Building Bankomat: The development of on-line, real-time systems in British and Swedish savings banks, c.1965-1985

Bernardo Batiz-Lazo and Tobias Karlsson and Björn Thodenius

Bangor Business School, Lund University, Stockholm School of Economics

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Bernardo Bátiz-Lazo, Tobias Karlsson and Björn Thodenius
University of Leicester (UK), Lund University and Stockholm School of Economics (Sweden)

Abstract

The massification of retail finance in the 1980s relied on the successful deployment of automated teller machines (ATM) and on-line real-time (OLRT) computing during the 1960s and 1970s. We document how the deployment of ATM networks interweaved with the adoption of OLRT computing in Sweden and the UK (alongside a running comparison of similar developments in the USA). Low transaction volume and small retail bank networks facilitated the early adoption of OLRT by savings banks in America. Although they started their computerisation rather 'late', British savings banks benefited from adopting 'tried and tested' technology while overtaking clearing banks. Meanwhile, Swedish savings banks spearheaded technological change in Europe. In documenting cases of organizational change in Sweden and the UK, we depart from predominant view that considers the development of OLRT in a single move. We put forward the idea that there are specific conditions inside banking organisations that require considering on-line (OL) and on-line real-time (OLRT) as two distinct stage of development in adoption of computer technology. As a result, we show how in the process of diffusion of OLRT computing enabled the transformation of cash dispensers into ATM at the same time that European financial intermediaries were active in shaping technological change.

Key words: cash dispensers (ATM), computers (on-line, real-time), technological change, savings banks, Great Britain, Sweden, USA.

1. Introduction

Cheaper, more reliable second-generation mainframe computers that used transistors, reliable core memory and storage in magnetic tape (augmented by random-access disk stores) became available for business applications by 1960. These computers were also instrumental in the successful migration of infrastructure and knowhow developed around the huge SABRE air defence system to real-time business applications that processed many transactions simultaneously (Cambell-Kelly 2003, 41). A requirement for which IBM used the term 'teleprocessing' included airline reservations, bank automation and retail systems (idem). Indeed, in 1965 there were 505 savings and loans (S&L) servicing 22 million accounts in the USA.[1] East coast S&L had installed 12 on-line systems servicing 3.2

million accounts and 62 branches.[2] Eight banks with 33 offices and 964,857 accounts took advantage of service bureaus supported by NCR 315 machines. At the same time, there were 17 on-line systems on order by the savings banks.[3] Teleprocessing had made its mark amongst east coast S&L.

Teleprocessing in European banking was rather slow when compared to developments in the East coast of the USA. However, by 1972 things had changed radically. A forecast for top teleprocessing users in 1985 ranked the demand from financial services eighth in the USA, while the same forecast for the demand in Spain ranked financial services first (Martín Tardío 2009). The difference in the forecasts suggests that teleprocessing was expected to become more popular amongst the large and densely populated retail bank branch networks of European banks than amongst the geographically constrained US retail banks. Moreover and according to Sprague (1977, 29), the view of US regulators while participating in the creation of an electronic fund transfer system (EFTS) was informed by developments in Europe in the mid-1970s, most notably those around cash dispensing by British and Swedish savings banks.

This paper, therefore, documents in greater depth the development of teleprocessing networks by British and Swedish savings banks. Exploring the creation of is relevant because establishing on-line, real-time systems (OLRT) by retail European financial intermediaries developed in tandem with the deployment of automated teller machines (ATM). These two developments were linked because a lack of over-draft facilities required savings banks to develop interconnection between computer centres so that cash machines could debit customer accounts without human intervention. In documenting cases in Sweden and the UK, we depart from predominant view in computer history that considers the development of OLRT in a single move. We put forward the idea that on-line (OL) and on-line real-time (OLRT) should be seen as two stage of development of the deployment of computer technology. Furthermore, documenting the move from OL to OLRT systems enables us to contrast and compare organizational changes within British and Swedish savings banks. As a result, we show how in the process of diffusion of OLRT computing and cash dispensers, European financial intermediaries were active in shaping technological change.

The reminder of this paper proceeds as follows: the next section provides some background regarding the origins and growth of savings banks in Britain and Sweden. The third section details the adoption of OLRT computing and cash machines in British savings banks. The fourth section documents similar developments in Sweden. In document the adoption of OLRT and ATM networks in Britain and Sweden we show that these developments intertwined with those of two engineering companies namely Speytec (that was to be purchased by Burroughs) in the UK and Metior (later to be Asea-Metior) in Sweden. The fifth and final section encompasses our conclusions.

2. Common Origins

2.1. Trustee Savings Banks

Savings banks date to 1810 in Scotland from where they expanded to other European nations during the 19th century while building around ideas about creating thrift habits within the proletariat (Horne 1947). There were

different forms of savings banks in the UK (including the National Security Savings Bank system and the Post Office Savings Bank, later called National Savings Bank) but our research only deals with that with the largest number of similar organisations, namely the so called trustee savings bank (TSB).

The governance of the TSB was different to other corporate bodies because there was no ultimate owner, while proceeds were usually reinvested in their totally as working capital. To create trust among potential depositors, the Savings Bank (England) Act 1817 required all such institutions to deposit their accumulated funds with the Commissioners for the Reduction of the National Debt, who held an account at the Bank of England (thus providing cast-iron security) for this purpose (Horne, 1947: 72). The same principles were extended to Scottish savings banks in 1835. Guarantees to depositors introduced by Act of 1817 were reinstated in subsequent legislation (enacted in 1833, 1863 and 1891) (Payne, 1967).

Early attempts at market diversification were curtailed by the Savings Bank Act of 1891. It was until 1965 that the TSB were allowed to issue current accounts, undertake the payment of utility bills and safeguard securities and valuables. Regulatory changes, therefore, limited the potential diversification of the British savings banks' investment portfolio and foreclose opportunities for direct lending to retail customers while their business remained in collecting low volume deposits. Funds and operation of the savings banks would be under control of voluntary managers or trustees (hence the roots of the TSB acronym), none of whom was to derive any benefit from that office (Maixé-Altés 2009).

At the end of nineteenth century there were 231 TSB banks in UK (Horne 1947, 388). This number was reduced through a number of mergers while most remained as a series of autonomous entities, many of them 'unit banks' (where the whole organization was encapsulated within the premises of a single retail office) as late as 1970. At the same time, some trustee savings banks began to open retail branches and sub-branches. Some of these came from converting premises of 'savings centers' into actual branches, tried for the first time in Gloucester in 1948.[4] But by and large most of the branches came from organic developments in close geographical proximity to 'head office' – thus responding to changes in local economic conditions while avoiding the sphere of action of another savings bank.[5] The emergence of a retail branch network for the whole movement was timid in terms of the number of retail outlets: with 386 in 1911, reaching 1,505 in 1970 (30 for the Preston bank and 37 for the Belfast Bank)[6] and peaking at 1,650 in 1981.[7] New and refitted branches would always be inaugurated with a 'social bang', as the opening accompanied with 'an impressive civic opening ceremony.'[8]

In 1960 the distribution of the number of banks and size of assets was highly skewed with the North of England and Scotland having the largest number of banks and accounts, the largest banks in terms of assets located in urban centres (namely London, Glasgow, Edinburgh and Belfast), the largest concentration of assets located in the South East of England (Revell 1973, 355-356; Bátiz-Lazo and Del Angel 2003, 355). At the same time, the share of total deposits in sterling made by UK residents was diminishing from 9.2 percent in 1962 (£16.5 million) to 6.2 percent in 1976 (£69.8m) (CLCB 1978, 56). As part of a change of government policy, 70 or so remaining banks amalgamated into a single provider between 1970 and 1985. This entity was then floated in the stock exchange following Thatcher's privatization program in 1986 while given its unique governance, the proceeds of the flotation were reinvested in its entirety as working capital. Nine years later, the TSB Group was acquired by Lloyds Bank in 1995.

