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Origins and Development of SWIFT, 1973–2009

Susan V. Scott* and Markos Zachariadis**

Research in this article traces the origins of a not-for-profit financial institution called the Society for Worldwide Interbank Financial Telecommunication (S.W.I.F.T.). SWIFT is a core part of the financial services infrastructure and widely regarded as the most secure trusted third party network in the world serving 200 countries with over 8000 users. Our analysis focuses on how the design and current state of SWIFT was influenced by its historical origins. In order to ensure widespread compatibility in a sector experiencing asynchronous technological development, legacy Telex specifications had to be accommodated in SWIFT's design. Over time, what began as a closed "society" founded to reduce errors and increase efficiency in inter-bank payments grew into an industry co-operative supporting an enthusiastic community of practice and transformed into an unexpected network phenomenon. SWIFT achieved such success that it has been accused of being an installed base stifling innovation. In recent years, SWIFT has had to institute new categories of membership in an effort to counter concerns about its bank dominated governance and it continues to search for ways to meet the requirements of key constituents in the financial supply chain.

Keywords: SWIFT; financial services; diffusion of innovations; networks; standards; payment systems; electronic funds transfer; ICT in banking

Introduction

It is widely presumed that there is a close relationship between globalization, financial institutions and financial markets however relatively little is known about the infrastructure that supports this interaction. Business historians have called for more research to investigate the creation of a 'second global economy' (Jones, 2007) reminding us that the organization of global business phenomenon are 'heavily contingent on time, industry, the state of technology, home economy and public policy, as well as the specific competences and routines of each firm (Jones, 2005). The aim of this research is to understand how the design and current state of SWIFT was influenced by its historical origins. Before we begin to analyse the development of SWIFT, it might be helpful to briefly explain what SWIFT is and why it is core to financial services infrastructure. SWIFT's primary role is that of a message carrier. More specifically:

> [The] object of the company is for the collective benefits of the members of the company and their affiliates and branches, the study, creation, utilization and operation of the means necessary for the telecommunication, transmission, and routing of international private proprietary financial messages between the members of the company.[1]

It is important to emphasise that SWIFT is not a bank or a clearing and settlement institution; it does not manage accounts on behalf of customers nor does it hold funds.

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Although it is involved in the organization and distribution of data, it does so on a 'store-and-forward' basis and does not maintain financial information on an on-going basis instead, '[a]s a data carrier, SWIFT transports messages between two financial institutions' ('About SWIFT', 2009). SWIFT is responsible for providing the platform, products, and services that allow member institutions to connect and exchange financial information. If one asks contemporary financial service professionals, they will say that the most critical part of SWIFT's role is achieving the secure exchange of proprietary data: reliability, confidentiality and integrity. Thoughtful practitioners will describe the SWIFT infrastructure as a key-operating asset while others regard it simply as necessary but fundamentally uninteresting sector-wide 'plumbing'. Its current status belies a more compelling account of institutionalization that charts SWIFT's evolution from an efficiency initiative driven by a closed 'society' of banks to a network innovation of world-class standing.

As McKenney et al. (1995) note, 'few firms have broken the mold of history and transformed their industries with a new dominant design for information processing'. A historical analysis of SWIFT is justified from this perspective alone. However, as this special issue shows, not-for-profit organizations that have had a transformative influence on their sector provide additional pause for thought. The story of SWIFT is one of international co-operation as much as competition between institutions which provides a nuanced rejoinder to the claim that changing infrastructure is 'akin to engaging in guerrilla warfare, in which the competent, effectively led group wins' (McKenney et al., 1995). Dominance can also be achieved by committee: designing the rules that govern a core infrastructure and setting standards. However, this depends upon sector-wide adoption and diffusion which eludes the majority of initiatives who may aspire to a similar status. SWIFT achieved its current taken-for-granted dominance with an intercalated design, in other words a pre-existing technological heritage was folded into the new SWIFT network. The starting point for appreciating the development of SWIFT is, therefore, to understand its relationship to Telex.

Understanding the origins of SWIFT: Telegraphy, cable technology and Telex

The use and impact of telecommunications and network innovations in banking can be traced back to the late 1840s when the recently developed electrical telegraph enabled faster inter-market communications and reduced differences in securities prices between remote stock exchanges in the United States (Garbade and Silber, 1978). Since then, further advances in telegraphy and cable technology gave rise to domestic point-to-point networks transmitting signals represented by alphanumeric characters. By the end of the century, national networks had become global, thus linking all continents and enabling information flows in almost every major financial centre of the world. Batiz-Lazo and Wood (2002, pp. 193-4) categorise this era as the '*early adoption* period' when individual banks began to carry out international transactions with correspondent banks. Similar use of the telegraph also enhanced communications between head offices and branches constituting the in-house bank network. Additional evidence in Garbade and Silber (1978) suggest that early innovations such as the introduction of the first trans-Atlantic submarine cable in 1866 also facilitated greater integration of securities trading between New York and London.[2]

