Reliability and security at the dawn of electronic bank transfers in the 1970s-1980s

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Introduction

The development of awareness by banking customers and the banks themselves of the reliability and the security of the financial processes with regard to the digitalization have increased over the last 50 years.[1] Our experience with modern digital computer systems has made reliability and security training a transcendental issue. At the beginning of the 1990s, these issues became even more important, and played a central role in debates on the identification and tracking of illegal activities and the risks of terrorist activity.[2]

ICT is an active subject in modern life. In the corporate world, many companies need information systems in order to function properly, and banks are no different. As a result, the need to protect their information assets becomes a crucial factor for banking institutions. Some authors in the management and economic sciences have developed conceptual models of the information security culture that suggest that many of the processes necessary to protect these assets require cooperation within the organizations themselves.[3] Likewise, Iryna Shkodina et al. identify an underlying circumstance conditioning financial digitalization: on the one hand, the use of digital technology increases competition and efficiency in the banking market, but on the other hand, it also increases the systemic risk associated with cyber security and fraud.[4] As a result, factors such as the different organizational cultures, the different strategic positions of the managers and the lack of qualified personnel can represent an obstacle to the transformation of financial institutions. All these factors are identifiable nowadays in the midst of the digital era; however, we have considerably less knowledge about which have been the guiding principles that have led us to the present situation. The end result is that we are losing, on the one hand, the capacity for analysis of the present, and on the

[1] Accordingly, the European Commission in 2016 published a Directive which outlines a "European Policy Approach" towards "Network and Information Security" (Directive (EU) 2016/1148), see also Pounder (2001).
[2] Different cases affecting the financial sector have recently resonated in the international press. An IT failure at Britain's TSB cost its parent company Banco Sabadell (Spain) more than €200 million; Bank IT failures have damaged the credit scores of thousands of customers (as experienced by Barclays, HSBC, NatWest, RBS and Ulster, among others); and in Australia, ANZ and Westpac suffered a temporary Boxing Day meltdown.
[3] VanNiekerk and Von Solms (2010).
[4] Shkodina, Derid, and Zelenko (2019).

other hand, a prospective vision of the problems faced by the new digital society, which lacks sufficient historical perspective.

A central purpose of this paper is to analyze the implications that the introduction of teleprocessing and other data transfer systems had on banking management and administrative processes, paying particular attention to the security and reliability problems generated by these new technologies.[5] In this sense, the main objective is aimed at evaluating the new horizon that companies faced with the emergence of the new networks, which in essence meant a new concept of security and reliability of the banking management and administrative processes, with intense repercussions on the business of banking.

From the perspective of economic and business history, the proposed topic allows us to seek answers to the problems that technological change was generating within banking institutions in the early stages of teleprocessing. In a general sense, it is important to know the technological limits of the early banking applications in relation to banking management and administration. Likewise, the creation of the data transfer systems and the subsequent development of electronic funds transfers (EFT) allow us to evaluate the extent to which the banking services were affected by the reliability of the new digital developments. More precisely, this focuses on the extent to which the conflicts between security and marketing were decisive in bank offices and, in economic terms, the impact of the improvements introduced on bank efficiency. Finally, it addresses the level of involvement of banks in the design of new standards that were being developed within international standardization organizations, especially with regard to the security and reliability of the new digital processes.

In general, these matters have not received a great deal of attention in the literature on the banking industry. Thomas Haigh outlined the enormous difficulties that hindered early attempts to develop new digital systems for information management in the 1960s.[6] JoAnne Yates, in turn, emphasized the importance this had in the insurance industry, a particularly information-intensive field, and the interaction between technology manufacturers and technology users.[7] Recently, Susan S. Scott and Markos Zachariadis addressed the issue of oversight, reliance and the robustness of operations,

[5] Teleprocessing is understood as the joint use of computing and telecommunications for the purposes of data transfer, and the true presence of this process began to be felt in the 1970s. (Maixé-Altés, 2019).
[6] Haigh (2001, 2006).
[7] Yates (1993, 2005).

as well as security in relation to SWIFT, at the start of its deployment in the 1970s.[8] Similarly, Bernardo Bátiz-Lazo discussed "phantom withdrawals", based on the fear expressed by users in the 1980s in relation to potential electronic ATM errors, a debate that makes reference to whether the errors are the fault of the user or the technology.[9]

The approach proposed in this paper seeks to address the early issues surrounding data transfer, studying certain internationally significant cases that will allow us to answer the questions that have been raised. It will address the Japanese, Spanish and German cases in terms of the implementation of their national banking networks. These three cases are significant, precisely because of the early installation of their first online banking networks and their scope, since in a relatively short time they were implemented on a national level, affecting a majority of the financial institutions. The first case examines the data telecommunication system employed by all Japanese banks launched in 1971, while the second case considers the problems of launching the Spanish savings bank clearing network in 1975, and the third case concentrates on electronic fund transfers for individual payment transfers within the German savings banks' giro network in 1976. This overview will be complemented by establishing some considerations regarding the participation of European banking institutions in the development of ISO standards in the 1980s in relation to banking reliability and security. In this sense, unpublished sources from the main commercial banks and savings banks and their national industry associations are used, as well as those from the World Savings and Retail Banking Institute - European Savings and Retail Banking Group in Brussels, in addition to contemporary material, including interviews with the individuals involved in the creation and development of teleprocessing networks.

The examination of various competitive environments suggests that these processes and innovations occurred within a framework of uncertainty in which the improvements that were gradually introduced reduced the risk of the operations in terms of security and reliability. In this area, the co-evolutionary factor favored the processes of banking institutions in adapting to the new technologies.

The proposed topic will be considered as follows: the second section will outline certain general considerations on security in the banking sector; the third section will study the stage prior to the online processes, assessing the extent to which they served

[8] The Society for Worldwide Interbank Financial Telecommunication (SWIFT) is a global institution dedicated to cooperative governance to promote network innovation, standards and the banking community, Scott and Zachariadis (2014).
[9] Batiz-Lazo (2018), pp. 219-224.

as a trial run for the subsequent management of the banking teleprocessing; the fourth section will delve deeper into the problems of online transmissions in the early days of teleprocessing; the fifth section will deal briefly with some cases in which the development of banking standards had an implication on the security and reliability of the EFTs; and finally, certain conclusions will be proposed.

An overview of banking security

The issue of banking security has a long history, starting with the security questions that some savings institutions in the USA began to ask in the second half of the nineteenth century to identify account holders, up to the modern personal identification number (PIN) that enables us to access ATMs or our accounts online. Behind these controls lies the progressive importance that data have taken on in our contemporary society, and the value that certain social institutions, such as banks, have come to give to their own information and that of their clients.[10]

Matters of computer security and reliability began to occupy a prominent spot among the concerns related to international banking at the beginning of the 1970s. Part of the international agenda of the International Savings Banks Institute (ISBI),[11] one of the most prominent institutions in global retail banking –the mutual and savings bank sector– addressed these very issues. Thus, the Business Organization and Automation Committee (BOAC) of the ISBI harbored a specialized working group known as the Security Working Group (SWG). The concept of computer security concerned itself with new issues at this time, as defined by the ISBI's SWG:

> *Computer security can be defined as the protection of computing assets from loss or damage, as well as the control measures aimed at the correct and complete processing of information. Protection encompasses both prevention and recovery, including insurance. Computing assets may be defined to include hardware, physical facilities, application programs, software programs, information or data files and personnel. Loss or damage should be considered from any source, both accidental and intentional, and for varying degrees of consequence.*[12]

As a result, banking experts had varying conceptions of security at the time when computers and EFT began to take on an important role in banking operations. It included the concepts of reliability, security in the strictest sense (in relation to possible

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[10] See Ruberg (2017), Gitelman and Jackson (2013).

[11] Founded in 1924, it is known today as the World Savings and Retail Banking Institute (WSBI), with headquarters in Brussels.

[12] ISBI Archive, Program for the Security Working Group (Outline for Study of Computer Security), Business Organization and Automation Committee-Security Working Group, Geneva, May 25, 1972.

losses or property damage and to the loss-recovery of information), and accidental (unplanned) errors or deliberate actions that might jeopardize any of the aforementioned aspects. In short, computer security in the banking environment in the early 1970s involved protection, control and prevention measures for software and hardware (considered computing assets) in the broadest sense.[13]

Old and new problems

However, one problem in the late 1970s and early 1980s in the banking sector continued to be the issue of security with regard to traditional crime (bank robberies).[14] Table 1 shows a situation in which some countries like the Federal Republic of Germany, France, the UK, Spain and the Netherlands in Europe, and others like US in North America experienced a huge increase in robberies in the early 1980s with substantial economic losses for banks. The trend had been established in suburban areas, where the branch offices were less protected. Robberies at night in Sweden and vaults attacks in Finland were on the rise. Meanwhile, Belgium, Luxembourg and the Netherlands were the targets of international gangs (due to their soft borders).[15] As a result, institutions began to design policies aimed at investments in security systems. In the cases of France, Italy, and Luxembourg, the installation of counter screens and bulletproof glass significantly reduced the attacks per branch office (France reduced their rate from 2.6% in 1979 to 1.8% in 1981, selectively installing security systems worth USD 6 million per year in the areas at the highest risk). The trade unions applied the greatest pressure in favor of installing the screens. In general, the new "pop-up" screens provided enough protection for customers and staff, especially in small offices. Centralized alarm systems began to be installed, although their users detected a high number of false alarms (in Sweden, this was as high as 95%).[16] Likewise, installing time delays on cash safes in savings bank branches in Northern Ireland cut the losses per raid considerably (GBP 40,000 to GBP 10,000).

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[13] For banking software considerations, see Schmitt (2016).

