

Switching Relations

The rise and fall of the Norwegian
telecom industry

by

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Switching Relations: The rise and fall of the Norwegian telecom industry

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Oslo, 2 February 2006.
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List of Acronyms

BTM	Bell Telephone Manufacturing Company (ITT's Belgian subsidiary.)
CE	Committee for Electronics (NTNF's Utvalg for Elektronikk from 1961)
CGE	Compagnie Generale d'Électricité (Alcatel's predecessor/former owner)
CGCT	Compagnie Générale de Constructions Téléphoniques (One of ITT's French subsidiaries.)
EB	Elektrisk Bureau (LME's Norwegian subsidiary)
ELAB	NTH's Electronic Laboratory (Elektronikk Laboratoriet)
FA	STK's R&D-centre (Forskningsavdelingen)
FDI	Foreign Direct Investments
FFI	National Defence Research Establishment (Forsvarets Forskningsinstitutt)
FFSB	Norwegian Defence Communications Administration (Forsvarets Fellesamband)
INDIG	Televerket's group for introducing digital switches (INFøring av DIGitale sentraler)
ITT	International Telephone & Telegraph
ITTE	ITT-Europe
IWEC	International Western Electric Company (Western Electric's international subsidiary, which ITT bought in 1925.)
KRK	Armed Forces Procurement Department (Forsvarets felles Materieltjeneste, Kontraksrevisjonskontoret)
LCT	Laboratoire Central de Telecommunications (ITT's French laboratory)
LMT	Le Matériel Téléphone (One of ITT's French subsidiaries.)
LME	LM Ericsson
NTNF	Norwegian Research Council for Science (Norges Teknisk- Naturvitenskapelig Forskningsråd.)

MNC	Multinational Company
No. 7	Signalling System 7
NOU	Norwegian Public Report (Norsk Offentlig Utredning).
NSC	Network Service Center (Developed for the Norwegian network while installing System 12)
NTH	Norwegian Institute of Technology (Norges Tekniske Høyskole)
PABX	Private Automatic Branch Exchange
P/E	Price/Earnings (stock price/companies earnings)
PCM	Pulse Code Modulation (digital transmission)
PTO	Public Telephone Operator
R&D	Research and development
RSU	Remote Subscriber Unit (Rural switches with limited intelligence developed for the Norwegian network while installing System 12)
SI	System of innovation
SKG	Skandinaviske Kabel- og Gummifabriker
SPC	Stored Program Control (programmable computer and/or switch)
STC	Standard Telephone and Cables (ITT's British subsidiary.)
STL	Standard Telecommunication Laboratory (ITT's British laboratory)
STK	Standard Telefon og Kabelfabrik
TA	Televerket's Technical Department (Teknisk Avdeling)
TDM	Time Division Multiplexing (transmission technique used with digital switching)
TF	Televerket R&D-institute (Televerkets Forskningsinstitut)

Introduction

“Why doesn’t Norway have a Nokia?”

The last ten years have been marked by the increasing use of information and communication technologies, and particularly by different forms of telecommunications. At the same time, the telecom industry has gone through radical changes, due mainly to the digitalisation and liberalisation that have revolutionised the sector since the 1980s. Some companies have disappeared, while new entrants dominate the global arena. The Finnish Nokia emerged in the wake of this development, and together with the old Swedish incumbent, L.M. Ericsson, they make Scandinavia a telecom centre in the world. Norway did not get a Nokia, despite its leading role in telecom in the 1980s. What is more, the old Norwegian telecom industry has virtually disappeared. An industry that employed thousands of workers in the 1980s has all but vanished. Nevertheless, Norway is still a leading country in telecom, and one of the most profitable and promising Norwegian companies in recent years is Telenor, the former Public Telephone Operator. This thesis will try to provide an historical explanation and understanding of this development, that is, the rise and fall of the Norwegian telecom industry.

The thesis has a particular focus on Standard Telefon og Kabelfabrik (STK), the largest Norwegian supplier of telecom equipment in the 20th century. Together with Elektrisk Bureau, STK divided the Norwegian market through a cartel agreement in 1934. This happened in the wake of the consolidation of the international telecom industry, after which a few companies dominated the global scene. The coming of automatic telecom switches spurred this development, as the costs of developing these switches were too high for small and medium-sized companies. STK and Elektrisk Bureau (EB) were subsidiaries of ITT and Ericsson, respectively, two of the largest telecom companies in the world. From the interwar period to the 1980s, the structure of the telecom sector was stable. Technological and political conditions ensured that multinational companies could sell telecom equipment to Public Telephone Operators (PTOs) at oligopolic prices, through their subsidiaries. It was difficult for other companies to get access to the market, as the PTOs were caught in an oligopolic grip. The thesis describes how this grip tightened from the 1930s, and explains how digitalisation and liberalisation eventually loosened it, and why this occurred so early in Norway.

The introduction of electronics in telecom in the 1960s marks the beginning of the end of the stable regime. First, this was due to the loosening of the oligopolic grip, and second, because it turned telecom into a high-tech industry, and it became a political

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goal to develop a national telecom industry in most countries. In Norway, Televerket, the PTO, set up a research institute in 1967, as did STK in 1968, and these became central institutions in the Norwegian system of innovation in telecom. For Norway and other countries, heavy investment in telecom-related R&D was a matter of industrial policy, but it was also an attempt to exploit the technological development, to free itself from the dominance of multinationals. Significant resources were poured into R&D in electronics and telecom, to try to develop a national industry that could replace and/or challenge the incumbent multinationals. A central field in telecom was electronic and digital switching. The new entrants in the industry, i.e. Nokia, Nortel and Alcatel, all ascended on the basis of digital switches.¹ Consequently, a key issue in explaining the absence of a vibrant Norwegian telecom industry today is that no one tried to develop a digital switch in Norway.

An alternative strategy for a PTO was to try to free itself from the dominance of the multinational companies (MNCs), and thus be able to exploit its procurement power to achieve lower price and better quality. These two strategies reflected the PTO's double agenda, as it was both a service provider and an *industry* provider. In Norway, both strategies had strong advocates and spokesmen, and public bodies did not follow a consistent strategy. Some wanted the PTO to support Norwegian industry through its procurement policy, while others wanted the PTO to focus only on price and quality. A recurrent question was whether it was possible to pursue an offensive industrial policy with foreign-owned subsidiaries as industrial partners. Two opposing perceptions of multinationals emerged. On the one hand, MNCs were seen as diffusers of products and technology, and thus economic growth: this was a commonly held view in Britain.² On the other hand, MNCs were perceived as obstructers of national industrial development, which was a normal perception in France.³ In its strategy toward the Norwegian authorities, STK favoured the first assessment, and praised its relationship with ITT. EB, however, accepted the "French" line of thought, and pursued a strategy of freeing itself from Ericsson. Thus, the two companies chose different adoptions.

¹ Llerena, Patrick; Mireille Matt and Stefania Trenti: "Government Technological Procurement: The Case of Digital Switching Systems in France" and Christopher Palmberg: "Industrial transformation through public technology procurement? The case of Nokia and the Finnish telecommunication industry" in Edquist et al. (eds.) 2002; Larry MacDonald: *Nortel Networks: How Innovation and Vision Created a Network Giant*, 2000.

² Geoffrey Jones: *The evolution of International Business*, 1996, p. 271; also see David Bailey, George Harte, and Roger Sugden: *Transnationals and Governments - Recent policies in Japan, France, Germany, the United States and Britain*, 1994.

³ About French scepticism towards foreign direct investment, see Jones, p. 277f. and Bailey et al. 1994.

Introduction

An important factor in explaining the later development is STK's strategy and conditions as an innovative enterprise in the 1970s. The question being how STK perceived its role in an industry that went through radical changes. A key element is how it handled its schizophrenia, of being a very large Norwegian high-tech company, and at the same time a very small subsidiary within ITT. In accordance with STK and EB's different strategies, the two companies' Managing Directors operated with different corporate governance systems in the 1970s. EB's chief followed a stakeholder version of corporate governance, whereas STK's chief, Fredrik Thoresen, highly influenced by ITT, pursued a shareholder-friendly corporate governance system. The thesis asks how this affected STK as an innovative enterprise. Moreover, it addresses how it affected STK and EB's strategy when the oligopolic grip had loosened, and enabled Televerket to arrange a competitive tender for digital switches in 1983. Both companies fell apart in the aftermath of the tender, partly due to rigid corporate governance systems.

An underlying view in this thesis is that the choices that were made, and the strategies that prevailed in the 1970s, by PTOs, MNCs and subsidiaries, had a decisive impact on the structure of telecom in the 1990s. An equally important presumption, however, is that there were strong historical forces that constrained and structured the same choices and strategies. There is, for instance, a causal relationship between STK's role as a switching supplier, and the fact that Televerket did not want to support the development of a Norwegian digital switch. Thus, STK and Televerket's joint history from the 1930s affected their line of thought and mode of conduct in the 1970s. That is why I have chosen to draw the lines back to the interwar period, to the establishment of ITT and STK. It makes the story more complete, and hopefully it contributes to a more comprehensive understanding of why Norway did not get an Ericsson or a Nokia in the 20th century; but instead a service provider of global standing. It is the story of the rise and fall of the Norwegian telecom industry, but it is also the story of the fall and rise of Televerket.

Comparing relations

The appropriate problem to investigate, to answer the research question, seems to be *how STK handled the digitalisation and liberalisation of the telecom industry*. This, however, emphasises STK as the proactive subject, which is not analytically advisable. STK ought to be analysed in its relational position between ITT and Televerket, as it was a mediator between the two. Televerket was the sole customer for the bulk of the products, while ITT was the main provider of products, technology and managerial principles. Televerket's procurement policy and attitude towards the industry and ITT's strategies and policies both had a decisive impact on STK. More-

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Moreover, a central claim in this thesis is that there are common causes for Telenor's present strength, and the faintness of STK's successor, Alcatel Norway. Thus, to explain STK's fate, we must incorporate Televerket's development. Furthermore, ITT, STK's mother company, also had a decisive effect on STK's development. And, more surprisingly, but nevertheless a major finding in this thesis, is the fact that STK and Televerket had a great bearing on ITT in the 1980s.

Accordingly, STK's handling of the digitalisation and liberalisation process was very much a question of handling the shifting policies and strategies of Televerket and ITT. A way to illustrate, and explain, STK's decline and Televerket's relative progress is to examine how the relationship between ITT, STK, and Televerket shifted over time. STK was a standard manufacturing subsidiary, so its telecom business was based on mediating between ITT and Televerket, as it manufactured and sold ITT's telecom equipment to Televerket. An important part of the business was to adapt the equipment to the standards and features of the Norwegian network, and to maintain and upgrade it. It was predominantly a *linear relation*, where the interaction between Televerket and ITT went through STK.

Televerket ↔ STK ↔ ITT

Yves L. Doz called the old relations between multinationals, subsidiaries and government agencies in the telecom industry “a negotiated environment”.⁴ He has documented how national governments and PTOs had a “direct influence on equipment suppliers”, through funding, ownership constraints, choice of suppliers, R&D contracts, and assistance for export sales.⁵ The multinationals and subsidiaries also had strong bargaining cards in this “environment”; for instance threatening to lay off workers, or offering interesting R&D projects to the subsidiary and host country. An important aspect is that in some instances, the subsidiaries sided with their compatriots, the PTO or other governmental bodies. It could be termed a “stakeholder-structure”, as there was a reciprocal stakeholdership between the parties. Still, technological aspects were just as important, as the PTO's freedom to choose equipment was limited by technological “lock-ins”, since it was difficult and expensive to make

⁴ As Doz claims, “key decisions affecting the strategy of the firm are not the result of any analysis of economic and competitive pressures, but they emerge in the interaction with the state-influenced customers.” Yves L. Doz: *Government Control and Multinational Strategic Management - Power Systems and Telecommunication Equipment*, 1979., p. 67-68.

⁵ Doz 1979, p. 64.

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switches from different suppliers interact. The lack of suitable technological interfaces between the suppliers' products upheld the industry's oligopolic position.

The oligopoly was institutionalised in Norway, through the above-mentioned cartel agreement. This thesis argues that the industry's oligopolic grip on the market consisted of five fingers. Two fingers stemmed from path dependency; first, the lack of suitable technological interfaces between electro-mechanical switches, which made it costly to make new switches interact with old switches of a different make. Second, the incumbent equipment supplier(s) had to be retained to maintain and upgrade the switches in service. Two fingers were related to stakeholdership: the fact that Televerket had responsibilities towards the workers of STK and EB, and the fact that Televerket acted as an industry provider, in trying to induce industrial activity. The fifth finger was Televerket's dependence on the equipment supplier's competence. It lacked sufficient control over its network and competence of the products to take advantage of its procurement power.

The thesis describes how this oligopolic grip loosened from the 1970s onwards. How computer-controlled switches eased the problems of interaction between different makes of switches, and how the liberalisation process eradicated former stakeholder responsibilities.⁶ And, how Televerket attained control over its own network through internal studies, and the acquisition of knowledge of technological development through cooperation with other PTOs and international equipment suppliers. Moreover, the historical investigation focuses on how the linear relation changed over time, from the interwar period to 1990. This study provides valuable insight. In addition, I compare STK's relational setting with EB's equivalent setting, i.e. $LME \leftrightarrow EB \leftrightarrow Televerket$, which allows us to draw conclusions on the Norwegian telecom industry as a whole.⁷

The comparison with EB illuminates STK's character as a company. Important differences between STK and EB derived from ITT and Ericsson, as these multinationals pursued different policies and strategies towards their subsidiaries, and the Norwegian market. Operating in several negotiated environments, ITT had to balance the need for national responsiveness to the subsidiaries' host countries, with

⁶ Kjell Eliassen and Marit Sjøvang (ed.): *European Telecommunications Liberalisation*, 1999, p. 16.

⁷ Literature on LM Ericsson: Artur Attman, Jan Kuuse and Ulf Olsson: *L.M. Ericsson 100 år Band I. Pionjärtid - Kamp om koncessioner - Kris 1876 - 1932*, 1976; *L.M. Ericsson 100 år Band II. Räddning. Återuppbyggnad. Världsföretag. 1932-1976*, 1976; Christina Jacobæus (ed.): *L.M. Ericsson 100 år. Band III. Teleteknikst skapande 1876-1976*, 1976; John Meurling and Richard Jeans: *The Ericsson Chronicle: 125 Years in Telecommunications*, 2000.

the need to coordinate and standardise the subsidiaries' activities to attain economies of scale. An essential part of the responsiveness was to allow the subsidiaries to take part in the host countries' system of innovations. Hence, there was a trade-off between economies of scale through international integration and access to markets through national responsiveness. Doz claims that "success in managing such trade-offs is the key to MNC survival and success".⁸ It was also the key to a subsidiary's survival and success. Thus, STK undertook considerable R&D, among other things to preserve its role as Televerket's favoured equipment supplier, not least as a switching supplier, which is the main focus of this thesis. The next section gives some brief definitions and clarifications related to telecom.

Switching

The thesis examines STK's supply of telecom switches to the Public Telephone Operator in Norway over a period of 50 years. Before I elaborate on the analytical and theoretical issues, it is pertinent to give a brief introduction to telecommunication.⁹

Telecommunication was previously defined as communicating at a distance, between two or more parties, using electromagnetic waves. Traditionally, there were two main economic actors in the telecom sector.¹⁰ The first was the *operator*, or the service provider, providing telecom services to the subscribers. Until the 1990s, the operators were normally state-owned monopolies, often called PTT (Post, Telephone, and Telegraph); in this thesis, however, I use the term Public Telephone Operator (PTO). The Norwegian Telecom Administration was established in 1855 as a provider of telegraph services. It was called Telegrafverket until 1969, when it was renamed Televerket, before it received its present name, Telenor, in 1994. The PTO's national headquarters in Oslo were called Telegrafstyret/Teledirektoratet, but were usually referred to as Telegrafverket/Televerket, which is why I have chosen to do the same in the thesis. The other actor in the telecom sector was the *industry*,

⁸ Yves L. Doz: *Strategic management in multinational companies*, 1987, p. 112.

⁹ The main literature on telecom technology and switching is the following: Robert J. Chapuis: *100 Years of Telephone switching (1878-1978) - Part 1: Manual Electromechanical Switching (1878-1960)*, 1982; Robert J. Chapuis and Amos E. Joel: *Electronics, computers and telephone switching : a book of technological history as volume 2: 1960-1985 of "100 years of telephone switching"*, 1990; ITT "History of ITT switching" 1976. Another important source of information in this field is Ivar Mo's unpublished manuscripts on the 8B and 11B: Ivar Mo: "Historien om 11B", 2000; and "Historien om 8B", 2001.

¹⁰ At present there are more actors in the telecom sector, like regulating bodies. Moreover, the convergence of IT and communication technologies has led to several "hybrid" actors, such as internet service providers, and companies that provide consultancy on ICT issues.

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or equipment supplier, such as STK, which supplied the equipment for the telecom network.¹¹

A telecom network has three main components. The first is the *links*, i.e. cables and radio link, connecting telephones to the network, and transmitting signals between them. The second is the *terminals*, telephones, fax-machines, data terminals etc. The third is the *switches*, or exchanges, which connect lines by reading the digits dialled by a subscriber and finding the adequate “path” through the telecom network to reach the desired number. In Norway, Elektrisk Bureau (EB) was the main supplier of telephone sets, STK of tele-cables, while the market for switches was more evenly shared between STK and EB. The two companies had other products as well, like PABX, a switch for private networks, broadcasting equipment, communication equipment for the armed forces, and equipment for radio communication.¹² Nevertheless, these other products amounted to little in terms of sale and significance, compared to the three main components of the network; links, terminals, and switches. The relative importance of these three has varied over time, but after the introduction of computerised switches in the 1960s, switching has been regarded as the central component and technology of the telecom network.

The switch became the fundamental technology in telecom, providing the network’s intelligence. It accounted “for over half the capital equipment costs of a telephone network”.¹³ Digital switches, which were dominant from the 1980s, transformed the industry. Equipment suppliers laid off thousands of workers, as they were less labour-intensive, R&D costs rocketed, and the stable markets disappeared. Furthermore, the distinction between information processing and communication became blurred as the technologies converged. The digital switch was in fact a computer, and was thus a product of the convergence of information and communication technologies (ICT). As the digital switch provided digital services, for instance allowing for the Integrated Service Digital Network (ISDN), it was also major facilitator of the same process of convergence. Consequently, switching was crucial to develop, or maintain, a sustainable business in the industry. Firstly, this was because it was

¹¹ In the United States, the operator and the equipment supplier were vertically integrated in AT&T, which owned its manufacturing subsidiary Western Electric. The Swedish PTO also manufactured telecom equipment. The normal trend, however, was that the operator and equipment supplier were in separate companies.

¹² An important feature of the Norwegian telecom industry was the high demand for ship radios, due to the considerable merchant and fishery fleet.

¹³ Doz 1987, p. 89; between 1976 and 1980, switching accounted for 56% of the telecom industry sales on average, terminals 9%, transmission 18%, and PABXs 12%, leaving minor shares for Telex and Data transmission. Nguyen 1985, p. 93. Televerkets langtidspan (NOU 1980:10), p. 104.

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the bread and butter of the industry in terms of sales, but also because the computerised switches became the brain of the network.

The digitalisation of switches and the liberalisation of the PTOs procurement of switches caused the global downsizing of the telecom industry. Digital equipment was much less labour-intensive in terms of manufacturing and installing. Moreover, as R&D costs increased, R&D was centralised by the multinationals, leaving less activity for the subsidiaries. Liberalisation led to fewer demands from PTOs and government for national manufacturing and R&D in the subsidiaries. The PTOs strove for international technological standards and digitalisation contributed to a shift from local products to global products, which allowed for competitive procurement policies from PTOs. Besides squeezing the industry's margins, it also caused the multinationals to centralise their activities. Thus, a general consequence was reduced activity for most subsidiaries in the telecom industry.

As digitalisation and liberalisation, and the ensuing deindustrialisation were an international phenomenon, one may argue that the downsizing of STK's telecom business does not require an individual explanation. Through a reductionist approach, one could reach an explanation in accordance with generalising theories. Even if this is true, I find several reasons for narrating the course of event and analysing how this process took place. Firstly, the historical knowledge of how powerful forces and trends, such as the digitalisation and liberalisation, affect small nations, is valuable. This line of defence is justifiable. It is, however, no more than that, a defensive justification. Another reason for asking *how* is that it is very seldom that global and transformative forces are deterministic, and digitalisation and liberalisation were definitely not that. They also opened a window of opportunity for entering an industry that traditionally had very high barriers of entry. Therefore, the main, and offensive, reason for asking *how* STK and the Norwegian telecom sector went through the digitalisation and liberalisation process, is that it is this way we find key reasons for why Norway - with its strong capabilities in telecom - did not succeed in using the window of opportunity to create a Nokia. The next sections elaborate further on the relationship between explaining and understanding.

Explaining and understanding

In this section, I try to clarify my theoretical position on some issues I find pertinent to history and business history in general, and to my research question in particular. Wilhelm Dilthey distinguished the cultural and social sciences from the natural sciences on the basis of their object: the former seeks understanding, and the latter

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explanations.¹⁴ Dilthey's point was that we explain nature, but we understand the spirit. Nature is studied from the outside, and uniformities are observed with the intention of creating causal laws. The human sciences, on the other hand, are studied from the inside, through an understanding of the human intentions and experiences behind texts, expressions and actions. An interpretive or hermeneutic method is required for reconstructing the cognitive process that motivates or gives meaning to human actions. This thesis has the ambition to both explain and understand the development of the Norwegian telecom industry.

Several branches of the social sciences, not least economics and sciences related to business, have more similarities to Dilthey's definition of the natural sciences: they seek explanations rather than understanding, and study human behaviour from the outside, observing uniformities with the aim to create generalising theories. An important reason for this development is the ambition to be useful, to be an instrumental science, which requires some degree of predictability in the theories. In order to achieve this, however, intentional explanations are often omitted, because generalising theories require uniform behavioural assumptions. I have always thought it a paradox of the instrumental social sciences' generalising approach: on the one hand they omit intentional explanations from their analysis, which is, on the other hand, designed to advise policy makers on intentional action.

An important reason for including intentional explanations is that they avoid deterministic explanations, which are problematic in several ways, not least because they leave out the moral responsibility for human actions. Moreover, the British historian Sir Geoff Elton claims that history will "instruct us in the use of reason", these instructions will be minimised if intentional explanations are left out.¹⁵ Francis Sejersted claims that the ultimate subject of history ought to be about human beings' never-ending struggle to avoid being the slave of history, and this is hard to reconcile with deterministic explanations.¹⁶ Hence, fundamental issues are at stake while omitting human actions based on free will. Operating with uniform behavioural assumptions, the generalising theories often take human preferences for granted, while an historical analysis often reveals how individual or collective preferences are historically constructed. In highlighting this, one admits that free will is structured, and thus reduces the danger of becoming a victim to voluntarism.

¹⁴ Poul Lübcke (ed.): *Engagement og forståelse*, København, 1982, p. 27f.

¹⁵ Quoted from Francis Sejersted: *Demokratisk kapitalisme*, 1993, p. 339.

¹⁶ Sejersted 1993, p. 243 ff.

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To clarify my position, I find Sejersted's distinction between disintegrating/generalising theories and integrating/totalising theories constructive, as the former is commonly used by social sciences, while the latter is more used by historians. Sejersted speaks of totalising theories; I prefer approach or method, as it is seldom we speak of totalising theories.¹⁷ Moreover, the term 'totalising' has unfortunate connotations, as it brings to mind the idea of including every relevant factor. An historical analysis is by nature reductionistic, as an essential part of the interpretation is how one chooses to reduce the number of factors. Thus, I prefer the term integrating approach, rather than totalising. Knut Kjeldstadli speaks of a corresponding distinction, that is between external and internal causes.¹⁸ Generalising theories will often limit themselves to external causes, whereas an integrating approach includes internal causes. Hence, my interpretation integrates internal factors and causes, without having any ambition to include all relevant factors.

Thus, generalising theories are reductionistic, in the sense that they seek external variables that have more or less similar causal effects in different cases, so the theory can be generalised. There is little doubt that fruitful generalising theories are valuable, not least for historians, who take them as a point of departure for more ideographic studies. Some go far, however, in indicating that generalising theories are the only research that "constitutes a contribution to knowledge".¹⁹ I distance myself from such a position. Disintegrating theories can provide authoritative explanations of *why* something happened, but tend to remain external to actual processes, that is, to *how* things happened. Conversely, integrating theories are not reductionist in the same manner, rather they try to integrate relevant internal factors to provide an understanding of how things happened, as they are not confined to the generalising ambition.

Several developments may be seen as general, in the sense that similar mechanisms are spelled out in different places, such as industrialisation, democratisation, and/or

¹⁷ Sejersted's theory about a specific Norwegian *democratic capitalism* is a totalising theory, which is inspired by the German *Sonderweg*-theories. One thing is that there are few such theories, but another is the fact that many would choose not to label them theories. My point is that the distinction is valuable, even if it does not apply solely to theories, but also to methods.

¹⁸ Knut Kjeldstadli, *Fortida er ikke hva den en gang var. En innføring i historiefaget*, 1992, p. 28.

¹⁹ Gary King, Robert O. Keohane, and Sidney Verba: *Designing Social Inquiry: Scientific Inference in Qualitative Research*, 1994, here after Svein Andersen: *Case-studier og generalisering*, 1997, p. 12.

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Stein Rokkan's nation building.²⁰ Whereas generalising theories reveal valuable similarities in each case, the totalising theories point to the dissimilarities. An integrating theory, according to Sejersted, shows *how* a country or an institution goes through such general developments. This distinction is particularly relevant for my research question, in as much as I ask how STK and the Norwegian telecom sector went through the digitalisation and liberalisation process. Through this, we learn of other, internal or integrating causes, why the Norwegian telecom industry has virtually disappeared. The point is that the generalising approach does not merely reduce the number of variables in the explanation, but it also reduces the field of the intellectual interpretation. On the other hand, the totalising approach broadens the field.

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It does not follow from my adherence to the humanistic and hermeneutic tradition, that I abandon the use of theories. On the contrary, it is my ambition to conduct a theoretically informed analysis, motivated by the axiom that "rich history is rich on theory". My theoretical position is eclectic, thus, it is the matter of the case that decides what theories or analytical approach I apply. As the thesis is about STK's relational position between Televerket and ITT, it uses theoretical perspectives that are designed to understand and explain relations. STK's relation to ITT requires theories regarding multinational companies, while its relation to Televerket calls for theories and literature on government-industry relations, including public procurement policies. A key concern is how STK, and Televerket, developed competence and innovative capability through interaction, thus theories regarding innovation in relations are used. Finally, STK's need to balance the interest of its many stakeholders, ITT, Televerket and Norwegian institutions, makes corporate governance theories valuable. The first branch of theory I present is that related to multinational corporations.

Multinational companies

Many books on multinational business and companies have contributed to the contents of this thesis, like Geoffrey Jones's *The evolution of International Business* and Mira Wilkins's analysis of *American Business abroad from 1914 to 1970*.²¹ These two authors have been central in studying freestanding companies (FSC), that

²⁰ Stein Rokkan: "Statsdannelse, nasjonsbygging og territoriell konsolidering i Europa" in *Stat, nasjon, klasse : essays i politisk sosiologi*, 1987.

²¹ Geoffrey Jones: *The evolution of International Business*, 1996; Mira Wilkins: *The Maturing of Multinational Enterprise: American Business abroad from 1914 to 1970*, 1975.

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is companies that were established to do the bulk of their business abroad.²² This is a focal point in this thesis, as ITT only did minor manufacturing and sales in the United States. FSCs were controlled from headquarters in the home countries; thus, they were a foreign direct investment, not a portfolio investment.²³ The concept is a rewarding analytical tool for understanding ITT and STK in its early years. It is not straightforward, however, to label ITT a FSC, as the term is used for companies operating in a foreign country.²⁴ Moreover, it was not normal that the non-operating headquarters had as many subsidiaries as ITT did. Furthermore, the FSCs were normally short-lived, thus ITT was atypical, in that this structure lasted for over 60 years in its telecom business.²⁵ Nevertheless, ITT followed the pattern of other FSCs, in as much as it undertook to construct and organise an infrastructure, and that it cooperated closely with the financial community.²⁶ Furthermore, the notion makes sense, as ITT was a freestanding company, not entrenched in any country: Europeans regarded it as American, and Americans regarded it as European.²⁷

An important feature of FSCs regards ownership advantages, a concept that is derived from John Dunning's eclectic paradigm for analysing foreign direct investment.²⁸ The ownership advantages explain the subject of the investment, i.e. the investor, while the locational advantages determine the object of investment. As Wilkins states, "a firm must have advantages over actual or potential local competitors to survive abroad".²⁹ For regular MNCs, these advantages are often perceived in line with Raymond Vernon's "product cycle" tradition, that MNCs develop owner-

²² Mira Wilkins and Harm Schröter (ed.): *Free-standing company in the world economy 1830-1996*, 1998.

²³ *Direct* investment means that investor retains the managerial control of the enterprise, unlike a portfolio investment. Hence, the degree of the investors' control decides whether it is FSC or a portfolio investment. Moreover, the designation of the headquarters, as a mother company or a location for control, determines whether the company is a FSC or not.

²⁴ Hence, in Wilkins terminology it was ITT's subsidiaries, such as STK, that were freestanding companies.

²⁵ Wilkins says she "was impressed with how often these (FSCs) were short-lived activities." Mira Wilkins: "The Free-Standing Company Revisited" in Wilkins and Schröter (ed.) 1998, p. 6.

²⁶ Wilkins 1998, p. 10.

²⁷ Chapuis 1982, p. 263. The main ITT literature used in the thesis is: Robert Sobel: *ITT - The Management of opportunity*, 1982; Robert J. Schoenberg: *Geneen*, 1985; Rand V. Araskog: *The ITT Wars*, 1989; Maurice Deloraine: *When Telecom and ITT were young*, 1974; Anthony Sampson: *The Sovereign State of ITT*, 1974; Peter Young: *Power of Speech - A History of Standard Telephones and Cables 1883-1983*, 1983; and Abo Tetsuo: "ITT's International Business Activities, 1920-40: The remarkable Advance and Setback of a 'Pure International Utility Company'" 1982.

