into two separate areas: a sorting room and a counting room.

A lady of Paris. For the national census of 1920, the DCBS acquired another new kind of machine: the "classicompteur" (see Figure 2). This was a sort of desk adding machine with 60 keys. Each key had its own counter. By pressing on a key the counter increased by one — a classic tallying device. The DCBS again employed women to operate these machines. For each census form containing personal details, they struck the appropriate key and read off the counters at the end.

In the housing statistics, for example, the number of rooms in the dwelling corresponded to the vertical axis on the keyboard and the number of people in the dwelling to the horizontal axis. For each dwelling, the key was pressed that corresponded to both the number of rooms and the number of inhabitants the dwelling contained. At the end of the process, the totals could be easily read off. Five classicompteurs were bought; the French machines were accompanied by a Parisian woman who gave initial instruction to the personnel. About one-third of the population statistics were carried out using the machines and the rest by hand. After the census the DCBS did not use classicompteurs anymore. For the few statistics for which they were suited, they hardly offered any practical advantage.

Punched-card machines in the Amsterdam Municipal Museum. During the 1920s, Dutch demand for punched-card machines increased. Large municipal firms, banks, insurance companies, and trading firms all acquired ma-
The Number Factory


cines. In 1926 the Amsterdam Municipal Museum held a large exhibition on business administration, where businesses told of their experiences with punched-card machines. According to Connolly, the Netherlands was an important market for punched-card apparatus:

In the early post-war period little Holland became an important unit in the computing world. There were a variety of installations of Hollerith and Powers machines in a wide assortment of business and government offices.

However, a big failure also occurred. In 1923 the National Post Office Girobank ordered $600,000 worth of Powers machines, then the largest European order of punched-card machines ever. The mechanization was accompanied by a reorganization of the service, unfortunately ending in enormous chaos. All machines were resold, and the service was closed for a year to straighten out the administration.

In the 1920s, the DCBS continued to restrict the use of their punched-card machines to trade and to no other statistics. Probably the trade statistics had a number of characteristics that favored machine computation:

1. A large amount of basic data.
2. A large number of tables (both imports and exports, warehouse stock movements, means of transport, transit ports). Punching the cards took considerable work, but once punched the cards could easily generate many different tables. Henceforth the number of tables required by a statistical process will be referred to as its complexity. The punched-card method was especially suited to complex statistics.
3. The type of calculations. This was adding numbers together, not simply tallying forms, as had been the case in the census. Adding was more work than tallying.

Moreover, the reorganization of the trade statistics facilitated the transition to the punched-card machines, as the working methods had been reexamined accordingly.

The complexity of the trade statistics was also connected to the number of different users of the statistics. Industrialists, traders, transporters, and government were all interested in the figures, but each sector wanted to see them set out in a different way: the one interested in countries of origin or of destination for a specific product, the other interested in the means of transport or in the transit ports. Yet another wanted to see the total import or export figures for one product.

Increasing mechanization

During the economic crisis of the 1930s, the government decided on a new economic policy. The DCBS therefore expanded the scale of its economic statistics, including, for example, an international balance of payments and a census of firms. The accuracy of various statistics was improved. Pressure from outside, particularly from trade and industry, sometimes led the DCBS to publish statistics that were more accurate than the bureau itself deemed necessary. The DCBS also began econometric research, the key figures in this work being the physicist and later Nobel prize winner J. Tinbergen. After a decline during the 1920s, between 1928 and 1939, the DCBS work force rose from about 215 to 560 employees.

During the 1930s more and more statistics were being carried out on punched-card machines. An important reason was the increasing complexity of the statistics. As has been mentioned, the punched-card technology was favored when many tables were required from one set of data. This was a two-way process, for once the machines had been used it was a simple matter to increase the number of tables derived from the data.

It seems likely that the machine cost/labor cost factor was rather less important for the increased use of the punched-card machines. During the 1930s the dollar exchange rate fell (from F 2.50 to F 1.50), which made the machines cheaper. However, the price of labor also decreased in the same period; wages fell and the DCBS could also cheaply employ the unemployed.

The first new statistical job to be transferred to punched cards, the 1930 census, offers an example. The growth of the population from 7 million in 1920 to 8 million in 1930 was a reason for the introduction of punched-card machines, but more important was the increasing complexity of the census statistics. For example, a “morality table” was now to be drawn up showing the number of families in which two persons, not married but over fourteen years of age and of opposite gender, slept in one room together. The data was to be derived from the given data on the number of rooms in the house, the number of male and female inhabitants, and their ages. A complex sorting and counting procedure was necessary. For the purposes of the census the DCBS arranged for the delivery of five “census machines,” which IBM had recently brought onto the market (see Figure 3). In one action, a census machine could sort according to one column and tally the cards according to the data in three columns, including the sorting column. The results could be printed on sheet paper by pressing the sheet against the counters (above which ran an inked ribbon).

