You've got to know when to hold 'em. Know when to fold 'em: Managing technology in the telecom sector during technological and institutional change.

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During the two decades after 1975 the telecom industry changed rapidly; a number of new technologies including 1G and 2G mobile telephony, Videotex, paging, digital switching and ISDN, was introduced, and telecom sectors in many countries was also opened for competition. The new technologies were available to all operators, but not all of them made the same bets.

Using new digital tools for business history in the form of relational databases, we use the management of the ISDN within the Swedish PTT Televerket as a case. Drawing on rich archival sources from the company, including a collection of internal strategy memos and reports previously unavailable to researchers, we explore the choices and rationales for initiation and ending a technology project. We find that development projects may be initiated and continued for political reasons, and that many years of losses are sometimes not enough to shut them down, we do not however find support for that Televerket used investment in ISDN as a way to avoid distributing free cash flow as dividends to the owner.

Introduction

In this paper, we will use digital tools to study the introduction of new technology (ISDN), and technology management by the Swedish telecom operator Televerket.

All business historians use computers, but it is hard to find many effects of computerization in published business history research. The researchers certainly use word processors to write their manuscripts, find journal articles in electronic databases and upload their finished manuscripts using the internet, but when it comes to the core of business history research, the work in the archives and the handling of the archival documents used as sources, in most cases the same methods that were used before the invention of the computer are still used. This phenomenon could be called the Solow Computer Paradox of Business History.[1]

Haupert has connected the use of quantitative methods in economic history, i.e clinometrics, to the increased access to computers after the 1960s.[2] Computers there enabled entirely new research projects, not that they had been impossible previously – but they had been too time and resource consuming to be practically defensible to perform. When computers replaced human calculators, it was possible to experiment and to pursue less promising avenues of research. Who would have spent months of his time as PhD-student to perform tedious calculations if the prospect to find significant results was low? The widespread access to computing power here enabled researchers to choose novel research question where the risk of "failure" was high, this benefited research as more different avenues were followed. The access to computing power also made it possible to increase quality and veracity, more specifications could be tested, and it was easier to do robustness checks. In addition the computers made it possible for grading committees or reviewers to re-do the calculations if necessary.

More recently, the use of computers have enabled additional methods to be introduced in economic history. Wehrheim has described how topic modelling could be used[3] and the possibilities for better research as result of digitalization has also been discussed, e.g by Grimmer and Stewart[4], and Hansen

[1] After the Solow Computer Paradox "***You can see the computer age everywhere but in the productivity statistics"***

[2] Haupert, M. (2016). "History of cliometrics." Handbook of Cliometrics: 3-32.

[3] Wehrheim, L. (2018). "Economic history goes digital: topic modeling the Journal of Economic History." Cliometrica.

[4] Grimmer, J. and B. M. Stewart (2013). "Text as data: The promise and pitfalls of automatic content analysis methods for political texts." Political analysis **21**(3): 267-297.

and McMahon.[5] Lamoureux has also discussed how research in economic history could be improved by adopting methods form other fields.[6]

Just like computers have facilitated the clinometric revolution, computers might also revolutionize Business History as the digitization of archival sources and the coding of sources and events in relational databases might enable research projects that otherwise, due to the time and effort required, would not have taken place. As archives increasingly are being digitized, it has become easier to access and search for an abundance of relevant documents.[7] The capacity to digitize qualitative research material is pushing the methods and analytics of how historical and qualitative research can be conducted. Especially promising is comparative historical longitudinal case or change process studies, where cases are few, while the data and historical accounts are rich.[8]

The potential for time saving is, as in cliometrics, substantial. We have estimated that the empirical work behind this paper amounts to about 2-5 percent of the time needed to do the same empirical investigation without the help of digitalized sources and the relational database.

The potential benefits for using relational databases in business history are not unknown. Murman and Homburg gave an early example how they could be used in 2001.[9] The relational database methods have later been more toughly developed by e.g. Gustafsson et al.[10] Recent examples of business history studies using such methods include Ernqvist's study on demutualization of stock exchanges and Nevalainen's on the deregulation of the Finnish telecom market.[11]

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[5] Hansen, S. and M. McMahon (2016). "Shocking language: Understanding the macroeconomic effects of central bank communication." Journal of International Economics **99**: S114-S133.

[6] Lamoreaux, N. (2015). "The future of economic history must be interdisciplinary." The Journal of Economic History **75**(4): 1251-1257.

[7] Harvey, D. R. (2005). Preserving digital materials, Walter de Gruyter.

[8] Pettigrew, A. M. (1990). "Longitudinal field research on change: Theory and practice." Organization Science **1**(3): 267-292.
, Van de Ven, A. H. and G. P. Huber ibid."Longitudinal field research methods for studying processes of organizational change." 213-219.

[9] Murmann, J. P. and E. Homburg (2001). "Comparing evolutionary dynamics across different national settings: the case of the synthetic dye industry, 1857–1914." Journal of Evolutionary Economics **11**(2): 177-205.

[10] Gustafsson, R., et al. (2016). Towards an Integrative Digital History Approach in Organization Studies. Academy of Management Proceedings, Academy of Management Briarcliff Manor, NY 10510.

[11] Ernkvist, M. (2015). "The double knot of technology and business-model innovation in the era of ferment of digital exchanges: The case of OM, a pioneer in electronic options exchanges." Technol. Forecast. Soc. Change.

The purpose of this paper is two-fold: first to show how modern digital tools can be used to improve business history research, both by making empirical research less time consuming, and by increasing veracity. Second to examine whether standard theories of agency and technology management can explain why a state owned company invest in projects that ex ante can be assumed to have limited economic potential.