²⁸ John Dunning: *Multinational Enterprises and the Global Economy*, 1993.

²⁹ Wilkins 1998, p. 10.

ship advantages from their performance and experiences in the home country, which serve as a basis for foreign direct investments.³⁰ These advantages are internalised within the boundaries of the firm, as opposed to FSCs, where the ownership advantages are not located within the firm, as they do not have activities at home, but rather within the owners' environment. The first chapter looks into the ownership advantages that led to the creation of ITT: the most notable one was the ability of ITT's first CEO, Sosthenes Behn, to operate in the politicised telecom market. An important element is that there were different ownership advantages underpinning ITT and LME's operations as multinationals, which help to explain differences in the room for strategic manoeuvring enjoyed by STK and EB.

A central query is STK's role as a subsidiary within ITT, thus theories concerning how MNCs organise their subsidiaries are crucial. MNCs have to balance the need for national responsiveness and international integration. When operating with integrated strategies, multinationals give subsidiaries responsibilities according to their, and their home country's, advantages. Several studies conducted by John Cantwell and others reveal that internationalisation of R&D within MNC follows patterns according to the host countries' relative advantages in industries and technological fields.³¹ Through this, subsidiaries can play a dynamic part in the MNCs' corporate strategy.³² They can pursue strategies, which enhance their rank as a subsidiary within the multinational, and, as Robert Pearce and others argue, try to attain a mandatory position in certain areas and/or product segments.³³ An important distinction, however, is whether a favourable position is granted as a result of governmental pressure or awarded on the basis of performance and/or locational advantages. Thus, there is a difference between *positive* locational advantages and *negative* locational advantages, even if both can pull in the same direction.

³⁰ Raymond Vernon: "International investment and international trade in the product cycle", 1966. Also see Mark Casson: "An Economic Theory of the free-standing company" in Wilkins and Schröter (ed.) 1998, p. 99.

³¹ John Cantwell's work on patent statistics shows that MNCs do R&D in subsidiaries where the host countries have specific advantages either in the technological field or the industry. John A. Cantwell: "The globalisation of technology: what remains of the product cycle model?", 1997; Cantwell and Elena Kosmopoulou: "What determines the internationalisation of corporate technology?", 2002.

³² First, in terms of innovation, in tapping into the respective host countries' innovation system. Second, with resource allocation, in exploiting the traditional locational advantages set up by John Dunning, and in a constant search for more efficient production through economics of scale and scope.

³³ Joseph R. D'Cruz: "Strategic management of subsidiaries", 1986, p. 81; Robert Pearce: "The evolution of technology in MNE: the role of creative subsidiaries", 1999; Robert Pearce: "Multinationals and Industrialisation: The Bases of 'Inward Investment' Policy", 2001.

It was an intricate game of politics and economics that determined a telecom subsidiary's rank within the MNC and within the host country. STK tried to attain mandatory positions within ITT, by participating in several R&D projects within telecom and switching. A political condition for granting STK governmental R&D contracts was that it could attain a lead position within ITT, or at least retain the intellectual property rights from the development contracts. A crucial element in explaining STK's destiny is to gain a firm grasp of how this game worked. A central dimension in this game was the government-industry relation, which the next section addresses.

Government-industry relations

The *government-industry* relation is an essential perspective in analysing the telecom industry, simply because the governments, through the PTOs, were the dominant customers. Thus, Televerket's policies and strategies in these matters had a more decisive impact on the development of STK's telecom business than anything else,³⁴ both for the technological strategy, in terms of when and how to modernise the network, and the choice of procurement relations with the equipment suppliers. In analysing this, I have used Doz' international study of negotiated environments in the telecom industry and the electrical industry. Moreover, the implications of national versus foreign ownership are pertinent. In this sense, the thesis is based on Tore Grønlie and my own work on state ownership in Norway, as the main argument for state ownership was to secure national ownership.³⁵ It was easier for governments to cooperate with national companies, for instance granting them R&D contracts. Many regarded foreign companies as obstacles to industrial development, and this concern about powerful multinationals increased during the 1960s. This was reflected in Jean-Jacques Servan-Schreiber's book *The American Challenge*,

³⁴ Literature on Televerket: Thorolf Rafto: *Telegrafverkets historie 1855-1955*, 1955; Evert Bestorp: *Oslotelefonen 1880-1985*, 1990; Harald Rinde: *Kontingens og kontinuitet : framveksten av stivhengige organisasjonsmønstre i skandinavisk telefoni*, 2004; Rinde: *Et tele-system tar form - 1855-1920 - Norsk telekommunikasjonshistorie bind 1*, 2005; Harald Espeli: *Det statsdominerte teleregimet - 1920-1970 - Norsk telekommunikasjonshistorie bind 2*, 2005; Lars Thue: 'Volume 3 in Norsk telekommunikasjonshistorie - 1970-2005', forthcoming; Christopher Sjuve: "Bredbåndshistorien - bit for bit : utviklingen av det norske telenettet 1967-1985 - visjoner og virkelighet", 2002; Gard Paulsen: "Samarbeidets protokoll - Utviklingen av et nordisk datanett, 1971-1981, 2004.

³⁵ Tore Grønlie: *Statsdrift. Staten som industrieier i Norge 1945-63*, 1989; Sverre A. Christensen: *Statens forhold til Norsk Hydro, 1945-1952*, 1997; "Statlig eierskap og nasjonal kontroll" in Christensen et. al., 2003. It was a variant of selective protectionism. Thomas David and André Mach: "Institutionalisation and questioning of ownership restrictions in Switzerland and Sweden", 2002.

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published in 1968, and numerous other books, which warned against the dominance of the American multinationals.³⁶ A Norwegian version came with Nils Petter Tanderø's *The Swedish Challenge* in 1974.³⁷

Still, as the Norwegian telecom industry was dominated by multinationals, the governmental bodies had to settle for cooperating with foreign subsidiaries, and try to help them achieve a mandatory position within their MNC. The governments balanced between appealing to and pressuring the subsidiaries to induce industrial development. Moreover, PTOs balanced between acting as a service provider and an industry provider. In being a service provider Televerket was more interested in access to the technology and competence of ITT and LME, to modernise the telecom network. As an *industry* provider, it tried to give the subsidiaries promising industry and R&D projects. In countries with a nationally owned telecom industry, it was normal to promote national champions, such as Siemens in Germany.³⁸ In countries where foreign equipment suppliers dominated, however, host governments could use the 'procurement card', to put heavy demands on the subsidiaries, for instance to reduce foreign ownership and influence. France was the main proponent of this strategy, and the French subsidiaries of ITT and LME were nationalised in this way in the 1970s.³⁹ Combined with high investment in telecom-related R&D, this interventionist policy paved the way for the establishment of Alcatel as a global player from the 1980s.⁴⁰

In the procurer relation, PTOs could either engage in close co-operation with the industry, to gain from knowledge flow and innovation through user-producer relations.⁴¹ Ericsson and the Swedish PTO had such a relation; Mats Fridlund called it a "development pair", which allegedly benefited both parties.⁴² The other strategy was

³⁶ Jean-Jacques Servan-Schreiber: *The American Challenge*, 1968. Other books are Edward A. McCreary: *The Americanization of Europe*, 1964; James McMillan and Bernard Harris: *The American Take-Over of Britain*, 1968. Conf. Wilkins 1975, p. 345.

³⁷ Nils Petter Tanderø: *Den svenske utfordring : multinasjonale selskapers innflytelse i norsk næringsliv: hvorledes kan oljepenger endre forholdet?*, 1974.

³⁸ Eli Noam: *Telecommunications in Europe*, 1992, p. 82.

³⁹ Llerena et al. 2000.

⁴⁰ Literature on Alcatel: Razeen Sally: "Alcatel's Relations with the French state: the Political Economy of a Multinational Enterprise" 1993; Razeen Sally: *State and Firms, Multinational enterprise in institutional competition*, 1995; Llerena et al. 2000; David Charles "Alcatel: a European champion for a globalizing market", 1996.

⁴¹ Bengt-Åke Lundvall: "Innovation as an Interactive Process: From User-Producer Interaction to the National Systems of Innovation" 1988; Lundvall (ed.): *National systems of innovation - towards a theory of innovation and interactive learning*, 1992.

⁴² Mats Fridlund: "Switching Relations and Trajectories: The Development Procurement of the AXE Swedish Switching Technology", 2002.

to opt for an arm's-length relationship, which would be beneficial according to economic theory, since the PTOs could exploit their *monopsonic* position in the market, i.e. being the only buyer in the market. Yet, a dichotomy of an efficient distant market relation and an innovative close user-producer relation is too simplistic. Firstly, close user-producer relations did not necessarily spur innovation. Secondly, an arm's-length approach was difficult, as the PTO needed to learn from the supplier. Technological control of the telecom network was necessary due to security and defence reasons. Moreover, the PTO needed technological competence to be able to exploit its monopsonic position. The next section addresses the innovative character of such relations.

Innovation

The third theoretical perspective I will draw upon is that associated with innovation. A main tradition relates to the concept of a 'system of innovation' (SI).⁴³ This was coined in the mid-1980s, emphasising that countries, regions, sectors or industries had certain systemic characteristics, which structure, spur and/or constrain innovation.⁴⁴ In a sense, the Norwegian system of innovation in telecom was set up in the 1960s. This is not to say that there was no SI before:⁴⁵ as long as economic activity takes place there is a SI, in the sense that systemic features will always influence innovation. Nevertheless, the normative aspects of SI, that innovation takes place through interaction, and through combinations of technologies and knowledge bases, came forward in the 1960s. Moreover, important R&D institutions were established. Thus, a R&D-system was created.

The technological development within electronics facilitated new ways of combining technologies, and this stressed that innovation took place through interaction and combinations. Christopher Freeman and Carlotta Perez argue that economic and institutional development is motivated by shifts in techno-economic paradigms, each containing a new key technology.⁴⁶ So, Norway was in line with other countries, in setting up a new institutional infrastructure to handle the new key technology, elec-

⁴³ Lundvall 1988; Charles Edquist, Leif Hommen and Lena Tsipouri (eds.): *Public Technology Procurement and Innovation*, 2000.

⁴⁴ The conceptual framework draws upon three theory-traditions: theories on interactive learning, evolutionary theories and institutional theories.

⁴⁵ There was, for instance, a vibrant innovation milieu within radio and wireless communication in Norway before 1960.

⁴⁶ These include the steam engine (late eighteenth century), railways (mid-nineteenth century), electricity (late nineteenth century), petrochemicals (early twentieth century) and information technology/electronics (mid-twentieth century). Christopher Freeman and Carlotta Perez: "Structural Crises of Adjustment: Business Cycles and Investment Behaviour.", 1988.

tronics. Knut Sogner has described how a public infrastructure for allocating resources to R&D, and to the electronic industry in particular, was set up in the 1960s.⁴⁷ Kjersti Jensen's has analysed how the public policy towards R&D in electronics was highly influenced by Telegrafverket's alleged lack of interest in R&D.⁴⁸ A result was the establishment of Televerket's research institute (TF*) in 1967, which John Petter Collett and Bjørn Lossius have written about.⁴⁹ Soon after, STK's inaugurated its own research centre (FA*).

There is an extensive literature on the Norwegian electronics and telecom industry in the post-war years.⁵⁰ Taking into account the number of historical investigations that have been conducted, it is striking that there is so little substantial research on either STK or EB.⁵¹ After all, these two companies were among the largest high-tech companies in Norway. As such, this thesis fills an empirical gap. Furthermore, the effort to combine theories on MNCs with the SI approach is an attempt to fill an analytical gap in the Norwegian literature. Being a small country, Norway is destined to rely on importation and adaptation of technology, which means that this perspective is particularly important. A key aspect in the SI literature is that innovation takes place through interactive learning, through user-producer relations between organisations. In this relation, Bengt-Åke Lundvall emphasises the home market, and that "long-term interactive learning is most easily organised in a setting where there are few linguistic and cultural constraints for the transfer of tacit knowledge and where a multilateral system of trust relationships can most easily be

⁴⁷ Knut Sogner: *Fra plan til marked - Staten og elektronikkindustrien på 1970-tallet*, 1994; *En liten brikke i et stort spill. Den norsk IT-industrien fra krise til vekst 1975-2000*, 2002.

⁴⁸ Kjersti Jensen: *Forskning og ny teknologi; fra mulighet til forutsetning. Om moderniseringsmiljøet som pådriver i norsk industriutvikling på 50 og 60-tallet*, 1989.

* Norwegian abbreviation for Televerkets Forskningsinstitutt.

⁴⁹ John Petter Collett and Bjørn Ole Helsing Lossius: *Visjon Forskning Virkelighet - Televerkets forskningsinstitutt gjennom 25 år*, 1993.

* Norwegian abbreviation for Forskningsavdelingen.

⁵⁰ Jon Petter Collett (ed.): *Making Sense of Space - The History of Norwegian Space Activities*, 1995; Olav Njølstad and Olav Wicken: *Kunnskap som våpen: Forsvarets forskningsinstitutt 1946-1975*, 1997; Knut Sogner: *God på bunnen - Simrad-virksomheten 1947-1997*, 1997; Olav Wicken (ed.): *Elektronikkentreprenørene - studier av norsk elektronikkforskning og -industri etter 1945*, 1993.

⁵¹ John Petter Collett's unpublished paper on Elektrisk Bureau is an exception to this: "I skyggen av svensk storkapital? A/S Elektrisk Bureau innenfor LME-konsernet" 1986. The books written for STK and EB's anniversaries are not based on academic research. G. C. Wasberg: *Standard Telefon og Kabelfabrik A/S 50 år - 1915 - 1965*, 1965; Bjørn Bjørhovde: *Alcatel STK Litt av en historie*, 1990; Peder Skogaas: *Over alle grenser, Elektrisk Bureau - 100 år i teleteknikkens tjeneste*, 1982.

organised”.⁵² The question is whether it was possible to establish such relationships with foreign companies.

The TF tried to form such innovative relations in the Norwegian telecom industry. Its main mission was to prepare Televerket for the digitalisation of the telecom sector, and another important task was to contribute to developing business in Norway. Since foreign companies dominated the industry, it wanted to promote the subsidiaries’ position within LME and ITT. The TF’s director, Nic. Knudtzon, argued that by using R&D contracts, it could help STK and EB attain a mandatory position within their MNCs.⁵³ The TF’s role for Norwegian telecom has been valued highly in the literature.⁵⁴ “In the 1970s, the TF played a role as a pioneer in a technically backward PTO” claims a report, “within 20 years it brought Televerket to a lead position in Europe.”⁵⁵ This thesis questions this postulation, and highlights the role of Televerket’s Technical department (TA), particularly how the TA attained technical control and knowledge over its network, which was crucial in programming and installing computerised switches from the 1970s.

An important source of knowledge and competence for Televerket in the 1970s was cooperation with other PTOs in the international telecom organisations. In addition, it needed an interactive relationship with an equipment supplier, to come to grips with computerised switches. Televerket formed a trans-national relationship with ITT’s Belgian subsidiary BTM, which was STK’s patron in switching. It is not straightforward to grasp this relation with the analytical tools provided by the rather nationally oriented SI approach. One thing is Lundvall’s point about cultural and linguistic constraints. Another is that national actors often will share visions and goals beyond short-term interests. Moreover, cooperation between national organisations is more often than not provided for by public financial support. An implication of these aspects is that SI relations are often characterised by trust and cooperation, and are less burdened by Oliver Williamson’s transaction costs.⁵⁶ It explains how Lundvall in one SI study finds that “interactions between agents had to involve non-price relationships”, and that market interactions are “incapable of transmitting the qualitative information between users and producers”.⁵⁷

⁵² Bengt-Åke Lundvall, Björn Johnson, Esben Sloth Andersen and Bent Dalum: “National systems of production, innovation and competence building” in 2002.

⁵³ TF’s annual report 1970, Collett and Lossius 1993, p. 93.

⁵⁴ Collett and Lossius, 1993; Terje Nord and Trond Einar Pedersen: “Endring i telekommunikasjon - utfordringer for Norge” 1996, p. 52.

⁵⁵ Nord and Pedersen 1996., p. 52.

⁵⁶ Oliver Williamson: *Market and Hierarchies*, 1975.

⁵⁷ Lundvall et. al. 2001, p. 218.

Michael Porter provides an alternative perspective with his “cluster theory”. He agrees that innovation takes place through interaction, in the interface between organisations, but it is indicative that Porter speaks of buyer-supplier relations, not user-producer. He talks of upgrading mechanisms, which develop due to demanding customers, and which are in accord with the market mechanisms, and that actors operate after an economic rationale.⁵⁸ This distinction between Porter and SI might provide a better understanding of the relational setting in the Norwegian telecom industry. A key point is that Lundvall’s user-producer relations entail a degree of trust and commitment, which goes beyond short-financial interests. This in turn makes the question of stakeholderhood relevant. STK’s ability and willingness to commit itself depended on how it ranked and valued its national stakeholders. Hence, the next section presents the last theoretical perspective, that of corporate governance.

Corporate governance

The concept of corporate governance is used in many different ways, but the underlying definition in this thesis is that it is a system/philosophy that is designed to take the interest of the corporation’s stakeholders into account. A loose definition of a stakeholder is a party that has something at stake in the company, though a stronger definition would be that the stakeholder has a legitimate claim on the corporation. The number of stakeholders will, normally, be proportional to the various purposes, or functions, the corporations fulfil. Such purposes or functions are to generate financial returns to the shareholder; to supply a given product, such as telecom equipment to Televerket; to create and secure employment; to contribute to economic growth, and thus prosperity and welfare in society; and, what is particularly important in telecom, to be a vehicle for innovation and technological development.⁵⁹ Each stakeholder will have particular interest in one or more of the functions: the shareholder in the financial return, Televerket in the price and quality of the equipment, the employees in secure work, the government in economic growth and technological development.

⁵⁸ Michael Porter: *The Competitive Advantage of Nations*, 1990, p. 19. This is evident for Torger Reve, who has performed two “Porter studies” in Norway. (Reve et. al 1992; Reve and Jakobsen 2001) Reve’s other theoretical mentor, besides Porter, is Oliver Williamson, who has developed the transaction costs theories. See Torger Reve: "The Firm as a Nexus of Internal and External Contracts," in Aoki, Gustafsson, and Williamson (eds): *The Firms as a Nexus of Treaties*, 1990.

⁵⁹ One might argue that a company's consequences should be incorporated, so as to include those affected by pollution or other environmental consequences are stakeholders as well.

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There are two main schools of thought regarding corporate governance: that is, shareholder and stakeholder philosophy.⁶⁰ The first has its origins in Berle and Mean's line of reasoning, regarding the separation of the owner and the manager. Hence, corporate governance regards how a dispersed group of shareholders can make sure that the corporation is governed according to their interests.⁶¹ This understanding is closely related to principal-agent theories and the shareholder value principle, i.e. that the corporations should be governed so as to increase the financial return of the shareholder. The second theory is closely associated with the idea of a *stakeholder society*; the normative assumption is that the governance should take all the stakeholders of the corporation into consideration. Moreover, there is a notion that the company has responsibilities towards society as a whole, that they are bound by a, more or less, tacit social contract.⁶² There is a general agreement that the shareholder value principle has conquered new ground during the last decades.⁶³ Some see this as an integral part of a converging globalisation process, where business is conducted increasingly according to Anglo-Saxon principles.⁶⁴

The triumph of the shareholder theory implies that former stakeholders, employees, local communities, the government, the society, have lost their prerogatives towards the corporation. The only stakeholder left, with legitimate claims in the prevailing corporate governance system, is the shareholder. Which also means, in theory, that all other functions are subordinated to generating financial returns to the shareholder. It follows from this that a financial conception of the firm dominates: this development started in the US in the 1960s. "The pioneers of this new strategy", says Neil Fligstein, "focused on the corporation as a collection of assets that could and should be manipulated to increase short-run profits".⁶⁵ One of the pioneers in this transition was ITT, and its CEO from 1959, Harold S. Geneen. He used ITT as a vehicle for creating one of the largest conglomerates in the world, and is regarded as the epitome of the financial capitalism of the 1960s. He developed a management system that came to be known as «Geneenism», which was based on financial con-

⁶⁰ Mary O'Sullivan: "The Innovative Enterprise and Corporate Governance, 2000.

⁶¹ Adolf A. Berle and Gardiner C. Means: *The Modern Corporation and Private Property*, 1932; Margaret M. Blair: *Ownership and Control: Rethinking Corporate Governance for the Twenty-First Century*, 1995.

⁶² Will Hutton: *The world we're in*, 2002.

⁶³ OECD: "OECD principles of corporate governance", in www.oecd.org; Trygve Gulbrandsen: "Internasjonal forskning om eierskap og kontroll i privat næringsliv" 1999, p. 23 f.

⁶⁴ "The philosophy of shareholder value is taking hold in countries which had resisted it for years and there are signs that the structures of corporate governance are acquiring an American - or Anglo-American - tinge to keep pace." "Governance responds to globalisation" in *Financial Times* 02.06.00.

⁶⁵ Neil Fligstein: *The Transformation of corporate control*, 1990, p. 226.

trol, and a resilient belief in the ability to run the corporation through analysing numbers.⁶⁶ As a result, ITT developed a new characteristic ownership advantage, of financial and managerial control. This underpinned Geneen's acquisition programme and success well into the 1970s, and also had strong bearings on STK.

As the financial conception of business swept over American business, there was a rapid technological development in electronics. The development in the semiconductor and computer industry in the 1960s was so strong that one can talk of an electronic revolution in the 1960s. All the major innovations in the field were carried out in the United States, which created a European anxiety to narrow the Atlantic gap in technology.⁶⁷ A result of this was a growing public initiative in the field of electronics and telecom, and several R&D projects and programmes were set up in European countries. Companies cooperated with other companies and public R&D bodies in different R&D projects. An implication was that the number and importance of national stakeholders increased.⁶⁸ Hence, the two development traits, i.e. the electronic and financial revolution in the 1960s, nurtured two competing corporate governance systems.

STK was, as many subsidiaries are, burdened by a type of schizophrenia; being a large Norwegian high-tech company and at the same time a small foreign subsidiary. This burden was not lightened after the electronic and financial revolution. On the one hand, STK had to come to grips with the emerging system of innovation in telecom, which required a technological and long-term perspective on business, within a national framework. On the other hand, it had to come to terms with Geneen, who stressed "that they were businessmen rather than engineers, that there were no compulsion to be in a technology if it was no business".⁶⁹ The financial conception of the firm left room only for one stakeholder, namely the shareholder, whereas the new system of innovation increased the number of STK's stakeholders. For Geneen, the sources of riches lay primarily in efficient resource allocation, whereas the new perspective on technology highlighted innovation as the prime source of future prosperity. Moreover, Geneen's managerial philosophy strength-

⁶⁶ The "difference between well-managed companies and not-so-well-managed companies is the degree of attention they pay to numbers, the temperature chart of their business". Harold Geneen, with Alvin Moscow: *Managing*, 1984, p. 184.

⁶⁷ OECD: *Gaps In technology: Electronic Components*, OECD-report, Paris 1968, *Gaps In technology: Electronic Computers*, OECD-report Paris 1968; *Gaps In technology: General Report*, OECD-report Paris 1968.

⁶⁸ This is in line with Alf Chaiton's claim, that "localization of competitive advantage fosters the stakeholder view." Alf Chaiton et. al.: "The Schizophrenic Corporation: Corporate Governance in a Clustered World" 2000.

⁶⁹ Young 1983, p. 143.

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ened STK's bond to ITT, while STK's participation in the system of innovation strengthened its national ties.

STK's schizophrenia affected its social conditions as an innovative enterprise, a concept that Mary O'Sullivan and William Lazonick have developed by stressing that a study of innovative enterprises requires a theory of the organisational economy, rather than the market economy.⁷⁰ O'Sullivan and Lazonick's point of departure is that the theory of the market economy sees resource allocation as individual, reversible, and optimal whereas the innovation process "is collective, cumulative, and uncertain"⁷¹ "The *learning process* that is the essence of innovation cannot be done all alone, all at once, (or) with any degree of certainty".⁷² They have identified three social conditions of an innovative enterprise: *organizational integration*, *financial commitment*, and *strategic control*.⁷³ These three conditions emphasise that it is the organisation, i.e. the enterprise, not the market, which creates incentives, allocates resources and determines investments.⁷⁴ It is not straightforward to apply this these concepts and approach to STK's telecom business in the rudimentary way this study does. Still, I find it rewarding, not least because it highlights STK's dependence on Televerket and ITT.

A final pertinent aspect related to corporate governance was the complex and mutual stakeholdership in the telecom sector. Most industries were important as they contributed to economic growth, employment and technological development. The telecom industry had an extra dimension, as it provided a crucial infrastructure for business and society, which was very important for security and military reasons. Thus, it has been asserted that there is a "tacit definition of the telecom sector as

⁷⁰ Among several publications is Mary O'Sullivan: "The innovative enterprise and corporate governance" 2000; William Lazonick: "The Theory of Innovative Enterprise", 2001.

⁷¹ William Lazonick, "The Theory of the Market Economy and the Social Foundations of Innovative Enterprise", 2003, p. 24.

⁷² Lazonick 2003, p. 24.

⁷³ O'Sullivan 2000. William Lazonick: "Innovative Enterprise and Historical Transformation", 2002, p. 14.

⁷⁴ "In our framework, 'strategic control' determines how strategic decision makers choose to build on 'asset positions'; 'organizational integration' determines the structure of incentives that characterize 'organizational processes' that can perform individual actions and individual capabilities (including those of strategic managers) into collective learning; while 'financial commitment' determines whether the enterprise will have the resources available to it to persist along an 'evolutionary path' to the point where its accumulation of innovative capability can generate financial returns.", Marie Carpenter, Lazonick and O'Sullivan: "The stock market and innovative capability in the New Economy: the optical networking industry", 2003, p. 974.

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belonging to the ‘hard core’ of national autonomy”.⁷⁵ Some, particularly the French, felt their reliance on foreign equipment suppliers as a threat to their independence.⁷⁶ Hence, most governments and PTOs felt an obligation to develop their domestic telecom industry. Moreover, governments were obliged to take the employees in the telecom industry into consideration. The industry exploited the PTOs’ stakeholder responsibilities to attain high margins in the negotiated environment. The liberalisation turned the table, as the PTOs were freed from the old stakeholder responsibilities.⁷⁷

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It follows from this presentation that I believe that a comprehensive theoretical approach is required to grasp the complex negotiated environment, and to explain why and understand how digitalisation and liberalisation tore it apart. Moreover, even though the theoretical fields are different, as they have a different subject matter, they contain dichotomies with strong similarities. Regarding foreign direct investment, it is a dichotomy between perceiving multinationals as engines of growth, or obstructers of industrial development; with public procurement, there are disputes whether the government should disregard industrial policy in favour of price and quality, or the other way around; regarding innovation, there are disagreements whether a demanding buyer-supplier relation induces more innovation than a trustful user-producer relation; and finally, concerning corporate governance, there are a set of shareholder-friendly norms versus stakeholder norms. Now, the recurrent dichotomies show obvious similarities, but are not always concurrent. Nevertheless, in an oversimplified way, we may label one of the positions Anglo-Saxon or market-friendly, and the other continental or market-sceptic.

Now, returning to the issues of free will, it is a common understanding that it is structured by norms and convention.⁷⁸ An important point in this relation is that there are often conflicts over which norm systems should prevail. Individuals’ or collective entities’ freedom of will is often put in actions as a choice among such system norms. This is not too dissimilar from George Kelly’s concept of “personal constructs”, by which we interpret reality.⁷⁹ The degree of freedom in these instances will vary according to the degree of contingency in the historical situation.

⁷⁵ Eliassen et al. 1999, p. 24.

⁷⁶ William Cats-Baril and Tawfik Jelassi, “The French videotex system Minitel: A successful implementation of a national information technology infrastructure”, 1994.

⁷⁷ Eliassen et al. 1999, p. 16.

⁷⁸ Sejersted 1993, p. 358 f.

⁷⁹ Here after Sejersted 1993, p. 366.

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Regarding the above-mentioned dichotomies, the thesis will show that the 1970s was a rather contingent phase, bestowing the actors with freedom to choose among the different sets of ideas or norm systems. More importantly, the thesis shows that the individual and collective preferences, in terms of which norm system to choose, can be explained historically, and that these in turn had a decisive impact on the historical development, and thus offers much in explaining the rise and the fall of the Norwegian telecom industry.

Sources

Alcatel STK's archive is the main empirical foundation in this thesis. The other major archival sources I have used have come from Televerket; some are located at the Norwegian State Archive (Riksarkivet) and some at the Norwegian Telecom Museum. In addition to this, I have used material from the Ministry of Communication and Industry. Finally, I have used empirical sources from Elektrisk Bureau and Nera. I tried to find relevant sources at BTM in Antwerp, but without any success. Regarding the empirical foundation for this thesis, it is pertinent to mention that the archives of STK's telecom business were a disappointing sight when I first visited them in 1999. Major parts of the company's archives had been, and were about to be destroyed.⁸⁰ I was given permission to take with me substantial parts of the archive, and it is my intention to hand this material over to Norsk Telemuseum. I have translated Norwegian texts into English, so I could quote them. When quoting primary sources, i.e. documents from archives, I have put the original Norwegian quote in the footnote. I have not done this when quoting from published material.

A major source of information has been interviews, with a total of 35 persons, mainly former employees of STK, but also from Televerket, BTM, EB, and Nera. I do not think the project, with its empirical orientation and analytical approach, would have been feasible without these interviews. It has been particularly important for the 1950s and 1960s, as these periods are scarcely documented in the archives. Furthermore, as often is the case, the interviews have provided an extra dimension to the understanding of the theme, which is difficult to find in the written sources. Even if some might find this analysis over-loaded with theoretical reflections and technical details, I hope I have managed to bring forth some of the smell

⁸⁰ Moreover, many of the records were not archived according to subject matter, but under the names of the managers who dealt with the issue. When these managers resigned, many of them took their records with them, and often destroyed them. Interview with the former Managing Director in STK, Fredrik Thoresen, and the former Manager of STK's telecom division Gunnar Tidemand.

and colour that the interviews contributed. The next paragraph gives a brief outline of the thesis.