[14] Nowadays, this topic has waned considerably as compared to "financial crime," understood as "crime that converts and corrupts the payment system to achieve its ends. This includes theft, fraud, money laundering, sanctions evasion, bribery, kleptocracy, cyber-terrorism, and electronic sabotage," Held (2019).

[15] ISBI Archive, Minutes of the Meeting of Security Experts, Business Organization and Automation Committee, Geneva, March 24-25, 1983 (confidential).

[16] The use of alarm controls spread with an alarm center in the branch office, information filtering and transmitting significant information to a national center, using the bank's own dedicated data transmission network.

TABLE 1 ▪ *A survey of robberies of savings banks in the early 1980s.*

Country	*Number of branches*	*Number of bank robberies*	*Bank robberies per branch (%)*	*Detection rate (%)*	*Total loss (USD)*
Australia	529	16	3.0	37	100,000
Belgium	c. 2000	67	3.3	20	NA
Federal Republic of Germany	17.400	255	1.5	42	4.1 million
Finland	1290	7	0.5	Raids: 100 Safe robberies: 0.0	170,000
France	7,370	135	1.8	NA	860,000
UK	1,641	31	1.9	NA	190,000
Northern Ireland	55	5	9.1	40	57,000
Luxembourg	89	0.0	0.0	-	-
Netherlands	1,000	10	1.0	20	1.1 million
Norway	1,218	5	0.4	80	32,000
Spain*	20,000	1,733	8.7	11	11.5 million
Sweden	1,400	35	2.5	65	201,000
USA	3,109	124	4.0	-	-
USA*	-	4,043	-	16.5	20.4 million

Note: * All banking institutions.
Source: ISBI Archive. Program for the Security Working Group (Outline for Study of Computer Security). Business Organization and Automation Committee-Security Working Group. Geneva, May 25, 1972.

The typology of these crimes was varied and they exhibited a growing trend: in the UK and the Netherlands, banks raids were on the increase in the early part of the decade, which was echoed to a lesser extent in France and Australia, while vault attacks multiplied in Finland and the Netherlands during the same period. In West Germany, Spain, Sweden, Finland, Norway and the USA, the statistics on bank raids were improving. In terms of attacks on the new cash installations, such as cash dispensers and ATMs, the statistics during this period had yet to show any substantive activity, although it was reported that their security conditions should probably be improved.[17] The human implications were noticeable and policies were developed that were aimed at staff training. The Nordic countries and Germany were leaders in this trend, while in most European countries, trade unions intensely expressed their concern regarding the problems related to bank workers and security.

Security issues and marketing problems

This evidence goes to show a problematic situation that had a direct impact on the profitability of the branch offices, because of both the losses they suffered and the increased costs associated with new investments in security equipment. As the 1980s progressed, effective solutions were implemented in response to security issues (hold-ups), some as early as 1985. However, there were new problems that affected bank

[17] Ibid.

offices. Specifically, a new situation arose in automatic branch offices, as a consequence of the conflicts between marketing and security considerations.[18] Certain findings in this regard allow us to answer one of the questions raised in this research study.

The case of the Belgian institution ASLK/CGER (General Savings Bank and Pension Fund)[19] is representative of this. In this case, the number of hold-ups decreased from 50 in 1981 (the record year) to 7 in 1984, figures much lower than in 1977, when the institution had far fewer offices. Nevertheless, the response by customers was less than friendly, because it was thought that the barriers hindered business contact. This dilemma led the banks to look for a new arrangement of their banking offices, based on more modern principles that encouraged customer contact (open space and the disappearance or reduction of the vaults present in the area accessible to the public). Along with the marketing problem, profitability problems also arose, due to the additional burdens with which this type of office operated (aspects that the institutions had to deal with in the long run).[20] The consequences of this new situation forced an adjustment to be made, focusing bank branch office reform in the center of the proposal: changing office functions and new concepts related to their design. In essence, importance was given to marketing considerations, i.e., the "new look" of the branch office. The new modules that characterized these branches were the introduction of the Teller Note Dispensers (no coins are dispensed, only notes) and the use of PNEUM-type (pneumatic circuit) pneumatic tube mail systems. In the case of the first system, its implementation was only profitable in offices with more than ten employees, while the second system was only suitable for very large branch offices. These transformations, once again meant additional burdens, which resulted in it only being implemented in new branch offices. Most institutions opted for a gradual introduction, based on financial considerations.[21]

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[18] ISBI Archive, Minutes of the Meeting of the Business Organization and Automation Committee, Helsinki, June 13-14, 1985.
[19] The Caisse Générale d'Epargne et de Retraite (CGER), known in Dutch as the Algemene Spaar- en Lijfrentekas (ASLK).
[20] ISBI Archive, Conflicts between marketing and security considerations when automating branch offices, Business Organization and Automation Committee, Geneva, June 20, 1985 (Geers' Report).
[21] The gradual application of these reforms softened their impact on the banks' operating expenses, as can be surmised from the public income statements, which were published from 1978 on in the yearly reports of the Spanish CECA for all affiliated savings banks (whose weight in the profit and loss account fell from 32.7% in 1982 to 22.8% in 1991, dates for which the comparison is homogenous).

These dilemmas between marketing and security considerations were exacerbated as the decade of the 1980s progressed. The so-called "cash adapters", common in German savings banks, and also in the US, were controversial among the security and marketing managers of some institutions in other European countries.[22] These devices were used in association with the installation of new online teller terminals in the 1970s; the Nordic financial terminal Project developed by the Nordic saving banks stands out as one example of this –Datasaab teller terminal– which was present in the European and North American market, starting in 1972.[23] The new teller terminal had a cash dispenser with a cash adapter mechanism that tracked how much cash each teller received.[24] The system substantially reduced the amount of cash a teller should maintain in the cash drawer. For this reason, in the USA it was initially implemented in New York City, in response to the high number of bank robberies. In West Germany, the system was introduced for reasons related to workplace efficiency, specifically for front office workers, and especially for security and marketing reasons, since German law considered that the notes and coins stored in cash adapter systems did not represent "cash money ready at hand". They were therefore not subject to legal requirements that compelled teller counters to be protected by bulletproof glass. In this sense, the different experiences and traditions of the use of these tools in each country resulted in preferences and decisions that were less than uniform across Europe.

In spite of the implications that these experiences had for the practice of banking and customer service, the most intensive changes emerged from the development of new services, favored by the processes of banking digitalization and technological change. Interestingly enough, problems both old and new contributed to a change in the customer-bank relationship. Simply put, they opened up a new horizon for service banking, in which the relationship between customers and bank employees, and the very configuration of bank offices, would begin to move in new directions.[25]

The phase prior to computerized banking networks: off-line systems

Unlike commercial banks, European savings banks had been late adopters of tabulating technologies in the inter-war period. When they incorporated these

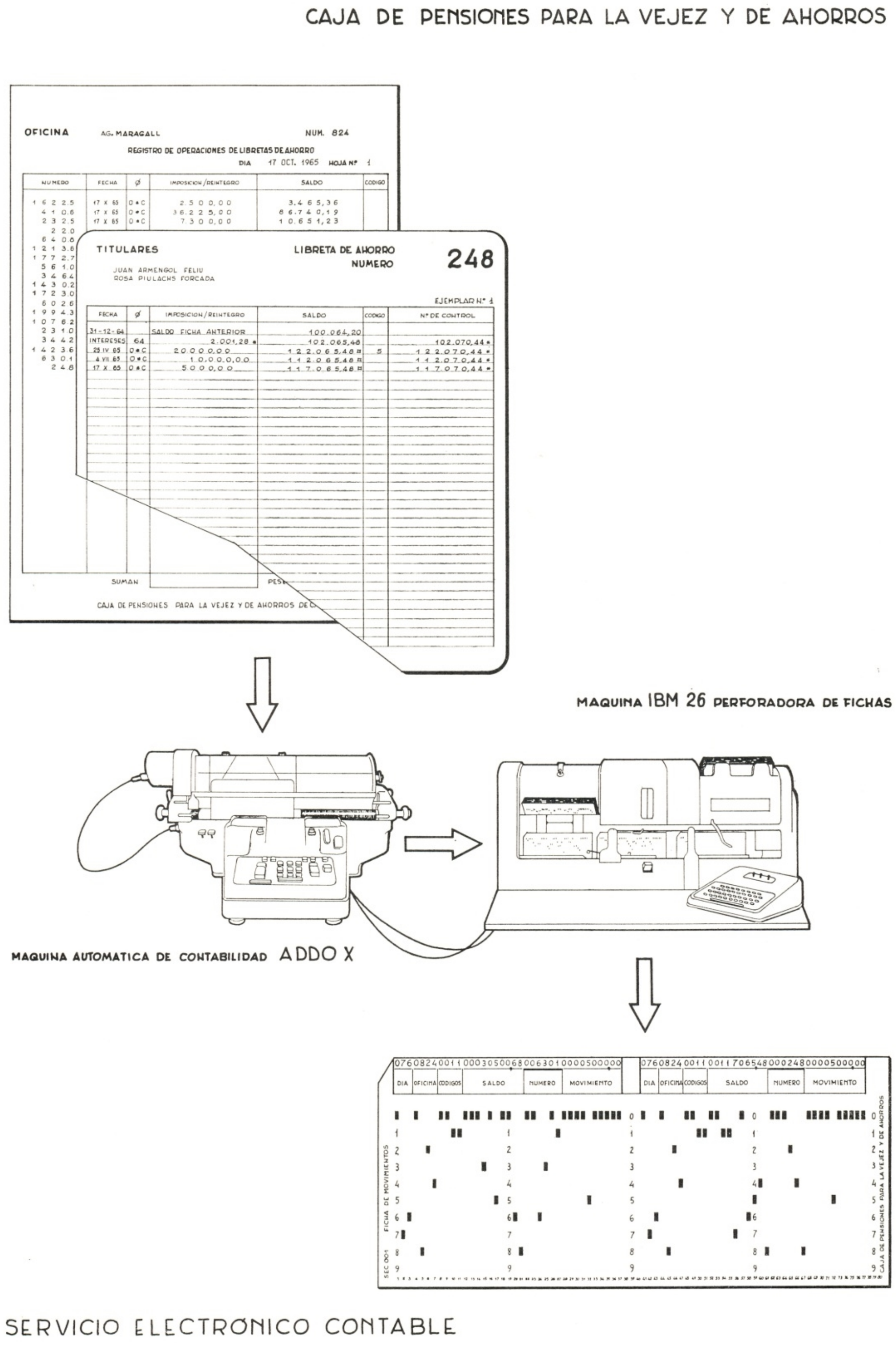
[22] ISBI Archive, Conflicts between marketing and security considerations with cash adapters, Minutes of the Meeting of Business Organization and Automation Committee, Geneva, September 27, 1985 (Richard Nowak's Report); Draft agenda, Minutes of the Security Experts Meeting, Business Organization and Automation Committee, Geneva, April 10, 1987.
[23] Maixé-Altés (2015 and 2020).
[24] Zientara (1979).
[25] Heide (2011), Bátiz-Lazo, Maixé-Altés and Thomes (2011), Ackrill and Hannah (2001), pp. 356-357.