As a case we have chosen the Swedish Telecom operator Televerket's investment in ISDN (a technology for digital telephone and data networks) from 1985 to 1997. ISDN is just such a narrow research area that that is suitable for studying when the researcher already has a digitized source material, but otherwise would not reasonably have come about. A somewhat boring, but still valuable contribution to science.

ISDN is a relatively unknown technology, just because it never broke through. Business history research has come to be mainly concerned with successful examples. In order to understand companies and how they handle new technology also projects that never succeeded needs to be studied. These latter type of research studies, on the other hand, are rarely carried out because they are as the investigation of success stories time consuming but not having the same potential.

We also wish to make a contribution to the history of technology, the period in question saw the introduction of a number of new technologies 1G and 2G mobile telephony, Videotex, paging, digital switching. These more well-known technologies have previously been the subject of extensive research, both on a general level and how individual companies handled them. However, this does not apply to ISDN.

In our study, we find that neither of these two more standard agency models can explain the actions taken by the company, but rather that Televerket's actions could be analyzed through a third lens. This is based on the special logic of monopolists. A monopoly needs to defend its position, and although the Televerket was not prepared to defend its monopoly in all areas during the current period, they would be happy to control the process of deregulation. Consequently, actions taken can be seen as a way to influence forthcoming regulation through establishing facts on the ground.

, Nevalainen, P. (2017). "Facing the inevitable? The public telecom monopoly's way of coping with deregulation." Business History **59**(3): 362-381.

ISDN was such an area that could easily be include or forgotten in such a process. ISDN could be counted as part of the fixed-line network, as part of data communications (outside the monopoly) or as a third area. By eliminating the most common simplifications from the agency and technology management, one can here get closer to understand this process. The action of the telecommunications agency can therefore, in the present case, be assumed to be linked to the current liberalization process. The study can be seen as one of how an organization tries to influence legislation by, in addition to the official channels, by acting instead of speaking.

Any technology decision take by a firm made will be made within and affected by a greater network of elements than simply those agents directly responsible for the decision-making process. The greater scope of the firm's constituent parts and their associated power to influence decisions taken within the firm form one such environment and explanation. The stakeholders of the firm, dichotomized as owners and managers, may have disparate goals that do not always jointly align; this managerial view of goal misalignment will lead to a history of decisions which when viewed solely through the lens of one stakeholder's interests will seem erratic. The managerial theory of firm decision-making allows for the two factions to work together in mutually beneficial ways, but only up to a point. Once a level of certainty of survival for the firm has been reached, their interests begin to misalign and managers will maximize their own benefit through their influence in the firm to the detriment of the owners.[12] [13] [14]

The larger and more diffuse macro-environment is that of the surrounding economy and the competitive, technological and social forces that affect the firm. The long cyclical turn of growth, Kondratiev waves, has had many explanations, the most conventional being technological development and diffusion.[15] As a major technological event develops and diffuses itself through the economy, it spawns new industries and transforms others. As these forces develop and change through the actions of innumerable sub-elements beyond the scope of the individual firm, they nonetheless come to exercise a powerful coordinating role in forcing each firm to inexorably develop itself. Depending on

[12] Baumol, W. J. (1962). "On the Theory of Expansion of the Firm." The American Economic Review **52**(5): 1078-1087.

[13] Marris, R. and D. C. Mueller (1980). "The corporation, competition, and the invisible hand." Journal of Economic Literature **18**(1): 32-63.

[14] Marris, R. (1998). Managerial capitalism in retrospect, Macmillan.
Ch. 5

[15] Perez, C. (2014). Technological revolutions and financial capital> The dynamics of bubbles and golden ages, Edward Elgar.

where in the cycle a certain decision has to be taken, the same behavior will have very different outcomes. Though disparate over time, the direction of development will on some occasions be more predictable than on others, such that developed learning and built-up knowhow will be more beneficial in choosing the best future path. The watershed technological moments are not immediately visible to those living through them, but are instead labeled post-fact. When such a technological watershed is about to be crossed, deep-grooved thinking may hinder the realization of the new paradigm, instead defaulting to what worked previously under very different circumstances. In this way of thinking, there are parallels to the behavioural theory of the firm wherein decisions are not considered to be taken under circumstances of perfect information.[16] [17] Instead, the elements of the firm act within the constraints of a bounded rationality, where the most optimal choices of profit maximization are not taken, not due to conflicting interest but rather through lack of foresight.[18] [19]The bounds of what can be conceived of and how certain the assumed outcome for a given technological project is will shift according to the phase of a technological era.[20] As the boundaries become more constraining and the options within less assured, the decision-making agent will be even more likely to rely on cautionary heuristics at precisely the wrong moment. [21] [22]

The problem at hand is not necessarily which project a firm should invest in, but rather which kind of attitude or regime would enable the firm to take the best available path when faced with uncertainty.

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[16] Cyert, R. M., et al. (1958). "The Role of Expectations in Business Decision Making." Administrative Science Quarterly **3**(3): 307.

[17] Cyert, R. M. and J. G. March (1992). A behavioral theory of the firm, Blackwell.

[18] Miner, J. B. (2006). Organizational Behavior 2, M.E Sharpe.
.ch.4

[19] March, J. G., et al. (1990). Decisions and ORganizations
Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers, Blackwell.
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[20] Perez, C. (2014). Technological revolutions and financial capital> The dynamics of bubbles and golden ages, Edward Elgar.

[21] Cyert, R. M., et al. (1956). "Observation of a Business Decision." The Journal of Busienss **29**(4): 237.