2.2. The Swedish savings banks – a brief overview

The first Swedish savings banks were inspired by the Scottish model and established in the early nineteenth century. These banks were non-profit organisations with the purpose to encourage thrift among poor people. However, from the start a large portion of deposits came from farmers and the urban middle-class. The passing of the first piece of legislation dealing with savings banks in 1892, stated that savings banks were to gather deposits from the general public and not only from the poor. Regarding the loan portfolio, the savings banks were mainly focused on investments in housing, real estate and agriculture. The first savings banks were established in towns and cities, but the movement spread to the countryside in the late nineteenth century. The number of savings banks increased rapidly until 1926 when they reached a peak of 497.[9] Although all savings banks were under the same regulation, there were clear differences between units operating in towns, at the county-level or in the countryside (Forsell 2002, 75-77).

The Swedish savings banks association (*Svenska sparbanksföreningen*) was established in 1900, some ten years after similar organisations had been established in the UK (1887) and the US (1893) but ahead of those in Spain (1928), Italy (1911) and France (circa 1960). Like its US and Spanish counterparts, the Swedish association played an important role in elevating the public image of thrift and from the 1920s onwards, lobby government on behalf of its members.[10] In 1925 a department for propaganda was established. According to Hessling (1990, 68-69), this department had three main aims: first, it was to encourage thrift, both internally within the savings banks and externally among the public. Second, it was to serve as a publishing house and, third, as a central purchasing unit to coordinate purchases of material that the savings bank needed in their retail branches. The department regularly published printed material and was responsible for launching national campaigns. In 1941 the propaganda department was re-named *Sparfrämjandet* and in 1943 it became an independent company. One reason behind the change of name was the negative connotation of the term 'propaganda'. The new *Sparfrämjandet* had three departments namely, publishing, external relations and central purchasing.

The co-ordinating structure of the savings banks movement was further enlarged in 1942 with the creation of a central bank for the savings banks (*Sparbankernas bank*) (Forsell 2002, 77-78; Körberg 2006). This organisation was a similar to those already operating in other European countries namely, Finland (*Skopbank,* established in 1908) and Norway (*Fellesbanken* established in 1919) in Scandinavia. In continental Europe there were the likes of ICCRI in Italy (established in 1919) and the Spanish Savings Banks Credit Institute (*Instituto de Crédito de las Cajas de Ahorro* or ICCA, established in 1933). But the Swedish move was ahead of that in Great Britain, where the Central Trustee Savings Bank Ltd. was established until 1972 to amalgamate clearing operations in England and Scotland and co-ordinate money transmission between all savings banks (Moss and Slaven 1992, 163; Moss and Russell 1994, 275).

During the first half of the twentieth century competition between savings banks and commercial banks in Sweden was rather weak. Each had different customers and offered different services. In some instances they even came together to collaborate in joint projects. Whereas the commercial banks had experienced serious problems during the inter-war period, savings banks flourished while operating mainly in local and regional markets. Although their number had already started a downtrend (approaching 450 in 1945 and as little as 60 in 2008),

jointly their share of total deposits increased from 26 to 43 percent between 1920 and 1950 and profits were high (Forsell 2002, 78-79).

The decades that followed the end of World War II were characterized by overall economic growth, increased affluence and expansion of the welfare state in Sweden. This era also saw increased competition in the banking sector as the commercial banks began to widen their customer base (while aiming to attract all sorts of new customers, from companies to wage-earners). Handelsbanken, for example, launched itself as the 'people's bank' in 1950. Shortly after it and other commercial banks used the contacts developed while financing the working capital of manufacturing companies to offer these companies direct payroll deposit services.

The savings banks were initially hesitating to this new service but there was a group of younger managers that pushed for a more aggressive corporate strategy (Forsell 2002, 78-79, 89; Körberg 2006, 232-233). Throughout the 1950s these young managers were under the leadership of Sven G Svensson, director of *Sparfrämjandet*, who also organised annual conferences in the resort town of Saltsjöbaden (in the Stockholm archipelago) to facilitate the meeting of like-minded young managers (Forsell 2002, 88-89). They were united by the idea that the savings banks had to adjust to ongoing social change. Furthermore, they had the conviction that the savings banks should met the challenge of Handelsbanken and other commercial banks but not by demanding protection from the state but by introducing better services. Many ideas that came out of the conferences at Saltsjöbaden were implemented during the 1960s as the attendants reached influential positions within the savings banks.[11] As a result the Swedish savings banks evolved from small-scale savings institutions to 'modern' business-oriented banks. During this process the emphasis on thrift was downplayed while the savings banks began to view depositors more like customers than savers.

Rocketing administrative costs provided a strong incentive for the savings banks to seek greater labour efficiency through the application of new technologies. As suggested by Table 1, the increase in the nominal value of deposits was accompanied by an increase in the value of administrative costs (measured as a percent of total deposits). It is around this background that they intensified efforts to introduce mainframe computers for various tasks during the 1960s.

Table 1: Administration costs in the 80 biggest Swedish savings banks, 1962-1967

Year	Million SEK	% of deposits
1962	114	0.847
1963	128	0.895
1964	150	0.963
1965	176	1.063
1966	213	1.124
1967	257	1.194

Source: Körberg (2006, 211)

As mentioned, the savings banks were late to respond to the direct payment of payroll service offered by commercial banks. This was to change in 1960 when most of the bigger savings bank introduced that service. But

unfortunately the number of individual accounts they managed to attract proved to be much lower than expected. This became evident two years later in 1962, when the commercial banks had more than twice as many accounts as the savings banks (respectively 387,000 against 143,000). However, close links with trade unions helped the savings banks to transform their position and eventually dominate the direct payroll payment service. By the end of 1970 the savings banks had no less 870,000 accounts (Hessling 1990, 239; Forsell 2002, 78-79, 89). At the same time, the number of Ordinary Department accounts in the British savings banks increased 16 percent from 8,635,637 in 1962 to 9,980,000 in 1967 (Moss and Russell 1994, 326). Table 2 below illustrates how the growth in business volume was accompanied with an increase in staff in Sweden. Meanwhile, staff numbers were also rising in the UK, reaching 17,070 in 1980 and peaking at 43,640 in 1989.[12]

Table 2: Estimated number of employees and deposits in Swedish savings banks, 1962-1967

Year	Number of employees	Increase in %	Deposits million SEK	Increase in %
1962	3,500		17,699	
1963	4,100	17	18,957	7
1964	4,700	15	20,531	8
1965	5,200	11	22,263	8
1966	5,800	12	24,511	10
1967	6,400	10	27,259	11

Source: Körberg (2006, 211)

While increased involvement in direct deposit of payroll reduced the number of cheques passing through the banking system, the savings banks found this involvement was not without costs. In order to keep up with the commercial banks, the savings banks had to expand their workforce. This resulted in payroll and related costs growing faster than the pace at which the value of total deposits increased. Consequently, administration costs bolted. Expressed as a share of deposits, administration costs increased by 40 percent between 1962 and 1967. Table 3 below summarises a closer study of the four largest savings banks. It revealed that the number of transactions (withdrawals and deposits) increased by 125 percent, whereas their total funds increased by 64 percent (Körberg 2006, 210-212). At the same time, the nominal value of deposits at the Ordinary Department of the British savings banks increased 67 percent from £823,800,000 in 1962 to £1,377,700,000 in 1967; while withdrawals increased 71 percent from £830,100,000 in 1962 to £1,417,900,000 in 1967 (Moss and Russell 1994, 327). These figures suggest that the relative success of Swedish banks was not matched by the British, as the TSB were losing deposits faster than they could acquire them.