Further improvements in message routing and switched-network technology, as well as the extensive use of the typewriter keyboard, laid the foundations for the first teleprinter exchange (or *Telex*) networks.[3] Automatic dial subscriber-to-subscriber services were first introduced in Germany before the second World War using a switching system from Siemens and Halske.[4] Soon after, the United Kingdom, France, US, and Canada followed (Carré, 1993). The Telex which operated as a privileged teleprinter network for the benefit of various industries, including the banking sector, was initially based on the use of the existing telephone and telegraph networks and allowed speech and teleprinter signals on the same connection (Beauchamp, 2008). The service promptly supplanted the telegram for business subscribers (Hills, 2007) and by 1957 it connected 19 European and 18 Latin-American, African and trans-Pacific countries with the US and Canada, giving access to more than 30,000 separate subscribers over international communications.[5] The participant base grew fast and it is estimated that in the late 1970s there were more than one million users worldwide.[6] One of the most compelling features of the Telex was its capacity for internationalization and it soon became apparent that the compatibility between Telex networks would be a significant issue to assure the feasibility of global message transmissions. Early in the process (June 1964), the International Telegraph and Telephone Consultative Committee (C.C.I.T.T.) proposed a mutually agreed way forward to manage the increasingly composite technical standards that paved the way for 'the advent of worldwide automatic telephony and Telex.'[7]

Although banks, stock exchanges and other financial institutions were the first and most numerous users of the Telex, there was a notable increase in subscribers from other industries towards the end of the 1960s. During the same period many large US and European banks established private networks and invested in computer installations to process and manage electronic data (Batiz-Lazo and Wood, 2002). Banks were focused on decreasing costs through automation and increasing transactional efficiency with other financial institutions. Domestic electronic funds transfer (EFT) systems emerged, (for example BACS[8] in the UK and CHIPS[9] in the US) to eliminate paper from the payments process. As international markets expanded, a number of Trans-National Banks (TNBs) began to compete in foreign markets pushing the boundaries of international operations ever forward (Crane and Hayes, 1983; Davidson, 1982). Their rapid growth meant that the majority of international banking was in the hands of relatively few banks. Langdale (1985, pp. 3) notes that during in the late 1970s, 67% of all foreign US lending business was conducted by 12 Trans-National Banks.

As large multinational banks turned their attention to establishing global operations and developing international business, their requirements for reliable computerised communication systems increased. This expansion was mainly driven by a strategic move from clearing banks to meet the requirements of their clients abroad as their distribution channels, suppliers, and customers were reaching to distant economies (Holland, 1995; Holland, Lockett, and Blackman, 1992). Such cooperation between multinational firms and Trans-national banks led to the development of a number of electronic data interchange (EDI) systems that would integrate financial processes offered by banking operations in order to manage payments (Holland, Lockett, Richard, and Blackman, 1994). At the forefront of such strategic expansions were banks such as Citibank N.A., Bank of America, and Chase Manhattan in the US, and Barclays, Lloyds, and Midland Bank in Europe. The employment of public networks was rejected mainly because their volume-driven rates were regarded as a potential constraint on future growth in banking activity.[10]

These major banks therefore found themselves in the role of pioneers developing proprietary private networks using circuits and satellite facilities leased from PTT (Postal, Telephone, and Telegraph) authorities.[11] The key design criteria for these elaborate international private-data arrangements was the need for reliable, secure transmissions and the accommodation of distinctive (sometimes unique) in-house standards developed for international financial transactions. Leading this wave of innovation in financial telecommunication technologies was Citibank's IT centre in New York which had developed a proprietary messaging standard known as MARTI (Machine Readable Telegraphic Input). The banking community balked at Citibank's attempt to impose their proprietary standard on international payments and competing standards emerged. As frustration with duplicated effort built up and an inter-organizational impasse emerged, key players began to recognise that they needed to negotiate a compromise and agree upon a common messaging language if they hoped to realise efficient international transactions.

From Telex to the Society for Worldwide Inter-bank Financial Telecommunication (SWIFT)

One of the most important challenges facing financial institutions in the design of a common messaging system capable of increasing volumes of international payments was the reduction of their operational risk (e.g. the reduction of error rates, increase of security, and greater reliability). In the existing system, a cross-boarder transaction would often require the exchange of more than ten Telex messages, which made the process costly and time consuming. Authentication procedures[12] needed to ensure the necessary level of security for fund transfers were also complex and increased labour intensity. To make things even more complicated, Telex messages were being transmitted in the form of free text allowing the users to send payment instructions in various formats. In the words of a former Vice President of Citigroup and ex-SWIFT board member:

> [It] was literally in English [free text] and then some guy had to interpret that and put all the account numbers on, the debit account, the credit account, and the typists would come along and type out forms…people realized if we're using this form as an input device with all the instructions and information coming in…if we got the messaging in the right structure you could cut out all these people. 50% of all transactions…was one community…if you took [the largest international] 20 banks, 60% of their interaction was with each other anyway. So if you put them together you don't have to have a big community to get efficiency, and it was really about how do we get these computers to create efficiency.
>
> Suddenly they realised that the aim of MARTI was correct but it had to be a community issue, where they all got the same benefit. Because the only time you would get the benefit was when the biggest banks would do it together, cause they all had the same technology, therefore, what you need to change wasn't that different per bank.[13]

The idea of a common standard and creation of an industry cooperative capable of addressing the problems inherent in the existing Telex technology had been widely discussed since the beginning of the 1960s. However, it was evident that such an initiative could only be feasible if there was close cooperation among the banking community (U.S. Congress, 1984). Throughout the history of banking, the boundary between competition and cooperation has had to be navigated; in the case of SWIFT, support for a *shared* network slowly gained momentum and began to achieve institutional form.