[22] Perez, C. (2014). Technological revolutions and financial capital> The dynamics of bubbles and golden ages, Edward Elgar.

There is a vein of research into the effects of free cash flows (FCF) on firm behaviour.[23] [24][25] There is also thorough theorization on the agency aspect of general investment within private firms, of which technology is a part, with not least, the analytical tool of free cash flows helping to elucidate the problem of overinvestment and suggesting debt financing as a solution.[26] The agency aspect then has been thoroughly explored in listed companies; by examining the two main ways of creating shareholder value and the way they interact to form the playing field for the different agents. State-owned enterprises or monopolies have access to the same avenues of shareholder value creation but with an added permeability through the diffuse influence of the government and the people, it is beholden to. This removal of insulation has been noted in resource rich economies where inefficiencies appear among state owned monopolies as their stakeholders can affect them in a way that would not be possible were it a privately-owned company[27]. The agency aspects as they relate to state owned companies are then often presumed to work similarly, rather than being known to.

The case of the Swedish ISDN network, implemented by the Swedish state monopoly Televerket, is a viable project for evaluating how these two models of firm decision making factor feature. The described analytical tools of the managerial and behavioural theory of firm decision-making can predict and categorize the purported drivers of inefficiencies in both as they feature in the source material

The paper is organized as follows, first a section on digital tools could be used in business history resrach and how we have used them in this paper, then a brief summary of the Swedish telecom market and the institutional setting that Televerket operated under during the period. Then an empirical part, divided in thee “epochs” where Televerket’s investment in ISDN are presented and analysed. Finally a concluding discussion.

[23] Schleifer, A. (1997). "A survey of Corporate Governance." The Journal of Finance **52**(2): 737-783.

[24] Shleifer, A. and R. W. Vishny (1989). "Management Entrenchment The Case of Manager-Specific Investments." Ibid. **25**(1): 123-139.

[25] Richardson, S. (2006). "Over-investment of free cash flow." Review of Accounting Studies **11**(2-3): 159-189.

[26]Jensen, M. C. and W. H. Meckling (1976). "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." Journal of Financial Economics **3**(4).

[27] Shafer, M. (1983). Capturing the mineral multinationals: Advantage or disadvantage? International Organization, 37(01), 93. doi:10.1017/s0020818300004215

Digital tools for business history

Digitization and computer software such as relational data base packages have greatly improved the research possibilities in business history. The new tools and methods makes it much easier to handle large amounts of archival documents, and greatly increases transparency.

The study is primarily based on a rich archive material from the Swedish Televerket, including an extensive set of internal research and consulting reports, strategy documents and memoranda that have been donated to the Institute for Economic and Business History Research. As part of the project, a large number of archival documents have been digitized.

All documents in the document series that have been deemed relevant for the project have been scanned or photographed. As no selection of documents is made on a lower level than complete archival boxes, the researcher can easily go back and retrieve documents that overviews have made additional visits to the archive necessary.

The digitized documents have then been searchable through OCR and coded in a relational database (Filemaker Pro). For each document have i. A. title, date, archive, archive box, the author of the document, persons or companies mentioned in the document been coded. Every source post contain, in addition to the entries above, also the complete text in searchable form, and the original pdf so that the researcher have direct access to the original layout of the document.

The relational database method also makes it easy for the researcher to link other documents to the source data base entry. If a document is mentioned in e.g. the minutes from a board meeting, these two document can be linked (if both are found in the archive). In the same fashion, letters can be linked to the replies to the letter, also when they are found in different archives. Also when the documents mentioned are not (yet) found links can be made, and completed with the document when it is found. In addition, other historical sources such as oral history interviews, photos or films can be linked to the source database.

In our case, we estimate that material retrieval; formulating appropriate search terms and a rough review of the material found took about two hours. To review the corresponding material in the archive had, although we had known which archives we would need to review (the finest list in a well-documented archive) the corresponding work had been taken about 400 hours. As the scanning, OCR and database coding, once it is performed, do not have to be repeated, sources and databases from one research project could be re used for new ones. Also archives that are “born digital” (Kirsch 2009)could easily be entered into the database, the same applies to collections of already scanned archival documents; in our database, we have e.g. included large numbers of digitized public records. Our

method of collection is also based on the idea that only entire archival boxes are scanned which ensure that the researcher know that no documents is missing. The scanning of all documents also make it possible for the researcher avoid new trips to the archives if he or she e.g. finds out that a project was known under different names at different times. The database enabled researcher can here easily connect the new name to existing labels or search the database for entries under the new name. For a researcher using the traditional method, this would have required a new trip to the archive and a new review of all the documents. More than one researcher have given up when faced with this.

As the next step events are coded. An event could be a decision made at a board meeting, a merger between two companies or a permit received. To each event the relevant source documents are linked (an event could be linked to a large number of source entries as a decision can be mentioned in e.g. the official minutes, in notes taken by one of the participants, in letters or in articles in media). In the event entries it is also coded who is acting (it could often be someone else than the author of the document). If projects are identified, they could also be coded. The researcher can therefore easily access e.g. all documents related to ISDN, or all board minutes were videotex is mentioned and a certain person is present.

Our method also makes it possible to be transparent with the material that was reviewed and where we can also show that we have not missed relevant documents. This is otherwise a problem for historical research. We can see right away if there are missing documents in any series or if the archives are weeded or silent in any respect (Decker 2013).

We can also show exactly which archival documents that have been used in the studied even if the documents are not quoted.