Table 3: Transaction volume and deposits in four biggest Swedish savings banks, 1962-1967

Year	Number of deposits and withdrawals	Value of deposits in million SEK
1962	2,011,600	989
1963	3,077,600	1,062
1964	3,528,900	1,147
1965	3,843,300	1,246
1966	4,473,000	1,425
1967	4,526,700	1,626

Source: Körberg (2006, 212)

Another aspect of the modernization of the Swedish savings banks that took place in the 1960 was concentration. In the beginning of the 1960 there were still over 400 individual savings banks in Sweden. As a result of amalgamation between small units operating in the countryside and city-based ones, only 273 savings banks remained in 1970. The concentration process went on in the following decades with merges between the biggest banks. By 1989 there were 109 savings banks left, but this population consisted of 20 big banks with regional coverage that had 80 percent of total deposits and 95 local banks (Forsell 2002, 101).

3. Catching up and Overtaking in England

3.1. Development of On-Line Systems

The nature of operations in retail financial intermediation had conceptualised the need for on-line systems in banking since early in the process of their computerization. This was evident in the pioneering effort of the Howard Savings Institutions of Newark, New Jersey which in 1953 began a study into the feasibility of automation for savings and mortgages operations. However, off-the shelf equipment at the time was found to be inadequate and '[s]econd, the problem was similar to that of the military system development with specified performance without specified hardware types.' (Sanders 1963, 708). Unable to find a computer provider whose system could guarantee the level of reliability and security required to keep customers satisfied (and the costs of the configuration within reason), the Howard had to wait almost 10 years to see a system that linked 32 'teller-registers' (counter terminals in all seven retail branches of the bank) with a central processing unit at head office. By 1965 two other banks (Union Dime Savings Bank, NY and Society for Savings, Hartford, Conn.) adopted the Teleregister system.[13] The Teleregister system then serviced a combination of 22 retail branches and 710,865 accounts.[14]

American savings and co-operative banks also use bureau services to solve their computer requirements. Located in Boston, MA, Bankers Data Processing, Inc. was heralded as a 'precedent-setting' development for US retail financial services. [15] Established in 1963 as a wholly-owned subsidiary of the Boston-based Provident Institution, two years later it had deployed passbook on-line processing terminals at the counter of 19 branches of seven banks. On-line terminals eliminated the need for ledger cards by automating the credit and debit of passbooks (including accrued interest) while speeding up services to individual customers and the balancing of individual

tellers at the end of the day. Installing a Burroughs B300 in September 1965 aimed to expand on-line terminals to 18 other savings banks in Massachusetts while using conventional telephone lines to bring on-line 44 separate offices to serve some 500,000 customers. At the time, the Bankers Data Processing's system was claimed to be not only the first bureau service for savings institutions but also the largest of its kind ordered or installed anywhere in the world.

But in spite of developments to automate passbook-based accounts in the USA, in Britain savings banks were 'late' adopters of computer technology (Bátiz-Lazo and Maixé-Altés 2009b). Their preference was to purchase 'tried and tested' devices while making little or no advertising of this; whereas British clearing banks were keen to advertise the adoption of new machinery as a sign of 'modernity' (Bátiz-Lazo and Wardley 2007). While clearing banks developed computer expertise in-house (notably amongst accounting and the operation and methods departments), savings banks recruited heavily from the market and notably engineers with experience in on-line systems such as airlines and television.

Early experiments took place by banks established in and around London. These banks developed a clearing centre in Surrey in the early 1960s around an IBM 1400, but the big incentive to bring the computer revolution to all the TSB was the decimalization of sterling in 1971(Bátiz-Lazo and Maixé-Altés 2009b). While clearing banks had already installed a number of computer installations by the mid-1960s, the mechanisation of the British savings banks was largely incipient: most TSB had just started to use mechanical and electro-mechanical equipment to speed up internal processes such as the accounting function (idem).

A speedy computerization using a bureau service was a particularly attractive idea as it would help to deal with the cost of capital investment and the lack of technical skills. Most English and Welsh banks mapped to a bureau service supported by the National Data Processing Service (NDPS), a subsidiary of the Post Office. After decimalization, operations were brought in-house and replaced by nine processing centres servicing 48 banks and some 1,550 retail bank branches: Manchester or MADCAP (6 banks); West Midlands-Kidderminster (6 banks); Bottle near Liverpool (8 banks); York (14 banks); Crawley in West Sussex (near Surrey, 5 banks); London (3 banks); Glasgow (4 banks); Belfast and north of Edinburgh in Falkirk (Moss and Russell 1994, 266).

As the TSB amalgamated into a single entity, the TSB managed to maintain heterogeneity across banks in administrative processes and other computer related applications (Bátiz-Lazo and Maixé-Altés 2009a). Indeed, early in their computerization, the banks around Manchester and the West Midlands-Kidderminster consortia committed to having their own computer centre running the same configuration system (built around an ICL System 4).[16] Expertise developed around these banks and particularly that in Manchester was to spear head technological and organizational change for all the TSB.

The roots of the development of on-line, real-time (OLRT) systems at the TSB took place in September 1970. On this date Tom Bryans, general manager of the Belfast Savings Bank (with assets of £124 million was the third in the UK and largest in Ireland), unveiled the first on-line (OL) system applied to a savings bank operation in Britain and Ireland.[17] The system brought together the savings banks of Northern Ireland and was based on the combination of an undisclosed Burroughs mainframe and TC700 terminals.[18] Initially these were to service 40,000 of the Irish consortium's 560,000 deposit accounts and provide instantaneous communication to 26 of the 42 retail branches.

Also in 1970 the Manchester and District Bank built a computer centre in Strangeways (Sale, Greater Manchester) and called it Manchester and District Computer Accounting Project (MADCAP). One of the banks serviced by MADCAP was the Manchester and Salford Savings Bank whose Chief Accountant was David Wilson. Wilson served in the war in the telecommunications regiment where he had been involved in operating the radar systems. It was from this experience that he became interested in communications. During the first stage of computerization of the TSB, transactions at the branches were collated into paper tape at regional offices and then processed overnight at NDPS machines. Wilson understood that this form of batch processing was breaking the law as it required that information on the passbook to match that in the bank's ledger. Wilson thus wanted to develop some form of communication where the computer record was updated immediately as the transaction took place at the retail branch's teller.