technologies into their operating processes, they tended to adopt means that had already been experimented with previously by commercial banks and other financial entities, such as insurance companies. As a result, there was no room for what JoAnne Yates refers to as "co-evolution" (i.e., the reciprocal influence between technology and its uses).[26] However, later, in the 1960s, when the use of mainframes (especially second and third generation machines) was introduced, new dynamics emerged in the savings bank industry. The co-evolutionary factor and the incremental migratory path were activated in relation to the application of computers in this industry. From then on, the banking operations management systems using computers were governed by formulas of co-evolution, especially in those segments of the industry where, like the savings banks, there was a greater cooperative tradition in technological and operational terms.[27]

Within this framework, it is interesting to highlight the experiences that the financial intermediaries developed in the data transfer processes prior to the implementation of online connections.[28] These processes prior to online data transfers are usually considered to be off-line processes. In other words, the bank branches and offices collected information that the mainframe then needed to process. The transfer of this information to the computer center was done by conventional means. The experience that the operators acquired with the off-line processes favored the later implementation of online processes and, to a certain extent, paved the way for the progressive solution to technical problems brought about by communication between computers.

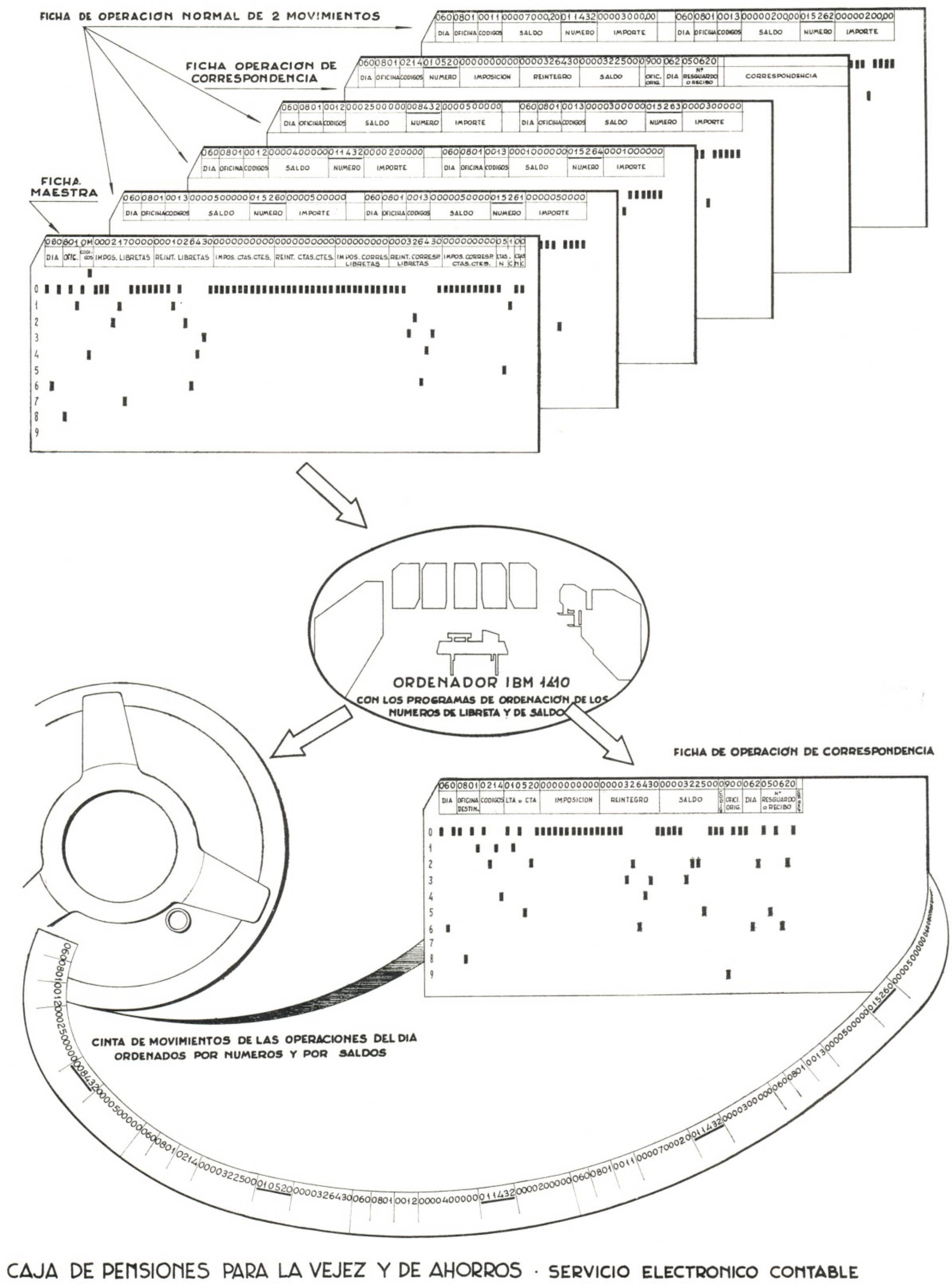
[26] Yates (1993), Maixé-Altés (2019).
[27] Ibid. and Comín (2007).
[28] The online connections were those that were established between computer terminals located in offices and mainframes located in the computer centers.

FIGURE 1 ▪ *Off-line automation of the front-office savings operations at "la Caixa" in 1963*



Source: AHC Informática. Servicio Electrónico Contable (file 49).

FIGURE 2 ▪ *Off-line automation of the back-office savings operations at "la Caixa" in 1963*



Source: AHC Informática. Servicio Electrónico Contable (file 49).

In the 1950s, many banking institutions in Europe and the United States already had vast experience in the use of tools based on tabulation technology. This technology made it possible to transfer the daily operations records from each office onto punched-card media. This process was carried out by an operator, who used a perforating machine with an alphanumeric keyboard that recorded on each card the fixed and variable data corresponding to each operation. However, more automated methods existed that allowed the operation to be transcribed and simultaneously recorded on a punched tape, which was then connected to a perforating machine to create the corresponding punched-cards. In the pre-computerized systems, the information contained on the punched-cards was processed via a series of electromechanical systems (sorting machines, tabulators and calculators), which made it possible to obtain the lists and statuses for the corresponding aggregate accounts.[29] However, important changes came about during the period of interest to us: the 1960s. The incorporation of second generation mainframe computers began to be generalized; they were responsible for processing all of the information transferred onto the punched-cards.[30]

In the case of "la Caixa" (now CaixaBank, the first largest Spanish bank in terms of assets),[31] between 1962 and 1966 an off-line system was implemented, managed by a second-generation IBM 1410 mainframe located in the computer center in Barcelona. Initially, the records of operations compiled at the offices were sent to the headquarters in Barcelona, where the punched-cards were created. The computer processed them by means of a program which, in the words of its creators, could be described as "handcrafted," built ad hoc, in cooperation with IBM's Barcelona laboratory.[32] This program calculated the balance of the operations and then another program proceeded to update the balance files on magnetic tape and draft the accounting reports, which were

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[29] CaixaBank Archive (hereafter AHC), Informatica, "Experiencia de la CPVA en el terreno de los ordenadores", 1968 (file 49). Heide (2009), pp. 208-209.

[30] The European savings banks primarily used BULL-GE Gamma 30, UNIVAC 9300, Honeywell, NCR 390, IBM 1401-1410, Olivetti-GE ELEA 4001-6001 and Burroughs B 200. Maixé-Altés (2019).

[31] The *Caja de Pensiones para la Vejez y Ahorros de Cataluña y Baleares*, CPVA (Pension and Retirement Savings Bank of Catalonia and the Balearic Islands), hereafter "la Caixa", has historically been the leading institution among Spanish savings banks and the leader in banking computerization in Spain since the late 1960s, Maixé-Altés (2012). Recently, following its merger with Bankia, it has become the top Spanish bank in terms of assets, ranking tenth in all of Europe.