The data processing was prepared with the greatest care. The two heads of the census drew up a comprehensive work scheme in which the data processing was set out step by step. This work scheme was translated into a handbook for the machine operators, which contained details about which columns were to be sorted and which counted for each card run. The handbook was hundreds of pages thick and reads remarkably like a computer program. Both, after all, consist of a series of instructions to be carried out by the hardware. However, in the handbook repeated operations are often described in full, whereas in a computer program this is not the case. We would nowadays describe the punched-card data processing method as “parallel processing,” as four machine operations (three counts and one sort) took place at the same time.

Complexity and the data model. The introduction of punched-card machinery was sometimes hindered by problems with the layout of the punch card. It was an issue of an
extensive debate about the mechanization of the business census, held for the first time in 1930. The Central Statistics Committee (the policy organ of the DCBS) was pressing for mechanization, but the census organizers were unhappy with the data model used by the cards because the number of data fields differed greatly between different businesses. This applied, for example, to details of power machinery (oil-fired engines, petrol engines, wind-powered machinery, steam-powered machines, electro-motors, and so forth). Since every machine could have a different power source, the cards devoted a great deal of space to such questions, vital space which was inevitably most empty. For this reason, the business census was carried out by hand.

Ten years later, in 1940, the data model for the business census was changed to allow punched-card processing. A separate card was prepared for each power machine in a business. The number of cards was variable, but the number of data options on each card was fixed. The DCBS also no longer recorded the exact power of each machine but placed it into a power category. The numbers thereby no longer needed to be added up, but could be tallied on the census machines. Ultimately the entire business census was dropped because of the war.

Also, skill requirements of personnel could hinder the introduction of punched-card machinery. This became apparent in 1935, when H.W. Methorst, the director of the DCBS, spoke to all his department heads to promote the use of punched-card machines. The introduction of the punched-card method in the Criminal Statistics Department, for example, meant having to encode the data. The problem was that the encoding had to be performed by trained staff, while counting the documents by hand was carried out by untrained staff. The department was unwilling to replace its untrained personnel with trained staff.

Despite such problems, the application of the punched-card method slowly diffused within the bureau. In 1934 the punched-card machines themselves were replaced. The DCBS replaced five sorting machines and six tabulating machines with four faster sorting machines and three new tabulating machines. The 80-column punch card, which had already been used for the national census, was immediately introduced for the trade statistics.

In 1937 an efficiency study was performed in the DCBS. As a result, the bureau gave punched-card processing its own separate department, initially simply a subsection of the Trade Statistics Department. Until that moment, only this department and the Population Statistics Department had their own machines; the other departments “borrowed” them. Centralizing the machines was an attempt to improve their efficiency and their accessibility to the other departments. In the efficiency study, the routing of the data was also investigated.

The final stages of data processing. In this period the number and variety of machines increased as a consequence of the mechanization of the final stages of the data processing procedure. In the case of the trade statistics, these stages consisted of reading the results off the tabulating machines and converting them into the final press copy. The growing accuracy, resulting in a growing number of goods types, was making the work by hand and desk calculators increasingly laborious.

In the second half of the 1930s, printing tabulating machines and “summary punches” were introduced. The latter read the numbers shown by a tabulating machine and punched them onto a new card. The machines were coupled electrically to the tabulating machines. The new cards could subsequently be processed by tabulating machines. The women with the Burroughs adding machines no longer had to type the figures direct from the counters, and sat not at the machines but along one side of the machine room (see Figure 4).
The Number Factory

Figure 4. The machine room in 1939.

The year 1937 also saw the installation of the first Dutch sorting machines, made by the firm Kamadex. Up till then, IBM had been the only supplier to the DCBS. The Dutch machines were considered cheaper. The purchase price of a Kamadex sorting machine was F 3500 (then about $2,300), whereas a Hollerith cost F 700 (about $450) a year to rent. The Kamadex machines were also faster. The DCBS held onto its IBM tabulating machines, so from 1937 the machine room had mixed apparatus. In 1939 the national government facilitated the use of Dutch equipment by forcing IBM to scrap its "competitor clause" in contracts with government institutions. This clause had prevented the client from purchasing equipment from other manufacturers.