At that point in time, having small computers in branch offices with the purpose of updating accounts was simply too expensive. Wilson kept coming round to the idea and then suggested to neighbouring banks about sharing the cost of one big central computer that would eventually hook the terminals at retail branches through telephones. That was how MADCAP was born. MADCAP went on-line in November 1971 while the West Midlands consortia did it successfully in 1972. Thus the TSB were defeating similar initiatives by the clearing banks – which as late as the mid-1980s still operated balances 'as of last night'. Of course there were important differences between the TSB and the clearing banks: while the TSB had 1,524 retail branches in 1971, Lloyds Bank (the smallest of the big four clearing banks in terms of assets) had 2,384 retail branches and 34,368 employees in the UK.[19] Moreover, although the savings banks had large number of accounts, there were neither a great number of transactions not were there many different types of transaction (Moss and Russell 1994, 271). As it turned out, more than fifty standing order payments per account stretch the system to its limits (idem). However, at that point in time, only Lloyds had seriously approached the idea of an OLRT system, while the other three large clearing banks (i.e. Barclays, NatWest, Midland) had at least a decade before they brought all retail branches on-line.

The eight bank consortia went on-line in 1974 and the North-East and Midlands the following year (Moss and Russell 1994, 271). But this resulted in mixture of on-line, off-line and manual systems: the London Saving Bank had abandoned its plans to go on-line while the Scottish banks, serviced through the Savings Banks of Glasgow, remained committed to their Burroughs off-line system as still more cost-effective than available OLRT systems while the Northern Ireland TSB, using Burroughs computers, refused to join the larger Altrincham-based consortia with ICL machines (Moss and Russell 1994, 282). Unable to secure a single national system, the chairman of TSB Computer Services, speaking at the Association's annual meeting in May 1975, cautioned that clearing banks were taking the advantage in on-line technology (idem). Shortly after, in late 1975, Tom Bryans, of the computer-pioneer of the Belfast bank, was named the first chief general manager of the TSB.

Well aware of the challenge, the four consortia using Altrincham and the South-West off-line consortium were determined to press ahead with a replacement system based on a single OLRT system housed at computer centre in Wythenshawe (built in 1979) (idem). At the time, no-one in the banking and the computer marketplace believed in the proposal to switch from an on-line system based on the ICL system 4 mainframe and Olivetti

terminals at the counter to an OLRT system built around a Sperry Univac and 3,500 Burroughs modular transaction control terminals (spread out at the counter of some 1,000 retail branches) without breaking the system.[20]

Few outside of the TSB technical area believe it possible. A manager in charge of the joint computer centre recalls: 'IBM's attitude was you can't do it. IBM wanted us to stop our system and transfer everything across to a new system off-line.'(Read, 17-Jul-2008). Moreover, a report on the 'cost-effectiveness and human aspects of computerization' commission to a group of academics by the TSB considered that the OLRT system would be more expensive than the off-line alternative (Moss and Russell 1994, 272). However, the view of computer specialist inside the TSB was that both the report and the market place were overlooking the productivity gains that could be achieved.

As mentioned in preparation for decimalization the TSB introduced Olivetti terminals sitting directly in counters, which allowed the input of information at the point of origin in the branches. This was solid ground to deploy the OLRT system based on the Burroughs terminals. The new system allowed providing information based on real-time interrogation of the data. One contemporary observer in the US opined that the computer success of the TSB was noteworthy to the extent that:

> 'The TSB ... [has] one of the most advanced on-line networks serving both teller windows and ATM's in the U.K. Competition is doing very well in all parts of the United Kingdom and the clearing banks are in for some rude shocks unless they awaken to the situation.'(Sprague 1977, 31).

To gain such praise, the TSB first had to close down of regional computer centres while making that in Wythenshawe service all branches. For security purposes, operations at Wythenshawe were duplicated with a second (dedicated) centre at Milton Keynes. Perhaps as a legacy of the Cold War, tapes, transaction logs and other back-ups were taken daily to a third back up site, whose location was 'secret' (but suspected to be located in Rowntrees in York) which assured the TSB would be operational in spite of 'an attack'. The centre in Milton Keynes was built in 1983 with the double purpose of, first, providing a back up to the computer at Wythenshawe but also amalgamating activities of the south east of England (which until then had remained off-line) with those in Wythenshawe (which already had within its remit operations in the North East, North of Wales, Cornwall and Devon).[21]

By 1983, the TSB were the only British bank to have managed to capture information as and when transactions actually occurred and there was no evidence other banks would be able to do it in the near term (Rajan 1984, 56). Shortly after, the government published a White Paper and a new TSB Bill in 1984. Together these resulted in abandoning the quasi-federal decentralised structure in favour of a central organisation which was no-longer legally unique but incorporated under the Companies Act. The aim was to give the then called TSB Group 'a more effective operating structure and also establish clear guidelines for ownership and accountability, neither of which was clear under former legislation.' (Marshall 1985, 41). Also in 1984, England and Wales amalgamated into a single organisation an all remaining off-line branches linked to the Wythenshawe/Milton Keynes computers. The same happened in 1985 when the TSB became a single entity when joined by the Scottish banks (whose branches had also remained largely off-line).[22] As a result, the TSB was the only clearing bank in Britain with a fully integrated on-line, real-time system when it was floated in the stock exchange in November 1986.

3.2. Deploying the on-line, real-time ATM network

The introduction of cash dispensing technology to the TSB took place when the West Midland made operational a Chubb MD2 at the Shrewsbury branch in June 1970.[23] Chubb & Son's Lock and Safe Company Group plc. (Chubb) had been one of the pioneering firms of cash dispensing technology in the UK thanks to its collaboration with Smith Industries and two large clearing banks, namely Westminster Bank and Midland Bank (Bátiz-Lazo and Reid 2008, 2-3). The MD2 was a standalone machine where customer's record had to be updated after the transaction and with mediation of a human teller. The West Midland's adoption of an MD2 followed similar moves by the clearing banks at the same time that Chubb became the dominant technology in British retail finance during the early 1970s (Bátiz-Lazo 2009, 7-8).

In an independent move and four years after installing its Burroughs mainframe in 1970, the first two 'on-line' (OL) cash dispensers (Burroughs RT 2000) were made operational in Belfast in 1974.[24] Here OL meant that the central computer was informed of withdrawals after the cash had been dispensed as otherwise the transaction would have been too time consuming for the customer. There were no opportunities to confirm availability of funds prior to dispensing the cash.

But neither of these two early experiments seems to have had widespread repercussions amongst the TSB. Instead the roots of what Sprague (1977, 31) described as the 'first community wide ATM network' in the UK dated to the deployment of MADCAP's English Electric (ie ICL) System 4 mainframe.[25] Around 1970, David Wilson pointed out to the programmers that communication between the mainframe and its Olivetti terminals (sitting on the counter of retail branches) would be 10, 20 or even 30 miles away and then back again. In the absence of random access memory and database management systems, they came up with 'Modus 11'. This was not encryption but a mathematical calculation that converted the account number to a specific address on the file on the disc. In this way, a specific query resulting from a passbook inserted into a teller terminal could go straight in and straight out.

'Modus 11' then became the key for a trial system of 10 Chubb cash dispensers. After having seen developments in London and in the USA, it was decided that one of the 'on-line' banks would move forward with the project. The General Manager of which was now the Manchester Regional Area Central Bank, volunteered. There was an advantage on the trial being in Manchester because that was where the computer centre was located. However, the selection of Chubb as provider of the cash dispensing equipment followed Harold Wilson's and Tony Benn's 'buy British' policy rather than technical specifications and preferences of the TSB's computer staff.

The first experiment with OLRT cash dispensers took place in 1974 (Moss and Russell 1994, 282). This first trial involved six branches wired to the Manchester computer centre.[26] Initially there were greater issues in making the Chubb machines work than the communication using conventional telephone lines. Shortly after, customers who had an account in the Manchester Regional Area could make withdrawals from these cash dispensers. Customers were no longer tied to their specific bank or branch. They could withdraw from any cash machine and their account debited immediately. Customers could also make balance enquiries.