The earliest available evidence for this is in the late 1960s, when the Société Financière Européenne (SFE)[14], a consortium of six major banks based in Luxemburg and Paris, initiated a 'message-switching project'[15]. By 1971, there was sufficient interest to generate sponsorship from 68 banks in 11 countries within Western Europe and North America ('SWIFT Plans to Start May 9: New SWIFT network gives banks an instantaneous link worldwide', 1977) for two feasibility studies to examine 'the possibility of setting up a private international communications network'[16]. These studies were conducted by two consultants: *Logica* in Great Britain who were made responsible for the technical and financial side, and the *Stanford Research Institute* (SRI) in the US, who analyzed the legal and organisational aspects[17]. Based upon the findings of these studies, completed in 1972[18], the banks continued with the project and user groups were set up in each country to coordinate views and comments from the member banks (BGA, SWIFT presentation, p. 2, June 1975). In addition to this, international working parties were assembled to work on standards relating to messaging formats, security, and network technology. As expected, disagreements between banks and attempts by countries to impose their own standards were commonplace at this stage; nevertheless, discussions moved forward and on May 3 1973, the Society for Worldwide Inter-bank Financial Telecommunication (S.W.I.F.T.) was founded as a co-operative non-profit organisation. SWIFT was headquartered in Brussels (a diplomatic alternative to the intense rivalry between New York and London) and permanent staff were appointed. At the time of its founding, SWIFT[19] membership amounted to a total of 239 banks from 15 countries. By the end of 1974 an initial design of the long-awaited network was complete and after an exhaustive selection process the Burroughs Corporation from Detroit, U.S.A., was selected to supply the computer equipment and install the system[20].

[Figure 1. about here]

Despite the challenges faced by SWIFT and its users in the early stages of its development, this phase is characterized by those involved as one of optimism in which members on both sides of the Atlantic showed considerable willingness to engage in the cooperative effort needed to ensure that the system ran smoothly. The technical network design gradually began to stabilize[21] and traffic started to increase rapidly as more countries went 'live'. By February 19 1979, the volume of messages passing through the SWIFT network exceeded 120,000 per day[22]. As the quest for new network solutions and communication technologies was taking place, SWIFT was already delivering benefits to its members beyond its core attributes. Among the early advantages that SWIFT members enjoyed were speed of messaging, lower costs, increased volumes, more secure transactions, and standardization. Table 1 provides a description of the benefits and advantages of SWIFT membership.

[Table 1. about here]

What is remarkable about the early history of SWIFT is that a "society" founded by a relatively small number of banks to reduce errors and increase efficiency in inter-bank payments, evolved into a broader industry co-operative and became an unexpected network phenomenon. The notion of a network effect was not part of the consciousness of those involved in the original SWIFT project during the 1970s. Their focus was solely on creating an entity, a closed society, to bind members together in an organizational form that would enforce standards designed to create efficiencies on transactions between the member banks.

Standards and regulation

In parallel to establishing their primary infrastructure, another significant issue for the future growth of SWIFT was the development (and adoption) of standard message formats. Prior to SWIFT, banks used paper forms or templates for cheques and transfer orders. These templates could be considered as a first attempt to standardise financial data by ensuring that users provided the required information in a generally established configuration. However, because free (unformatted) text messages could be sent via Telex a commonly agreed format had not been developed for international wire transfers. Part of the remit of the SWIFT design team was to ensure widespread compatibility which meant encompassing past practices and legacy technologies rather than innovating.

> [At] that time, since the Telex was one of the major tools for electronic communication, the new SWIFT language was heavily influenced by it. Much effort was spent to ensure compatibility between existing Telex information flows and the new SWIFT electronic information flows. This meant that the printed version of a SWIFT message looked very similar as its corresponding Telex version.[23]

Ensuring that SWIFT could accommodate existing manual practices and become part of automated back office projects in banks around the world was critical at this juncture. Telex compatibility meant that banks could produce the same outgoing message and then allow the communication application or SID to determine whether it should be sent via Telex or the SWIFT network depending on the intended destination. This was of major significance especially in the beginning where only a few banks had adopted SWIFT and needed to transmit messages to other banks that were using older technology. Information flow was organised accordingly into "message types" and "fields".[24] In the 'Telex world', each financial institution was described by its Bank Identifier Code (BIC) and this was simply incorporated into the evolution of the new system of work as "the SWIFT code".[25] All the registered SWIFT addresses were listed in the SWIFT directory. Figure 2 illustrates how a payment instruction can be translated to a SWIFT message.

[Figure 2. about here]

While it is interesting to consider how the design of SWIFT accommodated the historic Telex legacy[26], it is also important to appreciate its influence on the future momentum of techno-innovation in the sector. For example, there is evidence that banks began to extend their use of SWIFT standards to operations in business areas beyond international payments.[27] As a former banker recalls:

> [Our bank] had its own standard…then we suddenly realised, why do we have to have our own internal standard? If you're using one standard externally why don't we use that same standard internally?...We basically took the SWIFT message and put our internal wrap around it and used SWIFT standard internally from that point and on. We suddenly realised it's not only good for dealing with everyone else. [28]

Once banks realised the efficiencies created, interest in standards began to gain momentum in other pockets of financial services, the most significant of which was securities. The securities industry proactively organised itself under ISO (International Organization for Standardization), namely in a subcommittee (SC4 – Securities and related financial instruments) of the technical committee TC68 (Banking, securities and other related services)[29]. During this period, the

ISO/TC68/SC4 working group designed a series of message types under the ISO standard ISO 7775. This standard, which was based on the SWIFT language, contained about 50 message types that were implemented in subsequent stages on the SWIFT network between 1984 and 1997[30]. The SWIFT organization was mandated by ISO to assume management control and preserve the existing message set on behalf of the community.