[32] Josep Munt Alvareda interview (IBM marketing executive for "la Caixa" and director of systems IBM-Barcelona, c. 1960s-1980s.), Barcelona, June 14, 2011. Jesús Ruiz Kaiser interview (head of computer department, c. 1960s., and deputy general manager, c. 1970s-1980s. at "la Caixa"), Barcelona, April 13, 2011.

sent back to the offices.[33] In 1964, different accounting machines were gradually incorporated into the offices with the largest volume of operations. These included American-made Olympia-IBM, German Kinzle and Swedish ADDO machines. These machines compiled the record of operations and updated the office balance file. In addition, they were connected to an IBM 24-26 card punch, which automatically punched the dates, thus avoiding the need for this operation to be performed at headquarters (Figure 1).[34]

This phase, prior to the online processes, involved the development of logistics that permitted punched-cards to be created *in situ* at the larger offices. Likewise, four provincial mechanization departments were created that received the accounting reports from those offices with a lesser volume of activity and issued the corresponding punched-cards. This system permitted the mainframe to process the punched-cards every day from all the offices that were received by air or land and via the same procedure, to ensure that the accounting statuses for each office were returned first thing in the morning, the very next day. To have an idea of the complexity of the system, in 1963, the annual volume of movements transferred on punched-cards was 5.9 million operations (Figure 2).[35]

In the off-line phase, savings operations were automated, in addition to those related to current accounts, term savings (with the automatic incorporation of interest), direct payroll deposit service for customers, social security and mutual insurance scheme contributions and the collection of certain taxes by the Public Treasury.[36] Other operations that were automated thanks to the data processing capacity of the IBM 1410 were the calculation of interest, statistics, account statements, interest liquidations and periodic balance sheets, among others. Hundreds of programs were written that would

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[33] With regard to what is generically referred to as software, the client file management processes (file-management systems) in the 1960s and 1970s were based on ad hoc programs that underwent continuous development, gradually incorporating the processing of more complex transactions, which generated constant reliability problems. Campbell-Kelly and Aspray (1996), p. 188; Philipson (2005); Haigh (2001, 2006) and Maixé-Altés (2019).

[34] AHC, Informática. Reports, Evolución de la contabilidad. Propuesta de distribución de máquinas contables en agencias urbanas y sucursales, July 31, 1964 (file 49).

[35] According to this diagram, 2,709,883 operations were punched automatically at the teller window, 737,482 operations were recorded, while the rest (2,480,604 operations) were punched at provincial centers, based on the manually created records from the smaller branch offices, Maixé-Altés (2012), p. 127.

[36] By late 1964, "la Caixa" had 242 offices operating under the off-line system.

solve the problems posed by automation on the go; in this context, the interaction between users and manufacturers was crucial.[37]

The new system, in spite of its precariousness, dedicated special attention to process reliability. The ad hoc design of the programming incorporated automatic error control and correction in records, thus preventing the error from affecting the punched-cards and interrupting supply processes.[38] The control mechanisms were more secure and reliable than was previously the case with the tabulating technologies, since the mainframe assimilated all of the routines that previously had to be done on different machines.[39] The implementation of the off-line system at "la Caixa" was done progressively. The architecture that was applied to automate the processes at the branch offices was a projection of the system that had been established in 1963 in the main office and in certain agencies in Barcelona. When the system was expanded to the rest of the branches and offices, new monitoring procedures were gradually incorporated, such as control digits, which used a simple algorithm to allow errors to be detected during data input for accounting operations.[40] In short, the system would progressively incorporate improvements, thanks to the experience acquired.

The most interesting conclusion that can be drawn from the application of the off-line system by "la Caixa" is that it was the preface to the implementation of what would come to be called bank teleprocessing. This system was activated in the main office of "la Caixa" in January 1967, once a third generation mainframe, the IBM 360, had been incorporated into the institution's computer center.[41] The online systems would permit, through the combined use of computers and conventional cabled communications lines, information to be transferred over an internal network. Communications were established from office-based teller terminals to the mainframe at the computer center and vice versa, using the appropriate software and hardware. This was ultimately a giant step forward for establishing the first online banking giro/message-switching networks. There is no question that this was a challenge for the organizations involved, which had

[37] Some of the programs offered by IBM reached a more mature level of development, thanks to pressure from the users (Josep Munt Alvareda interview). It must be kept in mind that these programs operated in "machine language," as no high-level language was in existence yet, and the second generation computers worked with a specific language for each one, and with limited resources. Philipson (2005), Haigh (2006).
[38] AHC, Informática. Reports, Evolución de la contabilidad. Propuesta de distribución de máquinas contables en agencias urbanas y sucursales, 31 July 1964 (file 49), and Maixé-Altés (2012), p. 122.
[39] AHC, Miscelánea, Informe al Consejo sobre la visita de los comisionados de la CPVA a Europa, Barcelona, January 7, 1959.
[40] Maixé-Altés (2012), p. 130.
[41] Maixé-Altés (2019).

to deal with the subsequent problems in terms of reliability and security, resulting from the greater level of technical complexity of the new networks. However, the introduction of off-line systems was a significant preliminary step in the office automation processes of the savings banks. Management was streamlined, with effects that were especially visible in terms of customer relations. For example, the long lines in branch offices became shorter.[42]

Bank teleprocessing, networks and a new culture in digital security

As recently reflected in the literature, the introduction of online processes in the banking industry came about as the result of the expansion of office automation, promoting the flow of accounting and administrative information from the branches and offices to central services and vice versa. This demand was widespread among some European savings Banks with dense networks of offices and numerous accounts on their balance sheets.[43] To rationalize the intra-bank domestic exchange business, major banks installed online and message-switching systems. The introduction, adoption and use of this combination of computers, software and telecommunications (teleprocessing, as it was usually referred to in the 1970s and 80s) made the technical processes covering the new banking operations more complex.[44] As a consequence, new problems arose that went beyond the security of the funds deposited in the bank offices. The reliability of information transfer processes, the protection of the transmitted information, the security of these processes and the anticipation of potential system errors, in terms of both hardware and software, posed new uncertainties.[45] This situation was accentuated by the addition of the need to establish certain standards to define the elements and structure of the messages supported by the new electronic networks.[46]

Dating back to this period are the first bank giro/message-switching networks on a national level (the Data Telecommunication System of all Banks in Japan, the Interconnection System of Savings Banks in Spain, and Girozentrale –regional giro

[42]Jesús Ruiz Kaiser interview.
[43]Maixé-Altés (2019).
[44]The implementation of online processes did not imply the immediate development of online real-time processes (OLRT); see Bátiz-Lazo et al. (2014) and Maixé-Altés (2019).
[45] The teleprocessing management programs continued to be based on file management systems. It was not until the early 1980s that new teleprocessing management systems began to be implemented, such as IBM's proprietary databases (IMS FastPath for the MVS operating system), operating systems that offered multitasking capacities and programs that were much more integrated into the database management, Haigh (2006), Bergin and Haigh (2009), and Maixé-Altés (2019).
[46] For more information on the evolution of SWIFT standards, see Scott and Zachariadis (2014), pp. 55-86.

clearing centers– in Germany to mention a few). SWIFT was developed on an international level starting in 1973. A second phase consolidated over the 1980s saw the deployment of automated payment systems with the expansion of the bank EFT networks and electronic points of sale (POS) and the consolidation of plastic banking cards and ATMs.[47] This paper will now proceed to analyze three unpublished case studies on the banking networks in their early stages. First, the so-called "Data Telecommunication System of all Banks in Japan", allows us to analyze one of the first examples of establishing a national banking network that affected most banks in the country. The second case examines the first steps of the Interbank Domestic Exchange System of the Spanish savings banks (SICA, according to its Spanish initials). This is an excellent case to analyze the technological limits of the early banking networks. The third case involves EFT for individual payment transfers within the Giro network of German savings banks (EZU, according to its German initials). This significant case refers to an early EFT network. Together, these case studies make it possible to evaluate the implications of teleprocessing for the management and business of banking institutions.

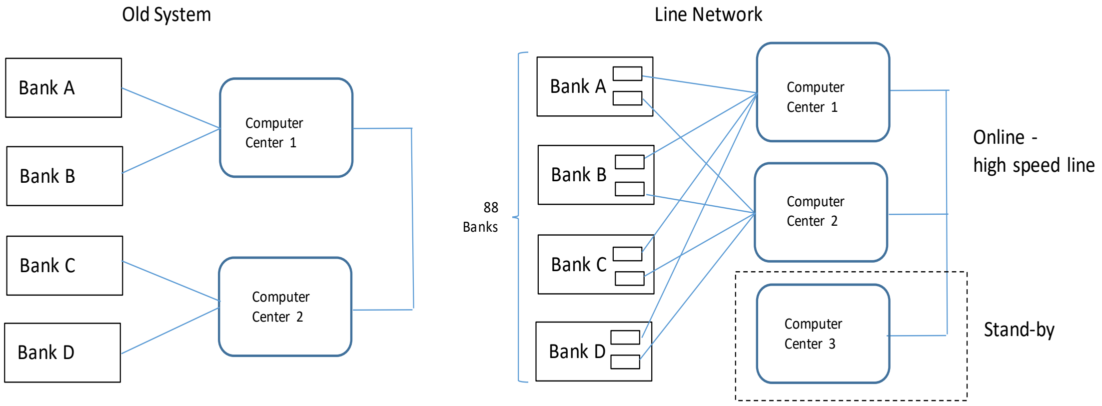
The Japanese Data Telecommunication System of all Banks

The Federation of Bankers Association of Japan initiated a new policy aimed at improving the domestic exchange business in February of 1971. The new system, inaugurated in April 1973, was a computer-based online message-switching system to carry out communications and settlements of the interbank domestic exchange transactions among 88 banks in Japan (city banks, local banks, trust and banking companies, long term credit banks and one governmental lending organization, encompassing a total of 6,800 offices). The new computerized system broke away from the previous rules and procedures, based on peer relationships between offices (Figure 3). A collective agreement was established that enabled any office of a bank to settle exchange transactions with any other office of the remaining banks, with the intervention of the Bank of Japan. The domestic exchange business consisted of three major categories of transactions (direct credit, payment against vouchers and the collection of bills), each of which was carried out either by wire or by mail. The sharp

[47] ISBI Archive, Où en est la monnaie electronique en 1984? Les experiences Françaises, Business Organization and Automation Committee, Security Working Group, Geneva, 1984. Maixé-Altés (2020), Bátiz-Lazo and del Angel (2018), Bátiz-Lazo (2018), pp.137-138.

growth rate in transaction volume intensified the need for computerization in Japan (9.5 million transactions, at a growth rate 17%).[48]

FIGURE 3 ▪ *From the old to the new banking networks in Japan (early 1970s.)*



Source: ISBI Archive, Todao Kodama and Yuzo Hirayama, Data telecommunication system of all banks in Japan, First USA-Japan Computer Conference, Business Organization and Automation Committee, November 30, 1972.