But in spite of the success with the trial adoption elsewhere within the savings banks was slow. As late as 1978, only few retail branches were equipped with a currency dispensing apparatus. Although some other banks also

installed Chubb cash dispensers, when the TSB wanted to embrace this technology in full it found that Chubb was unable to supply the machines (Neil, 16 March 2008). Moreover, there was resistance from the South region and resistance from Scotland, banks who were all on off-line systems. This was to change in 1979 when the South-East Regional Area ordered from Burroughs two B6800 large-scale computer system and 800 TD730 display terminals worth $7 million dollars.[27]

Managers had also resisted deployment on the grounds of cost as they thought that cash dispensing technology was expensive. Indeed, in 1977 a top of the line RT 5000 Burroughs cash dispenser (a direct competitor of the IBM 3624 and featuring printer and up to 4,000 bills of one or two denominations) ranged from $25,000 to $40,000 each (or a rent ranging from $860 to $1,400 per month based on a one year contract).[28] Moreover, an internal cost accounting exercise at the TSB suggested that cash dispensing technology would be ineffective unless it was strongly associated with a sharp decrease in the number of transactions though and off the teller's counter. The situation remained at an impasse until the end of 1978, when two of the leading clearing banks (namely Barlcays and NatWest) were actively deploying large orders of NCR 770 cash machines (Bátiz-Lazo 2009). TSB managers then panicked and pressed for cash dispensers to be rolled out throughout all regions.

Research into potential providers to service by the TSB by the Computer Research and Development Unit (CRDU) resulted in a large order of Burroughs cash machines being placed. This order was placed in spite of some senior managers thinking that Burroughs was not the better technology (Neil, 16 March 2008). The architecture of the Burroughs cash dispensers built on the system developed by specifications of the Midland Bank to a small engineering firm called Speytec (Bátiz-Lazo and Reid 2008). Speytec became a subsidiary of Burroughs in 1969 but as the following quote suggests the US computer manufacturer was keen in keeping the custom of British financial intermediaries:

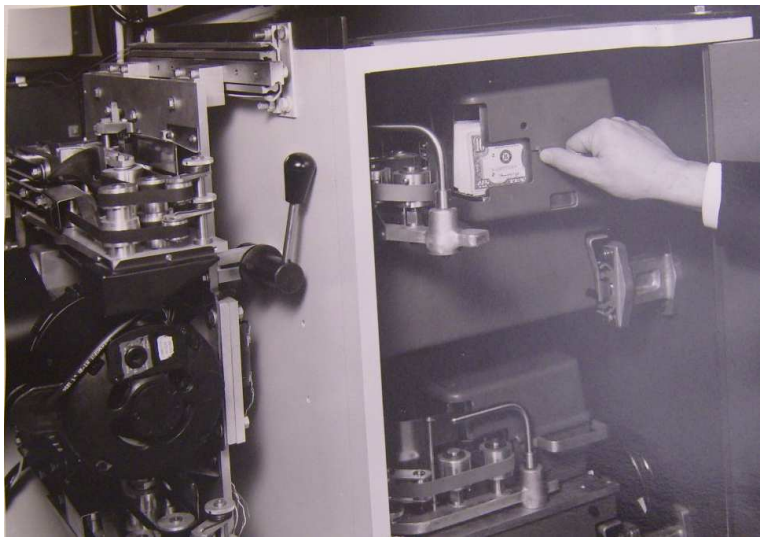
> '… they went away and came back with another machine. It was the RT650. [We thought of it as] the TSB's because [Burroughs] modified it to work with us. The beauty about it was it was a very simple machine. We looked at NCR and they had an excellent machine but it was too sophisticated to talk to the system we were operating, we wanted something simple the system would do it straight the way you see and it was a bit more expensive so that was put aside.' (Taylor, 17 July 2008).

As stated in the quote, Burroughs was happy to modify its equipment to suit the workings of TSB computer and administrative procedures (while marketing the RT659 to US banks from 1981 onwards). But as a result of the modifications, the day to day operation of the RT650 was not a challenge for human tellers at the TSB.[29] See Figure 1 and 2 below.

Figure 1: Fascia of RT650 by Burroughs Corp. (undated)

Source: Charles Babbage Institute (CBI), Burroughs Corporation Records (Ascension 90), Product Photographs, ca. 1940-1985 (Series 75), Box 43, Folder 6.

Figure 2: Back of RT650 by Burroughs Corp. (undated)



Source: Charles Babbage Institute (CBI), Burroughs Corporation Records (Ascension 90), Product Photographs, ca. 1940-1985 (Series 75), Box 43, Folder 6.

As illustrated in Figure 2, human tellers operated the machine through a back door. Here the machine stored a big tally roll (which later models replaced with magnetic tape cassettes and floppy disks), in which details of each transaction were recorded. Each morning the dispenser was refilled (always using new notes as otherwise they

would get stuck or cause the machine to malfunction) and the printed record balanced. This procedure was exactly the same as that used to balance tills serviced by human tellers. So after a brief explanation, any of the cashiers was able to service the cash dispenser for the purpose of routine transactions.

Currency dispensing worked well once individual customers overcame their fear of the activating card not being return or had a dislike for interacting with a machine rather than human teller. There were of course instances where the cash card would slip through the wrong slot or the machine failed to dispense the right amount (something easily solved if the customer returned at the end of the working day and the balance in the machine equal the amount he/she claimed had not been dispensed.) But largely, during the early 1980s, the Burroughs cash dispensers seem to have been free of associating with specific errors or malfunctions – illustrating how the TSB benefited from adopting a tried and tested technology after clearing banks had to endure 'teething problems' with early forms of currency dispensers.

In summary, the TSB became the first UK retail financial institution to have a full OLRT system. Through this process the savings banks created the largest network of computers and introduced leading edge software applications for fraud detection and management of cash machines (while replacing Burroughs RT650 with NCR 1780 equipment in the 1980s). British savings banks, therefore, explored cost efficient ways of using readily available technology that could sit on top of scarce resources to attract the inflow of deposits from geographically remote customers. This included opening of retail branches by the largest banks. But tight regulation and under-developed strategic and risk management skills amongst the top echelons of management, limited possibilities but for a handful of individual organizations in this constellation reaching critical scale to compete.

4. Shaping technology in Sweden

4.1. Establishing joint on-line systems around Spadab

Rising administrative costs and an increasing number of accounts in the late 1950s and the 1960s required Swedish savings banks to take urgent action. According to Körberg (2006), the savings banks of Stockholm and Gothenburg were the only two with the size and business volume to justify investment in punched card sorter-readers in the 1950s. These two savings banks also were the only two to invest in that technology. By the end of the 1950s, it was common to see the use of mechanical and electro-mechanical accounting machines amongst the Swedish savings banks.

Sparfrämjandet dealt with most technical questions for the savings banks. At Sparfrämjandet, the department for central purchasing was that which decided which technical equipment should be bought. Almost every savings bank was a member of Sparfrämjandet and although Sparfrämjandet's central purchasing department only issued recommendations about specific equipment and its use, savings banks who failed to follow these recommendations were reprimanded. The Swedish savings banks association had a committee to design paper forms. This committee effectively controlled the use and design of paper forms across the whole movement. The savings banks association also had technical advisers that primarily visited small and mid-sized savings banks and

helped them with decisions on and management of technical matters. At the Nordic level, there was also co-operation that included technical matters. This co-operation was named Nordic Central Savings banks Delegation (NCSD). In the late 1950s computerization of bookkeeping was something that was discussed within this group.