At the end of the 1930s, the DCBS replaced the tabulating machines with IBM Model 3S and 4S tabulating machines. These offered automatic control by sensing data held by the cards. The machines continued working as long as the data in a specific field was identical to that in the previous card. When it changed, the machine stopped, printed the counter figures onto paper or onto new cards, reset the counters to zero, and began counting again.

The war. Between 1940 and 1945 the Netherlands were occupied by the Germans. The Dutch economy was, at least initially, left largely intact by the Germans, and the DCBS continued most of its activities. In the beginning of the war period the institute actually underwent enormous growth. It received a new assignment: assisting the National Bureau of Industry in the registration of stocks and rations. In 1941, the DCBS took over a large bureau of statistics that had been set up by the Ministry of Agriculture in the 1930s: 200 staff and comprehensive machinery. The number of staff employed by the DCBS rose to almost 1,000. With 40 card-processing machines, the bureau now had the largest assembly of Hollerith machines in the Netherlands.

As the war progressed, work at the DCBS became more and more erratic. New machines were delayed and work slowed as general economic activity declined in the Netherlands. Many staff lost their jobs since wages were higher elsewhere. Many men disappeared, having been sent to forced labor camps or having gone into hiding. The unemployment crisis of the 1930s had meant that many men were given the women's jobs of operating the tabulating machines. During the war, women got these and other jobs back (see Figure 5). In 1944 work came to a complete standstill.

Postwar reorganization

After the war ended, work at the DCBS slowly returned to normal. In 1947 the Mechanical Processing Department replaced the obsolete machines. Orders were placed with the French company Machines Bull, whose Dutch agent was Bullatec, the erstwhile Kamadex. At this time there were about 40 punched-card machines, a number that would grow to about 60 in the 1950s. The equipment included sorting machines, tabulators, reproducers, summary punches, and collators, which merged decks of sorted cards. Around 1950 the Mechanical Processing Department had a staff of close to 200.

As a result of the growth of the DCBS the director, Ph.J. Idenburg (who succeeded Methorst in 1939), commissioned a study of its organization by external advisers. In addition, the DCBS set up an internal Office of Organization and Efficiency in 1948. Central to the new office's philosophy was "functional organization," a concept that went back to the 1920s and "scientific management." It represented a form of labor division in which tasks of a given difficulty were combined as far as possible into functional units. An office was even set up for adding and arithmetic work housing only boys and girls of 14 or 15 years of age.

The Mechanical Processing Department was also reorganized. In 1950 the DCBS stated that this department "forms, with its extremely sensitive apparatus, in a certain sense the 'bottleneck' in the Bureau's work cycle." A task preparation office was set up which produced operational instructions, describing specific processing tasks and the necessary control methods, for each incoming assignment. Assignments passing through the Mechanical Processing Department were now accompanied by an "order envelope":

The order envelope gives a schematic route of the machines to be employed and the tasks to be carried out, and gives the time planned for each task.
The actual times taken for each task were noted to calculate processing costs. Reorganization made certain employees work less attractive; some machine operators now had only to place the plug boards onto the machines and feed in cards. Nevertheless, they saw themselves as specialists and continued to wear the professional-looking white coats that protected them from card dust.

The directors considered the number of cards processed to be the measure of the performance of the department. In 1949 this number was 13 million (of which only 2 million were attributable to the Trade Statistics Department). In 1951 calculations were made of the weight of the cards transferred between the machines. It was an average of two and a half tons per day. Remarkably, the performance of the adding and calculation offices was expressed as the number of processed figures and the length of the printer rolls that passed through the calculating machines. In 1951, 50 million figures were processed, using 200 kilometers of printer roll.

The Mechanical Processing Department (renamed the Central Processing Department in 1953) was increasingly taking on the appearance of a “numbers factory.” In 1947 a member of staff of another department had called his department a “number-mill.” In 1949 the annalist of the DCBS's 50th anniversary remarked on the “factory element” in the processing work, though this was in reference to the 1916 introduction of the punched-card machine. In fact, the same factory comparison was being made at this time in other punched-card departments in many other parts of the Netherlands.9,10

The department went on to mechanize the processing of trade statistics still further. In 1951 it was able to produce the final, print-ready version of the trade statistics entirely mechanically. A collator combined cards holding numerical data and cards holding text, and a tabulating machine printed the tables on paper. The department brought in a new kind of punched-card machine, the IBM 101 Electronic Statistical Machine, which worked using vacuum tubes. It meant that additional selection modes were possible, and it could also be used to search for faulty cards. Programming the IBM 101 was, however, considerably more complicated than programming the conventional tabulating machines; the plug boards were sometimes a huge ball of wires. By this and other developments, the number of consecutive processing operations was constantly increasing, a fact revealed by the number of “intermediate” cards containing partially processed data. In 1956 there were 8 million of these, compared with 12 million original data cards.