Outline

Chapter 1 describes the establishment of STK and ITT in the interwar period, as a part of the automatisisation and oligopolisation of the telecom industry. The main purpose of the chapter is to explain and describe two central factors in STK's development. Firstly, the ownership advantages that underpinned ITT's foreign direct investment in Norway. The other key question, is why Televerket did accept the agreement, or in other words, why it was caught in the suppliers' oligopolic grip. The main purpose of chapter 2 is to explain why Televerket installed STK and BTM's electro-mechanical crossbar switch, the 8B, in the 1950s. Chapter 3 elaborates on the electronic revolution, as well as the new perceptions of research and technology that evolved in the 1960s, which contributed to the establishment of the TF in 1967, and STK's Research Department (FA) in 1968. A second important development was the growing scepticism towards powerful multinationals, where ITT was regarded as the incarnation of a powerful MNC, not least due to the its CEO, Harold S. Geneen, seen as the epitome of the financial revolution in the 1960s.

Chapter 4 presents STK's largest-ever telecom project, namely the development of the semi-electronic 11B switch. It also elaborates on how the oligopolic grip loosened in the early 1970s, inducing Televerket to ignore the cartel agreement from 1934. It also shows how the linear relation was changed when Televerket formed an independent relation with BTM. Chapter 5 examines STK as an innovative enterprise. Moreover, it undertakes to explain why EB was selected as a cornerstone company in 1976 by the government, rather than STK. The chapter analyses the differences between STK and EB on different levels: first comparing STK's Managing Director, Fredrik Thoresen, and EB's Managing Director, Kjell Kveim; and then discussing the impact of ITT and LME, respectively on STK and EB. The sixth chapter deals with Televerket's strategy for installing digital switches, and focuses mainly on the competitive tender for supplying Televerket with these switches. A central issue is why Televerket only ordered one system, and the importance of the Norwegian market for ITT. Chapter 7 seeks to explain why and how digitalisation and liberalisation led to the fall of the Norwegian telecom industry in the 1980s. The last chapter sums up my findings and seeks to explain Why Norway does not have a Nokia.

Chapter 1 Automatisation and oligopolisation

Introduction

This chapter provides the historical background to the rest of the thesis. Its analytical purpose is to elaborate on the developments from the mid-1920s that led to the establishment of ITT and STK, as well as the cartel agreement between STK and EB, which segmented the Norwegian telecom sector and industry for 50 years. This cartel agreement was a result of the industry's oligopolic grip on Telegrafverket, which in turn was based on several factors that will be presented in this thesis. An underlying assumption in this work, is that the question: "Why did Telegrafverket accept the cartel?", pinpoints crucial elements in the telecom history in general, and in STK's development in particular. The rise of ITT will be analysed using analytical tools from theories on multinational business, namely the freestanding company, and ownership advantages. These issues are central, as ITT's initial ownership advantages, and its lack of an operating headquarters, defined the company's character for the next 60 years, and thus STK's room for manoeuvre.

Standard Telefon og Kabelfabrik A/S came into being on 1 January 1934. It was a result of a merger between Skandinaviske Kabel- og Gummifabriker* (SKG) and Standard Electric A/S, which was an ITT subsidiary in Norway at the time. SKG is important as it represented STK's Norwegian and manufacturing origin. Still, it was a cable company, and this thesis is about telecom. Standard Electric A/S and ITT were descendants of the American Bell System. Hence, an understanding of STK's historical roots requires insight into the Bell System and its overseas operations through the company International Western Electric. The founding of STK also needs to be put into its local context. Norway contributed to the notion of a Scandinavian telecom wonder, with a very high telephone density and a growing telecom industry. The Swedish LM Ericsson developed into a world leader as an equipment supplier. In Norway, however, the most promising company, Elektrisk Bureau, was taken over by Ericsson in 1928. Thus, the establishment of STK, under ITT's ownership, was a part of the subsidiarisation of the Norwegian telecom industry.

STK came about as a result of the oligopolisation of the telecom *industry*. In this process, the larger companies, like ITT, LME and Siemens, swallowed small and medium-sized equipment suppliers, and carved up national markets for telecom equipment into monopolies and oligopolies. This was partly a response to the monopolisation of the telephone *operators*, through Public Telephone Operators

* Scandinavian Cable and Rubber Factories.

(PTO). In Norway, this development started in 1901, when Telegrafverket took over Christiania* Telefonselskap, which operated the large Oslo network. The early years of telecom were marked by several competing companies, both operators and equipment suppliers. This feature reappeared at the end of the century, when digitalisation and liberalisation reshaped the sector. Thus, the period in between, from 1930 to 1990, was marked by oligopoly and monopoly. The period coincides with the lifespan of STK and EB as subsidiaries. Thus, the establishment of STK took place in a time when the telecom sector and industry in Western Europe fell into structures that proved to be durable. These developments were in turn highly influenced by technological developments.

The establishment of (inter)national telecom networks through long-distance lines induced the PTOs' monopoly, while the automation of the switches segmented the telecom industry into national oligopolies.¹ Technological developments, which increased the fixed costs and the complexity of the telecom network, had a strong formative character.² Andrew Davies has, however, made a strong case in arguing that technological developments did not have monopolisation of the operators as an inevitable outcome.³ He argues that this market structure was more a result of the incumbent operators' - particularly AT&T's - desire to reap the benefits of a monopoly. "The national monopoly paradigm succeeded in the United States and most European countries not because it was superior in terms of efficiency", claims Davies, "but because it protected and promoted the interests of established or dominant communication monopolies."⁴ This is an important issue, and Davies is probably right that the deterministic perspective on technology has disguised human motives and actions in the traditional historical explanations of this formative phase of telecom. Still, this is not a major theme in this thesis.

Moreover, it is a common notion that the period 1890-1920 was particularly formative in Western societies. This is the basic assumption of the Chandlerian school, which operates with different taxonomies of capitalisms, based on how each nation

* Christiania was the name of Oslo, between 1624-1925, named after the Danish king Christian IV. From the 1870s it was normal to spell it Kristiania, to make it look more Norwegian.

¹ "The automation of the telephone service in large towns, and (...) the establishment of long-distance cables routes were to be the salient features of the development of telephony during the decade 1920-1930." Chapuis 1982, p. 249.

² Andrew Davies: *Telecommunications and Politics. The Decentralised Alternative*, 1994, p. 20 f.; Alfred D. Chandler: *The Visible Hand: The Managerial Revolution in American Business*, 1977.

³ Davies 1994, p. and Rinde 2004, p. 18 f.

⁴ Davies 1994, p. 32-33.

handled the second industrial revolution.⁵ Francis Sejersted's theory of a Norwegian *Democratic capitalism* is also based on this conjecture, with respect to how Norway handled capital-intensive industrialisation.⁶ Jan Glete underpins the assumption. He found that the ownership and power structures in Sweden in 1920 were more similar to those of the 1980s, rather than those of the 1890s.⁷ There is good reason to assume that the same holds for political parties and other central institutions as well. "During the great industrial breakthrough," Glete asserts, "several structural centres were established, which for a long time ahead had governing impact on Swedish big business."⁸ The same reasoning applies for the telecom sector.

The telecom industry was segmented through the process of developing and installing automatic switches.⁹ The contracts that were signed for the deliveries of the first generation of automatic switches in the inter-war period formed, by and large, the market structures and relations for telecom equipment until the 1980s. Telegrafverket's decision to install Western Electric's Rotary switch in 1916, for instance, led to the establishment of STK's forerunner, Norsk Western Electric. Its mother company was Bell/AT&T's manufacturing company, i.e. the supplier of telecom equipment and, hence, the industrial component in the Bell System, Western Electric. In 1925, ITT bought Western Electric's European subsidiaries, and Western Electric's international business thus became ITT's backbone. That is why this "telecom tale", like most others, starts with the Bell System.

The Bell System and the Scandinavian telecom wonder

Alexander Graham Bell's invention in 1876 led to the creation of the Bell System. In the subsequent years, the International Bell Telephone Company established and ran telecom networks in several large European cities, among them a network in Christiania, which was running from July 1880. In order to secure its supply of equipment, the Bell System in 1881 bought Western Electric, which was a leading manufacturer of telegraphic equipment. "In February 1882, Western Electric and

⁵ Alfred D. Chandler: *Scale and scope: the dynamics of industrial capitalism*, 1990. Among others who operate in this tradition is Williamazonick: *Business Organization and the Myth of the Market Economy*, 1991. One may argue that Alexander Gerschenkron initiated this line of thought, while arguing that the timing of a country's industrialisation, and particularly the mode of financing it, was decisive for its later character. Alexander Gerschenkron: *Economic Backwardness in Historical Perspective*, 1962.

⁶ Sejersted, 1993, p. 163 f.

⁷ Jan Glete: *Nätverk i näringslivet*, 1994, p. 27-28.

⁸ Glete 1994, p. 27-28.

⁹ I am not saying there was one-dimensional causal relationship here, but that the automation of switches was a cause, and was used as a reason for consolidating the industry into an international oligopoly.

Bell signed an agreement making Western Electric Bell's exclusive manufacturer of telephones in the United States."¹⁰ Hence, through Bell's ownership of Western Electric, the operating and manufacturing units became amalgamated in the US, which stood out as an exception in the telecom sector in the western world.

The year after Bell's acquisition of Western Electric, the Bell Telephone Manufacturing Company (BTM) was established in Antwerp, with Western Electric and Bell as dominant owners.¹¹ In the same year, 1882, Western Electric founded a subsidiary in the UK, which was later named Standard Telephone and Cables (STC). It held several subsidiaries in the Commonwealth and came to be in charge of Western Electric's "manufacturing of cables and transmission apparatus", while BTM was entrusted with the manufacturing of switches.¹² The Bell System's further expansion in Europe was to a large degree co-ordinated and supplied from STC and BTM.¹³ BTM remained one of Western Electric's, and later ITT's, chief subsidiaries, especially in the field of switching. STK, for instance, always belonged to the "BTM camp". Thus, BTM served as STK's mother company in the switching business.

Both Western Electric and the Bell System made considerable profits from their business in Europe: Western Electric on costly equipment and Bell on high subscription fees. It is argued that in countries where the Bell System held a strong position, the development of telecom was halted due to the high prices.¹⁴ In Scandinavia, however, domestic firms challenged the Bell System, primarily because Bell and Western Electric's prices were so high.¹⁵ Hence, both operators and manufacturers entered into competition with Bell and Western Electric. Private associations formed co-operatives that established telecom networks in local areas.¹⁶ The capitals of Norway and Sweden, for instance, each had two telephone networks, with one local operator competing with the International Bell Telephone Company. The local operators started out with much lower fees than Bell: firstly, because they made a conscious choice of price before quality, secondly, because they acquired equipment from others rather than from Western Electric.

¹⁰ Stephen B. Adams and Orville R. Butler: *Manufacturing the Future - A History of Western Electric*, 1999, p. 44.

¹¹ Of 4000 shares, Western Electric held 2160 and International Bell Telephone Company 800. No author *Bell Telephone Manufacturing Company 1882-1982*. 1982.

¹² ITT, 1976, p. 3.

¹³ Rinde 2005, p. 142.

¹⁴ James Foreman-Peck: "International Technology Transfer in Telephony, 1876-1914" in David J. Jeremy (ed.): *International Technology Transfer. Europe, Japan and the USA, 1700-1914*, 1991, p. 122-152. Here after Rinde 2005, p. 142.

¹⁵ Rinde 2005, p. 142; Attman et al. 1976a, p. 50-51.

¹⁶ The remains of the paragraph is based on Rinde 2005, p. 150 f.

Western Electric's main rival from the outset, and ITT's rival throughout the 20th century, was the Swedish LM Ericsson. In the late 1870s, Lars Magnus Ericsson's technical workshop received American telephones for repair and adjustment, and through this he acquired sufficient experience to start his own production. A decisive matter, it seems, was that Bell did not have patent protection in Scandinavia.¹⁷ Another important source of technology for LME was Siemens in Germany. There were significant improvements in transmission and switching until 1900, and the telephone, i.e. the actual apparatus, with microphone, handle etc., was also much improved.¹⁸ Before the automation, the telephone was the most cost-draining part of the network, partly because it had to generate its own electricity.¹⁹ LME's business during the first years was based on copying and modifying US and German technology, and offering telecom equipment at modest prices in Sweden, and later in the rest of Scandinavia.

A Norwegian competitor to LME, the Elektrisk Bureau (EB), was established by Carl Söderberg in 1882. Besides being LME's sales agent in Norway, Söderberg was among the founders of Christiania Teleforening, Bell's competing network in the Norwegian capital. EB was a considerable company in the Norwegian context. "It had a production capacity of 25,000 telephone sets" annually, and had considerable exports, with affiliates in Copenhagen, Rome and New York.²⁰ Initially, the bulk of EB's sales came from imported electro-technical products. But Söderberg also had aspirations to carry out independent manufacturing of telecom equipment. The first products, however, were mainly copies of those of LME and Siemens. Söderberg also took advantage of the sales network he had developed as LME's agent in Norway. Lars Magnus Ericsson's reaction to EB's technological and mercantile reliance on LME is noteworthy. He thought it was fair that EB tried to establish its own business based on copying the technology of others: after all, this was what LME had done itself.²¹ Moreover, Ericsson thought such plagiarism would only stimulate innovation, and that the best firm would prevail anyway. This resembles the attitudes that characterised the development of Internet-related technologies in the 1980s and 1990s, but is in stark contrast, however, to the technological strategy that LME applied towards its subsidiaries throughout the 20th century.

¹⁷ Jacobæus (ed.), 1976, p. 16.

¹⁸ Thomas Alva Edison's invention of the carbon microphone was a leap forward in terms of practical use of the telephone.

¹⁹ After the automation, the telephone received low voltage from the switch, Finn Jahren: *Glimt fra Televerks-kulturen - Abonnent og Teleteknikk*, 1995, p. 14.

²⁰ Skogaas 1982, p. 209; Rinde 2005, p. 221.

²¹ Attman et al. 1976a, p. 68.

The fairly advanced telecom industry in Scandinavia went hand in hand with a high density of telecom subscribers. The British telephone engineer Herbert Laws Webb concluded in 1910 that it was “in the Scandinavian countries that the telephone has the freest and most rapid development in Europe”.²² There were three times as many telephone subscribers per inhabitant in Norway, as in the leading industrial economies like Germany and the UK. As a colleague of Webb, A. R. Bennett, claimed, “wherever two or three Scandinavians were gathered, «they almost infallibly proceed to immediately establish a church, a school, and a telephone exchange.»²³

Table 1.1 Telephone subscribers per 1,000 inhabitants, 1900

Sweden	15.6	Germany	5.1	Austria	1.2
Norway	15.0	Great Britain	5.1	Spain	1.0
Switzerland	12.4	Netherlands	3.3	Hungary	0.9
Denmark	11.0	France	1.8	Rumania	0.3

Sources: Rinde 2005, p. 133.

There is an intriguing historical parallel between these years and the Scandinavians’ frequent use of Internet and mobile telephones in the 1990s.²⁴ It is fair to assume that the Nordic countries’ progressive role in telecom from the 1980s has important roots in the infant years of the telephone. For our purpose, however, the reasons for the Scandinavians’ affection for telephones and communication serve as an interesting and important background for STK's development.

One important reason for the technical and industrial development was Bell’s lack of patent protection in Scandinavia; it enabled the industry to evolve through copying US, German, and each other's technology. A notable factor is that Western Electric did not establish any manufacturing subsidiary in Scandinavia; Bell imported the equipment from the BTM plant.²⁵ Hence, the domestic industry’s initial growth was based on import substitution.²⁶ The local telephone companies' willingness to

²² Herbert Laws Webb: *The development of the telephone in Europe*, 1911, here after Chapuis 1982, p. 145.

²³ A. R. Bennett: *The Telephone Systems of the Continent of Europe*, 1895, here after Rinde 2005, p. 132.

²⁴ Johan Hauknes and Keith Smith: “Corporate Governance and Innovation in Mobile Telecommunications: How did the Nordic Area Become a World Leader?” 2002.

²⁵ This was probably due to the relatively small markets and the peripheral location in Europe. However, in this matter it might be a question of the chicken and the egg; Western Electric did not invest in Scandinavia, due to the stronghold of the local manufacturers.

²⁶ Attman et al. 1976a, p. 50-51.

opt for low cost and domestic products was vital and increased the density of telephones. There was a reciprocal effect here, the cheap equipment enabled the local telephone companies to compete with Bell for subscribers, and the local telephone companies enabled the domestic industry to compete with Western Electric.

Harald Rinde has highlighted the local willingness and ability to establish local telephone companies as an explanation of the high density of telephones in Scandinavia.²⁷ These companies made a conscious choice of accessibility and economy, over the higher quality that Bell could offer. Finally, Scandinavians have been said to be infatuated with technology, which in turn fuelled the expansion and development of telephony.²⁸ This structure, of many private networks, was challenged by the PTOs' monopolisation of telecom provision around the turn of the century.

PTO - monopoly and monopsony

The situation in Christiania, with two competing telephone companies, did not last for long. It was perceived as irrational and provoked a fierce debate about the "telephone issue" in the newspapers.²⁹ Christiania Telefonforening and Bell, however, were not able to agree on a merger, so the companies were forced to merge, and formed Christiania Telefonselskap in 1886.³⁰ It was privatised and obtained a concession to operate the network for 15 years. This reflected the prevailing opinion that telephony was not suited for competition, and that it was a natural monopoly since it was inefficient to operate two networks. Moreover, the City Council's action showed that a public initiative was required. The *Telegraph law* from 1881 had already given Telegrafverket a formal monopoly on long-distance calls.

The development of the national network and increasing long-distance traffic paved the way for a national monopoly. The minister in charge of telecom in 1899, Jørgen Løvland, argued that one should not organise the telephone affair by "dividing the country into several telephone provinces, but by creating one telephone empire".³¹ A new law was passed in 1899, giving Telegrafverket the exclusive right to run telecom networks and to redeem all telephone companies in Norway. In 1901, when Christiania Telefonselskap's concession expired, Telegrafverket took over the tele-

²⁷ Rinde 2004 and 2005.

²⁸ "Skandinaver er de beste forsøkskaninene" in *Dagens Næringsliv* 11.08.03. The article is about a US research report, which concludes that Scandinavian countries are the best place to launch new products, with mobile telephony used as an example.

²⁹ Bestorp 1990, p. 16 f.

³⁰ Rinde 2005, p. 148.

³¹ Quoted from Bestorp 1990, p. 48.

com network in Christiania.³² This was the largest private network in Norway, constituting 40 per cent of the local traffic. Hence, it was a decisive starting point for monopolising the telephone service in Norway. Still, Norway stands out in a European context, as the process of monopolising the telecom services took such a long time. Only 50% of the private networks had been taken over by Telegrafverket by 1920.³³ The process of *deprivatisation* was halted, due to the government's poor financial state.³⁴ Thus, Norway had a dual regime of private networks operating side by side with Telegrafverket. It was always the intention to put the private networks under Telegrafverket, but as this was not finalised before 1974, Rinde has coined the awkward Norwegian situation as "permanent temporality", and it had a profound effect on the Norwegian telecom sector, to which we will return.

Most European countries went through the same process around 1900 and sought to monopolise the telephone business under state ownership and control. PTOs were established, with the postal service and/or with the former telegraph administrations.³⁵ An important reason for the emergence of PTOs was the construction of national networks through long-distance lines. "The years 1910 to 1920 were marked by the appearance of the first long-distance and very long-distance routes", states Chapuis, "constituted by cable circuits using electronic tube repeaters."³⁶ Moreover, the national networks were connected to an international network from the 1920s. This entailed national co-ordination.³⁷ Furthermore, the increasing complexity of the technology required standardisation and raised the fixed costs. This contributed to an understanding of telecom as a natural monopoly.³⁸ As with telegraphs and railways, it seemed irrational to construct separate networks and administrations.

In most countries, the PTOs bought private telecom companies and developed into monopolists. Denmark and Finland were notable exceptions to the general European development, as these countries' networks were run by regional companies, with the government as an independent regulator. Nevertheless, the process of public control and monopolisation was well under way in most countries. This had different consequences for the networks and the subscribers. Our main concern, however, is that monopolisation turned the national markets for telecom equipment into mo-

³² Bestorp 1990, p. 49 and 51.

³³ Rinde 2005, p. 336.

³⁴ Espeli 2005, p. 279 f.

³⁵ Chapuis 1982, p. 117 f.

³⁶ Chapuis 1982, p. 247.

³⁷ Davies, 1994, p. 72 f.; Attman et al. 1976a, p. 50; Rinde 2005, p. 281.

³⁸ Rinde 2004, p. 17 f.

nopsonies, i.e. with only one buyer of equipment. Hence, the PTOs' monopolist position in their downstream activities - provision of telephones - gave them a monopsonic position in their upstream activities - procurement of telecom equipment. This had several consequences to which we will return throughout the thesis, the most important one being that it gave the PTOs great procurement power when dealing with the telecom industry. Thus, the industry had to comply with the demands from the PTOs in order to sell equipment.

One important demand from the European countries, concerning the international telecom industry, was domestic production. Apart from the general wish for industrialisation and employment, the security dimensions of telecom were important. In response to these demands Western Electric established manufacturing subsidiaries in Antwerp, London, Berlin, Paris, Milan, Vienna, St Petersburg and Budapest.³⁹ It also established subsidiaries in almost every part of the world, in cities like Tokyo (later NEC), Montreal (later Nortel), Buenos Aires and Sydney.⁴⁰ An important technological reason for the host governments' demand for domestic production was that the switches became more complex, first through the manual multiplex switch, and later with the automatic switches. This highlighted the need for national control of the networks, and the wish for technology transfer.

The path dependency of automatic switches

The cost of personnel for the manual switches halted the further expansion of telephone subscribers. Moreover, when a network surpassed 10,000 subscribers, it required more switches to communicate. This created a complex system, and thus diseconomies of scale. Hence, there were many attempts to create effective and reliable automatic switches. One of the first systems was the Strowger system, developed by Almon B Strowger, a funeral director in Kansas City.⁴¹ The switch, or selector, followed a step-by-step logic, responding directly to the dialled number, with vertical and rotating movements.⁴² The Strowger system was installed in numerous cities in the USA and Europe, among them Skien in Norway in 1920, which was the first automatic switch installed in Scandinavia.⁴³

³⁹ Western Electric also had production facilities in Tokyo, Montreal, Buenos Aires, and Sydney.

⁴⁰ Adams and Butler 1999, p. 50.

⁴¹ The anecdote is that Strowger invented the automatic switch in order to get rid of the manual operator, who was the wife of his competitor and ensured that her husband got more funerals than Strowger.

⁴² Chapuis 1982, p. 60.

⁴³ Rafto 1955, p. 344; Bestorp 1990, p. 68.

At the turn of the century, AT&T, which became the holding company of the Bell System in 1889, “authorized a study by Western Electric to develop a project for 10 000 line exchange”.⁴⁴ The outcome of Western Electric’s efforts was the Rotary switch, which was regarded as superior to the Strowger system.⁴⁵ It did not respond directly to the dialled pulses; instead, the numbers dialled were received by registers, which controlled the setting of the switches.⁴⁶ The registers “eliminated the fixed relationship between the numbering scheme and the number of switching stages”, which led to “less switch wear and lower maintenance”.⁴⁷ The Rotary switch was installed in several cities; it was produced for more than 60 years and was central in the Norwegian network until the 1980s.

The demand for telephones grew exceptionally in the Norwegian capital from the turn of the century. Telegrafverket realised that the manual switching system that was installed from 1895 would not be able to handle the traffic. The cost of personnel was very high with the incumbent network, both for the physical switching, but also because of the many errors that had to be taken care of. It became a problem for large cities to operate tens of thousands of subscribers by manual switches. With automatic switches, it was possible to allocate one switching station to each part of the city. In 1911, there were 130 automatic switches in use in the USA, and it gained ground in Europe too. The expansion of urban telecom networks in these years obliged most PTOs to consider the developments in switching. The Director General of Telegrafverket, Leonard Iversen, and his chief engineer, Sivert R. Abild, headed a committee that participated on international congresses concerning automatic switches. Thereafter, the committee went on a study tour around Europe and to the USA, before it produced a thorough report on the need for automating the Oslo network in 1913. This envisaged a plan for 30,000 lines, with a potential for 90,000 lines.⁴⁸

The Norwegian parliament, the Stortinget, sanctioned the plan, and international companies were invited to present tenders. The committee was extended with the inclusion of executives of the telephone companies in Copenhagen and Sweden, to evaluate the tenders. In January 1916, the committee chose Western Electric's Rotary switch for the Oslo network. Besides Western Electric's low price, it was the reputation of Western Electric and BTM that counted the most, along with the fact

⁴⁴ Chapuis 1982, p. 166.

⁴⁵ Godefroy Dang Nguyen: “Telecommunications: a challenge to the old order.”, 1985, p. 100.

⁴⁶ Meurling and Jeans 2000, p. 79.

⁴⁷ Meurling and Jeans 2000, p. 79.

⁴⁸ Rafto 1955, p. 333-334; Rinde 2005, p. 308.

that the Rotary switches had been tested in other cities. The contract with Western Electric was signed in 1916, and the first automatic switch was due already in 1917, but the project was postponed, mainly because of the World War.⁴⁹ The automatic switch was installed in 1921, which was early in a European context; Hague was the only capital that installed automatic switches earlier. This suggests that Norway still was in line with the other Scandinavian countries in being pioneers in telecom. The Bergen Telefonkompagni, which was privately owned, also ordered Rotary in the 1920s. The switches were imported from BTM in Antwerp, and installed by Western Electric Norway, which was founded in 1920, and which eventually became STK's telecom department.⁵⁰

The first contracts signed for automatic switches in large cities had profound effects on the market situation in the following years.⁵¹ As for the relation between the PTOs and the equipment suppliers, there were strong path-dependent effects from the ordering of automatic switches, through technological lock-ins, and what Brian Arthur calls increasing returns.⁵² The Rotary contracts secured STK's and BTM's positions as sole suppliers for Oslo and Bergen's telecom network until the 1980s. Hence, much of the 20th century's market structure for telecom equipment was laid in the interwar years. Through the ordering and installation of automatic switches, PTOs and equipment suppliers entered enduring and intimate relationships. The equipment suppliers that battled for these contracts in Europe were Ericsson, Siemens, Western Electric, and Automatic Electric Chicago (Autelco), which produced the Strowger system. Western Electric operated through its subsidiary, the International Western Electric Company (IWEC), which handled the overseas business. Thus, IWEC was a holding company for BTM, STC, Western Electric Norway and other companies. It was not very successful, however, in winning large switching contracts in Europe. The German PTO ordered a variant of the Strowger switch from Siemens, and IWEC lost a long-fought struggle to supply the British network in 1922.

The loss of the British contracts was allegedly due to amateurish political handling. IWEC confused the British by making a combined offer of Rotary and the US version of Rotary, called *Panel*. Moreover, IWEC and STC planned to carry out the bulk of the manufacturing in Antwerp, not in Britain. This was a “fatal political

⁴⁹ Rafto 1955, p. 300.

⁵⁰ Wasberg, 1965, p. 35.

⁵¹ Deloraine, 1974, p. 46.

⁵² Paul A. David: “Clio and the Economics of QWERTY” 1985; W. Brian Arthur: “Competing technologies: an overview”, 1998.

error” as it was politically impossible to entrust the manufacturing of “nationally important equipment to another country”.⁵³ “The British Post Office considered that Parliament would never sanction such a proposal” and dropped IWEC's offer, in favour of the Strowger switch.⁵⁴ The loss of the UK market implied that IWEC would have a hard time getting access to other Commonwealth markets as well. Thus, “by 1923 two large European countries had made their choice”, says ITT's famous French telecom engineer, Maurice Deloraine, “which was against the systems supported by Western Electric”.⁵⁵ The last large contract for automatic switches in Europe was for the French network, but IWEC had no reason to be optimistic given its record in Germany and the UK. As a consequence, Western Electric's owner, AT&T, considered divesting itself of IWEC. One possible buyer was International Telephone & Telegraph, with its eccentric manager Sosthenes Behn.

ITT - a freestanding company

The founder of ITT, Sosthenes Behn, was born on St. Thomas in the West Indies. He had a Danish father and a French mother, and was educated in Paris and Corsica, before he received US citizenship.⁵⁶ He served as a colonel in the Signal Corps for the US army during the First World War in Europe. “Fiercely proud of his wartime achievements, Behn enjoyed being addressed as «Colonel Behn» for the rest of his life.”⁵⁷ His military experience got him acquainted with telephony and the poor state of the European networks. However, he and his brother ran a sugar business in Puerto Rico, and received the local telephone company and its concession as a payment for bad debt.⁵⁸ ITT was created through the acquisition of a telephone company in Cuba and the one obtained in Puerto Rico.⁵⁹ It has been said that Behn chose the name, IT&T, hoping that others would confuse it with AT&T.⁶⁰

ITT's headquarters was in the US, but the company did not do any business there. Thus, it was a multinational company (MNC) without an operative mother company. Mira Wilkins has described such companies, which were established to do the bulk of their business abroad, as freestanding companies (FSC). They were controlled from headquarters in the home country: thus, a FSC was a foreign direct

⁵³ Young, 1983, p. 38.

⁵⁴ Deloraine 1974, p. 48.

⁵⁵ Deloraine 1974, p. 49.

⁵⁶ Tetsuo 1982, p. 105.

⁵⁷ American National Biography Online March 2002; <http://www.anb.org/articles/10/10-00117>.

⁵⁸ Tetsuo 1982, p. 105.

⁵⁹ Sobel 1982, p. 14 f.

⁶⁰ The original abbreviation was IT&T; it was changed to ITT in the 1960s, Sobel 1982, p. 36.

investment, not a portfolio investment.⁶¹ These kinds of companies, or foreign direct investments, were common around 1900, particularly in enterprises aiming to exploit natural resources such as oil, mining, pulp and paper, or constructing infrastructure, like railways, roads, banks and telecommunications.⁶² The FSCs served as agents for industrialisation and modernisation on the part of advanced countries, in relation to less advanced ones. They were often backed by large banks, which were eager to capitalise on national advantages by overseas investments. Hence, ITT's telecom business in the West Indies was a classic FSC, as was ITT's close relation with the National City Bank and the JP Morgan group. Both banks had representatives on ITT's board of directors from the outset.⁶³

Based on its business in the Caribbean, ITT expanded into Europe and obtained the concession for the telephone service in Spain in 1924. This was in severe competition with European equipment suppliers, such as LME, Siemens and Philips. These companies were not traditional operators, but were keen to obtain the concession in order to sell their equipment. The ordinary way of pursuing the business for the telecom industry in the first years was to obtain a concession for running a network and thereby sell the equipment.⁶⁴ Thus, it is indicative that the title of the first volume of LME's history, covering the period 1876-1932, is called "The Battle for concessions".⁶⁵ Later, Behn "referred to the Spanish situation as his "springboard" from which he hoped to develop other concessions in Europe".⁶⁶ He was reluctant to buy telecom equipment from European manufacturers, as he feared that unfavourable terms would squeeze the profit margins in his Spanish adventure.⁶⁷ Thus, in order to secure supplies for his Spanish project, Behn wanted to link up to, or buy, an equipment manufacturer with operations in Europe.