A major step towards computerization was taken in 1958 when a Technical Committee was formed within the Swedish savings banks association. The committee was formed after Hans-Erik Wihlborg, who was to become the first chairman of the committee, led a delegation to the USA in 1957. Their aim was to observe the use of what they called electronic computing machines by savings and loans banks. Wihlborg's report recommended that similar machines might be useful for the Swedish savings banks but within a time frame of five to ten years. One of the participants from the trip even said that "there is, however, reason to be sceptical whether these systems will work as supposed"(Körberg 2006, 203).

Per Olov Rimvall, another member of the Technical Committee, was a driving force behind research to solve the 'bookkeeping problem' in the savings banks and to find a common solution to the problem. Among the issues he face was widespread scepticism towards the idea that a great number of savings banks could work together on solving technical issue and making joint capital equipment investments.

In 1959 Wihlborg left the savings banks movement to be employed at Svenska Handelsbanken. As a result Rimvall took the position as chairman of the Technical Committee. Rimvall's first decision was to form a sub-committee within the Technical Committee that had the task of automating bookkeeping. The sub-committee started their work in 1960 and they scanned the market for suppliers of computing machines and got quotes from IBM, Ericsson, Bull, RCA and NCR. At this point time, most of the major commercial banks had already purchased computers. while some savings banks had started to use private computer service bureaus. The work of the sub-committee led in late 1961 to the formation of commonly owned computer and data processing company, which later was to be called *Spadab*.

Spadab's first large investment took place when a computer centre in Stockholm opened for service in early 1963. It housed a Bull Gamma 30 computer. The Stockholm computer centre was soon followed by a second centre in Gothenburg. Although some people at Spadab pushed hard for the purchase of an RCA machine at Gothenburg, in the end Bull once again secured the installation of another Gamma 30. Only some months after the decision was made the merger between Bull Sweden and RCA Sweden were announced (Spadab 1987). By the end of 1963, 16 savings banks used the Stockholm computer centre and 15 banks the centre in Gothenburg. A third computer centre was also opened in the south at Linkoping. Each computer centre was sub-divided into three main areas: the mainframe room, the punching room and a room for the distribution unit.

Although the Stockholm Savings Bank had developed its own computing facilities, it joined Spadab in 1966 while, at the same time, becoming the fourth computing centre of the Swedish consortia. By then, the computer centres had a dual organizational structure: while mainframes were located close to large urban centres of important economic activity, staff involved in systems development, system analysis and programming were all housed in Stockholm.

A fifth and last centre was opened in Malmö in 1967. The engineering group in Malmö had done some explorations around computer technology outside of Spadab. For instance, it pioneered the use of on-line services and the first on-line cash dispenser was installed in August 1968. The centre in Malmö was fitted with a third generation computer, namely a new IBM 360/40 was installed which had on-line teller terminals sitting in the counters of retail branches. The IBM machine was also connected to NCR cash machines. Interesting to note that one terminal offered the possibility to get automated voice responses to questions that were typed in. The terminals were connected through conventional telephone lines using 1,200 baud modems. But besides the development at the Malmö centre, OLRT services really took off in 1974 when 15 savings banks were connected in a nationwide on-line network.

4.2. The Metior cash dispenser

The roots of cash dispensing technology in the Swedish savings banks resulted from efforts at Sparfrämjandet and not Spadab. Sparfrämjandet was the initial driving force for savings banks to adopt cash dispensers because the central purchasing department of Sparfrämjandet had a parallel development within automation: in 1960, Hans Rausing and the Rausing company started to develop and sell coin sorting machines to the savings banks. This later became the firm Restello, a company within the Tetra Pak group.

The saving banks and Sparfrämjandet had for some years been discussing the possibilities of automating cash dispensing to rationalize handling of cash for bank tellers in the bank offices. One other need was to make it possible to distribute cash when the bank offices were closed, especially and as had been the case in Britain, after the banks closed retail branches on Saturdays in 196X. In contrast to Britain where banks introduced cash dispensers in 1967 and then bowed to labour union demands to end Saturday opening hours in 1969 (Bátiz-Lazo 2009, 5 and 19) , Swedish savings banks first ended service on retail branches on Saturday and then introduced cash dispensers.

Sparfrämjandet wanted some type of machine or automat that was able to dispense bank notes and discussed the issue with Metior, a company in the Tetra-Pak group that manufactured automatic petrol pumps and had taken over production of the Restello coin sorting machines.[30] The discussions went on for some time but the co-operation was not fully successful. Metior then contacted the commercial bank Svenska Handelsbanken who became the new partner in the development of a cash dispenser (Wentzel 1996, XX; Körberg 2006, 348). According to Körberg, Bengt Wetterholm, the CEO of Spadab at that time, reinitiated the contacts with Metior when learning about the interest of Svenska Handelsbanken (Metior Archive; Körberg 2006, 348).

Here it is worth noting that there are very few references to Spadab in Metior's archives. It seems like the company mainly had contacts with Sparfrämjandet and that it was this organization that influenced the design of the first generations of cash dispensers in Sweden. For example, when Metior in December 1966 was about to demonstrate its first machine it invited a representative from Sparfrämjandet but none from Spadab.[31]

The initial demonstration was planned for 11 January 1967 in Malmö. There were also plans to start testing the machines in Uppsala in January or February the same year. Whether the demonstration and subsequent tests actually took place according to plans is unclear but it can be established that the first Swedish cash machine was made operational and shown to the press on 6 July 1967 in Uppsala. This was only nine days after the first British

cash machine was operational by Barclays Bank and De La Rue, and a couple of days before Svenska Handelsbanken showed their first Metior machine.

After some months of testing, the general public could start to use the cash dispenser in Uppsala 24 hours a day in September 1967. The first machine had some problems and it took some time to get them sorted and have the machine operational most of the time.

In early 1968 Metior had manufactured five machines. Metior still called them prototypes and of these five machines, the savings banks had two and the commercial banks three. In the spring of 1968, mass production began as a result of Sparfrämjandet ordering 20 machines. This order included a number of specific requirements, indicating that the savings banks actively contributed to shape the new technology.[32]

Some 20 machines were also delivered to Switzerland and one to the Netherlands. Each machine sold at 58,000 to 59,000 SEK. About a year later, in April 1969, the Swedish savings banks ordered Metior cash dispensers for 1.8 million SEK, Metior's biggest order so far.[33] By February 1970, Metior had delivered 37 cash dispensers for the Swedish market, of which 24 had been bought by savings banks.[34] At the same time, Metior had exported 141 cash dispensers. For instance, Metior had achieved a dominating position in Switzerland, where De La Rue had left the market, and was about to enter the French market in collaboration with Transac, a division of Compagnie Industriella des Telecommunications (CIT).

The first cash dispenser went under the name 'utbetalningsautomat' and later 'Bankomat'. However this name was soon acquired by Svenska Handelsbanken and the commercial banks as the brand name for their dispensers. During its initial years Metior developed four generations of cash dispensers.[35] The first generation was not sold commercially. The second and third were developed for the savings banks and the fourth was designed for the commercial banks and the French market.