The traditional procedure to carry out the bank transactions required a specific system for each type of transaction and for each of their variants. For wire transfer remittances, a code was used to prevent both accidents and crimes. This required a great deal of time and effort dedicated to coding and decoding, which posed a new problem in a context in which job offer were waning and salaries were on the increase in Japan (at a rate of nearly 15% annually).

The new system resulted in a rationalization of the processes, first of all, by standardizing the data transmission format (9 lines and 48 columns). With the previous system, domestic exchange transactions were settled through the 28 branch offices belonging to the Bank of Japan, while liquidation under the new system was carried out by the computer center at the head office of the Bank of Japan, taking effect on the next business day (Figure 3). The efficiency and reliability of the processes were improved, reducing the data volume by one third (post-dated transfers and group collections, i.e. bills of exchange), decreasing the number of processes and increasing the lifespan of the hardware.

The Federation of Bankers Association of Japan was in charge of the design of the system. It established the operational criteria for the system, while the Nippon

[48] ISBI Archive, Todao Kodama and Yuzo Hirayama, Data telecommunication system of all banks in Japan, First USA-Japan Computer Conference, Business Organization and Automation Committee, Geneva, November 30, 1972.

Telegraph and Telephone Public Corporation (NTT) provided the hardware and software with the following features:

- Processing capability in the early stages of around 150,000 transactions per hour and a million per day.
- High level of reliability, considering that the average time between total system failures in a bank had to be between 3 and 5 years, with an average recovery time of 1.5 hours
- Verification of the messages (format and content), taking action to protect company secrets and to prevent crime.
- Suitability of the banking terminals via the use of flexible interfaces that coordinated intra-bank message switching systems.

The data transmission lines between the computers at the computer center in Tokyo and the terminal devices in each bank were connected on a network that combined online processes and batch processing. The so-called high-speed lines were being implemented, which relied on more advanced communications protocols to transfer data between a host computer and remote terminals.[49] This type of network was approved because of its reliability, efficiency and economy. The hardware system, including the line network for the data telecommunication system, was more reliable in terms of the following aspects:

- The computer centers were interchangeable in the event that any of them failed, making it possible to restore the capacity of the system process. Even the peripheral devices (vital files and line control units) had their own reserves.
- Reliability of the terminal devices installed at the banks was ensured (more than two terminals were always in simultaneous operation online).
- Maintenance of the terminal was performed by the branches of the NTT.

The security systems intended to prevent crime controlled access to the line network, limiting it to authorized staff only, disabling it for any third party. Control digits were established for each exchanged message, and banks monitored the number and the amount of the transactions issued and received in the computer center at any given time. Finally, programming prevented the entry of transaction messages at the computer center.[50]

[49] See more details about this type of lines in the case of SICA (Spain) in the following section.
[50] Ibid.

That is to say, the design of the new banking networks followed a double standard: one economic, related to the cost savings and work productivity and another related to improved reliability of the processes, a central aspect with the development of the computerization. Thus, the new system improved the interbank domestic exchange business in terms of speed, accuracy, reliability, security, and labor savings. In comparative terms, a central aspect of the Japanese case was the early deployment of a national network that involved a wide variety of banking institutions, managed by the Central Bank, with the technical support of the state-owned telecommunications company.

The startup of the Spanish SICA and the limits of technology in the early banking applications

This case illustrates the problems related to the start-up and the technical limitations of the online exchange systems between financial institutions in the early stages of the implementation of the first giro/message-switching networks. In the early 1970s, the Spanish savings banks, through their industry association (Spanish Confederation of Savings Banks, CECA, according to its Spanish initials), had begun to discuss in their technology committee (COAS, according to its initials in Spanish) the possibility of implementing an interconnection system among all savings banks.[51] Spanish savings banks traditionally offered external services to their customers traveling in locations where the institution did not have any offices (exchange services). They had developed a system that established that the exchange and transfer order between accounts belonging to different savings bank branches were implemented through the CECA and postal mail. This involved paper-based operations (original and six copies), which complicated procedures and caused a considerable delay in fulfilling the orders received from customers. The new objective of the savings bank industry association was to automate the exchange and transfer operations, as well as the communication of messages among the institutions.[52]

In October 1970, a preliminary report was issued that proposed various alternatives. On the one hand, it raised several possibilities: a connection system using teletypes over telegraph or telephone wires, radio frequency emissions or the use of

[51]The initiative stemmed from an earlier debate in 1968, prior to the creation of the COAS (CECA Archive, SecretaríaTécnica de la COAS, Informes, Madrid).
[52] ISBI Archive, SICA system report, Minutes of the Business Administration Committee, Geneva, November 22, 1978.

switching computers. On the other hand, the construction of a centralized teleprocessing network was proposed, or that of a system that maintained the teleprocessing networks already in operation in some savings banks, connected to the rest through the CECA's computer center in Madrid. The option that was finally applied was the establishment of a switching network of computers in which the autonomy of the teleprocessing networks was maintained for those savings banks that had already implemented them (in the form of internal communications networks). External operations, in turn, were focused on the CECA's computer center, which would be in charge of transferring the orders received among the different savings banks.[53]

The SICA project was strongly favored by the implementation of a new public telecommunications infrastructure: the High-Level Secondary Network (known as the RSAN, according to its Spanish acronym). The Decree of December 21, 1970 had authorized the Spanish Telephone Company (CTNE, a state-owned company, today Telefónica, a PLC) to implement the development and exploitation of public data transfer services and the corresponding networks.[54] In November 1971, the RSAN was inaugurated as the first public packet-switching network in Europe. It would come to provide coverage for banking and business networks in Spain during the decades prior to the Internet. In this context, the new project from the CECA established the public network as the basic communications infrastructure, although some of the savings banks had deployed their teleprocessing networks through dedicated point-to-point lines.[55]

In October 1972, the final parameters were established that were to launch the SICA project in the savings banks. Later, in March 1973, the CECA negotiated the contract for its connection to the RSAN with the CTNE, and in early 1975, the regulation was ready that was to govern all SICA protocols. At the same time, throughout that year, numerous tests and simulations were carried out. By October of that same year, the tests were quite advanced and different real connections had been made. However, problems related to the compatibility of different pieces of equipment and the need to create new programs to manage the teleprocessing lines prevented the immediate implementation of the network. Finally, after February 1976, the different services offered by SICA were gradually made available to the users. Among the

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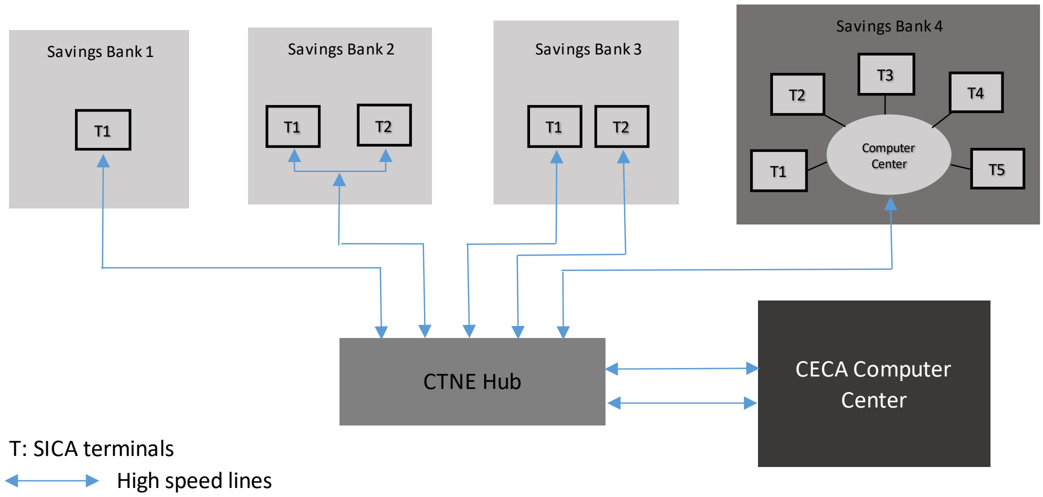
[53] AHC Informática, COAS-SICA Reports, October 1970 (file 49).
[54] Vidaurrázaga (1998), Adanero (2006).
[55] Some savings banks had been pioneers in teleprocessing, such as "la Caixa", which leased conventional basic telephone lines from the telephone company to connect their offices, but the telecommunications equipment and the corresponding software belonged to the financial institution, Maixé-Altés (2012), p. 163.

services that were automated in the initial stage were exchange and transfer operations, passbook savings account operations and current account check payments. Likewise, a SICA messaging service was normalized that made it possible to transfer information between the savings banks and the CECA (newsletters, notifications, stock and currency quotes, stock market orders and general statistics).

FIGURE 4 ▪ *The Spanish Savings Bank Interbank Domestic Exchange System (SICA)*



Source: AHC. COAS-SICA Report, October 1973 (file 49).