A historical perspective draws attention to the way in which the role of SWIFT has changed in relation to challenges facing the financial services community at specific points in time. The origins of SWIFT lie in finding a solution to the immediate problems occupying banks in the late 1960s: market access; transactional efficiency; operational risk; robustness and security[31]. Having been instituted to establish a jointly-owned global messaging communications network and achieved critical mass, a path-dependency with standards development is realised. As a consequence, SWIFT gradually assumes responsibility for a core self-regulated financial infrastructure and the development of standards needed to maximize benefits from it. SWIFT currently describes its combined organizational mission as follows:

> [SWIFT is]…a member-owned cooperative through which the financial world conducts its business operations with speed, certainty and confidence… Our role is [to]… act as the catalyst that brings the financial community together to work collaboratively to shape market practice, define standards and consider solutions to issues of mutual interest....SWIFT enables its customers to automate and standardise financial transactions, thereby lowering costs, reducing operational risk and eliminating inefficiencies from their operations'[32]

SWIFT's history has been characterized by negotiation and compromise between stakeholders from the start - by definition, its role as a third party places it in relation to on-going tensions. To understand how these relationships have been worked out in practice, it is necessary to study the changing governance arrangements at SWIFT and in particular how they have maintained the precarious dual role of network provider and standards development.

SWIFT by-laws and governance

The distinctive nature of SWIFT's governance is reflected in its ownership structure. Being an industry co-operative, SWIFT is solely owned by its member banks. Its capital structure was initially based on a mixture of equity and loan. On the equity side, each new member from the existing countries was allocated shares depending on their traffic volume. For new countries, members would only be given one share until cutover to operational status. After that they would also receive shares according to their usage of the network. Each share, apart from implying ownership rights, was also an obligation to grant SWIFT a loan (maximum $1,000 per share with an annual interest rate fixed by the Board of Directors) which enabled the cooperative to cover the costs of its international network operations during its development phase[33]. Once this initial capital base was established, SWIFT membership required payment of an entrance fee to cover operational costs. This was $3,200 for all members that joined before the 30 September 1972 and $5,000 afterwards. In 1982, SWIFT was able to completely repay the development costs of its network and break even. This 'cost-recovery' system along with the annual tariffs and messaging fees reflected the non-profit status of an organization whose ultimate objective was the collective benefit of its members.

The Society, which was created under Belgian law and registered in Brussels, is controlled by its Board of Directors. These are elected annually at the General Assembly by the member banks. In the early years, SWIFT was administered by the "General Manager" who supervised all the departments responsible for the daily operations of the organization: Operations, Administration and Engineering, Finance, and Services and Security[34]. However, a larger management structure has been put in place and the SWIFT Board of Directors currently delegates the day-to-day management of the Company to the Chief Executive Officer (CEO). The CEO chairs an Executive Committee formed by the CEO, the Chief Financial Officer (CFO), the Chief Information Officer (CIO), the Head of Marketing, the Heads of the three Regions and the Head of Stakeholder Relations.

The choice for the location of SWIFT's headquarters was fundamentally influenced by the studies conducted by Logica and the legal sub-committee of the Message Switching Project (MSP) steering committee (assisted by SRI Europe). Initial recommendations also included Amsterdam as a potential candidate but Brussels prevailed due to its stable 'social climate' and its regulatory, legal, and fiscal advantages. In parallel, other legal forms were considered for the entity of the company. At first the legal committee opted for the formula of an International Association as it was less costly than the Cooperative. Eventually, after considering the nature of SWIFT's operations in the commercial field and the obvious charitable character of International Associations, the decision was made in favour of the Cooperative Society. This was also partially due to the severe legal profit restrictions on the International Associations versus a more flexible regulation for the Cooperatives. In the next section, we examine the evolution of SWIFT's strategy in this distinctive context.

Objectives and strategy outline

Analysis of archive documents reveals that shortly after SWIFT commenced operations in 1977, the management team drew up a detailed report (which they refer to as the "Company Plan") on objectives, strategies, and the factors affecting the development of the cooperative. As an industry cooperative, SWIFT's primary goal was to serve its members in 'the best possible way':

> [Our] objectives should be defined in function of the service we wish to offer to our member banks. [First objective of SWIFT could be stated as] to offer member banks access to the largest number of national and international financial systems and networks through one interface.[35]

To understand this objective we need to remind ourselves of the original concept of SWIFT as a message carrier. Unlike other EFTs like CHIPS or BACS, SWIFT is only a channel for the transmission of financial messages. This means that once the financial instructions are communicated, the banks (and not SWIFT), are responsible for settling the transaction via a clearinghouse (Kozolchyk, 1992)[36]. SWIFT's standing as a trusted core financial services infrastructure rests not on the transfer of actual assets but on the value that the financial community places on secure connectivity. This is why the management team made it their priority to offer access to international financial systems by approaching national clearing systems, foreign-exchange (FX) dealing systems, and Eurobond settlement centers. In this way, SWIFT could play a key role in controlling service tarrifs[37], realizing end-to-end process efficiencies rather than just reducing transaction costs. As further parts of the financial services infrastructure evolved a number of connectivity events (for example, CREST[38] and CLS[39]) prompted more organizations to join SWIFT and thus increased the company's 'network effect' still further. Indeed, SWIFT is so effectively institutionalized into the core global financial services infrastructure that their defacto status has raised concerns.