The regulation of telecom i Sweden 1982-1997

Televerket was unlike many other national telecom companies no legal monopoly – but a de facto one. The company, however, was state-owned. Televerket was also its own regulator. The board of Televerket (“Telestyrelsen”) had both task to control operations and to design market regulation. In all material respects, Televerket could be viewed as a monopoly. The foundation of the de facto monopoly was the requirement of approval from Televerket to connect equipment (telephones, fax-machines, modems etc) to the network ("appratmonpolet") and a monopoly on automated switching. Operations that did not connect equipment to the Swedish Telecom network (i.e. private networks or microwave or satellite links) or did not use automatic (unlike manual) switching was permitted. There were, for

example, different private systems for mobile telephony (which are mainly used by the taxi industry and the trucking companies).

The monopoly was to not be taken for granted, if was gradually dismantled and Televerket lost the monopoly on fixed and mobile telephony in 1993, the last monopoly – on high speed modems was lost in 1994. In 1997 Telia (as Televerket had been renamed in 1993) was partly privatized and 30 percent of the shares were floated on the stock exchange.

Televerkets major projects at the time the monopoly begun to crumble was to replace the relay-controlled switches with digital switches (AXE). This would have a major impact on staffing requirements. Partly because they needed significantly fewer of the new switches, around 250 instead of 6000, and partly because other skills were needed to service them. It is estimated that the transition from relays based to computerized switches caused a skill loss of about 90 percent.[28]

As a monopolist Televerket was also required to provide service to all households. That meant they had to expand the network even where it was unprofitable. No matter how far from the existing route network someone lived they the right to have telephone installed at a fixed price. Televerket could not refuse any installation, only possibly delay installing. Televerket also had a requirement to maintain a decent coverage of telephone booths (the issue of installation of telephone booths in some places was on several occasions up in parliament).

Televerket was well aware that their monopoly on the most lucrative services was threatened (see the 1977 NP Report) and that they at the same time might be compelled to continue investing in unprofitable areas. In the late 1970s, however, Televerket was in a position where they could look forward to a period of high profits. The network was largely completed and the profitable business services remained. The profitability also gave great autonomy. As long as Televerket delivered dividends to the treasury, it had a significant room for maneuver However, if Telverket had to ask the treasury for money autonomy would me shapely curtailed.

Since the monopoly was centered on the requirement of approval by Televerket to connect equipment, Televerket could also decide where to add resources. By making demands of, for example, low resistance of the phones used, it was possible to build a network with fewer repeaters. By putting speed limits on the modems that was allowed to connect to the network, Televerket could also choose solutions that enhanced voice quality over long distances, but at the same time also disrupted the faster

[28] Thorngren, interview 2016

data communications. Since users would demand that the equipment they received by the telephone company worked, a reverse priority would likely have caused widespread protests.

Sweden had by the end of the 1970s almost completed the fixed telephone network, the number of telephones per 100 inhabitants amounted then to 57 - compared with 40 in the US and the OECD average of 25. It also meant that Televerket was not facing any costly investments in this area, although the transition to digital switches (AXE) would require more resources. The introduction of digital technology came however (by a wide margin) to be covered by the reduced costs of operation and maintenance , so this also meant that Televerket's expenses decreased , although investment capital would needed for the conversion.

Telephony is a business that has high fixed and low variable costs. Increased use of the net means basically pure profit (as long as capacity is sufficient). Televerket could therefore expect a significant increase in profits in the coming years (even though marginal lines may be unprofitable, for example if they cost more to maintain than the subscription and traffic charges). In order to expand business, increased utilization of the network was required. Televerket therefore sought in various ways to induce subscribers to use their phones more often and longer. This was done partly by advertising and partly by adjusting the pricing policy. Televerket was also looking for new services that may increase network utilization. ISDN could be seen as one of these services.

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The ISDN technology in context

The origin of the Swedish adoption of ISDN technology lies in it being able to upgrade existing legacy infrastructure to match emerging needs, improving services offered while still leaving the so-called last-mile infrastructure untouched. Due to cost considerations, there was a rationale for building any future information transfer solution around the backbone infrastructure, allowing the legacy copper wire network to remain in place[29].

In 1984[30] the International Telegraph and Telephone Consultative Committee (CCITT) called for standardization of a hybrid network protocol that was to become ISDN. The Integrated Services Digital Network would go some way towards integrating data transfer into the telephone network. It would digitalize voice traffic and at the same time allow for data transfer on the same wires. The Basic Rate Interface (BRI) could reach speeds of 128 kb/s, or 64 kb/s if speech were happening concurrently. The ISDN connection intended for businesses was the PRI or Primary Rate Interface, this more powerful line

[29] SWT 9108 "New Lines for old"

[30] NAT SE/RA/420509/420509.101/B 2 c/21 "Förutsättningar för 1985 års strategiska planering vid teleområdena"

gave speeds of up to 1.5 mb/s and was envisioned to integrate with intra-business telephone exchanges to allow for many outgoing calls and data transfers.

The standardization of the ISDN protocol would be slow and seriously delay the development of applications and implementation[31]. The ISDN protocol is first discussed in published minutes by the CCITT in 1984 and in spite of publishing to the effect that it is a complete technology in 1986, the final standard was laid down in 1988. Televerket was aware of this developing technology and discuss the nascent protocol as early as 1982[32].

Epoch 1: Conception 1984-1989

The ISDN project first appears as a potential follow up to the digitalization of the trunk lines called Digitalen-87[33]. When Digitalen was completed in 1987 [34] it was the "world's first digital network with country-wide coverage". Country-wide coverage is a somewhat nebulous term as only 1.7 million subscribers out of 5.2 million were served by its trunk lines, but it did stretch across the geographic majority of the country in that all Televerket regions were connected.