Bankomat Mark 2 and 3 were made of steel and had punched holes for identification, while in the UK Chubb's plastic card had punched holes, Barclay-De La Rue used a cheque-sized voucher with a magnetic stripe and Speytec-Burroughs' pastic card had a magnetic stripe on the back (Bátiz-Lazo and Reid 2008). Bankomat Mark 4 used a card with information embedded in a magnetic stripe that had been developed by the French Société General de Automation.[36] To withdraw money from the Metior machines a PIN-code was used together with the card.

Whereas UK banks had been adamant not to deploy machines until their security had been tested (Bátiz-Lazo and Reid 2008), some years after the first Swedish machines were being used the security of the system became an issue. Withdrawals using fake cards started to appear. Someone had discovered the algorithm used to associate card numbers with the PIN-code. One Easter holiday someone travelled around Sweden, withdrawing money from each machine they visited. This lead Metior to contact Bofors to help with the security issues. The co-operation lead to Bofors buying 80 percent of Metior's shares on 31 August 1969.[37] However, Bofors' interest and competence on these security issues regarding cash dispenser were insufficient. New problems, of such magnitude that the savings banks considered to close down its whole fleet of Metior machines, were reported in October 1971.[38] As a result Bofors sold control of Metior to ASEA in 197X.[39]

Interesting to note is that the Easter holiday incident lead to a change in the internal regulations of the savings banks. Before the incident the retail branch that had the dispensers was solely responsible for losses that might arise. This was changed after the incident so that all savings banks collectively shared any losses from resulting from the malfunction of cash machines.

Already at an early stage, in August 1968, Metior delivered the first machine to be connected on-line to the Malmö computer centre. The second to fourth generations of Bankomats were all possible to connect on-line via modem and Mark 4 also to a call system.[40] However, most cash machines at the savings banks operated as stand alone, off-line machines.

A turning point came in 1971 as a result of two developments. First commercial banks within the Swedish Bankers Association, the post office and the Federation of Swedish Rural Credit Societies set up the Automatic Cash Dispenser Center.[41] The aim of this independent company was to install and run cash dispensing equipment for the consortia, determine where the machines would be located, market its services (under the Bankomat brand) and administer card registration, data processing, clearing and statistical information. In November 1972, 15 Asea-Metior cash machines were made operational for the consortia in Stockholm. In 1973, 13 machines were deployed in Gothenburg and one more in Stockholm. The following year 10 more dispensers became operational in Stockholm. By 1974, the savings banks remained outside of the consortia which, at the same time, aimed to deploy a total of 100 machines throughout Sweden to service 1.8 million direct payroll deposit accounts. Between November 1972 and January 1974, banks in the Automatic Cash Dispenser Center consortia issued 29, 443 cash machine cards and dispensed some Skr 66 million (US$ 14.54 million), with an average withdrawal equal to SKr 268 (US$59).

A second important development took place when the new director of Spadab, Jan Rydh, attended the Automated Teller Machine Conference in Chicago in 1971. Rydh reminisced that during discussions dwelling on investments in off-line dispensers on the fringes of the conference, out of impulse he made the sudden decision to regard investments in off-line machines a sunk (i.e. irrecoverable) cost (Thodenius 2008). The decision was communicated to colleagues attending the conference and upon their return to Sweden, engineers at Spadab were free to start what became the Minuten project. The aim of this project was the adoption of on-line cash dispensers by the savings banks. In searching for potential suppliers contacts were made with a number of manufacturers of cash dispensers and in the end three companies competed for the project. These were the Swedish company Asea-Metior, the British company Chubb and the US-based Docutel. As a result of the deliberations, the savings banks finally abandoned Metior in 1975 by choosing Docutel as their suppliers of ATM devices (that is, on-line cash machines).

There are several competing explanations behind the move by the savings banks to abandon Metior. But one major factor was the weak US dollar at that time which made the Asea-Metior dispenser more costly than the Docutel machine (Thodenius 2008, 22). Installation and service in Sweden was to be handled by Datasaab. This engineering company was at the start of their collaboration with Leif Lundblad and his Stockholm-based Inter Innovation company. Lundblad had developed its own cash dispensing mechanism to accommodate the differences between dollar notes and European currencies. The experience Datasaab had of the Docutel machines combined with Lundblads dispensing mechanism led to decision to develop a Datasaab ATM. However, before a working

machine had been presented Datasaab became a part of Ericsson Information Systems. A number of machines were produced and installed in a number of countries.

The savings banks were the first to use this new generation of ATMs. These ATMs were initially known as mini-banks and 'Minuten' and the first machine was installed on May 24, 1977 in the city of Falun. In total, 600 Docutel machines were installed (Wentzel 1996). All Minuten machines were from the beginning connected OLRT. In 1982 Spadab searched the market for a new generation of ATMs. Spadab wanted to buy 1,000 new ATMs. The machine that Datasaab had started to develop did not fulfil the demands of Spadab. Instead, Ericsson contacted Omron and in 1984 a contract was signed and the new ATMs could start do de be deployed. In total, 900 ATMs of this type were delivered to the savings banks.

The Minuten network competed with that which built around commercial banks (called 'Bankomat'). In later years clearing agreements between the two networks allowed bank customers using each others' network.

5. Conclusion

Edgerton (2006:xvii, 3) has made claims about the need to move away from innovation-centric chronologies, that is, to avoid assuming that the impact of technology comes with innovation and early use. However, 'first use' is a relative concept. In this paper we document the creation of electronic data processing networks in British and Swedish savings banks while presenting a running comparison of similar developments in the USA. We explored how constellations of otherwise independent providers came together to achieve scale while adopting on-line, real-time (OLRT) computer technology. We provided details as to how savings banks in the East cost of the USA were the 'first' to adopt OLRT computing. But this meant relatively little for the first OLRT system in Swedish and British savings banks. This partly because they populated independent retail finance markets, each characterised by its own institutions, regulation and competitive dynamics.

We made a perhaps unusual distinction between on-line and OLRT systems. This distinction begs the question, when is on-line not real-time processing? When considering the processing of data within the central processing unit then OL is always OLRT. Indeed banks with a geographically concentrated retail branch network and relatively low volume of transactions took steps to wire terminals and cash machines with their computer centre (either physically or through modems and conventional telephone lines). This was the case of savings banks and co-operative banks in the East cost of the USA as well as savings banks in Manchester and Malmö.

However, here we also presented a number of examples in Europe where on-line terminals sitting on retail bank tellers and cash machines were not OLRT. This as through the wall cash machines updated customer records after the transaction had taken place (in order to avoid long delays and reduce customers' convenience) or as a result of organizational procedures, transactions were stored and batched together so central files were updated once or twice per day. The early on-line system at the TSB also showed how early computer technology could reach capacity quite easily (at least as far as transaction volume requirements of banks were concerned). These transactions also characterised as relatively simple and quite standard (i.e. the TSB have been characterised as a

single product financial intermediary, see further Bátiz-Lazo and Maixé-Altés 2009b). '"[Balance" between input, output, storage devices and main frame equipment was far more important than inherent speeds and capabilities of individual components... there was little sense to pay for equipment twenty-four hours a day when the equipment would be employed for a much shorter period of time.' (Sanders 1963, , 708-9). Understandably bureau services were an attractive solution on both sides of the Atlantic. Not only to address issues relating to sharing the cost of capital equipment and lack of technical skills but also as a way to work together and address concerns regarding reliability and security so that relations with retail customers remained unchanged or they were even strengthened.