Membership growth and network access

Concerns about the balance of power within SWIFT's governance have been ever-present. As a European initiative designed to thwart the potential dominance of proprietary bank standards (see previous discussion of Citibank's attempt to force MARTI on counterparties), SWIFT's membership was originally dominated by European banks which meant that despite the international nature of the markets for which they were competing there were inevitable geo-politics. Langdale (1985) notes that that one of SWIFT's initial concerns was 'the competitive advantage held by large U.S. TNBs because of their sophisticated leased networks' (p. 6). For this reason, SWIFT was often perceived as a means of competing with these large intra-bank systems (U.S. Congress, 1984).

Over time, it became apparent that direct competition with U.S. banks was not going to be the most defining feature influencing the design and development of SWIFT. The interest of US banks in SWIFT was tempered by the existence of their own federal systems such as FEDWIRE (owned and operated by the Federal Reserve Banks) and BANKWIRE (a private initiative) which met domestic demand for message transfers. Nevertheless, the deficiencies of the Telex technology for international payments meant that major US banks were keen for SWIFT to be in operation. US banks were among the first to adopt SWIFT and they proved highly effective in realising its benefits (Scott, Van Reenen, and Zachariadis, 2008).

While geo-politics were the cause of occasional thematic interest, the more enduring source of tension for SWIFT's governance has been managing the boundary between co-operation and competition among stakeholders with different strategic identities. This need for arbitration between multiple interests within the financial community has patterned the development of SWIFT from its inception to present day. Managing the boundaries of 'co-opetition' (Nalebuff and Brandenburger, 1993) in the financial community has proved crucial to the establishment of core not-for-profit infrastructure.

A source of controversy in this regard has been whether or not to extend SWIFT membership beyond banks. Accepting new types of members onto the network had been debated throughout the history of SWIFT ('SWIFT busters strike out', 1992). In 1987, SWIFT's member banks voted to expand the user base by including broker dealers, exchanges, central depositories and clearing institutions. SWIFT initially started its operations in the securities sector via a collaboration with CEDEL – a leading bank-owned securities and depository system in bond clearing. Additional cooperation agreements were drawn up with settlement system, Euroclear. Finally, SWIFT itself added a new message type suitable for direct securities transactions between banks ('Future directions for SWIFT' 1983). All these moves have been regarded as important ways to inject more value-added services into SWIFT to accommodate the emergence of new financial products.

Other financial institutions however did not find SWIFT so ready to extend membership. The efforts of international fund managers to become members of the Society were blocked by vote. After years of frustration they were accepted in 1992. This time it was the US banks that were 'swimming against the tide' amid fears of losing business as fund managers were going for other payment solutions ('SWIFT busters strike out', 1992).[40] In Europe there were fears concerning how fund managers would be defined and 'what status they will have in the system' ('SWIFT lets in fund managers', 1992). By the end of 1992, the membership of SWIFT had risen to 3,500 members (see Table 2).

[Table 2. about here]

Further complaints about the banks' exclusive hold over the governance of SWIFT were raised in the 1990s by triple A-rated corporations who expressed an interest in becoming SWIFT members on the grounds that they wanted to influence the priority given to standards innovation. They argued that SWIFT's ownership of both network and standards led to over-emphasis on the interest of financial services companies at the expense of innovations that would benefit corporate treasuries. Around 1998, SWIFT acknowledged that they needed to make some changes in their governance and later created a special category (MA-CUG) of membership in order to accommodate corporate interests. The Member Administered – Closed User Group allowed corporations to access the SWIFT network through member banks only.

By 2009, the SWIFT user base consists of almost 8,500 members that access the network everyday to carry out financial transactions. It is calculated that every year more than 3.5 billion messages (ranging from traditional payments to securities confirmations across the network). SWIFT's status as a core financial services infrastructure and its standing in the community as the most trusted secure network has placed an additional pressure on both its governance and design. In addition to demands for contingency planning and robustness that all major financial institutions have had to face since 9/11, SWIFT acknowledge that the next stage of their development has to be considered in relation to the advance of open standards and the emergence of phenomena such as cloud computing.

Discussion and conclusions

Understanding the origins and development of SWIFT highlights distinctive features of innovation in the sector as well as focusing attention on a number of important tensions characterising key relationships involved in establishing a not-for-profit financial institution responsible for critical inter-organizational financial services. The main emphasis in many accounts of information systems in business history has been on the development from 'people as computers' (i.e. clerks) to computer-based devices and techniques, primarily: the automation of document preparation (word-processing), information storage, and data manipulation such as financial analysis and accounting (see Campbell-Kelly and Aspray, 2004). Our study of SWIFT not only adds to the relatively few studies of core financial infrastructure[41] but also draws attention to a different kind of information systems innovation: a not-for-profit institution designed for collective benefit to study, create, utilize and operate the necessary means for the telecommunication, transmission, and routing of international private proprietary financial messages.

Robert Winder (1985) attributes SWIFT's uniqueness to the fact that it was a jointly owned cooperative at a time when 'the ambitious banks were already spraying computing power across the world in an attempt to establish a market advantage' (p. 55). This illustrates the contradictory tensions at the heart of SWIFT: it was suggested that SWIFT would be in immediate competition with existing financial institutions (U.S. Congress, 1984), however it found a way to leverage 'co-opetition' (Nalebuff and Brandenburger, 1993) and SWIFT currently promotes its operations on the basis of a productive complementarity.[42] Perhaps the most significant difference between other not-for-profit initiatives that became part of the global infrastructure, such as VISA (see Stearn, 2011), and SWIFT is that organizations have a choice regarding their use of the former whereas the latter is a *de facto* sector technology standard. SWIFT has become what Callon (1986) terms an “obligatory passage point” (i.e. if you want to do business with us you must join because there is no real alternative) for financial organizations around the world and the network expanded rapidly. SWIFT’s standing as a trusted third party has grown over time and later adoptees have signed up for the reputational kudos of membership as well as the benefits generated by the ‘network effect’ created by widespread adoption. These benefits both surpass the initial goal of transaction efficiency and reinforce the value of connectivity.