Since a decentralized network was chosen that preserved the individual teleprocessing networks of each institution, it was necessary to establish a SICA design that took into account the disparity that existed among the different mainframes in their respective computer centers. The savings banks involved concentrated on four suppliers: IBM, UNIVAC, NCR and HONEYWELL-BULL. On the one hand, under this scheme, the savings banks operated with their own teleprocessing networks (primarily dedicated point-to-point lines).[56] On the other hand, the SICA connections – with the appropriate adaptations to each group – were established between the institution's computer center and that of the CECA, through the RSAN via the CTNE hub. There were also those savings banks that still lacked teleprocessing networks, in which a SICA terminal needed to be installed, connected to the RSAN. Through the CTNE hub, it could connect directly to the CECA computer (Figure 4).[57] As a result, the SICA project had to overcome numerous incidents, some due to equipment

[56] The office teller terminals were connected via start-stop lines, with a less complex technology than the RSAN lines, which belonged to the new generation of packet-switching networks.
[57] As seen in Figure 4, the savings banks that had not developed teleprocessing could connect to the SICA network with a single terminal (Savings Bank 1), two terminals with a shared line (Savings Bank 2) or with two terminals and two lines (Savings Bank 3). In each case, the network capabilities were different.

incompatibility issues and other resulting from problems that arose in managing the new generation of teleprocessing lines.

During the first stage of the teleprocessing, the line management software was very rudimentary, with the so-called line control programs (LCP) managing the point-to-point lines. However, the technology offered by the RSAN, like that which was being implemented in the Japanese banking networks, permitted the use of high-speed lines, which required more advanced programs, known as terminal control programs (TCP). These lines made it possible to concentrate the traffic from a variable number of remote terminals and channel this traffic to the mainframe through single point of entry, with a lower cost than the dedicated point-to-point lines.[58] As a result, when the SICA was established, the savings banks and the CECA had to apply more developed software in order to implement the communications line connections with the mainframe computer channel.[59] Some episodes that occurred during the start-up of the network by "la Caixa", the CECA and the CTNE illustrate the difficulties and limitations that these early operations had, which were to lead to the setting up of the first banking networks:

> *Everyone was aware of the complexity of the SICA tests, compounded by the fact that the three centers [CTNE, CECA and "la Caixa"] had to be in perfect physical condition and that the software of the three was still under development. […] The current situation of the tests is that CECA has several logistical problems pending identification and solution in their program […] According to the CECA, problems have arisen in the mass testing of terminals, mainly as of the 15th [October 1975], possibly worsened by trying to connect with us; for this reason, they have requested that we suspend testing until at least the 21st, in order to dedicate all their efforts to the terminals.[…] The SICA programming group has spent many months working overtime, and in more or less inopportune shifts.*[60]

There were continuous errors and reliability problems during this first stage. It must be remembered that the SICA terminals operated in question-response mode, the messages were sent in bursts containing a package of characters with specific conditions (the system did not allow more than 30 seconds between each character entered, and

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[58] IBM introduced the Binary Synchronous Communications (BSC) protocol in the second half of the 1960s. It permitted control over the data transfer between a mainframe (host computer) and remote terminals, as well as between host computers. Initially, there were designed for point-to-point batch transmissions, but they quickly evolved for their application to more complex lines, becoming a standard that was used until 2013 (DATAPRO, 1990). By March 1972, "La Caixa" had introduced this technology on its teleprocessing network, incorporating its first telecommunications controllers (a computer that was the central unit of line management), thus providing previous experience to the SICA (AHC, Informática. Informe de IBM para la Caja de Pensiones para la Vejez y de Ahorros, Barcelona, June 1971).

[59] AHC, SEC, Reports 1973-1978: Informe del subjefe del Departamento de Programación sobre la situación, pruebas e implementación del SICA, Barcelona, October17, 1975.

[60] Ibid.

there was also a limit of characters per burst). Under these conditions, there were situations in which the reliability and satisfactory results of the process required the full attention of the terminal operator.[61] There were other technical restrictions, such as terminals that still did not have programmable controllers, as well as a whole series ofverifications that in the future would make teleprocessing more reliable.[62] For these reasons, the services exchanged between the CECA and the savings banks were not automated in their entirety through the SICA from the very start, rather gradually, due precisely to the technical difficulties of the process.[63] As a matter of fact, two clearing accounts were created at the CECA: one that included the services incorporated in SICA, and another that included those services that were still being temporarily provided in a conventional manner.

The CECA established a system of control over SICA operations, issuing a daily list of operations indicating the savings bank of origin and destination for the operation, as well as monthly incident statistics. The main anomalies in the initial stages referred to the differences between the operation and transfer dates, to offices with terminals that operated with a high percentage of delay, the improper use of certain operations and the mismatch between the balance shown by the savings bank in question and the CECA, with regard to operations carried out on a certain day. Finally, the early transfer of orders was controlled by telephone or telex, using passwords when the SICA media were not available for any particular reason.[64]

Along with the network implementation problems, there were personnel management issues. At both the CECA and the savings banks, SICA services initially enjoyed a certain level of autonomy in terms of general computerized services. On a similar note, a serious organizational and logistical effort had to be made in the savings banks as a whole to provide the necessary training on action protocols and operations of the SICA in all savings bank offices and branches involved in the process.

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[61] Since the terminal reel had a limited character storage capacity, the transmission often had to be performed in two or more bursts. The system permitted routines to avoid these incidents, but he processes were still not sufficiently automated (AHC, Informática. Normas conjuntas CPVA-CTNE relativas a la operativa de terminales IBM 2970 conectados a la RETD, April 1976 - file 49).

[62] Controllers would later allow the presentation screen formats to be stored and to facilitate certain controls (Jordi Lacasta Mussons interview (director of communications, “la Caixa,” c. 1980s–2000s), Barcelona, June 8, 2011).

[63] During this first stage, some of the SICA operations were immediate, so that the customer in the bank office received a response while he/she was still in the office, while other operations were delayed.

[64] AHC, Sots-Direcció Tècnica Departament de Procés de Dades, Informe sobre la evolución del Servicio de Instalaciones y Control del Teleproceso, Barcelona,May 11, 1983.

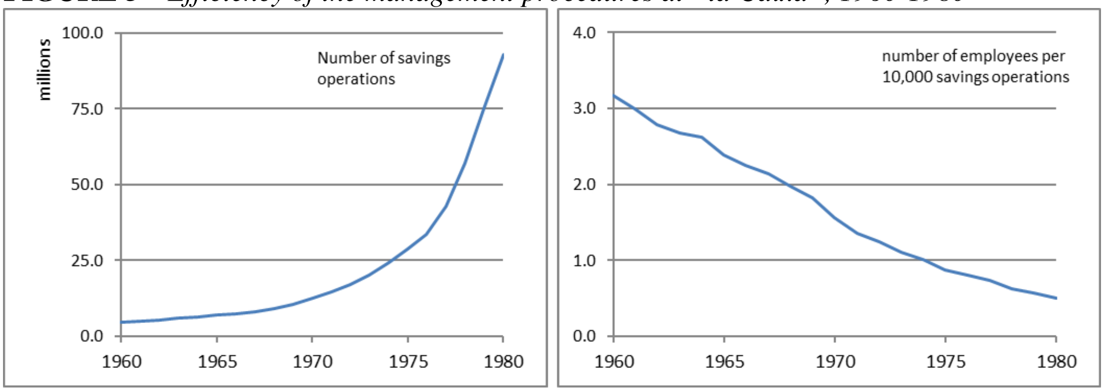
TABLE 2 ▪ *Employees by offices ratio in Spanish savings banks*

	All savings banks	"la Caixa"	Caja de Ahorros y Monte de Piedad de Barcelona
1970	NA	7.1	13.9
1975	NA	6.9	14.0
1980	7.5	6.6	9.3
1985	6.6	6.2	6.1
1990	6.2	4.8	5.9

Sources: CECA, Statistical Bulletin of the Bank of Spain and AHC.

The data offered by the SICA study suggest that the implementation of the bank teleprocessing networks prior to the implementation of the Management Information Systems (MIS) had to overcome numerous obstacles. Part of the problems was related to line management equipment, while another part had to do with the software employed. In both cases, they were experimenting with new technological developments that were less than tried and true and subject to continuous revision. As a result, the reliability and security standard with which the banks were working were far from those that characterized the following generation, which were those that truly incorporated the integrated teleprocessing and database management systems.[65] However, this complication did not prevent their effective application and, as suggested by the Japanese case, their implementation had very positive effects in relation to improved efficiency and reduced operating costs of banking operations. Table 2 shows an estimate of these improvements on the organization and management of the savings Banks through the continuous decrease in the number of employees per office between 1970 and 1990, considering both the mean of all savings banks affiliated with the CECA and certain significant savings banks, such as “la Caixa” and the Caja de Ahorros y Monte de Piedad de Barcelona, which from the very beginning subscribed to the SICA service offered by the CECA.

FIGURE 5 ▪ *Efficiency of the management procedures at “la Caixa”, 1960-1980*



AHC, “la Caixa” Research Service, Reports, 1959-1980 and Maixé-Altés (2012), 184-185

[65] Bergin and Haigh (2009) and Haigh (2006).