ISDN exists, as a known technology family prior to Digitalen's completion in 1987 but it only becomes a viable option to invest in once the project was completed. Given Sweden's lead in the digitalization of the telecommunications area Televerket is at that time in a position of being able to implement ISDN faster and more comprehensively than other corresponding telecoms companies. [35] [36] The potential lead brought about by Digitalen's completion would however be lost if not acted upon. This sense of impatience will be heightened by foreign developments. While Televerket waits for final standardization of the ISDN protocol to complete, the telecoms companies in Germany and France forge ahead and start their own ISDN networks ahead of time using domestic standards.[37] [38] Televerket clearly states in a board memo[39] that the basis for their development of the ISDN technology are to be the accepted recommendations of the CCITT.

In addition to work towards developing the ISDN standard, the first epoch is also characterized by a search for applications of the technology. The ISDN protocol is a standard for incorporating data transfer

[31] SWT 6101 "Treårsplan 1990-1992"
[32] SWT 9116 Bilaga 3, "Sweden: National Presentation ICCP Committee"
[33] SWT 11578 "Teldok Nr.3 Jan 1986"
[34] SWT 2032 "Årsredovisning 1987"
[35] SWT 2392 "Treårsplan Televerkskoncernen 1985/86 - 1987/88"
[36] SWT 6643 "Svenska televerket Del VII: Från myndighet till bolag: Kapitel 6. Nätutveckling. 6.3 Nya Nättjänster
[37] DNT SE/RA/420509/420509.088/B2/8 "IN och ISDN i accessnätet 92-04-08"
[38] SWT 11585 "Teldok 76" p.51
[39] NAT SE/RA/420509/420509.101/B 2 c/21 "Förutsättningar för 1985 års strategiska planering vid teleområdena" Nis 85 005

and telephony in the same network, its adoption and implementation created the potential for, but did not automatically create new products for the end-users. Equipment manufacturers could not and naturally would not develop customer-facing terminals until a well-established standard was laid down[40]. The extent to which the follow-up project Integralen 90 could see a use for ISDN was in providing simultaneous telephone and data-transfers from multi-functional terminals, co-traffic between the already existing data-networks Datex, Teletex and Datapak and faster file transfers from personal computers, and telefax. [41] In other documents, which focus more on the telephony aspect the improved voice quality and simultaneous capacity to transfer simple images is mentioned.[42] Compared to the estimations in 1985[43] of integrated service products being available as early as 1987 not just for businesses but even for consumers, there are to be delays of such magnitude that even as late as 1988 there is no clear timeline for commercialization or introduction which is instead pushed into the future pending CCITT commission work[44]. In the end, the decision to build the first commercial test network with later expansion is taken in a board meeting in early 1990.[45] [46] The memorandum that is the basis for the decision to build the basic ISDN-network is in line with an MOU signed between 25 operators in 20 European countries about a standardized ISDN-network within Europe. At this point the original idea of a comprehensive national network has been seriously reduced, while there is not a great degree of apprehension, the original certain optimism has been replaced with a degree of caution. There are inklings in outward communications that the ISDN technology may not be as important in Sweden compared to other European countries[47] [48]

Epoch 2: Inception 1990-1992

The second epoch stretches from the creation of the ISDN-task force in early 1990 until the decision in late 1992 to commercially deploy the ISDN-project outside of the commercial test areas in 1993. While there has been a technical testing group operating for some years, this is the founding date for an influential group in the future of ISDN: Teknikgrupp ISDN (TG-ISDN. This was to be a crucial group

[40] SWT 11583 "Teldok Nov 1986 Rapport 25" .p6
[41] NAT SE/RA/420509/420509.101/B 2 c/21 "Förutsättningar för 1985 års strategiska planering vid teleområdena" Nis 85 005
[42] NAT SE/RA/420509/420509.101/B 2 c/21 "Vad är ISDN? (Tjänsteintegrerade digitala nätet)"
[43] SWT 2392 "Treårsplan Televerkskoncernen 1985/86 - 1987/88"
[44] SWT 6452 "Videotex"
[45] KCL SE/RA/420509/420509.086/A 1 a/19 "2/6/1990 board minutes"
[46] NAT SE/RA/420509/420509.101/B 2 c/ PM Nis 90 005
[47] SWT 9429 Communications Engineering International 10/89 – "Moving from strength to strength in the future"
[48] SWT 11516 "Televerket Scenarios"

reporting to the networks and business divisions, for which complete series exist up until commercial launch.

Their remit involved taking the prototype network, insofar as one existed, and developing a product offering for customers around it. At the formation of the group, the ISDN-project is ill-defined and lacks a clear focus beyond a will to implement the product. The needs of the project are to fulfill obligations towards other companies, with the details of commercial viability and product positioning being secondary. The problems at the beginning of the decade can best be encapsulated by the technicians running the early technical tests.