The productive complementarity that many not-for-profit institutions aspire to has taken the form of a significant ‘community of practice’ (Lave and Wenger, 1991) around SWIFT. As banks extended their connectivity and straight-through-processing projects[43], SWIFT accumulated a wealth of best practice documentation which was made available to members. Research participants describe how regional SWIFT user groups provided useful brainstorming opportunities where technology and operations professionals could join forces to problem-solve. The international banking community may not have trusted each other, but they all trusted SWIFT. Over time, SWIFT has become the ‘forum for the financial community’ (‘History of SWIFT’, 2009). SIBOS, SWIFT’s International Business Operations Seminar has played a key role in this regard. It has developed into an important annual conference for the banking community where concerns and issues can be aired (see Table 3 where these are reflected in themed debates at SIBOS)

[Table 3. about here]

One final distinguishing characteristic of SWIFT is the diffusion of its standards internally and externally throughout financial services. It is notable that, as with the insurance sector (Yates, 2005), incremental change was preferred to radical transformation. As discussed above, once the underlying network had been established, the most important issue for the future development of SWIFT was the development (and adoption) of standard message formats. Just as paper-based form templates were used as the basis for Telex transmissions, the Telex message format was then used as the basis for SWIFT messages which were subsequently used for internal as well as external process innovation. Exploring the standardization of technology[44] in a related financial services context, Yates (2005) finds evidence to support the notion that past use of a technology shapes the adoption and use of a new technology. Furthermore, she suggests that standards hold significance in the structuring of organizations because as they become inscribed into routines and practices they have the potential to shape contexts in particular ways. From this perspective, the institutionalization of SWIFT at the core of financial services infrastructure could arguably be described as dominance by ‘design’ through everyday governance of both network and standards.

What is missing from the story of SWIFT? The launch of SWIFT brought to light an absence of common legal principles for international transactions (general case law). The original SWIFT guidelines were inadequate to deal with the multi-jurisdictional nature of international transactions. The complicated and technical mechanics of international fund transfers required the development of new case law clearly describing the responsibilities and liabilities of participants using the network. After a series of disputes concerning loss of interest losses as a consequence of delays from payments via the SWIFT network, in February 1979, the member institutions adopted new SWIFT-specific rules that addressed four particular issues: 1) the choice of forum and applicable law, 2) the standard of care and liability, 3) the amount of recovery, and 4) the duration and timing of payments (Ambrosia, 1980). However, as the 2008 credit crunch illustrated, the regulatory guidelines governing multi-jurisdiction disputes about financial transactions are still far from firmly established. SWIFT's history therefore has to be placed in the context of on-going technological developments, an emergent international regulatory landscape, the economic fate of financial services organizations and the limits of 'co-opetition'.

Although SWIFT was a significant innovation at its initiation, some have asked if its hold over both network and standards development has created barriers for further change. The issue of whether it is meeting the requirements of all the constituents throughout the financial supply chain has been widely debated (*Dialogue* 2005). In recent years, major corporations have felt the need to petition SWIFT for more recognition in its membership and governance. SWIFT has attempted to address this issue by developing some special categories of membership but steadfastly maintains that the majority of organizations must remain 'Users'. However, SWIFT management shows continued willingness to consult with other standards organizations and has formed working groups such as "Innotribe" at SIBOS in an effort to counter these claims. This illustrates the constant pressure placed on the SWIFT organization to meet expectations and offer new products or services to address these on-going concerns in which governance and technological innovation are inextricably linked.

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Notes

1 Organisation Bylaws for Society for Worldwide Interbank Financial Telecommunication (SWIFT), July 14 1972 provided by SRI (Stanford Research Institute), SRI Report accession No. L050042).

2 Garbade and Silber (1978) uncover statistically significant evidence illustrating that the introduction of three innovations in communications technology: domestic telegraph, the trans-Atlantic cable, and the consolidated ticker tape led to the significant (in the first two cases) narrowing of inter-market price differences.