Behn had been in touch with AT&T's management while trying to connect Cuba to the US network through a cable. Moreover, Behn learned of AT&T's desire to sell IWEC, through the National City Bank, which served both companies. Thus, Behn approached Western Electric, to buy IWEC in early 1925. This was a bold move,

⁶¹ *Direct* investment means that the investor keeps the managerial control of the enterprise, unlike a portfolio investment. Hence, the degree of the investors' control decides whether it is a FSC or a portfolio investment. Moreover, the designation of the headquarters, as a mother company or a location for control, determines whether the company is a FSC or not.

⁶² Wilkins and Schröter, 1998.

⁶³ Tetsuo 1982, p. 107.

⁶⁴ Chapuis 1982, p. 261 f.

⁶⁵ Attman et al. 1976a.

⁶⁶ Deloraine 1974, p. 49-50.

⁶⁷ Sobel 1982, p. 38 f.

given that IWEC dwarfed ITT, with “revenues in excess of seven times those of Behn's properties”.⁶⁸ IWEC's European subsidiaries, however, had problems with its profitability, supposedly due to mismanagement and undercapitalisation and, above all, because of the failure to get access to the British and German markets with Rotary. Hence, IWEC needed further investments and commitment from the parent, AT&T. Robert Sobel, the author of ITT's history, claims that the US government favoured the divesting of IWEC, because “American telephone customers had to subsidize the growth of foreign installations”.⁶⁹

The US government's attitude must be put in the context of the general concern for AT&T's dominant position in the USA. Thus, a sale of IWEC was a means of avoiding anti-trust charges, as was the establishment of Bell Laboratories in 1925, which was set up because the “Bell System needed to show that it was striving for the sorts of improvements that competition created”.⁷⁰ Finally, it is likely that the US government was concerned about the military importance of communication technology, and did not want AT&T to export vital technology. Western Electric's management, however, was not keen on selling its overseas operations, and turned down ITT's offer. Behn, still eager to secure supply for the Spanish contract, bought a French company, Thomson-Houston, soon renamed *Compagnie Générale de Constructions Téléphoniques* (CGCT), which also “could prove a perfect vehicle for entry into the lucrative French market.”⁷¹

IWEC's destiny was not settled. It became an integral part of a power struggle between AT&T and Western Electric's presidents. Western Electric's Charles DuBois had just lost the race for AT&T's presidency to Walter Gifford and hung on to IWEC as part of his power base, whereas Gifford, apart from being more anxious about anti-trust charges and AT&T's financial standing, did not mind reducing DuBois's influence.⁷² Gifford decided to sell IWEC to ITT. “DuBois and many others at Western Electric were crushed when they heard the news” of the divestiture of IWEC.⁷³ In September 1925, AT&T and ITT “divided the world between them-

⁶⁸ Sobel 1982, p. 42.

⁶⁹ Sobel 1982, p. 42. “Moreover, at this time A.T.T. was having to defend its domestic rate increase: A.T.T. pointed to the large interest charges it had to pay on loans. Why, the state regulatory commissions asked, did the company have the expense of borrowing when it had funds tied up in foreign investment? Was this to the American consumer's advantage?”, Wilkins 1975, p. 70-71.

⁷⁰ Adams and Butler 1999, p. 115.

⁷¹ Sobel 1982, p. 43.

⁷² Sobel 1982, p. 43.

⁷³ Adams and Butler 1999, p. 116.

selves. AT&T agreed not to compete overseas, and on his part the Colonel wouldn't erect telephonic-equipment plants in the United States".⁷⁴

The arrangement supports the widely held perceptions of the banks' integral role in organising FSCs in the first part of the twentieth century. The National City Bank and JP Morgan were instrumental in the transaction, initiating it by bringing Behn and Gifford together, and assuring its completion by arranging the financing of ITT's acquisition. \$25 million out of the \$30 million was paid in ITT gold bonds, "which AT&T turned over to J. P. Morgan & Co. for sale on the market."⁷⁵ Thus, ITT relied on the securities market and "in close connection with this deal, two executives of J. P. Morgan & Co. joined ITT's directorates in 1926".⁷⁶ From the banks' perspective, it reduced its financial claims towards AT&T, and raised its financial stake in ITT proportionally. All the same, it continued to be financially engaged in manufacturing and supplying of telecom equipment overseas.

ITT changed IWEC's name to International Standard Electric (ISE), and in the following years ISE acquired more companies in Europe, which were merged with former IWEC subsidiaries. Most of the subsidiaries were given a name that included "Standard" in order to link them to the mother company, like the German Standard Elektrik Lorenz (SEL) and Standard Telefon og Kabelfabrikk (STK).⁷⁷ ITT also invested in several telephone companies in Central and South America and bought a large US cable company. Its gross earnings rose from \$3.5 million in 1921, to \$100 million in 1929, while the number of employees grew from 1300 to near 100,000 in the same period.⁷⁸ The expansion was financed mainly by bond issuing. Still, how could an eccentric Colonel, Sosthenes Behn, turn a small freestanding company into one of the world's largest telephone companies? This question is essential for grasp-

⁷⁴ Sobel 1982, p. 44; IWEC's name was changed to International Standard Electric Co., which in turn was a subsidiary of ITT. The name International Standard Electric Co. was seldom used. Hence, for the sake of simplicity, I will use the name ITT throughout the thesis.

⁷⁵ "Of the staggering price of \$30 million paid to buy International Western, a large portion, \$ 25 million, was paid in ITT gold clause bonds (redeemable in 20 years and carrying an annual interest of 5.5 %)." Tetsuo 1982, p. 107.

⁷⁶ Tetsuo 1982, p. 107.

⁷⁷ Others were Standard Electric Aktieselskab, Copenhagen; Standard Electric Company Warsaw; Standard Electric Doms a Spolecnost, Prague; Standard Electric Romana S A, Bucharest; Standard Eléctrica S.A., Madrid; Standard Eléctrica S.A., Lisbon; International Standard Electric Corporation, Branch office Rio de Janeiro; Standard Elettrica Italiana, Milan; Standard Telephones and Cables, Ltd, London and Standard Telephones and Cables (Australasia) Ltd., Sydney.

⁷⁸ The networks in Central and South America and Caribbean were "to incorporate them into the All American Cables network, thereby connecting them with each other and with New York." Tetsuo 1982, p. 112.

ing the nature of ITT and how it pursued its strategies and policies throughout the 20th century.

ITT's ownership advantages

One way of explaining ITT's international growth is by using John Dunning's eclectic paradigm for explaining and analysing foreign direct investments (FDI). The subject of the investment, the investor, is explained by detecting ownership advantages.⁷⁹ Hence, to get an analytical grip on ITT, we need to take a closer look at the ownership advantages behind the company's acquisition of IWEC. Analyses of ownership advantages may seem like an academic exercise, with only theoretical relevance to the circumstances in question, but in this case there is reason to believe that the banks conducted such an analysis, comparing and evaluating ITT's and AT&T's ownership advantages for engaging in overseas telecom business. An important dimension of FSCs is that the ownership advantages are not located within any firm. Traditional multinationals develop ownership advantages from their performance and experiences in the home country, which serves as a basis for FDI.⁸⁰ This was not the case for FSCs or ITT, whose ownership advantages lay in the owners' environment. Thus, ITT's ownership advantages were partly derived from its American base and partly from Behn's personality.

It is straightforward to identify US firms' ownership advantages in telecom in comparison with overseas competitors. The US had been the world leader since Bell's invention. In 1928 there were 16 telephones per 100 inhabitants in the USA, while the corresponding figure in Europe was 2 per 100.⁸¹ Furthermore, the US corporate and financial system was keen to assist entrepreneurs who wanted to capitalise on US technological advantages with overseas investments. The US government also supported FDI, and ITT benefited from this when it ran into financial difficulties in the late 1930s, while having to pay its annual interest on its bonds. When this proved impossible in 1939, ITT was saved by the appearance of the Export-Import Bank of America as the "lender of last resort". It was considered "a matter of high policy that the United States not lose its important international communication enterprise".⁸² Thus, one should never underestimate the political power of the home

⁷⁹ Locational advantages can explain the object of the investment.

⁸⁰ Vernon 1966.

⁸¹ Chapuis 1982, p. 47.

⁸² "Even though the Export-Import Bank did not offer the entire loan, the Bank's decision induced the New York banks, which had been reluctant to extend loans to ITT, to agree at long last to supply the rest." Tetsuo 1982, p. 120.

nation as an ownership advantage. The UK and US's high level of FDI in the 19th and 20th centuries underpins this.

Still, IWEC had turned into a financial burden within the Bell System. Why should Behn and ITT stand a better chance in managing foreign subsidiaries in the telecom business? Behn was convinced that he could organise the business in a more profitable way than AT&T.⁸³ The subsidiaries in Europe required close political attention, as the host governments pursued protectionist policies. AT&T may have reasoned that Western Electric did not have the capacity to engage in complex political struggles to win contracts for telecom equipment overseas, and that it would be better if Western Electric concentrated on its obligations towards AT&T and the US market. The National City Bank and JP Morgan may have reasoned the same way, believing that their financial commitment to both AT&T and ITT would yield higher dividends, letting Behn and ITT handle the politicised export markets.

Behn has been characterised as “the epitome of the politicized businessman, earning his profits and building the I.T.T. empire through political maneuverings (sic.)”.⁸⁴ Telecom was at the core of national autonomy and called for gentle handling of the subsidiaries' conduct in the host nations. Moreover, international business was vulnerable to political volatility, and Behn's ability to manoeuvre in the landscape of business, politics and international relations is well documented - and severely criticised.⁸⁵ Last but not least, Behn's personality has been regarded as an invaluable asset in creating and developing ITT. His “fluent Spanish and courtly manner” have for example been highlighted as an important asset when ITT obtained the concession in Spain.⁸⁶ He also spoke French, and allegedly capitalised on his European ancestors.

The first major change that Behn implemented was to present the subsidiaries as national companies, with their prime loyalty to their home nations and domestic PTOs. This was crucial in the protectionist interwar years, and especially in the telecom industry. One of the first things Behn ordered, as a part of this strategy, was the establishment of R&D institutes in Paris and London.⁸⁷ Even if this was valuable in industrial terms, it was more important for political matters. It was an assurance

⁸³ ITT had a better chance to succeed, given that Siemens' foreign subsidiaries were confiscated as enemy goods after the First World War. Chapuis 1982, p. 258.

⁸⁴ Antony C. Sutton: “I.T.T. Works Both Sides of the War” in Antony C. Sutton: *Wall Street and the rise of Hitler*, 1976.

⁸⁵ Sampson 1973; Sutton 1976.

⁸⁶ Sobel 1982, p. 40; Sampson (1973) also emphasises these aspects.

⁸⁷ Sobel 1982, p. 44, Deloraine 1974, p. 76.

of ITT's compliance to the host-nations of the subsidiaries. ITT's technological foundation was secured for the next quarter of the century by the agreement with AT&T: ITT was given access to Western Electric's technical information for the next 25 years, "and also be authorised to manufacture under Western Electric's patents".⁸⁸ Hence, Western Electric's "Rotary became the chief weapon in (ITT's) switching armoury".⁸⁹ Behn and ITT's first critical test was the contest for delivering automatic switches to Paris.⁹⁰

Through the acquisition of IWEC, ITT obtained another French subsidiary, namely Le Matériel Téléphone (LMT), which was to be ITT's vehicle in the "fierce" battle for winning the Paris contract.⁹¹ Behn revealed his political qualities by outmanoeuvring the opponents, Ericsson and Strowger. A part of ITT's bait to the French administration was the promise to set up the aforementioned R&D "laboratory in Paris if Rotary was selected".⁹² Behn pursued an effective PR campaign towards the French public and government, including the creation of "a small company in France" called the "Company for French Telephone Development". ITT's pricing was also lower than those of the two competitors, and LMT and ITT won the contract with Rotary in 1926.⁹³

"Although the first order was to be placed with LMT, it was known that the real talent behind the proposal was at BTM-Antwerp."⁹⁴ Several BTM engineers moved to Paris, and Norwegians, Britons, Danes, Hungarians and Australians from other ITT houses were engaged in installing Rotary in France.⁹⁵ This reflected the fact that ITT did not have operating headquarters that could send experts to assist its subsidiaries. In 1974, Maurice Deloraine asserted that "LMT's reputation and strengths to this date are still largely based on the success" of the French Rotary contract. The exchange, "which had a life expectancy of 25 years, was still working 36 years later".⁹⁶ ITT's victory in Paris in 1926 was the European breakthrough for

⁸⁸ Chapuis 1982, p. 262.

⁸⁹ Chapuis 1982, p. 196.

⁹⁰ "In the year following the First World War it became vital that the Western Electric Rotary System should be adopted by at least one major telephone administration, as the future of the ITT manufacturing units for 30 years or more would depend largely on the degree the acceptance of the Rotary system." Deloraine, 1974, p. 46.

⁹¹ Deloraine 1974, p. 49.

⁹² Deloraine 1974, p. 53.

⁹³ "The price submitted by Rotary was the lowest, step-by-step and Ericsson were 8 % and 11 % above Rotary." Deloraine 1974, p. 52.

⁹⁴ Deloraine 1974, p. 53.

⁹⁵ Deloraine 1974, p. 55.

⁹⁶ Deloraine 1974, p. 55.

the Rotary switch, which was later installed in several European cities.⁹⁷ ITT installed the Rotary switch in Spain. The Norwegian branch of Western Electric had acquired competence through the early installation of Rotary in Norway, and several Norwegians from Western Electric went to Spain to install the Rotary switches there.⁹⁸

Hence, Behn and ITT succeeded where IWEC had failed, namely at winning a contract for a major European city. An important consequence of the contract in Paris was that France took a dominant position within ITT's European business. In the switching business, there was the French and Belgian BTM camp; in R&D matters, there was the London and Paris camp. France became ITT's main market for telecom equipment; it was a lucrative market - called ITT's "golden cage".⁹⁹ French telecom was dominated by foreign multinationals, particularly ITT. Compagnie Generale d'Électricité (CGE) tried to balance this by forging an alliance with Autelco. Although the attempt was abortive, it "marked the beginning of the CGE's long march against ITT".¹⁰⁰ ITT had to comply with the highly politicised French business, which eventually laid the foundation for Alcatel's acquisition of ITT in the late 1980s.

The subsidiarisation of the Norwegian telecom industry

ITT's acquisitions of manufacturing subsidiaries came about as a result of tariffs being put on imported products; if ITT wanted access to a market it had to produce in the host countries. LME followed the same path, and bought manufacturing subsidiaries to accommodate to the prevailing protectionism in the host countries.¹⁰¹ This was the background for ITT and LME's investments in Norway around 1930; LME became the largest owner of EB in 1928. STK was a product of a merger between Standard Electric A/S and Skandinaviske Kabel- og Gummifabrikker (SKG). Standard Electric was IWEC's former subsidiary in Norway, and its telecom business had been established when Telegrafverket ordered Rotary switches for Oslo's network.

STK had no Norwegian precursor in the telecom business, hence the founding of Western Electric's Norwegian subsidiary, and in 1934 STK augmented the Norwe-

⁹⁷ It was installed in The Hague, Zurich, Basle, Geneva, Budapest, Bucharest, and Barcelona. Chapuis 1982, p. 197.

⁹⁸ Wasberg 1965, p. 88.

⁹⁹ Doz 1979, p. 69.

¹⁰⁰ Noam 1992, p. 139-140.

¹⁰¹ Attman et al. 1976a, p. 216.

gian telecom industry. LME's acquisition of EB, however, meant that the only notable Norwegian equipment supplier came under foreign control. Hence, an important question is why the Norwegian telecom industry, represented by EB, deteriorated, when the Swedish company Ericsson flourished. There are several causes to take into account. First, LME started to export earlier than EB, so LME was entrenched in large markets when the market for telecom equipment became segmented. EB was a latecomer and focussed on smaller countries and companies, and was not able to compete for large contracts with PTOs.

The main reason, however, is that EB did not manage the technological transition from manual to automatic switches. It developed a small automatic switch, but it was not suited for more than 250 lines. There were few operators wanting to automate such small networks, so EB only sold 47 of these switches.¹⁰² LME, on the other hand, developed an automatic switch, the 500-point system that became a commercial success. It was used worldwide, and in many Norwegian cities, among the first to order were Hamar and Kristiansund in 1920.¹⁰³ Moreover, LME had an innovative culture, which was based on the engineering tradition of Lars Magnus Ericsson's workshop.

Another vital reason was that LME engaged in a fruitful relationship with the private operators in Sweden, and later with the Swedish PTO. LME's production of the 500-point switch came about as a result of a selection process by the Swedish PTO in the 1920s. The Swedish PTO manufactured switches itself, which enhanced its competence, and thus contributed to the fruitful relationship with LME.¹⁰⁴ This gave LME valuable input and stability to engage in technological development, and this was particularly the case for the development of switches. EB's relation to Christiania Telefonforening and Telegrafverket, however, was purely mercantile.

The government and Telegrafverket were not very concerned with securing a Norwegian telecom industry; this became apparent through the tariff policy on telecom equipment. There was practically no tariff on imported equipment from 1920, in contrast to for example Sweden, and EB's persistent demands for raising the tariffs were not heeded. As the cabinet stated, it was "rejected because these products ought to be «as cheap as possible» in consideration of «our nation's communication

¹⁰² Espeli 2005, p. 200.

¹⁰³ A later version of the 500-point system, with a modified selector, was called the XY-switch. It was designed for rural areas, and became an important export product for LME, and was widely used in Norway. Jacobæus 1976, p. 87 and 101.

¹⁰⁴ Meurling and Jeans 2000. p. 80; Fridlund 2000.

system»".¹⁰⁵ The toll and procurement policy towards the telecom industry had to balance Telegrafverket's need for high quality and low cost equipment, against the wellbeing of the Norwegian industry. Hence, Telegrafverket, like other PTOs, had a double agenda, being both a service provider and an industry "provider". This characterised the PTOs' policy and relation to the telecom industry throughout the 20th century, and Telegrafverket's line of policy did not serve EB's chances well.

There is no saying that the Norwegian telecom industry, represented by EB, would have developed into a potent equipment supplier, had it benefited from higher tariff protection or a favourable procurement policy from Telegrafverket. On the other hand, there is little reason to believe that the government or Telegrafverket considered EB's prospects carefully. It seems as if the competitive approach was preferred on principle and for short-sighted financial reasons. A competitive approach, however, with low tariffs and an arm's-length relationship with the suppliers is not one-dimensional. It could either be underpinned by a competent procurer, which took advantage of its monopsonic position and played off the suppliers against each other, or, it could be an isolated procurer, with meagre competence, left to deal with powerful MNCs.

The years after the First World War were a struggle for survival for EB, which during these years was headed by Jens Bache-Wiig. He became a central actor in ITT and the Norwegian telecom industry for half a century. He had an engineering degree from Karlsruhe in 1902, and worked in Germany for a few years, before he moved to the USA and served as a leading manager for Westinghouse in Pittsburgh. He returned to Norway and became Professor at the Norwegian Institute of Technology (NTH*), at the age of 30, in 1910. He left his chair in Trondheim in 1916, to become managing director of Elektrisk Bureau. EB started to manufacture home appliances: iron sets, ovens and broadcasting receivers. While telecom equipment had represented two-thirds of the sales in 1920, this was reduced to one third in the late 1920s.¹⁰⁶ Bache-Wiig's strategy was presumably based on his experiences from Westinghouse. It became a financial burden, however, when the economic crisis came; the export markets were nearly blocked, due to the emergent protectionism in the late 1920s and Telegrafverket reduced its orders of telecom equipment.¹⁰⁷

¹⁰⁵ Espeli 2005, p. 195, quotes from St. prp. nr. 5 1924.

* Norwegian abbreviation for Norges Tekniske Høyskole

¹⁰⁶ Espeli 2005, p 199; Jens Bache-Wiig: Unpublished memoirs.

¹⁰⁷ Espeli 2005, p. 197.

Bache-Wiig reasoned that if it was to stand a chance in the telecom industry, EB needed to link up with one of the major companies. He engaged in negotiations with Western Electric Norway in 1925 about a merger and/or EB installing Rotary switches in Norway on behalf of IWEC/ITT. These negotiations stranded when Bache-Wiig resigned after EB's annual meeting in 1926, due to a conflict with the company's shareholders.¹⁰⁸ In March 1926, a few months after Western Electric Norway turned into Standard Electric A/S following ITT's acquisition of IWEC, Bache-Wiig was asked to be managing director of ITT's Norwegian subsidiary.¹⁰⁹

Western Electric Norsk Aktieselskab was registered in Oslo in April 1920. This was a result of Telegrafverket's decision to automate the Oslo network with Western Electric's Rotary switches. The director was Einar A. Brofos, who had also functioned as Western Electric's sales agent in Scandinavia since 1910.¹¹⁰ IWEC's main business in Scandinavia was "Pupinised" cables. Brofos's biggest effort was the delivery of a cable between Stockholm and Gothenburg, which was the first European long-distance cable with Pupin spools.¹¹¹ Michael Pupin, a professor in electrical engineering at Columbia University, "had envisioned the loading coil, a method of amplifying the voice by long-distance telephone".¹¹² AT&T bought his patent in 1900, and it "became the single most important telephone-related invention between 1876 and 1913".¹¹³ On the basis of this patent, Brofos laid the foundation for ITT's business and subsidiaries in Scandinavia.

Brofos asked Bache-Wiig to take over Standard Electric A/S, and he started his tenure on 1 May 1926.¹¹⁴ In 1927, Bache-Wiig contacted Skandinaviske Kabel- og Gummifabrikker (SKG), and asked the company to produce cables based on Western Electric's patents, so Standard Electric A/S could avoid tariffs on imported cables. The first round of meetings did not lead to anything, partly because the government removed the tariff on such cables. In 1928, it was SKG that initiated new

¹⁰⁸ Jens Bache-Wiig: Unpublished memoirs, and Skogaas 1982, p. 232.

¹⁰⁹ STKHA: Letter from Brake to Mr. F.H Wilkins Vice President in ISEC (London) 08.03.1926; Jens Bache-Wiig: Unpublished memoirs.

¹¹⁰ Wasberg 1965, p. 35. His name is spelled Brofos, not Brofoss as the Labour government's Minister of Finance after World War II, Erik Brofoss.

¹¹¹ STKHA: Western Electric Norway and Standard Electric A/S' annual reports, Wasberg 1965, p. 35.

¹¹² "Western Electric - A Brief History" in www.bellsystemmemorial.com/doc/western_electric

¹¹³ Ibid.

¹¹⁴ Sir Francis Brake was Managing Director of Norsk Western Electric in the early 1920s, when Brofos worked for IWEC in London.

meetings, as the company was in financial trouble and wanted to produce Pupinised cables.¹¹⁵

SKG was founded by the Hanover company Hackethal Draht und Kabelwerke and Norwegian investors in 1915. One of the Norwegian investors, Johs G. Heftye, was the brother of Telegrafverket's Director General, Thomas T. Heftye (1905-1921).¹¹⁶ The company was to produce cables, lines and similar products, to supply the construction of telecom and electricity networks. From the late 19th century, the production and use of hydroelectric power grew rapidly in Norway. This paved the way for several new industries, including equipment suppliers for carrying the electricity, such as cable companies. In 1915 Thomas Heftye presented ambitious plans for expanding and modernising the national telecom network, which probably induced his brother to get into the cable business. SKG was in many ways an affiliate of the German company, importing machines and licensing technology from it.¹¹⁷ It experienced severe technological problems and tough competition in the cable market. Thus, while SKG was founded on an economic boom, it was hit heavily by the economic decline in the 1920s. The share capital was nullified in 1927, and its main bank and creditor - Den norske Creditbank (DnC) - became the owner of 99 per cent of the share capital.¹¹⁸

The negotiations for a license agreement between SKG and Standard Electric A/S developed into a question of a merger, and Brofos and Bache-Wiig negotiated with a representative from DnC. The interest from Standard Electric A/S was fuelled by a new "national cable plan" that Telegrafverket's Sivert R. Abild was working on during these years. This was a plan for erecting a network of long-distance telephone cables in Norway.¹¹⁹ Standard Electric took over DnC's interest in SKG in 1930, but the two companies did not merge formally until 1 January 1934, under the name Standard Telefon og Kabelfabrikk A/S (STK). By this time, Bache-Wiig had been sent to manage ITT's German subsidiaries, and Paul Hallgren was picked from a high position in the Swedish PTO, presumably to help ITT obtain better access to the Swedish market. ITT held 75 per cent of the shares, and another Norwegian bank, Christiania Bank og Creditkasse (Kreditkassen), held the rest, which were

¹¹⁵ Wasberg 1965, p. 41.

¹¹⁶ Håkon Gundersen: *Televerket med knute på tråden*, 1976, p. 74.

¹¹⁷ Wasberg 1965, p. 18.

¹¹⁸ Wasberg 1965, p. 41.

¹¹⁹ Rafto 1955, p. 461 f.; Wasberg 1965, p. 42.

preference shares. This split was only window-dressing to attain concessions from the Norwegian government.¹²⁰

EB was practically bankrupt when LME bought 75 per cent of the shares in 1928, a holding that was reduced to 40 per cent after negotiations with the Norwegian government.¹²¹ In 1931, EB bought a majority stake in Norsk Kabelfabrikk, a cable company situated in Drammen.¹²² Thus, STK and EB offered a fairly similar product range and faced similar business conditions. This did not, however, result in competition between the companies.

Cartelisation and oligopolisation

In 1934, ITT/STK and LME/EB entered the Lillehammer Agreement, a cartel agreement that divided the Norwegian market between the companies. It was one of several more or less formalised cartel understandings that were negotiated during these years. There had been several attempts to reach market arrangements on an international level between the major companies in the telecom industry, but with no success. Nevertheless, the Lillehammer Agreement was a result of attempts to restructure the industry on an international level. Our main query, however, is why Telegrafverket accepted this formalised oligopoly, while it had, in theory, a powerful position. It is important to note that Telegrafverket did not have a monopoly in the 1930s and, hence, was not a monopsonist in the market for telecom equipment either. In 1934, 253 private telephone companies held 80,000 of the 200,000 telephone subscribers in Norway.¹²³ Nevertheless, there was a clear ambition to extend Telegrafverket's position into a monopoly, and it was regarded as only a matter of time before it would take over the private companies.

Following the advent of automatic switching and the emergence of PTOs, there were attempts to divide the market between the world's major equipment suppliers. In 1921, in the midst of the post-war depression, Western Electric, LME, Siemens and Autelco met in Amsterdam in an attempt to reduce competition.¹²⁴ The Amsterdam meeting caused much bitterness among the players and led to them "crossing swords in the world market".¹²⁵ The abortive effort induced AT&T's divestiture of

¹²⁰ This is evident from later sources, like RA-S56: Memo from Statsselskapsavdelingsens 11.02.75 GB/LM.

¹²¹ Chapter 3 shows that LME in reality had full ownership control over EB.

¹²² Skogaas 1982, p. 209.

¹²³ Rafto 1955, p. 475; Espeli 2005, p 72.

¹²⁴ Attman et al. 1976a, p. 338 f.

¹²⁵ Chapuis 1982, p. 261.

IWEC. ITT's new and assertive position halted any further consultations on the issue. An arrangement endorsed by the British PTO was reached for the UK in 1924. The British market was divided among the major actors, all producing the British version of the Strowger System.¹²⁶ A not too dissimilar agreement was reached in Germany, although Siemens held a dominant position as it developed the switches. The Reichpost did not want to be dependent on a single supplier, however, and “pressured Siemens to license its technology” to other companies.¹²⁷ Siemens held 40 per cent of the market, ITT's subsidiary, SEL, had 30 per cent, and two other companies, puppets of Siemens, held the rest.¹²⁸ The British and German solution tried to combine the rationality of a single switching system for the whole country, with competition between suppliers.

The solution for Norway was formed by the fate of the Swedish “Match King”, Ivar Kreuger, who had acquired a majority stake in LME in 1930.¹²⁹ The telecom business had many similarities with the match business; it was a matter of gaining concessions and footholds in overseas markets and was thus a highly politicised business, with big opportunities for businessmen like Kreuger and Behn, who thrived on the borderline of business and politics. In the subsequent years, Kreuger tried to cut a deal with Behn and ITT, proposing either dividing the markets or selling LME to ITT. Swedish corporate law, with its prohibition of any foreign interest controlling more than 20 per cent of the shares in a company, halted Kreuger's attempts to sell LME. However, in desperate need of cash for his falling empire, Kreuger mortgaged his majority stake in LME to ITT, enabling him to borrow \$11 million from Behn's company in 1931.¹³⁰ Kreuger's bankruptcy and suicide in March 1932 left ITT and LME in a deep financial chaos that took years to resolve.

It was the Wallenberg family and their bank, the Stockholm Enskilda Bank, as more than once in Swedish business history, that saved LME from bankruptcy.¹³¹ Wallenberg succeeded in holding the New York banks and Sosthenes Behn at bay, when the Americans demanded that LME should limit itself to the Scandinavian market.

¹²⁶ Noam 1992, p. 124.

¹²⁷ Noam 1992, p. 82-83.

¹²⁸ Noam 1992, p. 82.

¹²⁹ Kreuger controlled 70 per cent of LME's A-shares, i.e. shares with voting rights. Attman et al. 1976a, p. 265.

¹³⁰ Attman et al. 1976a, p. 233 f. and Attman et al. 1976b p. 3 f.