We also departed from the common assumption that the nature of response of retail financial intermediaries to regulatory change and new technology is a rather deterministic (e.g. Gardener, Howcroft and Williams 1999). This was achieved by documenting how managers dealt with organizational change (or absence of change) within constellations of the same organisational form in different geographies. As noted by Guerreiro Wilson (2008), in approaching new technology managers of British and Swedish savings banks required that the machine fit the work and not the other way around. Indeed, we document evidence telling how in an effort to maintain the custom of European banks, US computer manufacturers were ready to modify their equipment to suit their technical requirements and specifications. This further suggested the relative importance of European financial intermediaries for US computer manufacturers: when compared to the atomistic nature of American retail banking, large volume of transactions and retail branch networks in Europe resulted in low frequency but high value orders of computer equipment. This evidence does not negate the importance of developments in computer technology the USA (particularly of manufacturers such as IBM and Burroughs with were both suppliers of systems for the US military) but it does contests naïve assumptions about the origins of technological change in financial services which considers a " …fact that many financial innovations originate in the U.S...." (Frame and White 2009, , 2).

In summary, we explore the first steps in the emergence of self service technology and the changes it brought about for consumers and organisations active in retail financial market while, at the same time, articulate an international comparison. The purpose being researching technology and corporate strategy in their social and historical context, that is, the dynamics of the design, construction, development, implementation and use specialised technology (Orlikowski and Barley 2001; Bridgman and Willmott 2006).

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NOTES

[1] Unless otherwise stated the reminder of this paragraph borrows freely from Spadab Central Archive, 'Diverse', 6-May-1965.
[2] Two based on IBM1440, six based on NCR 315, three on Teleregister and one on a Univac 490.
[3] Three for IBM 1440 to service five offices and 110,000 accounts; ten IBM 360 to service 46 branches and 1.85 million accounts and three NCR 315 to service 11 branches and 374,768 accounts ('Diverse', 6-May-1975). Seven banks with 19 offices and 161,043 accounts used bureau services of Bankers Data Processing, Inc. It built around a Burroughs B3000 computer (Charles Babbage Institute (henceforth CBI), Burroughs Corp (Ascension 90), Press Releases 1947-1987 (Series 72), Box 10, 'Bankers Data Processing Inc.', 10-October-1965).
[4] Anonymous (1948) 'National Savings Centres and Trustees Savings Banks', *TSB Gazette* vol. XVIII no. 3 (Jul), pp. 12-13.
[5] At the end of 1949 there were still at least 30 urban districts and county boroughs with 40,000 or more inhabitants without a savings bank retail branch (*TSB Gazette* vol. XX no. 2 (Apr), pp. 1-5.)
[6] 'Opening of the 1500th Branch', *TSB Gazette* vol. XXXIV no. 4 (Oct), p. 159-60 and 'New computer system for Belfast bank'. *The Irish Times*. 9-Sep-1970, p. 15.
[7] Branch and Staff Numbers, Lloyds TSB Group Archive, circa 2009.
[8] H.R.J. (1948) 'The New Branch', *TSB Gazette* vol. XIX no. 3 (Jul), pp. 7-10.
[9] However, there is also an unverified statement of 498 savings banks in 1928.
[10] Note that membership of *Svenska sparbanksföreningen* was voluntary. See Forsell (2002, 82).
[11] For example, Sven G Svensson was appointed managing director of *Svenska sparbanksföreningen* in 1962 (Körberg 2006: 158).
[12] Branch and Staff Numbers, Lloyds TSB Group Archive, circa 2009.
[13] Spadab Central Archive, 'Diverse', 6-May-1965.
[14] Idem.
[15] Unless otherwise stated this paragraph borrows freely from CBI, Ascension 90, Series 72, Box 10, 'Bankers Data Processing Inc.', 10-October-1965.
[16] Unless otherwise stated the reminder of this section borrows freely from Read (17-July-2008) and Taylor (17-July-2008).
[17] According to Sinnot (1970) in 1970 only the savings bank in the Irish Republic using a computer was that of Cork and this was a bureau service based on an IBM 360/20. There were other four savings banks in the Irish Republic were those of Dublin, Limerick, Monaghan and Watford.
[18] Unless otherwise stated the reminder of this paragraph borrows freely from 'New computer system for Belfast bank'. *The Irish Times*. 9-Sep-1970, p. 15.
[19] Branch and Staff Numbers, Lloyds TSB Group Archive, circa 2009.
[20] The exact part number was not disclosed in the press release. However, it was stated that the order was worth $18 million to Burroughs and the machines were to be installed by the TSB Computer Services (CBI, Ascension 90, Series 72, Box 10, Folder 12, Item 20, 'Order for new financial system', 26-April-1978).
[21] Read (17/Jul//08) and Taylor (17/Jul//08).
[22] Read (17/Jul//08) and Taylor (17/Jul//08).
[23] 'News from the Banks: West Midland', *TSB Gazette* vol. XXXIV no. 4 (Oct), p. 158.
[24] B. R. Johnson 'First steps in self-serving banking ', *TSB Gazette* vol. XXXVII no. 3 (Jul), p. 74-80.
[25] Unless otherwise stated the reminder of this section borrows freely from interviews with Read (17-July-2008) and Taylor (17-July-2008).
[26] As noted above, at this point the TSB in Manchester was now running a Sperry mainframe as the ICL/English Electric machine had been decommissioned.
[27] It is worth nothing that this transaction brought the total value of equipment order or installed at the TSB by Burroughs during the previous 12 months to $34 million.CBI, Ascension 90, Series 72, Box 10, Folder 13, Item 9, 'Large UK order', 8-February-1979.
[28] CBI, Ascension 90, Series 72, Box 10, Folder 6, Item 57, 'RT5000', 3-November-1976.
[29] Unless otherwise stated the reminder of this paragraph borrows freely from Whitmore (08 February 2008), which is consistent with similar recollections by McQuade (06 March 2008) and Shipley (11 March 2008).
[30] Metior was founded in December 1965 by Bevaknings AB Securitas and Vapor AB and its activities started two years later. Metior was originally based in Lund but moved to Malmö in 1967.

[31] Metior had also invited representatives from the police (Polistekniska rådgivningsbyrån) and a manufacturer of safes (most likely E A Rosengrens Kassaskåpsfabrik). *Source*: Metior AB (*henceforth* MAB), Huvud- och dagböcker (*henceforth* HD) 1966-1971, 20 December 1966, Vol 8.
[32] MAB, HD, 20 May 1968, Vol 8.
[33] MAB, HD, 18 April 1969, Vol 9.
[34] MAB, HD, February 1970, Vol 10.
[35] MAB, HD, 1971, Vol 15.
[36] MAB, HAD, 24 January 1969, Vol 9.
[37] MAB, HD, 1970, Vol 10.
[38] MAB, HD, 15 October 1971, Vol 13.
[39] Metior had also other problems that can have motivated why it was taken over by Asea. Technical problems had for example made the Swedish association of commercial banks to question further collaboration in September 1971 (Sammanträde hos Bankföreningen, 3 september 1971, PM Protokoll, Rapporter vol 13). As a rapidly expanding company Metior also suffered from organizational problems. Its customers frequently complained over delayed correspondence (Meddelande angående Metiors organisation, 20 oktober 1971, PM Protokoll, Rapporter vol 13).
[40] MAB, HD, June 1970, Vol 11; MAB, HD, 1971, Vol 15.
[41] Unless otherwise stated this paragraph borrows freely from Ekebrink (1974, 10-12).