Some of the productivity results for "la Caixa" point in the same direction with regard to the process of implementing teleprocessing and access to SICA. In two decades, the performance of the administrative processes made a qualitative leap forwards (Figure 5). In fact, from the time the off-line data processing systems in the early 1960s until 1980, at which time the online teleprocessing networks and SICA services were operational in all offices, the efficiency of the operating processes improved noticeably. During these 20 years, the number of employees for every 10,000 savings operations processed decreased from a ratio of 3.18 to 0.5 (taking into account that the number of savings operations processed increased from 4.5 million to 93 million). The results are similar if we consider the productivity of the deposits per employee at constant prices, which between 1963 and 1974 decreased from 4.91 to 2.43 employees for every 1 billion pesetas in deposits made (at 1986 prices).[66]

The German system for individual payment transfers (EZU)

The German case provides a good portrait of the different problems that had to be overcome to establish data transfer networks and EFT in the early stages in European banking institutions. The German savings bank developed a double strategy to become more competitive in the banking system in the second half of the 1970s. On the one hand, they expanded their online networks, creating a generalized data network that connected the savings banks via regional data centers and Girozentrale (regional savings bank giro clearing centers). On the other hand, they added individual payment transfer to the EFT systems.[67] This deployment showed greater similarities to the Spanish savings bank model, since it affected the entire savings bank sector, unlike the Japanese case that involved the banking industry as a whole.

The creation of a network providing EFT access on the individual savings bank level was necessary to increase the competitiveness of savings banks using the existing magnetic tape and paper clearing system, and it could also be used in future EFT applications. The first steps in the introduction of a system for individual transfers (EZU) were compatible with the current national system via Girozentrale, using telecommunications (data exchanges on magnetic tape, DATA system).[68] One of the

[66] AHC, "la Caixa" Research Service, Reports, 1959-1980 and Maixé-Altés (2012), 184-186.
[67] Maixé-Altés (2019).
[68] Deutsche Girozentrale (DGZ) (German Sparkasse Clearinghouse) is founded in 1918. Formed as a legally dependent banking division of the Deutsche Zentral-Giroverband (German Central Sparkasse Clearing Association) in Berlin, it is firmly rooted in the Sparkasse savings bank organization from the

objectives of EZU was to ensure that data transfers between two participating banks could be completed on the current day. This made it necessary to use the network in a uniform manner and avoid extreme load peaking. In this sense, the use of new software at the girozentrale (DAGUM program) level made it possible to gradually achieve these results.[69]

The solution to ordinary problems was gradual, because the transfer accounting periods were limited and the delays in the control processes slowed down these periods. These mismatches persisted during the early stages, even though the progressive capability of the network to handle a continuous flow of EZU data made the transition possible from "following day" to "same day" processing. In practice, there were problems with data transfer reliability in this early stage, as the result of various problems associated with data processing:

- The delays caused by the automatic insertion of the payee's name via batch processing.
- The bookkeeping cut-off time was too early.
- Different bookkeeping cut-off times.
- Delays due to controls at the initiating and receiving savings banks.

The data processing at the corresponding data centers required the reception of certain data message formats, the automatic comparison of the payee's name, the production of a control list (errors), penalties for wrong account numbers (including suspension of the account if not corrected by the receiving savings bank), and compilation of book keeping information. Therefore, it was necessary to check account exception lists, make corrections and inquiries/send it back at the destination.[70]

Finally, there were common reasons for errors that made certain payments unsuitable for EZU, as the result of various circumstances. In particular, this was related to missing key transaction data (payee bank name, payee account number, etc.) and errors on the giro forms with pre-coded general purpose fields (the payee may use

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beginning. Deka-Gruppe website, https://www.deka.de/deka-group/about-us/history [Accessed January 28, 2020].

[69] The German financial institutions, as was usual in the rest of Europe, also relied on the state-owned Deutsche Bundespost, the major telephone Company in West Germany, which was privatized in 1995. They used the traditional system based on circuit switching technology and the point-to-point lines. Until the late 1970s, development did not begin on plans in West Germany for a public network incorporating packet technologies (Roberts, 1978). They were therefore established relatively later than in the Spanish and Japanese cases with regard to packet technologies.

[70] ISBI Archive, Savings Banks Giro Committee (Germany), Electronic fund transfers for individual payment transfers within the German savings banks' giro network, Business Organization and Automation Committee, Geneva, October 4, 1978 (J. McGill's Report - confidential).

optical character recognition (OCR) to read the forms, and the manual entry of this information in EZU will inevitably produce errors). In many circumstances, in the case of errors, the only solution was to notify the receiving or issuing institution by telephone or telex.[71]

This data transmission system was still very much in its early stages, and although EZU was an online network, messages were in fact batched for transmission. EZU was therefore not suitable for data requiring rapid two-way transmission, e.g., Blitzgiros (in fractions of an hour) or cash dispenser pools (in seconds). For these reasons, the reliability of procedures and the subsequent errors relied on a capacity and a design still in progress, and that was not yet fully automated. The EZU case supports the arguments outlined above, with regard to the first steps taken by bank teleprocessing systems and the implementation of the corresponding data transfer networks. The results went beyond the available technology, at the expense of smaller reliability margins for the processes. However, the use of blended technologies, which combined online processes with batched transmissions, favored later developments in the area of bank networks.

In the German case, like the Japanese and Spanish cases, an incremental technology migration path occurred, in which new technologies were gradually incorporated, without immediately doing away with the previous technologies (aspects observed by JoAnne Yates in the insurance industry).[72] The new online systems still did not include OLRT processes, but they cut times, ensuring that the data transfer procedures were carried out on the same day. In short, new horizons were opening up for the provision of new financial services.

The new banking standards and digital security and reliability

In the context we are currently studying, the evaluation of the role that financial institutions and their industry associations played in the design of the new banking standards provides an interesting perspective on the security and reliability of banking services. This work was done by the international standardization organizations with the support of national institutions and various interested parties. As some authors have indicated, innovations in networks (both banking and others types) on an international level forced the development of new standards and the signing of global technical and

[71] Ibid.
[72] Yates (2005).

operational agreements by voluntary consensus.[73] This trend, which is in its early stages in the 1970s, could be situated in the period that JoAnne Yates and Craig N. Murphy identify between the 1970s and the 1980s (standards for a global market).[74] This is the preamble to the third wave and the eruption of the computing networks from the 1980s on.

The International Organization for Standardization (ISO), operational since 1947, and its predecessors, together with other global institutions such as SWIFT, largely contributed to the setting up of standards in the banking sector. The contributions by other non-governmental institutions, such as the ISBI, are less well-known in this area. It is precisely through this international institute formed by savings banks that it is possible to complement some perspectives on the progress in areas related to reliability and security through the design of new standards in the international and national banking system.

A significant case study on the process of standards definition in the banking sector is offered by "The proposed national standards for magnetic stripe encoding on pass books", which was discussed throughout 1978 within the framework of the ISBI.[75] Two proposals were made: one by the ANSI-MINTS Standard Committee (Mutual Institutions National Transfer System Inc.)[76] in the USA and another by the pre-standard (Vornorm)[77] for magnetic stripes on savings books, a debate which took place at the German Savings Bank Association.[78] At this time, the specifications were being defined for this standard: physical and magnetic characteristics of the passbook and the magnetic material, together with encoding specifications and data fields (Table 3). The proposal from the USA was set out in the ANSI (American National Standards Institute) regulations, while the German proposal was reflected in the framework of the DIN (Deutsches Institut für Normung e.V.), Figure 6.

[73] Ibid. and Scott and Zachariadis (2014).
[74] Yates and Murphy (2019).
[75] ISBI Archive, Two proposed national standards for magnetic stripe encoding on passbooks: MINT, USA and DIN, West Germany, Business Organization and Automation Committee, Geneva, October 6, 1978 (confidential).
[76] Forming part of the USA savings banks committee for standardization, with 14 members, were Donald R. Brown, Plymouth Savings Banks (chairman) and representatives of the major savings banks and other institutions, such as Banker Data Processing, Institutional Group Info. Corp., Savings Mgmt. Computer Corp. and MINTS itself (ISBI Archive, ANSI-MINTS Standards, Geneva, March 13, 1979).
[77] A pre-standard is a standard which is still subject to reservations with regard to its application.
[78] The expansion of passbooks with magnetic stripes in Europe occurred at the end of the 1970s and continued over the course of the following decade. The German and Spanish savings banks were pioneers in this process (Ibidem and Maixé-Altés (2012), pp. 285-286).

TABLE 3·*Magnetic stripe information layout proposal at 1978*

	ANSI - USA		DIN 32786 - Federal Germany	
Field number	Content	Length (n. of characters)	Content	Length (n. of characters)
1	Start sentinel	1	Start character	1
2	Format code	2	Land (province) code	3
3	Passbook identification	19	Bank routing number	8
4	Separator	1	Sort key	3
5	Passbook balance	9	Account number	10
6	Next line	2	Check digit	1
7	Last available line	1	Account balance	11
8	Service restriction	1	Special key	2
9	Retry count	1	Line number	2
10	Personal identification n. offset	4	Page number	2
11	Key control	4	Currency code	3
12	CSCN-SEP	4	End character	1
13	Discretionary data	2	LRC	1
14	End sentinel	1		
15	LCR	1		
	Total	53		48

Source: ISBI Archive, Two proposed national standards for magnetic stripe encoding on passbooks: MINT, USA and DIN, West Germany, Business Organization and Automation Committee, Geneva, October 6, 1978 (confidential).

Some aspects of the standards had to be defined provisionally, usually using previous definitions for similar materials. For example, the reference medium, which serves as a standard (primary reference medium) in the German format was used as a temporary reference medium in the form of punched-card material (DIN 66018) in A5 format, with affixed magnetic tape (reference tape SRM 3200 – DIN 66011). In relation to these topics, these standards placed special emphasis on ensuring that the processes that were encoded and their functions were not subject to errors (control digits). Likewise, they guaranteed control over the security of the transaction and the encoded data (security codes). In essence, the search for standards was one of the bases for the reliability of the new transfer processes. Early steps were taken, although they would have to wait for almost another decade before the financial institutions were assigned an identification code (a machine-readable code).[79]

Another significant case concerns to the evolution of the payment card systems of identification, as they transitioned from magnetic strips to memory chips (integrated circuit cards), which posed new problems in terms of security and data confidentiality in the early 1980s. The problem lay in the fact that an important part of the information was recorded on an object that was not part of the bank's computer equipment.[80] By

[79] It adopted the SWIFT in collaboration with the ISO, resulting in ISO 9362 in 1987 (Scott and Zachariadis (2014), p. 66).