¹³¹ The Swedish banks, most prominently the Wallenberg's Stockholm Enskilda Bank, played a decisive role in protecting Swedish industry from bankruptcy after the crisis in the 1920s. Knut Sogner with Sverre A. Christensen: *Plankeadel: Kiær- og Solberg-familien under den 2. industrielle revolusjon*, 2001 and Glete 1994.

Wallenberg insisted on keeping LME as an independent Swedish concern with access to a worldwide market. Even though market access in general was excluded from the agreement, it included settlements on market issues in Argentina and Mexico, and a clause on the two companies' sale of automatic switches in Norway and Denmark.¹³²

Thus, the STK-EB market agreement in Norway was forced upon the Norwegian telecom sector. This is not to say that such an agreement was not welcomed by Telegrafverket and the other stakeholders. The multinationals were accused of dumping the prices for automatic switches in the first bids in order to obtain a monopoly position. When International Western Electric won the contract in Oslo and Bergen, it was accused of dumping.¹³³ This was to a certain extent confirmed, in that Western Electric Norge, and later STK, lost several millions on the contract,¹³⁴ but STK secured its position for supplying the Oslo network for decades to come. STK and EB engaged in price wars for the delivery of automatic switches to the Norwegian market after LME took over EB in 1928.¹³⁵ Telegrafverket and the government did not, according to Harald Espeli, consider exploiting the buyers' market.¹³⁶ Still, one might argue that it had done so while procuring Rotary switches for Oslo from Norsk Western Electric in 1916.

EB tried to augment its position by claiming it was more of a Norwegian company than STK. In a meeting with the head of Telegrafverket and the minister of commerce, EB's union insisted that the remains of the contract for automating the Oslo network should be taken over by EB, at the cost of Standard Electric.¹³⁷ In order to secure Norwegian employment and the Norwegian telecom industry, EB also demanded that it be granted contracts for automating the cities of Trondheim and Drammen.¹³⁸ Standard Electric was consequently portrayed as the "Foreign Trust", which was not a compliment in these years. EB's union accused it of dumping: "Thanks to the trust's ruthless competition, a company that employs 600-700 com-

¹³² Attman et al. 1976b, p. 15 and 19.

¹³³ "Telegrafdirektøren og den udenlandske trustkapital" in *Arbeiderbladet* 31.03.1933.

¹³⁴ STKHAT: "P.M. by Jens Bache-Wiig from meeting with minister of industry Lars Evensen 31.8.46".

¹³⁵ Espeli 2005, p. 203; Wasberg 1965, p. 90.

¹³⁶ St.f. 1933: 2076-77, *Arbeiderbladet* 31.3., 3.4 and 10.4.1933, here after Espeli 2005, p. 203.

¹³⁷ "Telegrafdirektøren og den udenlandske trustkapital" in *Arbeiderbladet* 31.03.1933.

¹³⁸ "Telegrafdirektøren og den udenlandske trustkapital" in *Arbeiderbladet* 31.03.1933.

petent blue and white collar workers is threatened by partial or total termination due to lack of orders”.¹³⁹

Moreover, EB claimed that their automatic switches were far better and more economical than Standard Electric's. There is no sign of superiority of LME's 500-point switch over ITT's Rotary in any other sources, however; thus the union's description and characterisation of Standard Electric must be seen in perspective of the worker's interest. But EB held a strong card in that LME's switch was produced in Norway. Standard's lack of national manufacturing facilities was serious in these years of unemployment. The Norwegian subsidiary was aware of the sensitive issue and asked ITT for permission and funds to invest in a telephone factory.¹⁴⁰ The Rotary switches installed in the 1920s were imported from BTM. The problem for ITT was that BTM also felt the economic crisis and the prevailing protectionism in Europe, and had already laid off several thousand workers, and still had over-capacity in its plant.¹⁴¹ However, STK was not left with much of a choice, and in 1933 the company started minor assembly and installation of the Rotary Switches in SKG's cable factory.

In the same year, representatives from Standard Electric/STK and LME/EB met in Lillehammer to negotiate a cartel agreement for telecom equipment in Norway. Standard Electric's Brofos and Hallgren met the managing directors of EB and LME, Albert Kvaal and Hans Theobald Holm respectively.¹⁴² As mentioned above, it was a part of ITT and LME's settlement after the Kreuger crash, but it was also a response to the ongoing price war between STK and EB. The agreement's opening statement was that since Telegrafverket and the private operators wanted national manufacturing of telecom equipment, an agreement was necessary, as “Standard and E.B. understand that there is not enough of such business in Norway for two national telephone factories to operate on an economical basis”.¹⁴³

¹³⁹ “Takket være trustens hensynsløse konkurranse trues nu denne bedrift, som beskjeftiger 6 à 700 dyktige arbeidere og funksjonærer av hel eller delvis stans på grunn av manglende ordre.” in “Telegrafdirektøren og den udenlandske trustkapital” in *Arbeiderbladet* 31.03.1933.

¹⁴⁰ Wasberg 1965, p. 90.

¹⁴¹ No author *Bell Telephone Manufacturing Company 1882-1982*. 1982; and Wasberg 1965, p. 90.

¹⁴² STKHA: “P.M. angående förhandlingar i Lillehammer. 12-15 juli 1933”. Hallgren was also a member of LME, representing ITT as an owner in LME. Attman et al. 1976b, p. 12.

¹⁴³ STKHA: Lillehammer agreement (Standard og E.B. forstår at der ikke er tilstrekkelig av den slags forretning i Norge til at to indenlandske telefonfabrikker kan arbeide på en økonomisk basis.)

STK was granted the largest cities in Norway, Oslo, Bergen, Ålesund and Drammen, as well as large parts of the counties of Akershus and Vestfold, while it gave LME/EB the rest of the country. In general, this meant that ITT and LME kept their former geographical areas. Even though the agreement looked favourable to EB, it benefited STK, which by the early 1960s had over two-thirds of the Norwegian switching market.¹⁴⁴ The parties negotiated a similar agreement for the cable market in 1939. Both of these contracts stipulated that the market share should have been 50-50. If one party got more than the other, it was to pay 10 percent of the sale that exceeded 50% to the other party.¹⁴⁵ Such an “excess fee” was paid in the 1930s, but we do not know when this practice ended. The geographical division, however, was in accordance with ITT and LME’s specialities: ITT focused on urban switches, while LME, serving the relatively scattered Swedish population, had a competitive edge in rural switches.¹⁴⁶ Thus, STK and EB operated in different markets, with different products and with different technologies. In effect, there was not an oligopoly but two monopolies, or a *duopoly*, in the Norwegian market for telecom equipment.

“The «secret» agreement was soon known and accepted by Televerket”, according to Christian Westring, former director of LME and EB, who worked in Telegrafverket in the 1940s and 1950s.¹⁴⁷ But, Telegrafverket retained its arm’s-length relationship with the suppliers after the Lillehammer agreement. This combination - of a purely market relationship with the suppliers and no competition - is probably the worst buyer-supplier relationship a procurer in general, or a PTO in particular, can engage in. Telegrafverket was neither able to achieve fair prices due to competition, nor to reap the benefits of knowledge transfer, innovation through user-producer relations, or the trust that can be derived from a closer relationship. We need to ask why Telegrafverket accepted these conditions.

Oligopolic deadlock

There is little empirical evidence on how Telegrafverket and the government considered the agreement. In fact, we do not know when and how Telegrafverket learned about the treaty. Such agreements had to be reported to the “trust control”

¹⁴⁴ BGA: Christian Westring from EB Telecom, 27.10.86.: “Markedsutviklingen for offentlige telefonsentraler i Norge - historikk”.

¹⁴⁵ NTM-EB: Two different copies of the Lillehammer agreement.

¹⁴⁶ Interview with Jon B. Riisnæs, who worked in STK telecom division from 1958, and was marketing director in the 1970s.

¹⁴⁷ BGA: Christian Westring 27.10.86, “Markedsutviklingen for offentlige telefonsentraler i Norge - historikk” (Den “hemmelige” avtalen ble snart kjent og akseptert av Televerket).

according to the “Trust Law”, but there is no evidence that the parties did this.¹⁴⁸ Nevertheless, it seems as if Telegrafverket accepted the oligopoly when it rejected an offer from Siemens on automatic switches for the city of Drammen.¹⁴⁹ There is little empirical evidence on the matter in the archives. Thus, we have to come to grips with this issue with the modest sources available and theoretical reflections. In the answer to this question, why Telegrafverket accepted and/or preferred the Lillehammer agreement, and hence manufacturing subsidiaries as suppliers, lies nothing less than STK's reasons for existence, and its room for strategic manoeuvring.

There were three alternative ways for PTOs to organise their supply of telecom equipment. First, it could be supplied by a national-owned industry that developed its own equipment. This was the case in very few countries in the early years of telecom: mainly the USA, Sweden and Germany. Hence, the PTOs could not choose this variant in a straightforward way, since it depended on the industry and company's ability to succeed on the export market. Export was crucial in order to spread the R&D costs on a large sale, and the Norwegian market was far too small to support a first-class equipment supplier. Thus, the ambitions for a Norwegian “plant for radio-, telephone- and telegraph sets”, proposed in the “Three year plan” in 1933 - a pamphlet inspired by the Soviet Five-Year Plans in the interwar years, required considerable exports to be realistic.¹⁵⁰

EB was the only potential national supplier, but this possibility was ruled out, as the company did not survive the combination of the post-war depression and the technological shift to automatic switches. Nevertheless, EB still considered itself as the obvious alternative for supplying the Norwegian network, regardless of its subordination to LME. It presented itself as a full-blooded Norwegian company, as if LME's ownership did not matter. Telegrafverket's Director General Tore Olaus Engset saw this differently. He refused to give EB a national monopoly for telecom equipment, as he “thought it economically unwarrantable to encourage a large industry in this country, which had no chance of exports, and for which the home market was too small”.¹⁵¹ Hence, since EB was excluded from the export market, it did not need a protected home market, he reasoned. It seems as if Engset preferred competition, but the Lillehammer agreement did not give him that.

¹⁴⁸ Espeli 2005, p. 204.

¹⁴⁹ Espeli 2005, p. 544.

¹⁵⁰ Ole Colbjørnsen and Axel Sømme: *En norsk 3-årsplan*, 1933, p. 70, here after Espeli 2005, p. 205.

¹⁵¹ *Arbeiderbladet* 31.03.1933, (fant det nasjonaløkonomisk uforsvarlig å opelske en stor industri her i landet som ingen eksportmuligheter hadde, og for hvem det innenlandske markedet var for lite.” in “Telegrafdirektøren og den udenlandske trustkapital).

There were two other options left, importing equipment from a foreign supplier or procuring equipment from manufacturing subsidiaries. The first alternative was the case in Denmark and Finland, which was related to the lack of a PTO with a monopoly. One consequence of the regional telecom systems in Denmark and Finland was that the regional operators were more dedicated to their role as service providers than as industry providers. The third option, supply from manufacturing subsidiaries, was a natural outcome for Norway, as this was the rule in the rest of Europe. The establishment of such subsidiaries came about as a result of tariffs on imported equipment. There were different reasons for this choice. The first was the wish for self-containment, which was fuelled by the protectionism that prevailed in the interwar years.¹⁵² Importing equipment from abroad would mean a drain of hard currency. There were also ideas of national autarky - self-sufficiency - in these years, but such ideas had a radical flavour in a small country like Norway.

Another reason for domestic manufacturing of equipment was related to the transfer of competence and technology. This was crucial for assuring national control over the telecom network, which was even more important in the interwar years, when international relations were volatile. The chances of being isolated from foreign equipment suppliers in the midst of an international crisis were not unlikely. "Initially, PTT officials saw local manufacturing as a way to decrease the risks of relying on distant foreign suppliers for maintenance and follow-up contracts."¹⁵³ This argument was put forward by the British, when they rejected the idea of letting the Belgian BTM plant supply them with automatic switches.¹⁵⁴ Accordingly, domestic control had something to do with the military importance of telecom. In reasoning further along the same lines, it is pertinent to recall that telecom was often termed the nerve centre of a nation's communication system, thus being at the "core of national autonomy", which entailed a degree of national technological control. This "ensured its exclusion from the competition rules in the Treaty of Rome" after the Second World War.¹⁵⁵

One issue was technological control and competence, regarding the telecom network, and another was to lay the foundations for a technical industry in general. In this sense it was important to reap the benefits of producing one's own telecom

¹⁵² The newspaper debate between EB's union and Telegrafverket's Engset shows that this was important. "Telegrafdirektøren og den udenlandske trustkapital" in *Arbeiderbladet* 31.03; 03.04; 10.04; 29.04 and 10.05.1933.

¹⁵³ Doz 1987, p. 94.

¹⁵⁴ Young 1983, p. 38.

¹⁵⁵ Eliassen et al. 1999, p. 24.

equipment, but it was also regarded as valuable to have access to the technology and competence within a large MNC, such as ITT and LME. Another element was to create and secure jobs, which was crucial in the 1930s with high unemployment. The newspaper debate between EB's union and Telegrafverket's Engset demonstrates this.¹⁵⁶ Still, although this explains mainly why Telegrafverket opted for manufacturing subsidiaries, instead of importing the material, but why did Telegrafverket accept the cartel agreement? Firstly, Engset was explicit that he did not want a monopoly, and maybe thought an oligopoly would benefit Telegrafverket in terms of comparing prices. An important aspect related to employment is that the industry and the workforce were vulnerable to fluctuations in Telegrafverket's procurement of telecom equipment. The agreement provided some stability for the manufacturers and installers from STK and EB. Moreover, the need for creating stable employment dominated the economic and industrial debate in the early 1930s.

Moreover, 'cartel' and market regulation did not have those negative connotations in the 1930s, as competition was not regarded as entirely positive.¹⁵⁷ During the early 1930s, for instance, much of the Norwegian agricultural sector was organised in co-operatives, and with governmental supported market regulation.¹⁵⁸ Competition was to a large extent seen as a waste of resources, especially when it led to ruinous rivalry, which could be the case in industries with high fixed costs. Market agreements, on the other hand, were appreciated as a means of organising and rationalising production. This was also in line with the reasoning behind a state monopoly of telephony, to achieve common standards and a rational network. Hence, plan and organising were seen as values, as opposed to unorganised markets with resource-wasting price wars. After the Second World War, STK's and EB's division of the market became an accepted and integral part of the Labour Party's industrial plan economy.

An important aspect is that if Telegrafverket should have exploited its monopsonic position, it could have done so only with sufficient competence and knowledge of the technology and prices in the telecom industry. Moreover, the Norwegian market was so small, which left Telegrafverket with little bargaining power in relation to the MNCs. Thus, Telegrafverket would probably have ended up as an isolated procurer, with meagre competence, left to deal with powerful MNCs, with or without

¹⁵⁶ "Telegrafdirektøren og den udenlandske trustkapital" in *Arbeiderbladet* 31.03; 03.04; 10.04; 29.04 and 10.05.1933.

¹⁵⁷ Øyvind Tønnesson: "Fra selvstendighetslinje til forpliktende internasjonalt kartellsamarbeid - Norsk Hydros posisjon i verdens nitrogenindustri i mellomkrigstiden", 1997.

¹⁵⁸ Harald Espeli: "En reguleringshistorisk skisse av jordbrukssektoren: 1970-2000", 2002, p. 39.

the Lillehammer agreement. Finally it was the question of technological compatibility. Engset and the director of the Oslo network refused to procure equipment from EB for the Oslo network, because Standard Electric had started the installation. "For technical, practical and economical reasons, one was tied" to the already installed system from Standard Electric.¹⁵⁹ It was difficult for technological reasons, but also Telegrafverket's installers had to be updated on both technologies. This argument held sway until the digitalisation of the 1980s.

A five fingered oligopolic grip

An important part of the reason why Norway does not have vigorous telecom today lies in the interwar period, as automatisation and oligopolisation created very high barriers of entry into the industry. Thus, the window of opportunity for creating an independent telecom industry was closed for the next 40-50 years. It was in this formative period of monopolisation and oligopolisation that the multinational telecom companies ITT, LME and Siemens established firm grips on their markets. The introduction of automatic switches, with high development costs, contributed to the segmentation of the industry. The Norwegian telecom industry, represented by EB, did not manage this transition. It is beyond the scope of this thesis to explain why EB did not succeed in this, but some factors are worth bearing in mind. First, Espeli has showed that EB received little support from the government in terms of tariff protection, or from Telegrafverket or the private operators through a national procurement policy. There is little probability that EB would have developed into a telecom multinational at any rate, but without such a support it was impossible. The Norwegian market for telecom equipment was probably too small to foster a multinational in telecom, even if Ericsson's success demonstrates that this was not an absolute obstacle.

As to Ericsson, it is essential to recall that Sweden was a remarkable exception, in being a small country with many MNCs. A key reason for this development was the bank-oriented capitalism, and the banks' role during the economic crisis in the 1920s. The Wallenberg bank, the Stockholm Enskilda Bank, as well as Den Svenska Handelsbanken, bought insolvent companies, so the companies survived the financial crisis that knocked out their owners and entrepreneurs.¹⁶⁰ As a result, Swedish

¹⁵⁹ *Arbeiderbladet* 03.04.1933. (Med hensyn til Oslo telefonanlegg centralstasjonssystem uttalte telegrafdirektøren i tilslutning til Oslo telefonanleggs direktør at man ved telefonanleggets centralstasjoner av tekniske, praktiske og økonomiske grunner er bundet til det ved anleggets ombygging innførte Standard Electric's system." in "Telegrafdirektøren og den udenlandske trustkapital).

¹⁶⁰ David and Mach 2002; Christensen 2003, p. 76.

industry was consolidated and strengthened through this crisis. In Norway, on the other hand, the crisis in the 1920s led to a massive inflow of foreign investment, through foreign acquisitions of Norwegian companies.¹⁶¹ In the wake of this, both EB and SKG were sold to LME and ITT. Hence, the subsidiarisation of the Norwegian telecom industry in the 1930s was in line with the general development of Norwegian industry at the time. What is more, it was in line with the international trend in telecom.

Even in large countries like France and Britain, the telecom industry became dominated by foreign subsidiaries in the interwar period. A special relationship developed between the subsidiaries and the PTOs and other governmental bodies in the host nations, which Yves Doz has termed «negotiated environments».¹⁶² Different actors had more or less effective bargaining cards at hand. An aspect of this was that the telecom industry was able to attain favourable prices for its telecom equipment.¹⁶³ An important question is how the industry could establish an oligopoly, when the PTOs had such strong procurement power. One might say that the telecom industry in Norway, and elsewhere, held a five-fingered oligopolic grip over the PTOs. Most of these factors were apparent when Telegrafverket accepted the Lillehammer agreement. The two first fingers were related to path dependency.

The *first* factor was the lack of standardised technological interfaces, so that different kinds of equipment could interact in good manner. Automatic switches, for instance, operated with different signalling systems, which could not communicate with other switches in a straightforward way. Interaction was not impossible; one could for instance 'translate' the signals, but this was expensive. The PTOs were caught in technological path dependencies, as new equipment had to be accommodated to the incumbent equipment it was to interact with. Moreover, it would be expensive for Telegrafverket to install equipment from both STK and EB in the same district, since it would need more personnel, able to operate both systems. The *second aspect* was that Telegrafverket was dependent on STK and EB for repairing, maintaining and upgrading the switches in the network. As the PTO acquired equipment from a supplier, it was dependent on its assistance for maintenance, so it could not undertake a one-off procurement from a company that did not have manufacturing subsidiaries in Norway.

¹⁶¹ Fritz Hodne: *Norges økonomiske historie 1815-1970*, 1981, p. 477; Christensen 2003, p. 76.

¹⁶² Doz 1979, p. 67-68.

¹⁶³ This is documented in several sources: Noam (1992) give a good account of this.

The *third* factor relates to Telegrafverket's lack of competence. It was not able to be a proficient procurer and exploit its monopsonic position, as it lacked oversight and control over the network and the development of new generations of equipment in the industry. The two final factors, which called for a national procurement policy, relate to the PTO's stakeholder responsibilities. The *fourth* factor was the interests of the workers in the telecom industry. Each time Telegrafverket reduced its equipment orders, STK and EB played the employment card, showing a great deal of concern for their workers. In this relation, the industry had important allies in the labour unions. The *fifth* factor was Telegrafverket's responsibility as an industry provider, which ought to be separated from the employment issue. The PTO was expected to contribute to industrial development and innovation within a national context. This was a main argument for demanding national manufacturing of telecom equipment. STK and EB became two of the largest high-tech companies in Norway, but at the same time they were subsidiaries of foreign multinationals.

To summarise, ITT/STK and LME/EB's oligopolic grip consisted of these five fingers:

1. Lack of technological interfaces
2. Televerket's dependence on the industry for maintenance of old equipment
3. Televerket's lack of knowledge and competence in general
4. Televerket's employment responsibilities
5. Televerket's responsibility as an industry provider

The rest of the thesis can, among other things, be read as a tale of how the strength in each of these fingers varied over time, according to the technological, institutional and political developments. This is not to say that other things did not have an effect on the Norwegian telecom industry. One major factor was ITT's special trait as a freestanding company, which will be demonstrated in the following chapter.

Chapter 2 Lonely riders

Introduction

In 1952, Telegrafverket installed a modern electro-mechanical crossbar switch at Ski outside Oslo. It was ordered from STK/BTM, and Norway was to be the first country to use the switch. The event was celebrated with extensive media coverage: one newspaper described the switch as “a mixture of a radar and electronic computers!”¹ STK and Telegrafverket were to gain first-mover advantages in switching, by manufacturing and using the most modern telecom switch in the world. Later versions of the switch was named the 8B, the name, however, came to be synonymous with trouble for Telegrafverket, as Norway became the only user of the switch, and it incurred heavy costs, technologically and financially. The 8B situation shaped Telegrafverket's relationship with STK for decades. Moreover, it had a decisive impact on Telegrafverket's technological strategy in the 1970s. That is why this chapter seeks to explain how STK and Telegrafverket ended up as a lonely rider with the 8B switch.

This chapter covers STK's history during the 1940s and 1950s. In hindsight, this phase seems relatively stable in international telecom: the technological and institutional setting was fairly stable.² Nevertheless, the 1950s had a decisive impact on later developments in the Norwegian telecom industry. Firstly, this was because STK and BTM were able to persuade Telegrafverket to be the first to install the 8B. This stands in an interesting contrast to the second important theme: that Telegrafverket refused to procure advanced radiolink equipment, i.e. for wireless transmission, from Nera, a Norwegian company. This is the most hotly debated issue in the history of Norwegian telecom.³

Many claim that Telegrafverket's rejection of Nera's radiolink equipment is the prime example of the PTO's technological backwardness at the time. Telegrafverket “had no vision for the technological development that took place”, says Randi Søgner.⁴ It did not “take any initiative to find its place in the new technical envi-

¹ Mo 2001, p. 5.

² Although the transistor was invented in 1947, it did not have a transformative impact on telecom before the 1960s.

³ The bulk of the historical literature on Telecom, Telegrafverket, and R&D in the Norwegian ICT industry highlights the radiolink issue. Collett and Lossius 1993, p. 17; Njølstad and Wicken 1997, p. 65; Jensen 1989, p. 97 f.; Lossius 1991, p. 34; Oland 1993, p. 17; Søgner 1984 and 1985.

⁴ Randi Søgner: *Offentlige innkjøp som industripolitikk - telekommunikasjonssektoren*, 1984, p. 40.

ronment”, and opposed “impulses and pressure from the industry and R&D establishment”.⁵ Moreover, Telegrafverket was accused of not assuming a role as an industry provider, as other PTOs did, i.e. it did not help Norwegian industry through its procurement policy.⁶ The two issues, the 8B and radiolink, will be analysed in view of how the oligopolic grip affected Telegrafverket’s decision in each case.

In being the first subsidiary to install the 8B, STK hoped to attain a mandatory position within ITT. Instead, STK and Telegrafverket became victims of ITT's lack of operating headquarters and a home market in telecom. This led to a competition between BTM and the French subsidiary, CGCT*, over which crossbar switch ITT should market. BTM was outmanoeuvred by the French, who once again proved their dominance in ITT. The chapter examines the bizarre competition within ITT. When ITT's New York head office was not able to halt the internal competition, it was because it was preoccupied with domestic US problems. A consequence was more freedom for the European subsidiaries, which gave ITT an almost confederate structure, which the French were able to exploit to their own advantage.

A final subject in this chapter is that Norway lost its position as a leading telecom nation during these years, because the investments in telecom were very low in the 1950s. Telegrafverket's main argument for not installing Nera’s equipment was that it lacked resources to assist the Norwegian telecom industry in product development, the reason being that the Labour government did not prioritise telecom in its economic plan, which was geared towards energy-intensive industrialisation. This was decisive for the relationship between STK and Telegrafverket, which is why this chapter also includes a political level in the analysis. The quality of the network deteriorated, while the “telephone queues”, i.e. of people waiting for having a telephone installed, grew. The chapter suggests why the Labour government was so negligent towards telecom. Even so, in the early post-war years, the government did consider turning STK into a «national champion», by acquiring a share of the ownership, as it had done with other companies.

STK's telecom business from 1933 to 1960

Standard Electric began the minor assembly of telecom equipment in SKG’s cable plant in 1933. The year after, STK rented a location at one of the switching stations in Oslo, Fagerborg, which was suited for training personnel. In 1935, the telecom

⁵ Søgner 1984, p. 40.

⁶ “Foreign suppliers were chosen even in areas where Norwegian companies could deliver the equipment.” Søgner 1985, p. 130.

* Compagnie Générale de Constructions Téléphoniques.

Chapter 2 Lonely riders

staff moved to Økern, STK's main industrial site, with 16 people working at the plant. As mentioned above, about 20 Norwegian engineers went to work for other ITT companies in the 1920s. Among them was Sverre Ramstad, who later came to be in charge of STK's telecom business; he was trained at BTM before he went to Seville and Madrid in the late 1920s. As a result of the economic crisis, however, several of these engineers returned to Norway in the 1930s. The home-comers supplied STK with valuable competence in the telecom field. STK's manufacturing increased throughout the 1930s, and in 1937, there were 90 employees in STK's telephone factory.⁷

The Oslo network was automated with Rotary switches, which led to an increase in the number of subscribers from 30,000 in 1926 to 56,400 in 1939.⁸ The project was a success for Telegrafverket; a substantial share of the errors in the network was rectified, and the workforce in the Oslo District was reduced from 1200 to fewer than 600 between 1920 and 1940.⁹ The automation and modernisation of the telecom network helped Norway sustain its high telephone density; with 250,000 telephones in 1940, Norway was in eighth place in the world, in terms of telephones per capita.¹⁰ It seems that Telegrafverket was satisfied with STK's role as a supplier.¹¹ This is no surprise, given that STK had several experts on Rotary, with experience of installing the switch in Europe. STK supplied more Rotary switches, in accordance with the Lillehammer agreement, to the rest of the Oslo-fjord area, and to Ålesund and Bergen, increasing its switching sales tenfold between 1933 and 1938.¹² These installations entailed increased sales of transmission equipment and related products. Another important area for STK was the sale of radio equipment; thus the delivery of switches accounted for only 30% of the telecom business in the 1930s.¹³

Nevertheless, STK was mainly a cable manufacturer; the sale of switches accounted for only 15% of STK's turnover in the late 1930s.¹⁴ The share of telecom and cables was fairly stable during this decade, and telephone, telegraph and radio equipment

⁷ Wasberg 1965, p. 92.

⁸ Rafto 1955, p. 485.

⁹ Annual errors per line were reduced from 5.2 in 1921 to 0.6 in 1940, Rafto 1955, p. 485.

¹⁰ Rafto 1955, p. 562.

¹¹ This is the general impression of Thorolf Rafto's account of these years.

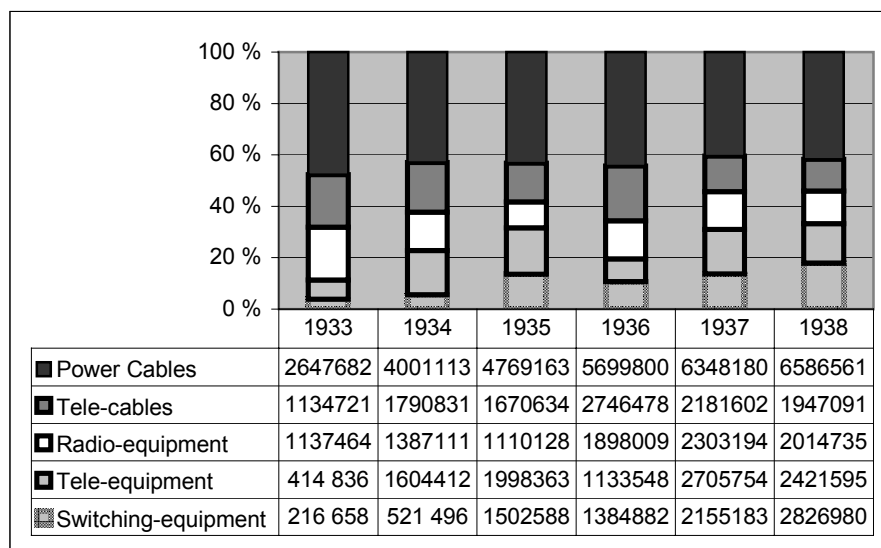
¹² From NOK 216,658 in 1933 to NOK 2,826,980 in 1938. STK's Annual Reports from 1934-1938.

¹³ STK's Annual Reports from 1934-1938.

¹⁴ According to STK's annual report, all of Telegrafverket's procurement of long-line cables was from STK; moreover, 60% of Pupinised cables came from STK.

accounted for around 45% of the total sales in these years.¹⁵ The supply of lines and cables, on the other hand, constituted about 55% of the turnover. Thus, according to these numbers, STK was more of a cable company than a telecom company. However, a large part of STK's sales of lines and cables was for the telecom network, i.e. long-line cables and subscriber cables. Thus, if one adds the sale of telephone lines and cables to that of tele-equipment, the combined total constituted almost 60% of STK's revenues.¹⁶ Consequently, the cable business dominated in terms of product range, while telecom was largest in terms of customers.

Table 2.1: STK's sales, 1933-1938 (NOK)



Source: Annual reports.