> Apprehensions before commercial launch:
> *After the board's decision to implement a basic network there is a lot of information being disseminated about ISDN. In everything written, wording is now used which indicates/claims that Televerket is currently testing the network which will be put into commercial use in 1992. It is therefore important to point out that the field-tests in no way have any connection to the net which will later be put into use.*
> *Since Televerket still have not specified its demands on its ISDN, the field test cannot test for these. Out of necessity then, the field-test has had to formulate their own demands, which may be completely different from those which Televerket which will later require from ISDN. [...]*
> *If Televerket does not immediately commence research and formulates the demands on how their ISDN will work as a network, in cooperation with others and in cooperation with the customers and their terminals, there will never be time to test this in the field before a commercial start.*
> *–Rapport från Teknikgruppen till TG-ISDN 1990*[49]

If the network cannot be tested to specifications because there are none, then there clearly was no product plan. The decision to move forward has been taken without a clear plan in place. It is this situation that the project-group will try to remedy during this epoch. The project group is aware of the difficulties facing them and their mandate is primarily to create plans for further development of ISDN, finding products which use the protocol that can be marketed as services. Their mandate is not however to develop a market or business plan for them but their results will be the basis of on which such can be created.[50] The idea that ISDN will grow to encompass the entire telephony network has at this point been quietly dropped in favor of a limited deployment. From the market sub-committee in the ISDN-

[49] DNT SE/RA/420509/420509.088/F 5/50 "Rapport från teknikgruppen till PG-ISDN"
[50] DNT SE/RA/420509/420509.088/F 5/51 "Lägesrapport Oktober 1991" LG vidar PM 1991-08-19

group there is a suggestion that ISDN should be marketed as the new telephone network and not a new data-transfer network, as late as a week before the decision to implement a limited network.[51]

The most pressing concern for the group then is finding a way to be able to deploy a technology which due to delays has already lost its relevance. Originally, ISDN's early adopters were supposed to be businesses and public administration which did not see the need to invest in proprietary data-transfer lines but still needed a better communications solution than just the telephone network could provide.[52] Due to an already wide product offering in this area, with different dedicated networks, the hybrid solution that ISDN can offer is only afforded a rather narrow niche [53] [54] wherein it is recommended for heterogeneous demands (picture, data, voice), but not pure data transfer.[55]

For businesses another important potential use was the upgrading of private branch exchanges (PBX). The PRI-interface with its many potential voice channels was well suited to this task,[56] however as late as 1992 there were no such products available.[57] Beyond this limited but important use, the issue of terminals which were ISDN compatible is a large problem. Throughout the years of the commercial tests (1990-1992) the group mentions that there is a real lack of interest and products from suppliers as well as for equipment with which to build the networks locally.[58] [59]

In addition to low levels of interest from suppliers of ISDN-compatible equipment, the search for a market for what products did exist did not go well. The demands from businesses were primarily for faster speeds of data-transfer, which ISDN by the group's own admission was poorly suited for at this point.[60] The most prominent aspect of the market-subgroup in the protocols is not their input but their conspicuous absence.[61] All meeting protocols contain briefs from the major roles in the project, with most of the time going to technical aspects; the market group has most often nothing to say. Since there is a real dearth of products for the market group to work with, this may be a problem upstream. However, considering later developments, it could also be a case of simply not wanting to report that there is little or no market for ISDN. This was at the very least readily evident to outside observers who

[51] DNT SE/RA/420509/420509.088/F 5/50 "Möte nr.27" PG-ISDN 1990-01-30
[52] NAT SE/RA/420509/420509.101/B 2 c/21 "Tema integralen 90"
[53] DNT SE/RA/420509/420509.088/F 5/51 "Positionering av Televerkets Datakommunikationstjänster" 1991 02 07
[54] Appendix B1 & B2
[55] DNT SE/RA/420509/420509.088/F 5/51 "Ansats – Marknadsscenario år 2000"
[56] SWT 11585 "Teldok 76" p.51
[57] DNT SE/RA/420509/420509.088/F 5/51 "PM 92-03-23" NUL 92009
[58] DNT SE/RA/420509/420509.088/F 5/51 "Protokoll TG-ISDN-009" 1991-09-02
[59] DNT SE/RA/420509/420509.088/F 5/51" Projektinfo ISDN 1-91"
[60] DNT SE/RA/420509/420509.088/F 5/51 "Lägesrapport Oktober 1991" LG vidar PM 1991-08-19
[61] SE/RA/420509/420509.088/F 5/50-51

describe it as a non-specialized general technology looking for applications and customers.[62] In the end, these issues are never satisfactorily answered before the commercial launch is given the go-ahead.

Epoch 3: Reception 1993-2001

From the commercial deployment in 1993 and onward, the internal sources of Telia/Televerket are not publicly available. Therefore, this section will primarily concern itself with the launch of the publicly available ISDN-network and its reception as can be gleaned from secondary sources. This epoch can be said to terminate with the wide availability of the ADSL protocol in 2001.

In the budget for 1993, the expected uptake in the first year of ISDN is 4000 BRI interfaces and 800 PRI interfaces for a channel sum total of 32000-37000 channels.[63] The true uptake would be substantially lower. The actual launch of the ISDN-network is a disappointment, even with the much-reduced expectations. In trying to compare the subscription numbers for ISDN versus internet it is important to keep in mind that the actual number of subscriptions could be anywhere from 50-97% lower than the number of channels, depending on the breakdown between the two ISDN types. Since the uptake is presented in such an incongruous way it seems likely that the true figure tends towards the conservative end. Outside of the yearly reports, in internal documents the ISDN-uptake is described as low[64] and in official histories is described as "[..] never a success in Sweden, in contrast to Germany and Norway.".[65]

Teliakoncernen

	1997	1996	1995	1994	1993
Fast och mobil telefoni, utlandssamtal, samtalsminuter (miljoner)	747	708	700	697	683
ISDN, kanaler Sverige (1 000-tal)	198	104	40	18	10
Internet, abonnemang Sverige (1 000-tal)	232	105	9	—	—
Internet, abonnemang Danmark (1 000-tal)	10	—	—	—	—
Kabel-TV, abonnemang Sverige (1 000-tal)	1 308	1 291	1 275	1 259	1 250
Kabel-TV, abonnemang Danmark (1 000-tal)	145	137	135	—	—
Kabel-TV, abonnemang Estland (1 000-tal)	14	11	—	—	—
Kabel-TV, abonnemang Lettland (1 000-tal)	7	—	—	—	—

Fig.3 key figures relating to adoption of ISDN.