Keypunch operators wanted. The number of women at work in the machine department fell once again during this period. Of the 30 staff in the machine room in 1955, only about eight were women. Nevertheless, the head of the machine room was a woman. The cause of the decline must be sought in the tendency in this period for women, and especially married women, to be pressed to devote themselves once again entirely to domestic work.

The DCBS actually had problems recruiting enough women for the punching. In 1953, the DCBS was actually forced to carry out a large assignment by hand. The bureau did not raise the low salaries — a difficult move in those times of cost-cutting and a controlled wages policy — but it did seek alternative, technical solutions. In 1947 it had already tried an alternative to the punched card, namely mark-sense cards. These were cards printed with little boxes that were selectively penciled in, these cards being automatically read by a “mark sensor.” However, filling in such a card took more time than punching an ordinary card, and for this reason this method was used only in a small number of statistics. The Dutch Post Office also carried out research into the possibility of replacing the punching process with a machine able to automatically read written numbers, but no useful results emerged.9,10

In 1956 the DCBS set up a second punch room in the city of Apeldoorn, outside the urban conglomeration of Western Holland, where women were easier to find. In addition, the situation improved in 1957 when the Dutch Parliament reversed the 1924 ruling that had prohibited married women from working for the government. In short, this period demonstrates that the whole punched-card method was dependent on fast and cheap keypunch operators, and that the early abundance of women in the labor market had stimulated its introduction.

A glorified tabulating machine

In 1955 Idenburg, the director of the DCBS, asked the head of the Central Processing Department to investigate the application of the digital computer. He and his assistant wrote several reports about the choice of machine, comparing different models. The computer eventually chosen was the Dutch Elektrologica-X1.11 This was a scientific computer that had been specially adapted to carry out administrative work.
The Number Factory

Before it was delivered, future programmers, operators, and systems analysts were trained. Most of them were selected from existing personnel with a psychological test. At that time the Central Processing Department had around 150 staff, 70 of whom were keypunch operators. Those who had been carrying out the “task preparation” work since the 1950s reorganization now turned out to be the most suited to the post of “systems analyst.” It appeared that the progressive reorganizations over the years had simplified the eventual introduction of the computer.

The XI computer was delivered in 1960, and for a while it was used merely as a glorified tabulating machine. The reason for this was that it was not yet equipped with magnetic tapes; its memory was therefore too small to carry out any sorting. To give an example from the trade statistics, each combination of country/goods type needed a memory location if sorting was to be carried out. For 4,000 goods types and 150 countries this meant 600,000 memory locations, more than the computer had. So the department continued to sort using conventional machines. At first, the computer only reduced the total number of processing runs from 450 to 200; two summary punches transferred the computer results onto new cards, and these were then processed further. In 1963 the computer generated a total of 1.3 million cards in this way. As the stacks of cards had once been dragged to and fro between punched-card machines, now they were dragged to and fro between the punched-card machines and the computer.

The early years with the computer were not without a great number of teething problems. Every day brought small but annoying breakdowns. Moreover, the computer reduced the flexibility of data processing; the systems analysts and programmers needed to know what was required of the data well in advance.

One advantage of the computers over the tabulating machinery was that more validation could be carried out on the raw data. The growing demands being made on the accuracy of the statistics made this increasingly important. For example, the computer checked the trade statistics product prices by dividing the cost of each cargo by its weight and determining whether this price lay between given boundaries. The result was a printed list of all the most improbable figures, which was checked further by hand. An important saving of labor resulted, which, however, was not well received by some of the personnel of the statistics departments since part of their expertise lost its usefulness. Only when the computer was fitted with magnetic tapes in 1965 did it achieve its most important advantage: It could perform many consecutive steps in one run, since now it also could carry out sorting operations.

The decline of the conventional punched-card machine room took longer than one might have expected. The final curtain was not to fall on the punched-card machine age until 1983, when the last sorting and reproducing machines succumbed. It is also important to remember that the DCBS carried out a considerable number of statistics by hand up to the 1960s, before they were finally transferred to the computer.

Conclusions

We have seen that the DCBS subjected the tallying and calculating work to increasing degrees of mechanization and automation. Over the years the bureau used three methods to achieve this end:

1. calculations by hand, with or without the aid of desk calculating machines;
2. punched-card machines, with or without the help of detailed operational instructions or descriptions of plug board configurations; and
3. digital computers.