A minor issue worth mentioning concerns the plan to turn STK's into ITT's main switching manufacturer in Europe. In 1939, ITT feared that BTM's plant in Antwerp would be damaged by the war and halted by a German occupation, as had happened during the First World War. It was not expected that Norway would be involved in the war. Thus, ITT "planned to transfer the manufacturing of automatic switches from BTM in Antwerp to Oslo".¹⁷ Equipment and machines were sent to Oslo, and STK had received approval from the Norwegian authorities to erect a

¹⁵ The products were switches, transmission equipment, and other telephone equipment, telegraph equipment, and radio equipment. STK's Annual reports from 1934-1938.

¹⁶ This is based on the STK's Annual Reports from 1934-1938.

¹⁷ Wasberg 1965, p. 92-93, ([P]lanlagt å overføre en store del av fabrikasjonen av automatisk telefonsentralutstyr fra BTM i Antwerpen til Oslo).

large telephone factory.¹⁸ Construction was to start in April 1940, but the German invasion of Norway in that month put an end to the project. However, the plant at Økern was expanded during the war. The civil investments in the network were surprisingly high during the occupation, and the number of telephones increased by 77,000, or 30%, between 1940 and 1945, of which the Germans used only a fraction. Hence, Harald Espeli claims that the occupying authorities gave the civil telecom network a higher priority than the post-war Labour government did.¹⁹ After the war, there was a reshuffling of the industrial sector in Norway, partly due to the handling of former German-owned companies, which also affected the telecom industry.

State ownership

In the early post-war years, the Norwegian government increased its ownership in the manufacturing industry substantially.²⁰ This was a result of the confiscation of German ownership, a more radical and nationalistic sentiment on the part of the voters and the Labour government, and the lack of a strong and wealthy bourgeoisie that could organise and finance industrial expansion based on hydroelectric power, which was capital-intensive.²¹ The war created an opportunity for restructuring Norwegian business and industry, and for reducing foreign ownership and influence. STK was probably also seen in this light. The Swedish PTO had its own equipment plant, and STK's managing director Jens Bache-Wiig feared a similar development in Norway, since the activity at Telegrafverket's own workshop had increased.²² "It is yet a long way off for the Telegraph Administration to start any real production," reported Bache-Wiig to ITT's New York head office, "but some of the men in the Administration are interested in bringing this about, same as it has been done in Sweden already".²³ To halt this development, in August 1946 Bache-Wiig met with the Minister of Industry, Lars Evensen, and invited the government to become a shareholder in STK.²⁴

Bache-Wiig and Evensen were acquainted, particularly on issues regarding state ownership. Bache-Wiig was elected as Chairman of the Board in Årdal Verk, a

¹⁸ Wasberg 1965, p. 69 f.

¹⁹ Espeli 2005, p. 254.

²⁰ Grønlie 1989.

²¹ Christensen 1997.

²² STKHAT: "P.M. by Jens Bache-Wiig from meeting with minister of industry Lars Evensen 31.8.46 and 02.10.46".

²³ STKHAT: "Jens Bache-Wiig to Fred T. Caldwell 02.10.46".

²⁴ STKHAT: "P.M. by Bache-Wiig from meeting with minister of industry Lars Evensen 31.8.46 and 02.10.46".

wholly state-owned aluminium company established in 1946.²⁵ He was also Chairman of the Board of Norway's largest industrial enterprise, Norsk Hydro, a fertiliser company in which the state had attained a 44 per cent stake as a result of a post-war settlement.²⁶ The ownership model, which combined a dominant state ownership with private shareholders, came to be known as the Hydromodel. The name indicates how the government handles the ownership, namely as an ordinary and passive shareholder, so the company is managed according to principles of free enterprise.²⁷ Evensen laid down the principles of a non-interfering ownership very early after the war, which might explain why Bache-Wiig did not show a traditional reluctance to a governmental stake in STK.

Bache-Wiig's strategy was both defensive and offensive. The defensive element was pointed out in his report to ITT: he wanted to avoid a situation where "somebody else starts manufacturing in our line of production".²⁸ Bache-Wiig was probably more concerned about losing the market position for cable than that for telecom equipment. The offensive dimension was as clear, when Bache-Wiig asserted, "that cooperation with the Government will increase our business possibilities".²⁹ A crucial element of the Hydromodel was the reciprocal relationship between control and industrial growth; national and governmental control provided a company with political legitimacy, which made it easier for the government to stimulate industrial expansion.³⁰ By introducing the state as an owner, Bache-Wiig wanted to lay the foundations for a dominant position in the Norwegian market for cable and telecom equipment. As Bache-Wiig told ITT, "In case we had the Government as our shareholder, we may work towards absorbing E.B.s telephone business".³¹

The Norwegian cabinet approved Bache-Wiig's idea, and was ready to take over Christiania Bank og Creditkasse's 25% stake in STK.³² The government's consent

²⁵ The Germans started to erect an aluminium plant at the head of the Sognefjorden in Western Norway; the government took over what was left behind.

²⁶ Bache-Wiig's tenure as the chairman of Hydro's board led to a close cooperation between STK and Hydro. See further down. Christensen 1997.

²⁷ Christensen 2003.

²⁸ STKHAT: "Jens Bache-Wiig to Fred T. Caldwell 02.10.46".

²⁹ STKHAT: "Jens Bache-Wiig to Fred T. Caldwell 02.10.46".

³⁰ The same logic applied for most nations; countries operated with some sort of selective protectionism to secure national ownership and control in selected companies; such companies are often called national champions and were given favourable conditions for industrial expansion. David and Mach 2002; Christensen 2003.

³¹ STKHAT: "Jens Bache-Wiig to Fred T. Caldwell 02.10.46".

³² STKHAT: "P.M. by Jens Bache-Wiig from meeting with minister of industry Lars Evensen 02.10.46".

should be seen in the light of its handling of the former German-owned companies in the electro-technical industry, i.e. the Norwegian subsidiaries of Telefunken, AEG and Siemens. The former owners of Bergen Telefonkompagni, the private operator in Bergen, which Telegrafverket redeemed in 1947, formed a holding company, Bergen Industri-Investering, which took over the former German subsidiaries. However, the government retained a 20% stake in the companies. Most of these companies became important players in the electro-technical industry, but one of the companies - Nera - was in telecom. It proved to be the only Norwegian-owned company in the telecom industry of any significance throughout the 20th century. Its competence base had its roots in the Norwegian community in exile in the United Kingdom during the war.

Norwegian engineers, who spent the war years in the United Kingdom, returned home with technologies, knowledge and aspirations, and had ambitions to create a national electronic industry. They were instrumental in establishing the National Defence Research Establishment (FFI*) in 1946, which became the central institution for the «military technicians». The radar technology was essential for the founding of FFI, mainly because of its military significance, but also because of its anticipated economic value for the Norwegian merchant fleet. It was also the basis for radiolink in high frequencies, i.e. broadband wireless transmission.³³ Nera's Bergen department was set up when it was granted FFI's license on radiolink in 1950.³⁴ It rented a location at FFI's office, and with several of the employees recruited from FFI. So, Nera-FFI became a *development pair*. Nera's industrial ambitions to create a large new export industry have been described as “a vision in Kristian Birkeland's and Sam Eyde's spirit”.³⁵ A precondition for its success, however, was that Telegrafverket supported Nera by procuring the radiolink equipment, but Telegrafverket and the government had modest ambitions for the telecom industry during these years, which might also explain why the government did not become a shareholder in STK.

It took almost a year before Sosthenes Behn and ITT decided to welcome the Norwegian government as a minority owner in STK. Behn's acceptance was not surprising, given his strategy of national responsiveness. At this time, however, in

* Norwegian abbreviation for Forsvarets Forskningsinstitut.

³³ A key actor in bringing this technology to Norway, and developing it further, was Helmer Dahl, who headed FFI's radar department in Bergen. Njølstad and Wicken 1997, p. 65.

³⁴ The company was established with Norwegian owners in 1947, based on the former subsidiary of Telefunken. Dahl convinced the director of Bergen Industri-Investering, Aage Figenschou, who was a close friend of his, to invest in the electro-technical industry.

³⁵ Collett and Lossius 1993, p. 17. Birkeland and Eyde were the pioneers and entrepreneurs behind Norsk Hydro and its initial technology for producing fertiliser.

prising, given his strategy of national responsiveness. At this time, however, in late 1947, the Norwegian government asked for a postponement of the arrangement, due to fiscal problems. This delay, however, rendered the plan futile.³⁶ Thus, nothing came of Bache-Wiig's scheme to turn STK into a national champion in cable and telecom. The abortive attempt and the cabinet's lack of interest in concluding the deal that ITT had accepted may reflect the Labour government's relative lack of concern about telecom in the post-war period. Norway went from being a pioneer in telecom before World War II, to being one of the laggards in Europe. The main reason was that the Labour government did not prioritise this sector in its plan economy, which was geared towards the construction of power plants and investment in energy-intensive industry.³⁷

The Labour government's low priority of telecom

Despite the relatively high telephone density, with Norway being in ninth place in the world in 1947, there was a large number of Norwegians waiting for telephones.³⁸ In 1950, there were 62,700 on Telegrafverket's waiting list, and by 1955 the number had risen to 76,400.³⁹ The waiting list, or the "telephone queues", became Telegrafverket's nemesis into the 1980s. Even though it shared this problem with most PTOs in Europe,⁴⁰ it became a heavy burden, which reflected the fact that the Labour government did not prioritise telecom in its allocation of the scarce resources after the Second World War. When Telegrafverket presented a five-year plan for upgrading and extending the network in 1945, it was granted only 60% of what it considered necessary.⁴¹ This continued throughout the 1950s, when Telegrafverket never received what it deemed necessary for upgrading and modernising the network. At Telegrafverket's centennial anniversary in 1955 the Director General, Sverre Rynning-Tønnesen (1942-62), "tore his hair" because of the insufficient funding from the government.⁴²

The main reason for the meagre government funding of telecom was the scarcity of resources in the reconstruction period, but it also reflected the Labour government's perception of telecom as a social good: it was not regarded as a necessity. The head

³⁶ STKHAT: "Bache-Wiig to Evensen 15.12.47".

³⁷ Christensen 1997.

³⁸ Espeli 2005, p. 320. Norway had 12 telephones per hundred inhabitants. The United States had 24, and Sweden was second with 19.4, while France only had 5.3.

³⁹ Øvregaard p. 26; Oland 1992, p. 19.

⁴⁰ Rafto 1955, p. 570; Fridlund 2000.

⁴¹ Rafto 1955, p. 570.

⁴² Elektroposten 1955:36, here after Espeli 2005, p. 319.

of the National Labour Union, Konrad Nordahl, spurned the public desire for telephones by calling it “a noble need”.⁴³ In 1956 the Minister of Communications, Kolbjørn Varmann, praised the telephone queues, claiming the high demand was “a sign of wealth and prosperity”.⁴⁴ Why did such ideas not halt investments in Sweden, where a Labour Party also ruled? Its telecom network was regarded as among the best in the world. A reason might be that the Norwegian labour movement was more puritanical than the Swedish one.⁴⁵ Rynning-Tønnesen regretted that he was not able to convince the “finance technicians” to invest more in telecom.⁴⁶ When rejecting an application for hard currency for manufacturing telecom equipment, the Minister of Finance Erik Brofoss asked rhetorically: “Does anyone believe that the Norwegian people can solve its dollar problem by calling each other on the telephone?”⁴⁷ The need for telecom was recognised for the incumbent industry,⁴⁸ and it was acknowledged that poor communication facilities could halt growth in existing industries. Thus, although telecom’s value for logistic purposes was appreciated, the idea that communication in itself could spur growth did not prevail.

The notion of communication as a trigger of and precondition for growth was accentuated in the 1990s, particularly in the request for broadband. Such ideas are anachronistic in analysing the immediate post-war period, because they are intertwined with a market conception of the economy, which entails that actors in the market strive constantly for more efficient resource allocation, and act upon new information. Thus, the economy, i.e. the resource allocation, will be more efficient, the better the infrastructure provides distribution of information. The importance of communication and information is also in accordance with the evolutionary perspective on the economy, which stresses that new combinations (mutations) of knowledge are the main source of innovation and growth.⁴⁹ Hence, communication and distribution of information and knowledge will facilitate new “mutations”, and thus spur growth. These notions, underpinning the relation between communication and growth, do not correspond to those of the planned economy, which is defined by

⁴³ Collett and Lossius 1993, p. 19 and 20 or Espeli 2005, p. 319.

⁴⁴ Minister of Communication, Kolbjørn Varmann in the Stortinget in 1956, St.f. 1956, p. 1539-1540.

⁴⁵ Francis Sejersted made this point at a seminar at the Norwegian School of Management 17.11.05, where he presented his book: *Sosialdemokratiets tidsalder: Norge og Sverige i det 20. århundre*, 2005.

⁴⁶ Espeli 2005, p. 318.

⁴⁷ Here after Einar Lie: *Ambisjon og tradisjon. Finansdepartementets historie 1945-1965*, 1995, p. 119.

⁴⁸ Norsk Hydro’s need for sufficient telecommunication was a recurrent topic in its expansion after the war, Christensen 1997.

⁴⁹ Robert Nelson and Sidney Winter: *An evolutionary theory of economic change*, 1982.

hierarchical co-ordination; it was only 'the planners' that needed first-rate access to information.⁵⁰ Besides, the prevailing conception of technology was according to the linear model or science push, i.e. that scientific research and progress is the main driver of technological development, which is exactly what the evolutionary economy opposes.⁵¹

STK's telecom business expanded its manufacturing capacity immediately after the war, and its sales increased from NOK 500,000 in 1945 to NOK 14 million in 1949.⁵² As the government funding of telecom decreased, so did Telegrafverket's orders: STK's telecom sales stagnated and were still NOK 14 million in 1958. EB had to lay off workers, and STK used only half the plant's capacity in 1956.⁵³ STK's sales figures in the 1950s reflect the state-led industrialisation: they were dominated by cables and lines, which constituted between 70% and 80% of STK's turnover. Telecom and radio equipment accounted for only 10% to 20% of the sales in the annual reports.⁵⁴ STK's sales to Telegrafverket and private operators, which included telecom cables and lines, were between 25% and 30%. Nevertheless, STK was perceived mainly as a cable company, not least due to its supply of cables in the reconstruction era. As ITT's annual report in 1951 stated: "The important hydroelectric program now under way in Norway requires large quantities of power cable, which is being supplied by Standard Telefon og Kabelfabrik A/S".⁵⁵ The table below illustrates this pattern.

⁵⁰ Friedrich von Hayek has highlighted the problem of information for the planned economy. conf. Raghuram Rajan and Luigi Zingales: *Saving capitalism from the capitalists*, Crown Publishers, Inc 2003, p. 52-53.

⁵¹ Christopher Freeman: *Technology Policy and Economic Performance: Lessons from Japan*, 1987, p. 118-119; Nelson and Winter 1982.

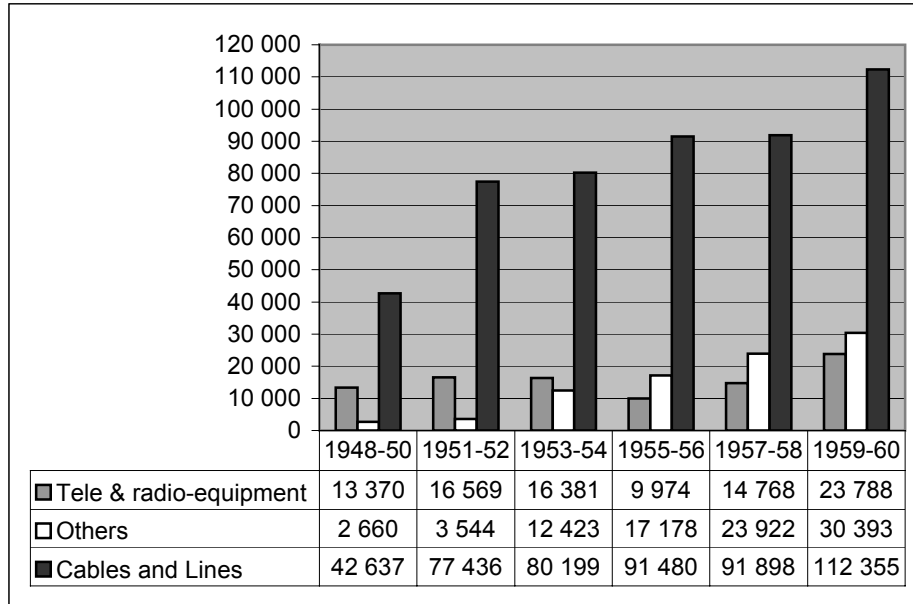
⁵² Wasberg 1965, p. 144, and STK's Annual Report 1949.

⁵³ Espeli 2005, p. 402.

⁵⁴ STK's Annual reports 1948-1960. The remaining sales were posted under the heading "Various"; in 1952 cables represented 80% of STK's sales.

⁵⁵ ITT's Annual Report, 1951.

Table 2.2: STK's average annual sales, 1948-1960 (1000 NOK)



Source: Annual reports.

STK's choice of leaders illustrates the dominance of cable. Rolf Østbye, who replaced Bache-Wiig in 1946, was a chemical engineer, and thus a «cable man». Østbye became CEO of Norsk Hydro in 1955, and was replaced by the head of the cable division, Amund Braaten, in 1953. Neither of them was an expert in telecom, so this field was entirely left to Sverre Ramstad, who became Technical Director in 1946.⁵⁶ In contrast to Braaten, who was a rather shy person, Ramstad was a very strong figure in STK, almost a potentate, in total control of STK's telecom business.⁵⁷ Whereas Braaten was acclaimed for the (re)construction of the cable plant after the war, the same is said about Ramstad, with respect to the telephone plant.⁵⁸ Telegrafverket's funding and procurement increased from the late 1950s; thus, STK's telecom sales doubled from NOK 13.7 million in 1957 to NOK 27.7 million in 1960, and had risen to NOK 46 million in 1964.⁵⁹ The main reason for this was STK's supply of the electro-mechanical 8B switch. But before we turn to this issue, we need to take a brief look at ITT's history from 1940.

⁵⁶ Interview with Jest Braathen, led the "Nodal Switch project", later worked in Thomson CSF/Thales. Son of Amund Braaten, STK's Managing Director in 1953-1972.

⁵⁷ Interview with Fredrik Thoresen.

⁵⁸ Wasberg 1965, p. 123.

⁵⁹ Wasberg 1965, p. 144.

ITT after World War II

ITT's prospects were dim at the outbreak of World War II, as its subsidiaries in occupied countries were at the mercy of the Axis countries and their allies. Yet, Behn navigated it through the difficulties, so ITT came out of the war with a very healthy financial balance - underpinning the myth of "the nine lives of I.T.&T."⁶⁰ Much has been said about Behn's ties to the Germans during World War Two,⁶¹ but Robert Sobel puts more emphasis on Behn's cooperation with the US government, than on his alleged collaboration with the Germans.⁶² ITT's ties to the US government paved the way for vital sales of overseas telephone companies in the 1940s. ITT ran telephone networks in Romania, Spain and Argentina, which for different reasons and at different times were prone to expropriation. Behn was able to convince the governments in these countries, and the US State Department, that it was better for all parties that ITT's telephone companies were "nationalised", financed by these countries' reserves of US dollars in the United States, which were blocked anyway.

ITT sold its Romanian utility for \$13.8 million in 1940, after the Germans' arrival in Bucharest.⁶³ It was able to sell its Spanish utility, CTNE, to the Spanish government for \$80 million in 1944.⁶⁴ The most remarkable deal was struck when Behn convinced Juan Peron to buy ITT's utility in Argentina for \$94 million.⁶⁵ This was in due time, as the Argentine dollar deposits in Washington ran out shortly after, and the developing Peronism would have ruled out any compensation a few years later. A part of the arrangements in Spain and Argentina was that ITT was to supply the equipment to the companies for decades to come. Thus, with vital assistance from the US State Department, ITT was transformed from insolvency into a "cash melon".⁶⁶ As a result, in 1947 ITT was attacked by corporate raiders, who disapproved of Behn's management ability and luxurious habits, the lack of dividends to the stockholders since 1932, as well as the firm's meagre profitability, compared to its sales and assets.⁶⁷

⁶⁰ This was the title of an article in *Fortune* in the 1920s, here from Sobel 1982, p. 98.

⁶¹ Sampson, 1973; Sutton 1976.

⁶² Sobel 1982, p. 82f and 97f.

⁶³ Sobel 1982, p. 101.

⁶⁴ Sobel 1982, p. 116.

⁶⁵ Sobel 1982, p. 118; Schoenberg 1985, p. 102.

⁶⁶ Schoenberg 1985, p. 102.

⁶⁷ Sobel 1982, p. 123f; Schoenberg 1985, p. 102-103.

ITT had been regarded as the international counterpart of AT&T, but this notion faded away as it was nearly out of the telephone operating business, with only the Chilean telephone company amounting to anything substantial. Moreover, ITT's domestic manufacturing took off during the war, mainly as a contractor for the military. Through acquisitions, greenfield investments, and service from European ITT-refugees such as Maurice Deloraine, it created International Telephone Development, operating from New Jersey, near ITT's headquarters in New York. Its domestic business was profitable during the war, but it did not fare well in peacetime, when the stable orders from the military ceased.⁶⁸ Behn was eager to use ITT's financial muscles to increase the domestic business, to offset the risk of political instability and expropriation in the overseas business.⁶⁹ His ambition was that two-thirds of ITT's revenues should come from the United States. This led to a series of poor acquisitions. ITT lacked experience in businesses serving customer markets. Thus, it was still ITT's European telecom business, International Standard Electric, which in terms of "sales, profits and dividends was the corporation's star performer".⁷⁰

Behn never regained his dominant position in ITT after the raiders placed representatives on the company's board in 1948. William Henry Harrison, recruited from Western Electric and AT&T, was to co-pilot ITT with Behn, but their rivalry never ended. A former ally hypothesised Behn's thoughts during these years: "I'm never going to be able to satisfy these devils in building up domestic business. I understand the manufacture of telephones; I know how to sell to the kings and queens and the post-office department. I just don't understand this fast-moving American economy".⁷¹ The ownership advantages that turned Behn into the master of a global telecom company were not adequate for navigating ITT through the commercial markets and shareholder capitalism. One outcome of the corporate raiders' attack on ITT, Behn's rivalry with Harrison, and the focus on domestic operations, was increased autonomy for the European subsidiaries.

⁶⁸ Sobel 1982, p. 103-104 and 120f.

⁶⁹ "Behn's attempt to deploy assets to America were based on his experiences of the 1930s and during the wartime period, when first it was difficult to repatriate earnings and then his plants were seized and in some cases bombed out. In the late 1940s there were fears that parts of Europe might turn to communism, in which case ITT would once again suffer losses, and there was constant talk of a possible new European war, one that would ravage the Continent." Sobel 1982, p. 141.

⁷⁰ Sobel 1982, p. 141.

⁷¹ Sobel 1982, p. 127.

ITT was compared to the Habsburg monarchy; the subsidiaries were sovereign and “only loosely linked to the others at the administrative level”.⁷² An important reason for this was the national identity and the independent role that ITT's subsidiaries had. It had been a conscious policy on Behn's part to be responsive to national sentiments in order to secure contracts for ITT, such as when he agreed to invite the Norwegian government to become a shareholder in STK. Furthermore, in contrast to many US multinationals, ITT employed almost exclusively national managers in its overseas companies. A Swedish ITT veteran says that ITT “was a loose federation of disagreeing companies!”⁷³ This became evident when ITT's main switching weapon, the Rotary switch, lost its sting after World War Two, and the new generations of crossbar switches appeared.

ITT's crossbar battle

The crossbar switch received its name because of its vertical and horizontal bars. Ericsson played a central role in developing it; the principles were discovered while the Swedish PTO searched for a first-generation automatic switch in 1910.⁷⁴ The Swedish PTO developed its own version of the crossbar switch, and Bell Labs sent representatives to examine it in the 1930s.⁷⁵ It laid the foundation for AT&T's crossbar switches, first introduced in New York in 1938. Ericsson also took up its investigation in the 1930s, and cooperated with Bell Labs on this matter, “and in 1943, LME decided to start its manufacture of crossbar switches”.⁷⁶ Since the Swedish PTO had its own version, Ericsson had to find a customer abroad, which it did in the regional companies in Finland and Denmark.⁷⁷ These operators were more dedicated to their duties as service providers and, less prone to take industrial considerations, which made them natural targets in LME's search for a customer. Another noteworthy point is that, along with the United States, the Scandinavian countries were once again pioneers in telecom, this time in installing crossbar switches. Even if LME did not benefit from a secure home market for its crossbar switch, it did not

⁷² Chapuis and Joel 1990, p. 226.

⁷³ “Stig M. Eriksson's memorials from his time in the Swedish ITT house Standard Radio & Telefon AB” in http://www.iclinvia.se/veteran/99q4/itt_hist.htm (1999-09-22).

⁷⁴ LME had been a latecomer with the automatic switches, and had tried to reach a license agreement with Siemens for producing a step-by-step switch, but failed. Therefore, the Swedish PTO started to search for an automatic switch around 1910. The outcome was two switches: the AGF, a 500-point selector switch, which belonged to the first generation of automatic switches, and the second switch, namely the crossbar switch, belonged to the next generation.

⁷⁵ Chapuis 1982, p. 379.

⁷⁶ Meurling and Jeans 2000, p. 181.

⁷⁷ JTAS from Jutland placed its order in 1949.

have subsidiaries following their own agendas with competing products, as was the case with ITT.

ITT lagged behind its competitors in developing the crossbar switch. An important point was that the technology agreement with Western Electric expired in 1950. AT&T was not keen on assisting ITT, as it feared that it would intrude into the US market. AT&T's new partner was LME, with which it cooperated in developing the crossbar switch, and it entered into a technology and licensee agreement with the Swedish company in 1951.⁷⁸ Thus, ITT's opponents joined forces. The main problem, however, was ITT's lack of a mother company coordinating the R&D, and a secure home market that could be a springboard for exports. Thus, four different versions of the crossbar switch were developed within ITT. First, Kellogg Switchboard and Supply Co. developed a switch in 1950; the company was one of Behn's fairly successful acquisitions in the US, carried out in 1951.⁷⁹ Second, ITT's German branch SEL developed a crossbar switch in 1955, but the Bundespost wanted only one system for the whole country, and chose Siemens's version instead.⁸⁰ The last two switches were developed by BTM and CGCT.

BTM was designated to be ITT's centre of switching, and the Belgians carried out substantial R&D on introducing electrical circuits to switches in the 1930s. BTM could pride themselves with electronic elements in the 7E version of the Rotary switch, allegedly the first switch in the world with such elements.⁸¹ This, however, only reflected the fact that BTM was stuck too long in the first generation of automatic switches. Based on this work, BTM developed the 'Mechanic-Electronic System', and the descendants were called the 8A and 8B.⁸² The rotating selector of the 7E was replaced by a crossbar selector, which allegedly "gives an exact account of how the 8-A System came into being".⁸³ The French crossbar switch, the *Pentaconta*, was fairly similar to the standard crossbar switches that LME and AT&T

⁷⁸ "In 1950, AT&T approached LME about a mutual patent exchange which included the patent on the transistor. In 1951 LME and Western Electric closed a similar exchange contract which also allowed LME's engineers to visit Bell Labs and Western Electric." Fridlund 2000, p. 148.

⁷⁹ The 1040 System, The newly formed ITT Kellogg introduced the 7 XB switch in 1952. Chapuis 1982, p. 405.

⁸⁰ SEL's HKS was exported to Austria and Greece. Chapuis 1982, p. 407-408.

⁸¹ Chapuis 1978, p. 201.

⁸² The Rotary switch had the serial number 7; this was apparently because No. 7 was the code number for Western Electric's equipment "intended for use *exclusively outside the United States*". However, ITT used this as a starting point for numbering their switches. Thus, the next generation switches - the crossbar switches - were given the number 8. Chapuis 1982, p. 193.

⁸³ ITT 1974, p. 130.

offered. BTM's version was more futuristic: it was a “radically different crossbar switch”, according to STK's Ivar Mo, “with extensive use of electronics to control it”.⁸⁴ Later versions of the switch used transistors, which were developed at Bell Labs in 1947, and ready for industrial exploitation from the mid-1950s.⁸⁵ BTM's main task was to find a PTO that was willing to inaugurate what was described as the “the world’s most modern telephone switch”.⁸⁶

Telegrafverket and the Oslo District authorities were eager to upgrade the Oslo network. This was chiefly because Telegrafverket’s main problem was long telephone queues, with almost 80,000 applicants.⁸⁷ The bulk of these were in Oslo; hence, an elimination of the queues in Oslo would reduce the national queues by 50%. Furthermore, the Oslo network was crucial for the national network, since it was a transit network for national long-distance calls and international calls. Telegrafverket got to know about BTM's crossbar switch through STK, and had technical personnel present when BTM installed a trial switch in the suburbs of Antwerp. It was apprehensive, however, about being the first procurer, as it was aware of the French Pentaconta project, and the ongoing competition in ITT.⁸⁸

If the switch turned out to be successful, STK might have benefited from its initiating role by obtaining export contracts on behalf of BTM/ITT. This could contribute to industrial and economic growth in Norway, and moreover, export orders for STK could solve a serious employment problem in the industry. The parties might have had the installation of Rotary switches in the 1920s in mind. Due to Telegrafverket’s early automation and order of the Rotary switch, Norsk Western Electric's sent several installers abroad. Besides, export could benefit Telegrafverket economically. STK and EB's production lacked scale, which rendered their equipment more expensive than in other countries.⁸⁹ Hence, a common goal for STK and Telegrafverket was to provide STK with production for export.

⁸⁴ Mo 2001. A main difference from the common crossbar switches was the use of the multi-selector, which gave it superior capacity. Both the 8A and the 8B “were ahead of their time”. ITT 1974, p. 23.

⁸⁵ “To telephone switching, the great advantage of electronics components, instead of traditional electromechanical ones, were primarily their high speed in switching on and off. In electronic components, that used electrical currents, it took about one millionth of a second which was 10.000 times as fast as the mechanical action of an electromechanical relay.” Fridlund 2000 p. 50.

⁸⁶ Wasberg 1965, p. 146.

⁸⁷ Nils Jacobsen (Ap) in St.f. 1964, p. 1345, (8. Dec.) “Telegrafverkets budsjett for 1965”.

⁸⁸ Riisnæs’ chapter 3 “Marked, Langtidsavtalen” in Mo 2001, p. 7.