3 For a detailed review of the technological advances that led to the development of the Telex see Carré (1993).
4 Siemens and Halske (now Siemens A.G.) also provided the equipment for the early Telex network installations in the US and Canada. One of the early commercial models was the Siemens T 100 Page Teleprinter. For more technical information on the installations see Easterlin (1959, 1962).
5 Retrieved December 2009, from Colombo (1958).
6 This estimate was retrieved in December 2009, from Introduction to Data Communications for "Post-Modern" SMEs. CORDIS archive, from http://cordis.europa.eu/infowin/acts/ienm/products/ti/chap1.htm. Additional estimations for later dates can be found at Jeppesen and Poulsen (1994).
7 The International Telegraph and Telephone Consultative Committee (C.C.I.T.T.), Blue Books, Third Plenary Assembly (Geneva: May 25 to June 26, 1964). Among the Recommendations of the 3rd plenary assembly was E.29, the international telephone numbering plan that defined the country and area codes.
8 Banker's Automated Clearing Services (BACS) is a 'not-for-profit, membership based, industry body' which is responsible for the clearing and settlement of automated payments in the UK. BACS which is own by 15 of the leading UK and European banks and building societies, started its operations in 1968. For more information see: www.bacs.co.uk
9 The Clearing House Inter-bank Payments System (CHIPS) is a privately (member)-owned clearing house in the US that mainly serves the needs of large financial institutions operating in the United States and dealing in US dollars. CHIPS stared its operations in April 1970 with 9 participants and in 2010 serves 48 banks. Both BACS in the UK and CHIPS in the US are bank-to-bank electronic transfers. For more information see: www.chips.org.
10 U.S. Congress, Office of Technology Assessment, *U.S. Banks and International Communications—Background Paper,* OTA-BP-TCT-100 (Washington, D.C.: U.S. Govern. Printing Office, September 1992).
11 U.S. Congress, Office of Technology Assessment, *Effects of Information Technology on Financial Services Systems* (Washington, D.C.: OTA-CIT-202, September 1984).
12 Telex authentication procedures between corresponding banks were quite complex and time consuming. A former installations engineer who is now a Senior Manager in Securities Market Infrastructures at SWIFT opined: "[On] a Telex machine you had two sets of tables, like logarithmic tables…then the Telex sender would basically perform some calculations based on the valued A currency and amount, and then bringing these tables and work out the keys and come up with a tested Telex result…for every single Telex that was sent had to manually calculate what this Telex test key was…So you can imagine, not only were there hundreds if not thousands of these messages being sent every day from some of these banks, the chances of human error, of getting the result wrong or when it was received at the other end, if it was from one small bank to another small bank, this would be a manual process to transmit and it would also be a manual process to receive. So when you received the tested Telex you then have to do the reverse calculation to make sure that the Telex hadn't been tampered with during transmit and receive cycles. So it was incredibly labour intensive, it was incredibly prone to human error… imagine the costs." (Interview, 31st March 2009, London).
13 Interview, 13 November 2008, London.
14 Incorporated in April 1967, Société Financière Européenne (SFE) was a conglomerate of six major banks: Algemene Bank Nederland, Banca Nazional del Lavoro, Bank of America, Banque National de Paris, Barclays Bank Ltd., and Dresdner Bank (Ross, 2002). It was initially founded to finance investments in Europe that was rapidly growing at that time. The SFE, 'a typical consortium bank', had operational and legal independence and largely reflected the strategy of its shareholders towards the European competition. For more information on this subject see Ross, 2002. In CBI 90, Tray 21, Video No. M36, it is claimed that the driving force behind the idea which goes back to 1969, was the first Board Chairman of SWIFT, Johannes Kraa.

15 Guildhall Library Manuscripts (GLM) Section, M32326B, File No. 253, British Bankers Association (BBA), Private and Confidential Communication, February 27, 1979.
16 Barclays Group Archives (BGA), 80-4134. A talk delivered at the Computer Conference of Barclays Banks International, June 1975.
17 Charles Babbage Institute holdings (CBI), Burroughs Corp. records (CBI 90), Videotapes and films, Tray 21, Video No. M36, SWIFT presentation given by Charles Rodeshaw in opening speech at the 3rd Annual International Banking Operations Seminar (SIBOS) held Sept. 1980 in Copenhagen, Denmark and attended by over 1000 bankers from 37 countries. Also additional information were obtained from "Organisation By-Laws for Society for Worldwide Interbank Financial Telecommunication (SWIFT)", July 14, 1972 provided by SRI (Stanford Research Institute), SRI Report accession No. L050042.
18 According to private communication between the BBA and the SWIFT [UK] Ltd., *Logica* delivered its final report at SWIFT on the 4th of February 1972, GLM, M32326B, File No. 253, BBA, 13th March, 1978.
19 We have checked the naming convention with the Society and they have confirmed that they have shifted from using the acronym S.W.I.F.T. to the word 'SWIFT'. After defining the full name of the Society and noting the acronym, we therefore conform to the Society's preference for 'SWIFT'.
20 According to (CBI), Burroughs Corp. (Ascent ion 90), Press Releases 1947-1987 (90:72, Box 1, Folder 17, 7th of March, 1974), the initial value of the equipment was more than 6 million USD, and included two dual central processor B 3700 computer systems, four data communications processors, and 14 data concentrators.
21 Our discussion of the early stages of SWIFT network design and technology development has been edited but can be found in Scott and Zachariadis (2010) and Zachariadis (2011). This includes technical details about: the switching centres; data concentrators; network interface issues; the SWIFT Interface Device known as SID, ST100, ST 200; the founding of SWIFT Terminal Services S.A. (STS); and the emergence of a supporting software market. We also discuss the development trajectory from central switches to distributed networks and packet switching.
22 Guildhall Library Manuscripts (GLM) Section, M32326B, File No. 253, British Bankers Association (BBA), Private and Confidential Communication, February 23rd, 1979. Up to then SWIFT had a theoretical capacity of 200,000 messages per day however, there were concerns regarding its capability to deal with the transactions' load in the near future.
23 Unpublished document on SWIFT standards, Brussels, circa Jan., 2001.
24 Each "Message Type" (MT) was codified using a three-digit number. The most common message type was MT100, which was an instruction for a customer fund transfers. Other commonly used messages were the MT200 for bank transfers, and the MT300 for foreign exchange transactions. "Fields", which had a distinct business meaning, were identified by a two-digit number. An additional alphanumeric character could be added in the end of the number to specify additional options. Not all fields were mandatory for a transaction to take place.
25 The SWIFT code (or SWIFT address) consisted of 12 characters: the primary four were to identify the bank, the next two were identifying the country (based on the ISO standard), the next two were identifying the location, and the last four consisted of the terminal code (1) and the branch code (3). (BGA, 80-4134).
26 For example, SWIFT messages are limited by the need to conform to the four-line thirty-five character format institutionalised during the Telex era (interview, Head of Standards Initiatives, SWIFT Headquarters, Brussels, 7th May 2009).
27 Unpublished document from unknown author on SWIFT standards titled "Message Standards evolution in the Securities Industry: from paper-based to XML communications", Brussels, circa Jan., 2001.
28 Interview, 13 November 2008, London.