[80] In France, the Groupement Carte à Mémoire (Card Memory Group) was created in 1979; it clustered a majority of French banks. ISBI Archive, Où en est la monnaie electronique en 1984? Les experiences Françaises, Business Organization and Automation Committee, Security Working Group, Geneva, 1984.

1984, different pilot experiences had already been launched in France, led technologically by three companies: Honeywell Bull, Flonic Schlumberger and Philips. The trial was conducted in three cities (Blois, Lyon and Caen), and involved the issuance of 57,000 cards and service by 545 terminals, accounting for a total of nearly 10,000 transactions per month. As a matter of fact, the main objective of the operation was to see the feasibility of the memory chip card (which some doubted), and in particular, its reliability. The test produced positive results, and the reliability was reinforced by the fact that each manufacturer had different technical solutions, with good results in each case. In essence, the memory chip card was above all a powerful data medium, which immediately presented the problem of standards and security.

FIGURE 6 ·*Global Standards Organizations*

Source: Corporate websites.

This problem came to a head in June 1981 with the creation of the International Association for Microcircuit Cards (INTAMIC), on behalf of the European and USA banking sector and for the purposes of offering secure proposals for these application and to support standardization activities.[81] The rules studied by INTAMIC, proposed to the competent international authorities (ISO), needed to ensure the reliability and security of this new technology, strictly in its financial applications. In 1984, the work done by the ISO's TC97 achieved interesting results and, in this framework, the functions, applications and security of the card had also mustered the interest of the international card systems: Visa, MasterCard and Eurocheque. This convergence of interests was not free of controversy. At the TC97/SC17 ISO meeting in London on October 9-11, 1985, it was necessary to opt for a period of transition in order to deal

[81] A Standard Working Group was created, presided over by Bert Muller, of NederlandscheMiddenstands Bank (NMB) and John Tunstall, of the Bank of England (Ibidem). INTAMIC ceased activity in 1992.

with the lack of agreement on the location and dimensions of the card contacts. The differences between the French representative's position and that held by the USA and Japanese banks led it to temporarily accept two quite incompatible contact positions.[82]

By the start of the 1980s, the participation of the ISBI in the actions of the ISO had intensified. The ISBI followed the developments in international standardization being undertaken by the ISO. In fact, the ISBI served as a liaison member for the two ISO technical committees, the TC68 (banking procedures) and the TC97 (credit cards and identification cards), which produced banking standards and were represented by J. McGill, the ISB representative at the plenary meetings of TC97/SC17 in May 1982.[83] This situation was shared with reputable institutions worldwide, such as SWIFT. The objectives of the ISBI in its relations with the ISO and banking standards can be summed up in three aspects:[84]

- To inform ISBI members promptly of new developments in banking standards.
- To enable members to submit their views through the ISBI, when the ISO requested guidance on a particular subject.
- To provide a platform for individual ISBI members to participate directly and have their opinions heard on ISO committees, independently of their national delegations.

Through the ISBI and its subcommittees, European and North American savings banks actively participated in the results that were being obtained on banking standards at the ISO meetings in the 1980s. The organizational capacity of the savings bank committees and work groups, representing the sector on a worldwide level, and their technical capacity were the main assets in terms of the ISBI's action on these international forums. The topics that shaped the participation of the ISBI in actions by the ISO covered a wide range of concerns. On the one hand was the definition of standards for magnetic stripes on savings books, issuer identification numbers (IINs), PIN-pad standards and security problems, the new integrated circuit cards and different reforms pertaining to Eurocheques. On the other hand were proposals to limit the risk of the ISO making theoretical or out-of-date standards and being out of touch with the

[82] ISBI Archive, Report on ISO TC97/SC17, London, October 9-11, 1985.
[83] ISBI Archive, Report of activities, Geneva, 1982. J. McGill was Head of the Automation Section of the ISBI in Geneva. ISBI representatives participated on the ISO technical committees (TC) and subcommittees (SC).
[84] ISBI Archive, Working program of the BOAC, Business Organization and Automation Committee, Geneva, October 3, 1984.

latest practical applications of technology.[85] Ultimately, the role of the banking institutions in the development of the banking standards in the 1980s reveals that the reliability and security of the computerization processes already formed a central part of their agenda.

Conclusions

The persistent trends that have characterized banking over the last sixty years have been marked by an increasing process of dematerialization (digitalization) of part of their assets. The accelerated process of its dematerialization has been supported by a material environment of computers, fiber optics, manufacturers of electronic devices, and scores of engineers and supervision officers.[86] This has resulted in the consideration of hardware and software as bank assets needing protection and control, and the reliability of the processes governed by these assets generate a new conceptual framework, which is underscored by the introduction of data transmissions and electronic bank transfers, especially from the 1970s on. Banking universe has not been oblivious to these dynamics, particularly after the 1970s when the first electronic data transfers took place via messages (giro/messages-switching networks) and EFT began to be more prominent. Without a doubt, these were the first steps in a new wave, as with the new millennium, the omnipresence of data has overwhelmed all sectors of the economy and society with the emergence of Big Data.

In the 1980s, classic security problems (hold-ups), which had been controlled in the previous decade by means of direct measures in the offices (bullet-proof glass and alarm controls, among other solutions), conflicted with the bank marketing strategies and the concept customers had of bank branch offices. This conflict between security and marketing opened up a new horizon, which will have consequences for the development of the branch office concept, its functions and the relationship of branch office staff with customers. This dynamic converged with the new needs that the development of new bank services was creating, along with the digitalization and technology change. The available information suggests that the banks were gradually introducing these reforms, thus softening their impact on their operating expenses.

The cases studied reflect how the previous technological experiences, off-line processes and batched transmissions favored online processes. This was especially true

[85] ISBI Archive, ISO/DIS 8484 Draft International Standards, Geneva, October 15, 1985.
[86] As Baubeau (2016) shows in the case of money.

when the evolution of software and hardware permitted processes of technological migration: initially, first-generation teller terminals ("dumb terminals"), later minicomputers used as remote terminals, and in the early 1980s, IMS programs were introduced. The co-evolutionary factor had a great influence on overcoming problems with reliability and security in the early stages of electronic bank transfers. Bank teleprocessing in the 1970s and 1980s experienced the reciprocal influence of technology and its uses as a revitalizing and adaptive factor in the face of the processes of bank service diversification and business expansion. This dynamic forms part of the incremental technological migration path experienced by the computerization of the savings banks and other financial institutions, following a blueprint similar to that indicated by JoAnne Yates for the insurance industry.[87]

The results obtained suggest that the difficulties in terms of reliability and security did not halt the introduction of the computerized data transfer systems or the improvement in the efficiency of many operating processes. While it is true that there were limitations, as evidenced in the case of the SICA in relation to the Spanish savings banks, but the results show that critical situations were successfully dealt with. Of the cases studied, it can also be inferred that the processes of implementing the new technologies were not disruptive: from an analytical perspective, this result is backed by the aforementioned persistence of an incremental technology migration path, favored by co-evolution processes that softened the impact of technological change.[88] In general, all these networks, along with the technological support from national telephone companies, received logistical and financial support from the central banks of the industries and their own industrial organizations. This coverage allowed them to cushion the levels of risk associated with their initiatives, since they were deployed under the auspices of collaboration (or competitive collaboration, as the case may be).[89]In this sense, the banking industry actively participated in the nexus with national and international standardization institutions, in the framework of what some authors refer to as voluntary consensus.[90]

In the end, the developments that occurred in the 1970s and 1980s in relation to the deployment of online data transfer networks had intense repercussions on the

[87] Maixé-Altés (2019).
[88] Yates (2005); Maixé-Altés(2019).
[89] Bátiz-Lazo and Maixé-Altés (2011) and Comín (2007).
[90] Murphy and Yates (2009).

progress towards service banking.[91] The implementation of bank teleprocessing initially had noticeable implications in office automation and improved quality of services customers received in bank offices. However, the implications went beyond internal bank management and accounting, as the new developments constituted the basis for the deployment of new services. The technological change represented by the introduction of the first giro/message-switching networks had direct repercussions on the productivity of the operations of these institutions, reducing data processing times, improving the monitoring of these processes and establishing barriers and controls that ensured their reliability and security. These were all factors that opened up new horizons to what was already starting to be defined as service banking.

In relation to the digitalization processes in the early stages of the banking computer networks, the expansion of cash dispensers and ATM networks can be considered as a valid indicator to assess the intensity of these processes. As Bernardo Bátiz-Lazo reports, in the mid-1970s, the national cash dispenser and ATM networks began to be deployed at an increasingly faster rate in the USA, Europe and Japan.[92] In the cases studied, Japan represented the country with the greatest rate of growth per capita, with strong growth in the 1970s, followed by acceleration in the 1980s. Spain, as a late adopter of this technology, began its development in the early 1980s, but went on to expand its network very quickly in per capita terms. The presence of the infrastructures that we have discussed was a positive factor for the installation of online ATMs.[93] Similar circumstances affected the networks in the Federal Republic of Germany, in that the successive improvements that occurred in the online networks favored the deployment of cash dispensers and ATMs and were unquestionably a set of innovations that helped explain the advancement of the global networks set up around Visa and MasterCard.[94]

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[91] Especially noteworthy are improvements in hardware (line control equipment) and software (line control programs and file management systems, before the developments in the area of MIS).
[92] Bátiz-Lazo (2018), pp. 137-141
[93] Maixé-Altés (2013).
[94] Bátiz-Lazo (2018), p. 147.

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