⁸⁹ “Prices for conventional equipment vary from \$250 to \$300 (per line) in low-wage countries with efficient large-scale production and up to \$600 in smaller markets such as Switzerland and Norway.” Doz 1979, p. 75. The lack of scale in the manufacturing operations of STK and EB is a recurrent theme in sources from Televerket and STK in the 1970s.

The worst scenario, however, was if the switch became a failure on the world market, and Telegrafverket was stuck as the only user. Then it would have to pay a high price for further development and upgrading of the switch. It was particularly important for small countries to avoid this, since larger networks would attain greater economies of scale in upgrading a system. Yet, in 1952 it ordered BTM's switch, which was installed at Ski outside Oslo. Telegrafverket was still apprehensive, but when it learned that Brazil was to become a major customer of BTM's 8B, it installed another 10,000 lines at Åsen in 1958. BTM promised Telegrafverket all technical support, and it was essential for Telegrafverket that STK should participate in the development of the 8 series, in order to enhance the technical and manufacturing competence in the Norwegian telecom industry.⁹⁰ The 8B's use of the transistor only added to this point. Several engineers from STK went to BTM to learn from and join in the development. The first 8B, installed in 1960 at Eiksmarka, a suburban area of Oslo, was produced by BTM, but the second 8B, installed at Grorud in 1963, was fully produced at STK's plant at Økern.⁹¹ But before this took place, the French had outmanoeuvred BTM.

France was ITT's largest market in Europe, and was essential to ITT's success, both in itself, but also through its influence on the Spanish and Italian markets. Consequently, France was ITT's main market for switches in Europe, while the main producer of switches was BTM. However, the strategic decisions were supposed to be taken in New York. In the early 1950s, "CGCT had cooperated with BTM in an unsuccessful attempt to interest the French Administration in the 8-A System".⁹² To get access to the French market, CGCT had to comply with the demands of the French government and PTO to develop a French telecom industry. Hence the French PTO never seriously considered BTM's crossbar switch. CGCT developed its own crossbar switch, the Pentaconta, and fought LME for contracts in France. The Pentaconta was chosen for the urban networks, and LME's French crossbar was chosen for the rural networks.⁹³ Thus, as with the Rotary system in 1926, ITT succeeded in becoming the major supplier of switches in France, and the French decision had a major impact on ITT - and STK. Matters were even worse for BTM and STK, since the Brazilians called off further orders of BTM's 8B, because the iron in the selenium diodes rusted due to the warm and humid climate in Brazil.⁹⁴ CGCT

⁹⁰ Mo 2001.

⁹¹ Mo 2001.

⁹² ITT 1974, p. 18.

⁹³ Chapuis 1982, p. 408-409.

⁹⁴ Mo 2001.

used the Brazilian failure for what it was worth, and it was decisive in CGCT's "victory" over BTM.

ITT arranged a meeting in Paris in 1959 to compare "all recent switching systems developed by the various ITT companies".⁹⁵ No discussion was allowed, and "the meeting was informed that the (Pentaconta) system had been chosen as the ITT standard system, to be promoted wherever feasible".⁹⁶ BTM's representatives were furious, and claimed that Pentaconta won because there were too many Frenchmen residing at ITT's headquarters in New York.⁹⁷ ITT ordered BTM to manufacture the Pentaconta, and to stop the "manufacture of the 8-B System and to transfer the tools to STK, Oslo".⁹⁸ BTM lost the Belgian PTO as its customer, the Dutch PTO also refused to order the Pentaconta, and, thus, BTM's oldest and most stable markets vanished. These markets were small, however, compared to the French and CGCT's potential export markets. The Pentaconta became ITT's "warhorse" on the export market, used in over 70 countries. BTM joined the Pentaconta camp, and Norway was left alone with the 8B.⁹⁹ The next section asks why Telegrafverket agreed to become the first procurer of the 8B.

Telegrafverket's procurement policy

In 1959, Rynning-Tønnesen said that Telegrafverket chose equipment that was tried out, in order to avoid "children's diseases",¹⁰⁰ which is difficult to reconcile with the procurement of the 8B. He was probably referring to Telegrafverket's unwillingness to buy radiolink equipment from Nera, which had, in cooperation with FFI, developed a high-frequency radiolink for transmission, and wanted Telegrafverket to install this equipment for long-distance transmission. Many have perceived Telegrafverket's refusal to support Nera through procurement as a token of its backwardness in terms of technology.¹⁰¹ The rejection of Nera instigated a fierce debate regarding public procurement; it was discussed in the cabinet, and led to the establishment of a committee for electronics, whose main message was that Telegrafverket had to support the Norwegian electronic industry. Despite harsh criticism, Telegrafverket insisted that with its meagre resources it had to focus on being

⁹⁵ ITT 1974, p. 20.

⁹⁶ ITT 1974, p. 20.

⁹⁷ Interview with Ivar Mo, who was director of switching in STK's telecom division, and head of the 11B-project.

⁹⁸ ITT 1974, p. 20.

⁹⁹ BTM "succeeded in building up an important export market for the Pentaconta System". ITT 1974, p. 20.

¹⁰⁰ In *Telektronikk* 1959: 85, here after Espeli 2005, p. 408, (å unngå barnesykdommer).

¹⁰¹ Collett and Lossius 1993, Oland 1993, Søgner 1985.

a service provider, not on supporting uncertain industrial products.¹⁰² Its main argument was that it could not afford to take any chances. It is interesting that this was put forward at the same time as Telegrafverket procured the 8B.

Jon B. Riisnæs, who worked at STK's Telecom Division from 1958, claims that Telegrafverket was a competent and aggressive procurer from the late 1950s.¹⁰³ Riisnæs recalls that Telegrafverket was confident and demanding in the meetings with BTM in Antwerp. The general impression, however, is that Telegrafverket did not take on such a role before the early 1970s,¹⁰⁴ but Riisnæs insists that this tendency was clear from the late 1950s.¹⁰⁵ The time aspect is essential, as the first 8-series switch, installed in 1952, was regarded probably as a trial switch, while it is probable that the next procurements were seen as a more permanent choice. When the Brazilians called off further orders in 1959, however, Telegrafverket was to some extent caught in a lock-in, i.e. it would be expensive to drop the switch after having installed several. If Telegrafverket took a confident and conscious choice, as Riisnæs indicates, one could argue that it was in line with Norway's leading position in telecom, in the beginning and the end of the 20th century. Furthermore, Telegrafverket followed the other Scandinavians' course, in being among the first in the world to install crossbar switches.

There is little evidence, however, to support the claim that Telegrafverket's switching personnel were at the forefront of the technology in the 1950s. No one has supported Riisnæs's view.¹⁰⁶ In fact, there are very few traces in the archives of the procurement of the 8-series switches, which is in stark contrast to the Nera issue.¹⁰⁷ It also remains unclear whether it was Telegrafverket or the Oslo District authorities that were instrumental in the decision regarding the 8B. Harald Espeli makes a good point, when arguing that the lack of empirical evidence indicates that Telegrafverket

¹⁰² It had to procure the equipment it thought was best, regardless of national industrial considerations.

¹⁰³ When Telegrafverket negotiated with BTM regarding the 8B, they really impressed the Belgians according to Riisnæs. Interview with Jon B. Riisnæs.

¹⁰⁴ Some see the establishment of Telegrafverket's R&D institute in 1967 as the turning point (Collett and Lossius 1993), while others stress the increased competence in switching technology that Telegrafverket's technical department attained from the 1960s. This aspect will be discussed later in the thesis.

¹⁰⁵ Interview with Jon B. Riisnæs.

¹⁰⁶ Interview with Bjørn Gladsø, Nic. Knudtzon, Magnhild Slettbak, Gunnar Tidemann, Ivar Mo all suggest the opposite of Riisnæs' claim. Slettbak worked in different sections in Televerket's Technical Department, Bjørn Gladsø had leading positions in Televerket's Technical Department, most notably in the Station (switching) office from 1958-1993. Knudtzon was Director of Director of Televerkets Forskningsinstitutt.

¹⁰⁷ Harald Espeli has not found any substantial evidence on this matter either.

did not reflect too much upon the question, and that it merely accepted the products BTM/STK offered. Sverre Ramstad played a decisive role in convincing Telegrafverket to order BTM's switch.¹⁰⁸ He was a figure of consequence in ITT's European telecom business, and had a high standing at BTM. Ramstad shared BTM's anxiousness to find a customer for the 8B, and he had the personal qualifications to enrol Telegrafverket into his vision of turning STK into a major switch supplier in ITT and Europe.

BTM's problems with marketing its crossbar switch demonstrate the importance of a secure home market. It also explains why it was so difficult to find the first customer for a switch; PTOs were wary of being left alone with a system. In this respect, Norway served as a testing ground for BTM's 8B, and being a small and developed country it was well suited for this. It was easier to implement a new switch in a comparatively small network, with few types of switches to interact with. Moreover, the 8B switch was to be installed in areas where the Rotary switch had been installed, and these switches had no problem interacting since the 8B was based on the Rotary. Another important aspect of Norway's small network was that Telegrafverket had less bargaining power in terms of customer mass (number of lines) than other PTOs. Thus, Telegrafverket was probably the only PTO - in fact it proved to be the only one - which BTM could use as a guinea pig for its switch.

Telegrafverket's options were limited by the Lillehammer agreement; it could not have chosen LME's crossbar in STK's areas. Also, STK belonged to the BTM camp, as opposed to the German SEL camp, to which the Austrian ITT subsidiary belonged, or to the French camp, as Italy and Spain did to a certain degree.¹⁰⁹ Thus, it was no alternative for Telegrafverket to buy the Pentaconta from CGCT instead, like the Italians and Spaniards did. Then again, there was little reason for Telegrafverket to disregard BTM; its merits in the switching field were impeccable, probably only equalled by LME in Europe. It had been a dominating force in the switching industry since 1882, and Telegrafverket regarded BTM's supply of Rotary switches as successful.¹¹⁰ Hence, it may be an exercise of over-explanation, i.e. to explain why Telegrafverket wanted to engage in cooperation with BTM, on developing and installing cutting-edge technology in its network. And, as noted in the introduction, Telegrafverket received positive media coverage on the project as well.¹¹¹ Still, it is

¹⁰⁸ Interview with Ivar Mo and Fredrik Thoresen.

¹⁰⁹ Mo 2000, p. 66.

¹¹⁰ This is the impression that Thorolf Rafto gives.

¹¹¹ Mo 2001, p. 5.

worthwhile to reflect upon Telegrafverket's modest competence in the switching field.

A major problem for Telegrafverket was the shortage of qualified engineers, which hampered its proficiency, and thus its relationship with the industry. Olav Skeie, a chief engineer in the PTO, explicated this problem in a memo in 1957. He proposed to expand and reorganise Telegrafverket's technical department.¹¹² He claimed that Norway was a laggard in telecom, and that the main reason was insufficient planning. The chief task as he saw it, was to plan better, not short-term and project-based planning, but “to lay down basic specifications and planning of the entirety - I will call it a lack of fundamental planning”.¹¹³ Skeie wanted to release engineers from the operating day-to-day business, and reassign them to a strategic level. The reaction to Skeie's memo was unanimous; there was a shortage of engineers in Telegrafverket.¹¹⁴ It was difficult to circumvent this problem.

Telegrafverket had a poor standing in the post-war years, so most telecom engineers preferred to join STK and EB, due to higher salary and status.¹¹⁵ Norwegian companies, like Nera, and research institutes, like the FFI, were also more attractive. Besides, there were relatively few candidates graduating in the “light-currents” field, i.e. electronics and communication, from the Norwegian Institute of Technology (NTH*). It was dubbed the “flashlight-field”, indicating its low standing among the students.¹¹⁶ Strong current was particularly important in Norway, due to the many waterfalls, and the construction of hydropower stations. The meagre interest in telecom has also been explained by the claim that the industry and/or technology were regarded as mature until the late 1950s, i.e. before the “transistoration”.¹¹⁷ The exception to this notion was the development of radio technology, and particularly

¹¹² NTMS: O. Skeie II.F.15/12-57: “Om utbygging, eventuelt reorganisering av de tekniske avdelinger ved Telegrafverket”, (Skeie's memo 1957)

¹¹³ Skeie referred to several technical aspects of Telegrafverket's business, and argued that better planning would have solved serious problems. His main concern was the lack of common and basic standards for Telegrafverket, and not least for the tele-districts. This meant that most problems had to be solved without standard procedures, even though several of these problems and tasks were common for each district. Skeie's memo 1957.

¹¹⁴ NTMS: Three memos commenting Skeie's memo: “Noen merknader til overingeniør Skeies brev av 15/12 1957 om utbygging av de tekniske avdelinger i Telegrafstyret”.

¹¹⁵ This assumption is based on numerous interviews with former NTH students, who worked for Telegrafverket (Televerket) or for STK.

* Norwegian abbreviation for Norges Tekniske Høyskole

¹¹⁶ Tore Jørgen Hanisch and Even Lange: *Vitenskap for Industrien, NTH - En høyskole i utvikling gjennom 75 år*, 1985, p. 165-166.

¹¹⁷ Thue 2006.

radiolink in Norway. Nevertheless, because of its poor standing, Skeie claimed, Telegrafverket was in the hands of the industry.

This was even more so in the case of switching, as Telegrafverket's main expertise was in transmission.¹¹⁸ The *raison d'être* for PTOs was transmission, i.e. the running of national and international networks. Telegrafverket organised several tele-districts, which were comprised of former independent and private operators, and its main task was to bundle these districts together into an efficient national network. Hence, it is indicative that Skeie does not mention switching in his report. One possible reason for the low switching competence is that it was left to the tele-districts. Another reason was that Telegrafverket simply relied on ITT and LME and their subsidiaries in this matter. There was allegedly only one person in Telegrafverket, Nils Johnson, who had real capability in this field in the 1960s.¹¹⁹ In a report from Telegrafstyret's committee on establishing a laboratory in 1961, "the ambition was limited to attaining one engineer «with good knowledge of both, or at least one, of the two main types of automatic switches» the PTO used."¹²⁰ Magnhild Slettbak, who worked in Telegrafverket's technical departments from 1961, says that there was much more prestige in working with transmission than with switching.¹²¹

The uneven competence, i.e. transmission over switching, was not a Norwegian idiosyncrasy. The "importance of switching was obscured on the international scene", claims Chapuis; the issue was discussed at international conferences when the first generation of automatic switches appeared, but "disappeared entirely from international meetings (...) from 1922 onwards".¹²² Hence, there was little flow of knowledge and information across national borders. This meant that countries without a switching industry had little chance to enhance their competence. This also explains why there were so few candidates studying switching; it "became a semi-arcaic technique for which engineers had no objective point of comparison".¹²³ "The engineers of the operating services did not pay any great attention to that very

¹¹⁸ Telegrafverket's strength in the field of transmission was underpinned by the contributions of Tore Olaus Engset, the former Director General, to traffic theory on an international level. Arne Myskja and Ola Espvik (ed.): *Tore Olaus Engset 1865-1943 : the man behind the formula*, 2002.

¹¹⁹ Interview with Magnhild Slettbak.

¹²⁰ NTM, "Innstilling fra laboratorietvalg", here from Espeli 2005, p. 405.

¹²¹ Interview with Magnhild Slettbak.

¹²² Chapuis 1982, p. 333-334. This changed after the transistor made its impact on telecom. The electronic switches that were developed from the 1960s were easier to assess and compare; thus, the International Telephone and Telegraph Consultative Committee (CCITT) decided to undertake switching studies at its first meeting in India in 1960. Chapuis 1982, p. 190.

¹²³ Chapuis 1982, p. 252.

special technique”, claims Chapuis,” as their duty was merely to ensure that the equipment installed performed its function with reasonable efficiency.”¹²⁴ Thus, the international context underpins the fact that Telegrafverket's competence was in transmission, not switching. This was also the case for the Norwegian telecom sector, particularly for Nera-FFI.

The radiolink issue

After setting up a trial link, between Bergen and Haugesund, in cooperation with Telegrafverket, Nera-FFI wanted to set up a radiolink between Oslo and Bergen in 1951. But Rynning-Tønnesen refused, partly because Telegrafverket had a project for laying a coaxial cable over the same route. The PTO did not reject wireless transmission in itself; it had experimented with radiolink, using German UHF-equipment, but it was hesitant of Nera-FFI's use of high frequencies. Nera-FFI had developed a radiolink using high frequency, the microwave areas, and argued that it was the future of (wireless) transmission. Telegrafverket was uncertain of this and regarded the project as too risky because the technology was not fully developed. Nera-FFI agreed, but saw the project as a way to further develop it, and claimed that the PTO had a responsibility to contribute. Telegrafverket, on the other hand, could not envisage allocating scarce resources to an uncertain R&D project, while the «telephone queues» reached almost 80,000, equivalent to more than 1/8 of the number of connected telephones.¹²⁵

NATO became the saviour of Nera-FFI's radiolink project in the 1950s. A radiolink was set up between Oslo and Bergen, financed by NATO's project to establish a common control and command system.¹²⁶ As a result, the Norwegian Defence Communications Administration (FFSB*) was set up in 1953 and administered a separate military telecom network. Norway differed from most countries in having two separate telecom networks. This broadened the existing gap between Telegrafverket and the military technicians. First in line to ridicule Telegrafverket's laggardness was FFSB's leader, Colonel Bjørn Rørholt.¹²⁷ Rørholt allowed himself to be photographed standing upside down; he claimed he wanted to see the world from Telegrafverket's point of view.¹²⁸ Rørholt's provocativeness, and the ensuing strained

¹²⁴ Chapuis 1982, p. 252.

¹²⁵ This was in 1956, Collett and Lossius 1993, p. 18.

¹²⁶ It was the NATO organisations Supreme Headquarters Allied Powers Europe (SHAPE) and Allied Forces Northern Europe (AFNE) that ordered Nera-FFI's radiolink.

* Norwegian abbreviation for Forsvarets Fellessamband.

¹²⁷ Eirik Oland: “Telegrafverket og forskning 1945 - 1967 - Etableringen av Telegrafverkets forskningsinstitutt”, 1993, p. 33.

¹²⁸ Oland 1993, p. 33.

strained relations with the PTO and Rynning-Tønnesen, has been emphasised as a major cause of Telegrafverket's stubbornness towards the military technicians.¹²⁹ The need for broadcasting TV signals settled the technological issue, since this required microwaves.¹³⁰ Telegrafverket was given the responsibility of constructing the new network, which would also serve telecom purposes.

The Ministry of Industry and Defence, as well as the Norwegian Broadcasting Corporation (NRK*) wanted Telegrafverket to buy Nera's equipment. Nonetheless, Telegrafverket ordered the bulk of it from ITT's British subsidiary STC, as it did not trust Nera's capability.¹³¹ STK eagerly advised Telegrafverket to choose STC, before Nera.¹³² Telegrafverket was severely criticised for choosing STC rather than Nera. Even though the cabinet intervened in order to secure Nera contracts later on, it seems that Telegrafverket had an ally in the Ministry of Communication.¹³³ It reflected the fact that the PTO was more dedicated to its obligation as a service provider than to the support and promotion of Norwegian industry. Its resources were so scarce that it did not conceive of being an *industry* provider; it had a hard enough time providing a telecom service to the public. It did not object to supporting national industry through selective procurement, but it wanted more financial backing and did not want the responsibility of procuring Nera's equipment, when it did not regard it as advisable from a technical point of view.¹³⁴ One of Telegrafverket's most interesting arguments was that STC was a safer bet, since it was a part of a large MNC. As such, the issue bears similarities to the 8B procurement.

Conclusion

Telegrafverket's acceptance of the 8B, and its rejection of Nera's radio link, can be explained in light of the oligopolic grip. Firstly, the 8B had few problems interacting with the Rotary switches already installed in the Oslo network. Thus, this *finger* did limit Telegrafverket's choice. The same applies for the second finger: Tele-

¹²⁹ Knut Endresen in an interview with Oland (1993), p. 33.

¹³⁰ The Stortinget sanctioned the Norwegian Broadcasting Corporation's (NRK) plan for television in 1957; this instigated a national radiolink plan from Telegrafverket in 1959. It was to serve civilian telecommunication and television. Espeli 2005, p. 388 and 412.

* Norwegian abbreviation for Norsk Rikskringkasting.

¹³¹ Telegrafverket argued that Nera would not be able to deliver its equipment within the specified time. Nera's allies complained that Telegrafverket should have notified Nera about its plans earlier, so that the company could have planned its delivery better. Jensen 1989, p. 97f.

¹³² Interview with Ivar Mo.

¹³³ Espeli 2005, p. 412.

¹³⁴ Interview with Bjørn Gladsø.

grafverket needed STK to maintain and upgrade the Rotary switches. Still, it could have chosen CGCT's Pentaconta, which would have accommodated these first factors.¹³⁵ The same goes for Telegrafverket's responsibility for securing employment at STK. Thus, it was the remaining two fingers, the lack of competence and the role as an industry provider, which made it the first procurer of the 8B. As an industry provider, it supported STK's attempt to attain a mandatory position within ITT's switching business. Still, most of the evidence suggests that Telegrafverket lacked the competence to assess the question of crossbar switches thoroughly. It perceived itself as a facilitator of transmission and entrusted the industry with the switching issues. This is not to say that Telegrafverket did not consider the benefits of installing such a modern switch in Oslo, and the possible rewards STK could get from cooperating closely with BTM on the project - only that Telegrafverket was not in a position to evaluate the 8B and its future prospects in an adequate way.

Nera had a weak grip on Telegrafverket with respect to selling radiolink equipment. It could appeal to the PTO's responsibility as an industry provider, and activate political authorities to instruct Telegrafverket. In contrast to switching, radiolink involved no question of interfaces or maintenance of old equipment, and the employment issues were negligible. Telegrafverket had an ally in the Ministry of Communication and was thus able to free itself from Nera's potential grip. Most historians who have discussed the radiolink issue accept the «military technicians'» version, i.e. that Telegrafverket did not support Nera because it lacked competence. It is interesting that the scholars put less emphasis on the scepticism among FFI's own engineers, many of whom believed the technology was too futuristic to develop, especially for a small country like Norway.¹³⁶ The Air Force reasoned the same way when it rejected Nera's equipment.¹³⁷

Telegrafverket certainly had competence in transmission; perhaps that is why it did not want to buy Nera's equipment. Bjørn Gladsø, who started his tenure in Telegrafverket in 1955, stresses that the company certainly knew what it was doing when it disappointed Nera.¹³⁸ Maybe its competence enabled the PTO to assess the technological and financial issues, and thus be a demanding and proficient procurer. Without crediting Telegrafverket with foresight, it is worth mentioning that the technological development proved Nera-FFI to be wrong. Later development in coaxial cables provided much higher capacity, with which radiolink could not com-

¹³⁵ The Pentaconta was installed in networks that had Rotary switches, for instance in France.

¹³⁶ Njølstad and Wicken 1997, p. 139.

¹³⁷ Oland 1992, p. 13.

¹³⁸ Interview with Bjørn Gladsø.

pete. The political impact of the radiolink issue was immediate. The next chapter shows how this formed the discussion on how Norway was to handle the electronic revolution, and formed the Norwegian system of innovation in telecom in a decisive manner.

The negative effects of the 8B procurement did not surface before the late 1960s. During the 1960s, it contributed to increased sales for STK's telecom department. As Mo claims, the "8B became the backbone of STK's telephone-business".¹³⁹ A major source of revenues for STK's telecom business over the next years was to provide service and maintenance for the 8B. As the only user of the switch, Telegrafverket was totally dependent on STK, thus the 8B tightened the oligopolic grip. So STK profited from being a lonely rider with the 8B. The next chapter will show that a key reason for the 8B's expansion in the 1960s was that the government funding of Telegrafverket increased, in order to overcome the telephone queues. One may argue, as Mo does, that STK's system responsibility provided the firm with competence in switching technology and systems.¹⁴⁰ Yet this electro-mechanical competence was obsolete within a decade. The 8B also affected ITT's strategy. The resource-wasting battle between CGCT and BTM for switching primacy in ITT led the New York headquarters to seek greater coordination and control over its overseas subsidiaries. So, Harold S. Geneen was picked as Behn's successor, and became an epitome of the financial revolution that swept across the United States in the 1960s.

¹³⁹ Mo 2001.

¹⁴⁰ Mo 2001.

Chapter 3 STK as a foreign high-tech company

Introduction

Harold S. Geneen became ITT's CEO in 1959, and on one his first trips to Europe, he was received at the Orly Airport by ITT's renowned French scientist Maurice Deloraine. "Geneen looked him up and down for a few moments and then said: «Ah, so you are Deloraine, the fellow who spends all this money on research and development.»"¹ The incident encapsulates two key developments in the 1960s, namely the financial and electronic revolution. As such, this decade marked the beginning of the end of the electro-mechanical oligopoly, and digitalisation and liberalisation were in an embryonic stage. The chapter is not centred around Telegrafverket's procurement of switches from STK, but rather on how the increased focus on electronics and R&D, as well as ITT's financially oriented management, affected STK's room to manoeuvre.

There was an institutionalisation of a new R&D system in Norwegian telecom in the late 1960s, which was inspired by the same normative assumptions that came to underpin the system of innovation approach in the 1980s. Telegrafverket's research institute (TF*) became the foundation stone in the new R&D system. STK and EB were expected to take part, and as Olav Skeie claimed in 1960, they had a duty to attain a more active position in research and development within their respective multinationals.² To accommodate this, STK set up a Research Department (FA*). This chapter tries to explain the establishment of the FA in 1968. The TF gave STK development contracts to help them attain a mandatory position within ITT. This pinpoints a crucial theme of this thesis, namely STK's room for strategic manoeuvre in the telecom industry within Norwegian society and ITT's corporate structures.

A main rationale behind the FA was to increase STK's absorptive capacity, so it could import ITT's technology and products to Norway. Through this process of adapting and installing the technology, STK could attain the competence that could serve as a platform for industrial development. This indicates two contending perceptions of multinational companies, which is a second major theme in this chapter. The first is that foreign companies obstruct the development of a national industry. One way of avoiding foreign domination, as practiced, for instance, by the French government, was to nurture *national champions* within electronics. The other, more

¹ Deloraine to Sobel, Sobel 1982, p. 186.

* Norwegian abbreviation for Televerkets Forskningsinstitutt.

² *Telektronikk* 1961, here after Espeli 2005, p. 418.

* Norwegian abbreviation for Forskningsavdelingen.

positive perception, was that multinationals were diffusers of technology, competence and growth. The chapter shows how STK and EB chose different strategies in proving their worth to Norwegian society, by playing on these different perceptions of multinationals. On a different level of analysis, this dichotomy can be viewed in terms of competing corporate governance systems, which is the final theme of the chapter.

The financial and electronic revolution nurtured two conflicting corporate governance systems. Geneen's financial conception of business was epitomised by statements such as "the only line is the bottom line". In this perspective, employment, welfare, or economically relevant goods, such as competence and technology, were regarded as more or less irrelevant externalities of ITT's prime concern, i.e. profit-seeking. This was in stark contrast to the increased stakeholding that followed the creation of new R&D systems in the 1960s. The new normative assumptions regarding innovation that surfaced in the 1960s bore a strong resemblance to the *system of innovation* approach from the 1980s, not least because innovation took place through interaction between users and producers. STK's increasing cooperation and interaction with Norwegian institutions meant that its Norwegian stakeholders increased in number and importance. More than ever, STK had to balance between accommodating national stakeholders and American shareholders. It had to find its role as a foreign high-tech company.

STK's telecom business and lucrative long-term agreements

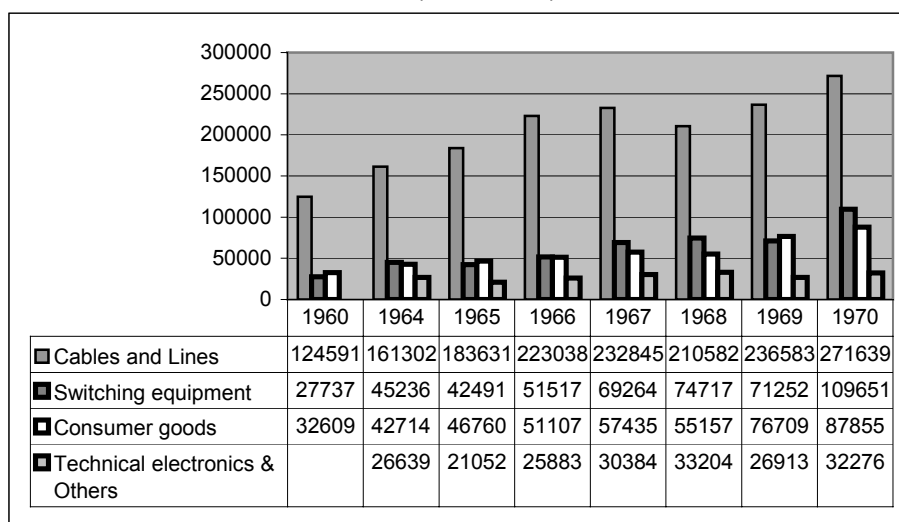
The growth of STK's telecom business in the 1960s was based mainly on the increased installation of the 8B switch, which in turn was a result of a new procurement regime for telecom equipment in Norway. STK and EB entered long-term agreements with Telegrafverket to rationalise the equipment suppliers' production. The main thing, however, was that Telegrafverket's investments increased, in order to get rid of the telephone queues. These long-term agreements were lucrative for the industry, as STK's figures for income on telecom equipment reveal. Unfortunately, we lack STK's figures for the first years of the 1960s, so the quantitative presentation is somewhat limited.

STK had experienced strong growth after the war; the number of employees reached 2725 in 1965, up from 675 in 1945.³ Sales in the 1960s increased from NOK 185 million in 1960, to NOK 501 million in 1970; the increase in fixed prices was 75 per

³ Sigmund Fjeldbo: *Veien fram - Telefonsentralmontørene ved STK gjennom 50 år 1933-1983*, 1983.

cent.⁴ The relative share of cable and lines decreased from 67 per cent of STK's total sales in 1960 to 54 per cent in 1970. Cables and lines for telecom were a growing part of this, representing 20 per cent of STK's total sales in 1970.⁵ As a result of ITT's conglomeration in the 1960s, STK had attained a sizeable consumer business, selling different types of domestic appliances produced by ITT companies; this grew from 10 per cent in 1964 to 16 per cent in 1970. Sales of telecom equipment increased substantially from the 1950s. They averaged 15 per cent in 1960, though they still included radio equipment, which was reclassified under "technical and others" from 1964. Telecom equipment accounted for 16 per cent of sales in 1964, and increased to 22 per cent in 1970, according to the annual reports. The sales increased from NOK 45 million in 1964 to NOK 110 million in 1970, with an 86 per cent increase in fixed prices. Switches, mostly the 8B, dominated this product line, with 79 per cent of the sales, which is why the annual report labelled telecom equipment as switching equipment.⁶

Table 3.1: STK's sales, 1964-1970 (1000 NOK)



Source: STK's annual reports.