29 Unless otherwise stated, this paragraph borrows freely from unpublished document (unknown author) on SWIFT standards titled "Message Standards evolution in the Securities Industry: from paper-based to XML communications", Brussels, circa Jan., 2001.
30 These message types covered the securities areas of post-trade, pre-settlement, settlement, reconciliation, corporate actions and reporting.
31 Even though SWIFT brought together a set of recent (during that time) technologies, it was never based on a distinct ground-breaking technological improvement. From our discussions with experienced bankers and SWIFT executives we were told that in some instances large banks with superior equipment even had to degrade their networks in order to be able to use SWIFT.
32 'About SWIFT', 2009.
33 The initial financial proposition for SWIFT involved loans granted from member companies during the 'development period' (before message processing began). These were repaid afterwards either as credits against message transmission charges, or in cash at the option of the board of directors. In addition, an entrance fee was charged to all members joining for the first time (this was $3,200 for all members that joined before the 30th of September 1972, and $5,000 afterwards). Information obtained from "Organisation By-Laws for Society for Worldwide Interbank Financial Telecommunication (S.W.I.F.T.)", July 14, 1972 provided by SRI (Stanford Research Institute), SRI Report accession No. L050042. These loans, which were repaid with a fixed interest assigned by the board of directors, were later abandoned when the company started its operations in 1977.
34 Information obtained from (GLM) Section, M32326B, File No. 253, SWIFT General Information booklet, circa 1979, and BGA, 80-3056-2. Services and Security seemed to be closer to sales, whereas, Administration and Engineering was in charge of the maintenance of the installed base and technical support.
35 SWIFT "Company Plan", BCG, 25 January 1979.
36 Evidence suggests that, even though SWIFT messages were not implying any legal transfer of funds from one bank to another, they were gradually accepted by banks as authentic and authoritative (U.S. Congress, 1992), although this would not preclude the settlement of the transaction through a large EFT.
37 Our discussion of SWIFT's pricing negotiation with PTT and the achievement of reduced tariffs has been edited but can be found in Scott and Zachariadis (2010) and Zachariadis (2011). Achieving connectivity on SWIFT's terms was key to the development of SWIFT's strategy and linked to the cooperative nature of the society. In parallel to the negotiations with the local telecommunication providers, SWIFT also leveraged the ongoing technological developments to reduce the costs of its network operations globally.
38 CREST Co was the central securities depository for the UK, until August 2002 where it was acquired by Euroclear UK and Ireland ltd. For more information see: www.euroclear.com
39 CLS (Continuous Linked Settlement) is the 'largest multi-currency cash settlement system' founded to reduce and control the risks of foreign exchange (FX) transactions (www.cls-group.com)
40 The "big" banks came to realize that they 'can no longer push their proprietary networks on to investment managers as an alternative to SWIFT' (pp.1) from 'SWIFT lets in fund managers'. (1992). *The Banker*, *142*, 1. 'The big US banks led the opposition', along with some German, French, and Japanese banks, however, their resistance is expected to be reversed. Information obtained from 'Global Custody' (1992), *The Banker, 142, 795, (pp.1).*
41 See bibliography for: Frazer (1985); Kirkman (1987); Mandell (1990); Howells and Hine (1993); Bátiz-Lazo (2009); Bátiz-Lazo and Hacialioglu (2005); Bátiz-Lazo and Wood (2002); Wonglimpiyarat (2004); Stearns (2007, 2011); Panourgias (2008); and Khiaonarong and Liebenau (2009). For an interesting analysis of the emergence of core information services see Preda (2006).
42 In the entrance of SWIFT's headquarters in Brussels there is a digital screen that welcomes visitors with the message "More, Together" (observed on the 7th of May 2009). This has also

been part of SWIFT's marketing campaign in 2007 and it was used as a cover for the 2006 SWIFT Annual Report (SWIFT Annual Report, 2006).

43 Research participants gave us examples of the programmes of change that might be stimulated by SWIFT adoption: automating nostro statement generation; reconciliation systems; routing of domestic payments; automating of dealing systems. The aim was to remove manual processing and intervention wherever possible to achieve 'Straight-Through-Processing' (STP). In addition to internal programmes of process reengineering, there is evidence that connectivity events such as the adoption of SWIFT (or other core infrastructure such as CREST, CLS) stimulate internal process innovation and have a domino effect through related functional areas particularly when they reveal duplication of effort or avoidable operational risks.

44 There is a substantial extant literature that examines the role of standards and standardization in shaping organizations, for example: Bowker and Star 1999; Hanseth and Monteiro 1997; Law 1992; Monteiro and Hanseth 1995; Star and Ruhleder 1996; Timmermans and Berg 2003. See bibliography for details.