After the disappointing years up to 1995, with the advent of the internet in the late 1990's ISDN will experience a short renaissance as it offers faster speeds than the prevailing modem technology, an unanticipated product segment. It should be noted that the benefits compared to the original vision for ISDN as a phone network with data transfer capabilities were reversed; instead it was primarily a data transfer network with a legacy voice transfer component. However, the upswing will be short-lived, the

[62] SWT 7842 "Swedish Telecommunication Series" Capgemini Consulting 1 June 1992
[63] DNT SE/RA/420509/420509.088/G 2/3 "Budgetunderlag för utbyggnad av ISDN-nätet 1993"
[64] SWT 3417 "VL-U 1/1994"
[65] SWT 7007 The History of Telia p.33

number of installed channels peaks at ~900,000 in the early 2000's [66] and 126.000 subscribers, less than 3% of the amount of POTS subscriptions.[67] Contrast this with the then conservative estimate shortly before the launch of 9.5% of the connections being ISDN by 2000.[68] The 1997 yearly report contains the most positive post-launch evaluation of the project after the number of channels grow rapidly, from a low base. Internet is described as the "Killer-app" for ISDN, one that was never anticipated even tangentially in the planning process.[69]

Analysis

For a network that was originally supposed to upgrade and replace the entire telephone network[70] there was a real lack of a comprehensive idea of what purpose it would serve[71]. It was supposed to offer new lines of data-communication for consumers and business, without affecting sales of current custom-built lines. In addition, it was going to safeguard the future of the data transfer networks and in the long-term integrate them. It would improve the basic telephony services and service quality, while at the same time integrating data transfer capabilities to allow new (in comparison to telephony) services such as the telefax improved service[72] [73]. The end result was that the ISDN technology was supposed to be many things to many different departments and stakeholders.

There would also be a substantial change in the scope of the project. Instead of a comprehensive digitalization of the telephone network to ISDN being the next generation of telecoms infrastructure, to a limited commercial network, to a "Consumer pays for investments"-model. The shift in attitude within the company towards the ISDN-project which this signifies is quite stark, not least since the networks division is not a revenue generating department at this time, rather a cost center.

The cyclical malinvestment case

The country wide ISDN network should be seen as the original project, the reason behind all the commission work, the test networks and the anticipated developments stated in the strategy documents. In the beginning, contrary to what the behavioral theory would assume, there was no large sense of uncertainty in the discussions surrounding ISDN, in addition there is at this point no awareness

[66] Telia AB Annual Report 2000, Telia AB Annual Report 2001, Telia AB Annual Report 2002, Telia AB Annual Report 2003
[67] SWT 5611 Liberalisering, regler och marknader SOU 2005:4
[68] DNT SE/RA/420509/420509.088/B2/8 "IN och ISDN i accessnätet"
[69] SWT – 6446 "Omvärldsanalys @ Omvärld & Strategiutveckling"
[70] TDA SE/RA/420509/420509.103/F3 bs/1 "Systemstudie "Datavision"" p.9
[71] SWT 7098 "Tele Nr.3 1987"
[72] MAR SE/RA/420509/420509.097/A 1 a/1 "Strategisk inriktning för företagssystem" PM 85-12-13
[73] SWT 5625 Teldok Rapport 40

of a technological crossroads. While ISDN was to be a shift in transmission technology, it would not be one in transmission philosophy. ISDN was seen as the natural culmination of a wave of innovation affecting the telecoms market, the next logical step.[74] In the three-year plan written immediately after the completion of Digitalen-87 the ISDN technology is described as a long term conclusion of the previous modernization work, rather than one potential future technology to develop.[75]In its original conception as the culmination of the analogue telephone network, its primary component would be providing voice communication over long distances, but as an added benefit it allowed for data transfer as well.

On some level the failure to recognize the coming growth of data transfer and the stagnation of voice traffic in the terrestrial network is tantamount to accusing Tvt of not anticipating the internet, which would be a tall order for any organization. However, criticism can be levelled at the lack of foresight when comparing growth rates for communication products. Data transfer networks had shown high and steady growth for many years by the mid 1980's with no signs of abating. POTS growth had been low and only marginally profitable for years. Spending resources

There is a path-dependency created by the work laid down in the CCITT commission, the commitment implied by the time and resources laid down in the commission work builds a similar kind of inertia as a technological linkage, one of a sunk cost. The delays on an international level associated with the ISDN project can be said to have been to Tvt's benefit. The long time that passed from the conception to the first potential deployment of ISDN no doubt allowed for a more thorough examination of the technology, with many of the inherent flaws becoming obvious.

The rollout of ISDN that would come to reap the most success was not the anticipated urban businesses and households; rather it was through the more parsimonious distance losses compared to the competing protocol ADSL that made it a viable option in rural locations. Putting the project into context and comparing the actual outcome in terms of adoption and deployment to what was originally planned, there is a case to say that while the pursuit of ISDN went far further than it should have, the potential loss from realizing the original plan would dwarf the real costs incurred.