Two important directors of the DCBS stimulated the introduction of new machinery. H.W. Methorst promoted the introduction of punched-card machinery. Ph.J. Idenberg did the same with the digital computer. The DCBS was very active in the international world of statistics and had a good reputation. They wanted to keep their organization abreast of the most modern technology.

The difference between manual calculations and punched-card processing was considerable, because data models, organization of labor, and the skill levels of the personnel had to change. Processing flexibility was reduced, as all the processing steps had to be established well in advance, and the statistics departments lost part of their autonomy after the punched-card processing department was centralized. Working conditions also changed, sometimes for the worse — for example, the din caused by the machines.

The computer, on the other hand, followed naturally from the punched-card method. Every statistical calculation performed using the punched cards could be transferred to the computer. Moreover, the computer offered more possibilities, especially in data checking. In this sense, the computer simply meant speeding a process already in existence, since improved, electronic punched-card apparatus was also available. The computer did nevertheless have far-reaching effects on the Central Processing Department, whose organization of labor had to be radically changed, even though the creation of a “task preparation office” in the 1950s had paved the way for the kind of organization of labor needed by the computer.

In the history of the DCBS there has always been a relationship between the evolution of the statistical program prepared by the bureau and the development of the machinery used. Up to 1960, changes in the statistical requirements formed a significant inducement to mechanization and automation. Four developments were particularly important:

1. the increase in the number of statistics produced,
2. the increase in the size of the database,
3. the increase in the statistical complexity, and
4. the increasing accuracy demanded of the statistics.

In this period other factors — such as the changing array of technologies available, the labor market, and labor costs — were of less influence. The punched-card machines became faster and more versatile, but the machinery costs grew faster than labor costs; in 1925 a tabulating machine cost
F 2100 per year to rent, approximately equivalent to 18 months’ salary for a machine operator, but in 1957 the machine cost F 20,000 per year, four years’ salary. Similarly, the digital computer did not bring the DCBS great immediate benefits, in terms of cost and capabilities, compared with the punched-card machines. The development of the statistical requirements themselves must therefore be seen as the chief cause of the increased application of technology at the DCBS during this period. In other words, this period saw a “demand pull.”

Around 1960, a new force began to stimulate mechanization and automation. DCBS activities continued to expand, but the application of the machines was principally stimulated by the rapid improvement of computer technology. (This can be called “technology push.”) User-friendliness and performance improved dramatically, while prices fell. The DCBS’s use of computers grew, and it became increasingly easy to widen the scope of statistical activities.

Questions can be posed about the societal background of the growing demand for statistical information up to 1960. Three developments can be mentioned:

1. the expansion of government activities,
2. the increasing integration — both horizontal and vertical — of private companies, and
3. the increased degree of participation by social groups in the public decision-making process and the increasing degree of consultation among these groups.

The expansion of government activities increased the need for statistics on societal phenomena. For example, in the 1930s recession the government began to consider the regulation of the national economy as among its responsibilities (before the recession, the national economy had largely been left to free market forces). As a consequence, economic statistics were expanded within the DCBS. This expansion of government activities also increased the demand for complex and accurate statistics; for instance, the “morality tables” were considered important for public housing programs.

The second social change was actually a change in the industrial structure: the increasing integration of private companies. This change also increased the requirements for scope and accuracy in statistics. In the Netherlands, the first half of this century saw considerable company integration. Businesses increasingly controlled the complete production cycle, from raw material to finished product, and moreover marketed a wider range of different but related products. These integrated companies requested more accurate statistical information from the DCBS; they needed it for planning purposes and to monitor production agreements (on cartels, for instance). This development is central to Beniger’s analysis. As has already been mentioned, Beniger points to a control crisis in the industrial system as the cause of the growing demand for information technologies, and integration in private companies did indeed bring control problems.

The third change, the increased rate of participation of social groups in public decision-making processes and the increased degree of consultation among these groups, also increased demand for statistical information. In the 1930s, consultation on economic policy between government (particularly the Ministry of Economic Affairs) and trade and industrial boards intensified. Employers and employees entered into regular consultation. Intense consultation also took place among representatives of social groups (for example, concerning labor conditions) and parties to infrastructural projects (such as the new National Roads System). Large differences of opinion could exist among the parties to such consultation that could be diminished by reliable statistical information. To guarantee that reliability, statistical activities were transferred from ministries and social institutes to the DCBS, which had an independent status within the government.

As a consequence, the DCBS often found itself compiling statistics on controversial subjects. Not only the number of statistics compiled by the DCBS was affected, but also their complexity and accuracy. The reason was that each group had its own requirements of the data. In this way, increased participation of social groups in public decision-making processes contributed to the growth in demand for computing machines and to the success of the digital computer.

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References

The Number Factory


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