The managerial collusion case

In the inception phase, the lack of a clear original definition seems quite reasonable from the managerial theory perspective. The main objective of invested management would be to build support for and

[74] SWT 9766 "Från dagens Telenät till Bredbandsnät" – Bilaga 1 1985-01-11
[75] SWT 2394 "Treårsplan Televerkskoncernen 1988-1990" p.46

present the future project as serving the interests of whomever can help its acceptance. The unresolved questions of the ISDN technology as it relates to the Tvt market are not discussed to a great deal in the early prospects. The lack of a market of products that goes beyond improvements in performance of already existing ones is a clear example of this. The focus lies squarely on the positive aspects, with sometimes contradictory communication as to what it will accomplish.. Since the first epoch is the period in time wherein the different stakeholders can affect the design of a future ISDN-net there was a reason to present it in a manner, which forms the expectations of the end result in their favor.

Characteristic for the second epoch is that of the expectations leveraged against the potential of the technology meeting the twin issues of real applicability and a harsher financial environment. The ISDN-project is substantially scaled down in the 1990 board decision but is at the same time cemented in what seems to be an irrevocable way. It is difficult to disengage the two drivers of rationalization from one another, as the sources from the ISDN-project group do not mention any change in mandate or scope of the project due to cutbacks. But there is evidence in the 1993 budget of precipitous cuts to investment for the networks division. The managerial theory suggests that once satisfactory profit has been achieved other considerations start affecting decision behavior at the managerial level and only if survivability is at stake does a symbiotic relationship reappear. While the scope of the final deployment was circumscribed there were no major issues raised by the ISDN-project group. The lack of prescience in criticism could be assigned either to the obvious explanation of setting the project's success above the needs of Televerket, but also the possibility that it wasn't within the project group's remit to give any such criticism. The mandate of the working group was to suggest a proper way to implement the ISDN-network, as had been decided in the board meeting, following commercial tests. Therefore, the lack of criticism of the internal project as a whole could either be assigned to the futility of the action or to the ulterior motive of wanting to reach deployment. The criticism that does exist is directed outside of the company and most crucially never directed at the technology.

The ISDN-technology's very conception is indicative of a managerially driven project. The certainty in the mentions of an "imminent"[76] change of the telephone network into an ISDN network with integrated services is reminiscent of inertia infused hubris. The ISDN standard at this time was not laid down to a satisfactory degree such that much anything could be said about what the future of the telephone network would look like, even if it was to be as an ISDN-like solution. Though it was the most likely

[76] SWT 9766 "Från dagens Telenät till Bredbandsnät" Bilaga 1 1985-01-11

successor technology to the legacy POTS system at the time it was not the only possible one, nor was there only one way of implementing ISDN in Sweden.

The strongest indicators of a managerially motived project are in the incipient epoch wherein the nebulous nature of the project seems to be worked to the benefit of making it a more palatable. The rationalization of the data networks and wide product line -which would surely come- would pave the way for wide and rapid adoption, which in turn would pay for the invested capital in short order. The project would at the same time streamline Televerket's infrastructure to cut costs. The certainty of the presented future scenario was plausibly to give the technology a sense of inevitability.

The questions raised early on regarding possible product applications and market need where brushed aside for as long as was possible and would affect the project as though they were unforeseen external events rather than integral parts of the discussion at hand. Later, the constant lack of candor of the ISDN-group on these subjects as they became more obvious also indicate that some level of occlusion of problems towards management was present. Their primary mandate was to test the basis for an ISDN-network in Sweden and form the basis of an actionable decision to management. The fact that these problems were never satisfactorily rectified before commercial deployment could indicate that there were other motives present than purely to improve Tvt's bottom line.

At the same time the shape that the ISDN-project finally took must temper this analysis. Some limitation of scope and economic rationalization happened from 1990 to 1993. The primary sources do not mention that the mandate for the project has changed due to owner or managerial intervention. Rather this seems to have been an internal process of due diligence towards the ISDN-technology after the ISDN group's completion of their report. So even though there are strong indications that there naturally were agents whose interest in the project went beyond the company optimal, the control structures of the company somewhat efficiently handled those within the confines of the committed to deployment.

End note – concluding discussion

The complex system of business areas, divisions and political considerations has yielded too much supporting evidence for both analytical frameworks to easily allow the project to be categorized as squarely supporting one or the other theory. Instead, there is a shifting dual layer of ISDN supporters building up political support for a commitment to ISDN. When this commitment comes, it comes from the top management MOU. This MOU forms a strong commitment dependency for the project, with instead the work of lower levels of management working to lay bare and curtail some of the issues of the project. This need not be an inherent contradiction, as not only do the theories both acknowledge

the existence if not the importance of the other motivating principle of inefficiencies. They focus on different aspects of a firm condition, with the behavioral theory taking a macro stance irrespective of the financial health of the firm and the managerial theory suggesting its driver of inefficiency is an always underlying phenomenon, the self-interest of agents, which recedes only in times of firm financial stress. The delays of the ISDN project would have allowed for awareness of issues inherent in the technology as well as other technological options to appear, so shifting outward the boundary of uncertainty that otherwise limited the conceived available options. The budget cuts that happens at a pivotal moment in the ISDN-project's timeline would have reduced the scope of the project by constraining available resources, just as the managerial theory suggests.

The big unexplored question is what motivated Tvt to sign the MOU on ISDN and so actually give the project a strong enough commitment that some sort of deployment became inevitable. Top management would have been acting on information passed to them from agents more intimately involved with the technology, so it is likely that the extant sources with exuberant expectations form part of the decision basis for the MOU.

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MAR	**Televerket Marknadsavdelningen 1975-1990**
TDA	**Televerket Data / Televerket ADB-Service / Televerket ADB-Avdelningen 1979-1991**

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