⁴ Annual reports. The annual reports for 1962-64 are missing from STK's archive; the figures for 1964 are derived from the annual report for 1965. Inflation between 1960-70 was 54%, according to Statistisk Sentralbyrå's consumer price index (<http://www.ssb.no>).

⁵ STKA: STK's Business plans 1967-1971 & 1968-1972; the internal business plans submitted to ITT separated power cables from tele cables, which the public annual report did not.

⁶ STK's business plan 1967-1971; in 1966, switching equipment accounted for \$4.8 million, while total telecom equipment was \$6 million.

The 8B became the largest switching system in use in Norway, with almost 350,000 lines installed, and was running for nearly 40 years. A considerable part of STK's revenues came from 8B equipment for national automation, so one could call across districts automatically. STK installed a large transit switch for national automation in Oslo in 1965.⁷ Based on the increasing demand for the 8B, STK established a telephone plant in Kongsvinger; the location was a result of the government's policy for rural areas.⁸ STK held 60% of the Norwegian switching market in 1966, against EB's 40 per cent.⁹ The increased sales of the 8B in the 1960s were caused by the growth in Telegrafverket's investments, which in turned were a result of the wish to eliminate the telephone queues. Leif Larsen launched his tenure as Director General from 1962 with the slogan: "Do away with the waiting-lists!" The queues drained Telegrafverket, and were used against it in the radiolink conflict. In a lecture before NATO colleagues in 1959, the provocative Colonel Rørholt talked about Telegrafverket and its 17,000 employees in scathing terms: "A surprisingly large number is occupied with such tasks as collecting revenue or writing to subscribers, for instance to tell them that they cannot have a telephone installed until 1963 or something like that."¹⁰ Telegrafverket's network was indeed in a poor state in the 1960s.

Norway also failed to keep up with the automation of the network, both for local and long-distance calls. Hence, the Norwegian network was definitely not among the most modern in Europe. Technical problems, resulting in long waiting times for long-distance calls, the lack of a dialling tone, and problems getting through to other subscribers, gave Telegrafverket a bad image. Still, it was the telephone queues that hurt the most: the official records showed 80,000 applicants in 1965.¹¹ The queues would have been much longer than the official records reveal, if those who did not consider it worthwhile to apply were included. Moreover, the waiting time was long: nearly 5,000 applicants had waited for a decade in 1960, some as long as 20 years.¹² The inadequate telephone services also became a problem for the governing Labour party. The willingness to sacrifice something for the common good declined as the memory of the war became more distant, and the voters were no longer willing to accept Labour's portrayal of this as "wealth queues" or "welfare state queues".¹³ They were more inclined to accept the Conservative opposition's jibe,

⁷ STK's Annual report 1965.

⁸ STK's Board Meeting 06.10.66., and Annual report 1969.

⁹ STK's business plan 1967-1971.

¹⁰ Oland 1993, p. 34.

¹¹ Nils Jacobsen in St.f. 1964, p. 1345, (8. Dec.) "Telegrafverkets budsjett for 1965".

¹² Espeli 2005, p. 467.

¹³ Minister of Communication, Trygve Bratteli in St.f. 1960, p. 948; and Bratteli, in St.f. 1963, p. 1167.

that these were “flaw queues”, a sign of bureaucracy and political inability.¹⁴ The failure to present telephone queues as wealth queues affirms John Kenneth Galbraith’s assertion from 1958: “In the affluent society no useful distinction can be made between luxuries and necessities.”¹⁵

On the one hand, Telegrafverket received modest governmental funding, and on the other, the grants fluctuated from year to year, depending on the financial state of government. This led to employment problems for STK and EB, which had to lay off workers when Telegrafverket’s investments were reduced in 1964.¹⁶ There is every reason to believe that STK and EB suffered from the reduced procurement from Telegrafverket, but the companies also used the “employment card” in the negotiated environment, in pursuit of their own interests.¹⁷ The long-term costs of unpredictable funding for procuring equipment were high.¹⁸ STK and EB were not able to plan and rationalise their production of telecom equipment, which in turn rendered the equipment expensive. In addition to the economies of scale STK and EB could reap from larger and stable orders, Telegrafverket and the equipment suppliers would benefit from the ability to plan future deliveries and installations, not least in better resource allocation. This was especially important for Telegrafverket’s allocation of its switching experts, which were, to put it mildly, a scarce resource.¹⁹

The new Minister of Communication from 1964, Erik Himle, did not continue Brateli’s rhetoric that the telephone queues were a sign of prosperity. It was not the “lack of understanding for the telephone problem” that was halting the development, Himle maintained, “but the lack of capital”.²⁰ His short tenure as minister was busy;

¹⁴ Reidar Bruu (H) in St.f. 1964, p. 1347.

¹⁵ Galbraith 1958. Sejersted (2005) says: “The social democrats had problems in incorporating the consumerism. (...) They did not like the affluent society, but contributed to its making.”, p. 350.

¹⁶ Both companies had increased their capacity, in order to be able to meet Telegrafverket’s growing demand and verbal guarantees. EB decided not to go public with Telegrafverket’s verbal guarantee of increased orders. It figured that this would harm the relationship with Telegrafverket, on which the company depended. NTM-EBii: EB to Ministry of Communication 08.06.63; and Internal EB Memo 14.01.64, “Telefonsituasjonen - Fylkesarbeidssjef Fiskaa’s P.M. av 30.12.1963”.

¹⁷ Doz 1979, p. 62.

¹⁸ Thus, it was a short-sighted policy to let Telegrafverket’s investments be decided by the financial condition of the state. Besides the immediate problems for the workers at STK and EB, a structural problem became evident with the cutbacks in 1964.

¹⁹ Interviews with Bjørn Gladsø; Magnhild Slettbak.

²⁰ Erik Himle, St.f. 1964, p. 4326 (10. June) “Interp. fra repr. Kyllingmark om Regjeringen vil ta telefonpolitikken opp til ny vurdering.”

besides introducing a new financial policy for Telegrafverket, he was also in charge of the 1964 White Paper to the Stortinget that drew the political conclusions from the Tvedt Commission.²¹ This was a Post and Telegraph Commission established in 1955 to reorganise Telegrafverket and its relationship with the government. As the Commission argued, “Telegrafverket could not solve its financial problems within the present form of organisation”, as that entailed “a strong binding to the national budget”.²² Himle and the Labour party did not support “the recommendation of a more liberal solution for Televerket’s organisation”, and it “continued to be a part of the Norwegian central administration, but with the board and management now organised as a detached directorate” from 1969.²³

In addition, Himle was able to put a new procurement regime in place. STK and EB entered a four-year agreement for the supply of telecom equipment, and ITT and LME supplied loans in exchange. There were several reasons why the Labour government finally approved increased and sustainable funding of Telegrafverket. Firstly, there was a greater appreciation of the importance of telecom for business and growth.²⁴ Secondly, investment in the telecom network was no longer considered to be a zero-sum game. The industry was able to rationalise production, which in turn led to less expensive equipment for Telegrafverket, or at least greater profits for STK and EB. Third, the long-term agreements solved an employment problem for STK and EB. Finally, and most importantly, however, was the public outrage over the telephone queues, and the success of the political opposition in linking this to the perception of the Labour party as less concerned with the everyday life of the people. An indication of this was that while fewer resources were allocated to modernising the national network in the four-year plan for 1965-69, reducing the telephone queues “was given top priority in the new four-year programme”.²⁵

Himle feared that Telegrafverket was too close to the suppliers, and that they would not be tough enough in negotiating the long-term agreements with STK and EB.²⁶ Himle himself was a radiolink man from the armed forces, and regarded Telegrafverket as “cable-verk”. He asked Jens Chr. Hauge to lead the negotiations on behalf of Telegrafverket. Hauge had been a Minister of Defence and Justice in the

²¹ St. prp. nr. 82 (1964-65), “Telegrafverkets og Postverkets organisasjon m.v”.

²² St. prp. nr. 82 (1964-65), “Telegrafverkets og Postverkets organisasjon m.v”, (Telegrafverket ikke kan løse sine finansieringsproblemer innenfor den nåværende organisasjonsform som innebærer en sterk finansiell binding til statsbudsjettet.)

²³ Hauknes and Smith 2002.

²⁴ This is a general impression from Stortinget’s documents and debates.

²⁵ St. prp. nr. 82 (1964-65), “Telegrafverkets og Postverkets organisasjon m.v”, p. 20.

²⁶ Interview with Erik Himle, Minister of Communication 1964-65.

1940s and 1950s, and a key player in forming Labour's industrial policy. Himle wanted to exploit Hauge's competence in economy and negotiations.²⁷ This was not very successful, as Hauge lacked intimate knowledge of telecom, which was crucial in negotiating such agreements, since they were riddled with technicalities.²⁸ Telegrafverket benefited from the long-term agreement, but not as much as the suppliers did. The agreements were very lucrative for STK and EB, and both companies made large profits on their telecom business in the second half of the 1960s.²⁹ EB made most money on its supply of LME's crossbar switches, the KV, while for STK the tele-cables contributed the most.

STK had higher manufacturing costs for its switches than EB, since it was the sole manufacturer of the 8B.³⁰ Still, STK's switching business was very sound, with a return on sale, after taxes, of more than 4% between 1965-1968. Nevertheless, it was tele-cables that dominated STK's telecom business in sales and profit. Its return on sale averaged 7.2% in the same period and provided over 30% of STK's total net income between 1965-68, almost three times as much as the sale of telecom equipment. The high sales and profits in tele-cables were partly a result of the long-term agreements, which included transmission equipment, and enabled a more rational manufacture. STK's strong position in tele-cables was based on its cable competence. STK's switching business, however, was not up-to-date in terms of efficiency. Even if Sverre Ramstad was a very qualified telecom engineer, he was not perfect for running a telecom plant. The same goes for his successor, Ernst Berentsen, who became STK's telecom director in 1964.³¹ The director of tele-cables, Arve Rambøl, was recruited from FFI, and attained a strong position within STK; he replaced Sverre Ramstad as Technical Director in 1966. Thus, he was to direct STK through the electronic revolution the industry underwent.

²⁷ Interview with Erik Himle.

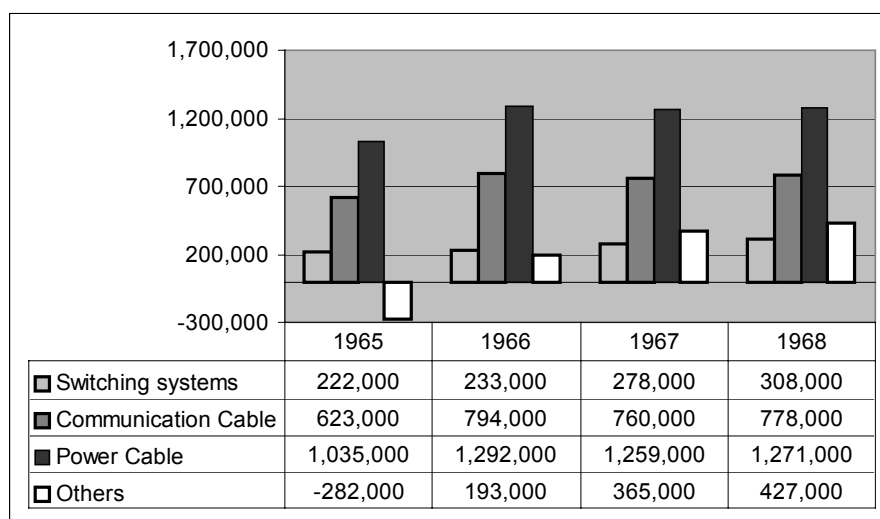
²⁸ Mo 2001.

²⁹ Espeli 2005, Thue 2006, Knut Elgsaas og Otto Døscher Tobiesens: *Samfunnsmessig styring av statlig forretningsdrift*, 1981, p. 138; Interview with Fredrik Thoresen.

³⁰ This became evident after Telegrafverket's cost inspections in the mid-1970s, see chapter 4.

³¹ Interview with Fredrik Thoresen.

Table 3.2: STK's Net Income after tax in dollars, 1965-1968



Source: STK's Business Plan 1967-1971 and 1968-1972

STK and EB reaped the bulk of the economic benefits from the long-term agreements; hence Telegrafverket was not successful in utilising its procurement power to reduce the prices. Telegrafverket tried to use this power for other purposes, however, as Larsen suggested the agreements “ought to have a clause” obliging the suppliers “to perform improvement and development work” in the areas covered by the agreement.³² This was merely to secure increased system competence on the equipment the companies sold to Telegrafverket. Larsen also suggested, however, there should be a clause stipulating that a “certain amount of the research and development work” performed by the parent companies of STK and EB “should take place in Norway”.³³ This suggests that Larsen wanted STK and EB to conduct R&D on a broader scale, to stimulate a general industrial development, and that Telegrafverket should use its procurement power to be an industry provider. The rest of this paragraph, however, gives an ambiguous impression of Larsen’s stance, as he considered whether to “demand that the ‘engineering group’ that worked in Antwerp with the 8-B switches” be transferred to Norway.³⁴ Thus, it remains unclear

³² NTM-EBiii: Larsen/Telegrafstyret to EB 08.05.65. (I avtalene bør en bl.a. få med bestemmelser om at leverandørene har plikt til å foreta forbedrings- og utviklingsarbeid på de områder avtalen omfatter).

³³ NTM-EBiii: Larsen/Telegrafstyret to EB 08.05.65. (Endelig bør en få med bestemmelser om at en viss del av det forsknings- og utviklingsarbeid som de to bedrifters moderselskaper driver, skal skje i Norge).

³⁴ NTM-EBiii: Larsen/Telegrafstyret to EB 08.05.65. (å kreve at den ”engineeringgruppen” som arbeider i Antwerpen med Standards 8-B-sentraler blir flyttet hit).

whether Larsen reasoned only as a service provider, or if he had the provision of industry in mind.

Larsen's suggestions regarding R&D were not included in the written agreement, but it is clear that it was a "tacit understanding" within the new procurement regime that STK and EB were obliged to participate in Norwegian industry in general, and the electronics industry in particular.³⁵ This was not least due to the improved financial results STK and EB attained from the long-term agreements. A main reason for why R&D became a part of the procurement regime was the increased focus on R&D and electronics in the 1960s. The next section looks into this.

Electronics and innovation

The word *electronic* did not come into everyday use before the 1950s; the rapid spread of the word reflects that the transistor is regarded as the most important invention of the 20th century.³⁶ It revolutionised several industries, through automation, and increased accuracy, control and production capacity. The development of semiconductor technology, or microelectronics, had a strong bearing on computers, which benefited several service industries, and it was also a major facilitator of new combinations of products and technologies. There were three basic developments in the electronic and computer revolution: *firstly*, the transition from electro-mechanical technology to semiconductors, *secondly*, the development of programming principles in computers; and *thirdly*, digital technology. All three developments radically changed the telecom sector. This section gives a short elaboration of technological change in the semiconductor and computer industry until the 1970s, before it moves on to an account of the new perceptions and understandings of research and technology that evolved in the western countries from the late 1950s.

The historical background to the transistor is closely related to the challenges of amplifying long-distance phone calls. The triode vacuum tube, developed by Lee De Forest in 1906 and perfected by Bell Labs, "allowed the signal to be amplified regularly along the line", and thus "a telephone conversation could go on across any distance as long as there were amplifiers along the way".³⁷ Yet, it proved to be unre-

³⁵ Interview with Jon Stenberg, who was Director of Personal relations in Elektrisk Bureau.

³⁶ It has been defined as the "technique that is based on the utilisation of the free electrons' physics in vacuum tubes, gas filled tubes and semiconductors, and encompass both the electronic elements and those apparatuses and equipment that exploits these elements." *Elektronikkutredningen* 1963, here after Jensen 1989, p. 108.

³⁷ "AT&T bought De Forest's patent and vastly improved the tube. It allowed the signal to be amplified regularly along the line, meaning that a telephone conversation could go on across

liable and the numerous tubes needed caused complexity. Bell Labs researched solid-state physics, hoping the solution might lie in the use of semiconductors. The use of radar during World War II brought advances in the use of tubes for detecting radio signals, as well as an understanding of semiconductors. In 1947, Bell Labs presented its first transistor.³⁸ AT&T licensed the technology, which contributed to a rapid distribution of the technology.³⁹ It had a wide variety of applications, not least for the military, which became the main market for the rapidly evolving semiconductor industry.⁴⁰

The increasing use of the transistor met with the same problem as the vacuum tube, i.e. problems of reliability and complexity. “As the number of transistors employed in a system grew, the probability that the failure of a single component or interconnection would cause a failure in the system increased exponentially”.⁴¹ The invention of the Integrated Circuit, in 1958/59, was a response to this; it combined several transistors on one silicon chip.⁴² The integrated circuit, or microchip, was later integrated into several different products, thus increasing the accuracy, reliability and applications of the product. It became a major building block in the digitised telecom network; moreover it was essential in the development of computers. Its successor was the microprocessor, invented by Intel in 1972.⁴³ This is a programmable microchip, containing thousands of transistors.

The different generations of electronic computers follow the development of semiconductors. The first generation of electronic computers used tubes, and was put into service in 1946. The IBM 360, launched in 1965, belonged to the second gen-

any distance as long as there were amplifiers along the way.” David C. Mowery and Nathan Rosenberg: *Paths of innovation: technological change in 20th-century America*, 1998, p. 124.

³⁸ Physicists John Bardeen and Walter Brattain at Bell Labs presented the point-contact transistor in December 1947. “Three years later, their colleague William Shockley developed the junction transistor, a vastly improved model that made the transistor commercially viable and launched the electronic revolution.” All three scientists won the 1956 Nobel Prize in physics, for their work. in <http://smithsonianchips.si.edu/augarten/pv.htm>

³⁹ AT&T sought cross-licenses in return for its patents. “As a result, virtually every important technological development in the industry was accessible to AT&T and all of the patents in the industry were linked through cross-licenses with AT&T.” Mowery and Rosenberg, 1998, p. 125.

⁴⁰ Mowery and Rosenberg, 1998, p. 125.

⁴¹ Mowery and Rosenberg, 1998, p. 126.

⁴² Jack Kilby at Texas Instruments invented the first Integrated Circuit in 1958; the components in Kilby’s Integrated Circuit were wired together. Fairchild Semiconductor presented a new Integrated Circuit in 1959, Robert Noyce was essential in putting all the components on a chip of silicon and connecting them with copper lines that were printed on an oxide layer.

⁴³ Chapuis and Joel, 1990, p. 111.

eration, using transistors. It marked the computer revolution, and became the leading mainframe computer that fortified IBM's dominant position in the 1960s and 1970s.⁴⁴ The third generation of computers, launched by Digital Equipment Corporation, used integrated circuits.⁴⁵ The fourth generation is marked by the microprocessor, and was widely used from 1975. As the underlying semiconductor technology has remained stable, subsequent computers have been regarded as belonging to the fourth generation, but processing power and storage capacities have increased beyond imagination, in accordance with (Gordon) Moore's Law, i.e. the number of transistors in an integrated circuit doubles every 18-24 months. At present there are several million transistors on a chip.⁴⁶

An essential factor in the development of computers was the Stored Program Technique, which implied that a computer could be programmed to perform different tasks and operations, regardless of its hardware.⁴⁷ It meant that the instructions could be reprogrammed according to new tasks, but also - which is pivotal for telecom - according to different surroundings. Another significant trait of the electronics and computer revolution was the development of digital technology. It was deployed in the first electronic computers after World War II; the registration of numbers in computers was initially done in a decimal form, but was replaced by binary digits, '0' and '1'. An essential feature of computer and telecom networks was that the binary digits could be transmitted easily, by varying the electrical signals, on/off. Pulse Code Modulation (PCM) transformed the human voice into a digital form, thus allowing digital transmission of voice telephony, which enhanced capacity, reliability and accuracy. Moreover, PCM became "the launching pad for digital switching" from the 1980s.⁴⁸ The rapid technological change from the late 1950s went hand in hand with an intellectual development regarding science and technology, which also had a strong impact on the telecom industry. The remainder of this section looks into this.

⁴⁴ "The computer performances were spectacularly increased regarding both speed of calculation and reliability", due to the transistor". Prices also fell in terms of quality of service offered." The use of computers spread rapidly: 20,000 were in use in the Western world in 1964, "80% of them in the United States"; Chapuis and Joel, 1990, p. 111. W. E. Steinmueller: "The U.S. Software Industry: An Analysis and Interpretive History.", 1996, p. 15-22.

⁴⁵ Chapuis and Joel, 1990, p. 149.

⁴⁶ The Large Scale Integration (LSI) in the 1970s, had tens of thousands of transistors per chip, than it was Very Large Scale Integration (VLSI) in the 1980s, with hundreds of thousands and beyond, well past several million in the latest stages.

⁴⁷ The stored program principle, i.e. that the instructions of the computer, the programme, were stored in the electronic memory, and were handled the same way as other numerical data, was essential to telecom.

⁴⁸ Chapuis and Joel 1990, p. 293.

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The developments of microelectronics contributed to an increased focus on research and technology, and its importance for economy and military made it a matter of high politics. The intellectual developments in *economics* reinforced this tendency. The awareness of the relationship between technological change and economic growth was strengthened in the late 1950s. Formerly, economic growth had been explained by the allocation of capital and personnel. A new generation of economists accentuated the human factor, i.e. technology and knowledge, or what is known as the residual factor. It is also called the “Solow Residual”, due to Robert M. Solow’s influential studies in this field; he claimed that 87.5% of growth in output in the US between 1909 and 1949 could be ascribed to technological improvements alone.⁴⁹ In an article from 1962, Kenneth J. Arrow claimed: “It is by now incontrovertible that increases in per capita income cannot be explained simply by increases in the capital-labour ratio”.⁵⁰

Moreover, Arrow and Richard R. Nelson presented the ‘underinvestment rationale’ around 1960. They claimed there was a market failure in R&D spending; firms would not invest as much in R&D as would be beneficial to society’s interest.⁵¹ Arrow asserted that there was a free-rider problem: “A conclusion was that private sector could be expected to underinvest in scientific research,” says Vernon W. Ruttan, and “that public investment would be necessary to achieve a socially optimal level of research.”⁵² A central presupposition for Arrow was that technology was regarded as information, which, as other commodities, is accessible at no cost. This perception, that technology was like information, was soon outdated.⁵³ Never-

⁴⁹ Robert M. Solow: "A Contribution to the theory of Economic Growth" in 1956.

⁵⁰ Kenneth J. Arrow. “The economic implications of learning by doing”, 1962. This was based on Moses Abramowitz: “Resource and output trends in the United States since 1870”, 1956; John W. Kendrick. “Productivity trends: Capital and labor”, 1956. These scholars laid the ground for what has been called the new economic growth theory, or endogenous growth theory, and gave an economic and academic justification for pursuing a more offensive science and technology policy.

⁵¹ Kenneth J. Arrow: “Economic welfare and the allocation of resources for invention”, 1962; Richard. Nelson “The simple Economics of Basic Research Scientific Research.” 1959; Here from Vernon W. Ruttan: *Technology, Growth and Development - An induced Innovation Perspective*, 2001, p. 538-539.

⁵² Ruttan p. 538-539.

⁵³ The prevailing paradigm regards technology and knowledge as sticky and context-dependent, which reduces the chance of copying. E. Von Hippel: “Sticky information and the locus of problem solving: implications for innovation”, *Management Science*, 40, 1994, 429-

theless, the underinvestment rationale was significant in gaining acceptance for increasing the public R&D spending, which was an important feature of the electronic revolution that took place in the United States.

The major inventions in electronics before 1970 took place in the USA. An important reason for the US dominance was the stable market that the military and NASA* provided, and the public funding of R&D. Important reasons for this were the Cold War, and the «space race» between the USA and the USSR, which was intensified after the Sputnik shock in 1957. President Dwight D. Eisenhower, warned about the *military industrial complex* in 1960, stating an “increasing share (of research) is conducted for, by, or at the direction of, the Federal government.”⁵⁴ John K. Galbraith’s concept of the *techno-structure* also pointed to the close ties between the government, business and the R&D system.⁵⁵ Hence, the role of the US government is decisive in explaining how the electronic revolution widened the technology gap between the United States and Europe. In his influential book, *The American Challenge*, Jean-Jacques Servan-Schreiber claimed that the “most serious (handicap) European business suffers in competition with its American rivals (...) is the systematic and organized assistance the US government gives to key industries through its contracts and research grants”.⁵⁶

Servan-Schreiber asserted that 63 per cent of the US electronic industry’s business was “in the form of government contracts, compared to 12 per cent for European industry”.⁵⁷ The US government financed 85 per cent of the electronic industry’s R&D. As a “percentage of sales”, Servan-Schreiber claimed, “European research funds are less than half those in the United States”.⁵⁸ The European countries were eager to narrow the “technology gap” and took on new R&D policies to enhance their competence and control in electronics.⁵⁹ They also had to confront an increasing volume of FDI from US companies. One of Servan-Schreiber’s main points was the degree to which large US corporations were increasing their operations in

439. Conf. Lucia Cusmano: “Technology Policy and Co-operative R&D: the role of relational research capacity” 2000.

* National Aeronautics and Space Administration.

⁵⁴ “Military-Industrial Complex Speech”, in *Public Papers of the Presidents, Dwight D. Eisenhower, 1960*, (<http://webusers.anet-stl.com/~civil/docs-militarycomplexeisenhower1961.htm>).

⁵⁵ John Kenneth Galbraith: *The New Industrial State*, 1967.

⁵⁶ Jean-Jacques Servan-Schreiber: *The American Challenge*, 1968, p. 44.

⁵⁷ Servan-Schreiber 1968, p. 44.

⁵⁸ Servan-Schreiber 1968, p. 44.

⁵⁹ OECD: *Gaps In technology: Electronic Components; Gaps In technology: Electronic Computers*; and *Gaps In technology: General Report*.

Europe.⁶⁰ Thus, there was an apprehension about being too reliant on the United States and American MNCs. Several books were published on the subject, including *The Americanization of Europe* and *The American Take-Over of Britain*.⁶¹

Still, there was also a trans-Atlantic cooperation, as many in the western societies perceived the Sputnik shock as a warning of future Soviet predominance in science and technology. Many feared that the liberal Western model was inferior to the state-dominated industrial policies in the eastern bloc. This feeling of inferiority seems paradoxical, taking into account the unparalleled growth the western societies experienced in the 'golden age' between 1945 and 1970, still, it created yet another rationale for state activism. In 1961, the former Marshall Plan organisation, the OEEC, was transformed into the OECD, i.e. the Organisation for Economic Cooperation and Development. In 1963, it published the Piganiol Report on "Science, Economic Growth and Government Policy", which, among other things, called for more public funding of R&D. In the same year, the Frascati Manual was drawn up to measure the level of R&D and technological development, and, thus, to help form policies.

The period up to 1960 is often characterised as the naïve period, where the linear model of technological development, i.e. science push, dominated.⁶² The new science and technology policy reflected a stronger belief in the ability to influence technological change.⁶³ R&D activity increased in general, particularly in electronics. An institutional infrastructure for allocating resources and coordinating R&D was established and national R&D programmes were launched. The intellectual and political development demanded new institutional forms, but one should not underestimate the impact of the new dominating technology, electronics. Christopher

⁶⁰ Servan-Schreiber was not in favour of a Gaullistic protectionism, but he stated that: "If we allow American investment to enter freely under present conditions, we consign European industry - or at least the part that is most scientifically and technologically advanced and on which our future rests - to a subsidiary role." Servan-Schreiber 1968, p. 52.

⁶¹ McCreary 1964; Servan-Schreiber 1968; McMillan and Harris 1968, Conf. Wilkins 1975, p. 345.

⁶² It was nurtured by the technological breakthroughs from 'big science' during the World War and the Cold War. Christopher Freeman: "The 'National System of Innovation' in historical perspective", 1995; Johan Hauknes and Olav Wicken: "Innovation policy in the post-war period - Trends and patterns" 1999. A commonly used reference to the "science-push" is J. Langrish, M. Gibbons, W.G. Evans, and F.R. Jevons: *Wealth from Knowledge: A Study of Innovation in industry*, 1972.

⁶³ The traditional notion, in line with the linear model, was that technology shaped society, but during the 1960s, there was a growing confidence that society could shape technology. Lars Fuglsang: "Three perspectives in science, technology and society studies (STS) in the policy context", in 2000.

Freeman and Carlotta Perez argue that economic and institutional development is motivated by shifts in techno-economic paradigms, each containing a new key technology.⁶⁴ Thus, a concrete institutionalisation took place, with the establishment of new organisations and public bodies, which reshaped, and to some extent, created new R&D systems. Moreover, institutions, in terms of norms and attitudes towards R&D, were also reshaped and created.

The perception of what spurred innovation also changed in this decade; incremental innovations, learning by doing, as well as new “mutations” of technologies, knowledge, competence, were accentuated as sources of innovation.⁶⁵ This has much in common with the ideas put forward in the literature on evolutionary economics and systems of innovation. The policies and institutionalisation that took place created new systems of science and technology, or what eventually came to be called *systems of innovations*. Being a general-purpose technology, electronics was decisive in shaping new attitudes towards innovation, as it facilitated new mutations of technology. Moreover, much incremental innovation took place by implementing electronics in products and processes. Hence there were reciprocal effects between the electronic revolution, the character and usage of electronics, and the abandonment of the linear model, and thus the development of evolutionary economics in the 1970s, and the system of innovation approach in the 1980s. The next section looks into how these processes took place in Norway, and how they formatted the Norwegian system of innovation in telecom.

A Norwegian system of innovation in telecom

In Norway, the policy discussions regarding a new science and technology policy, and electronics, were much influenced by the radiolink conflict, i.e. Telegrafverket's refusal to support Nera through procurement. It set off a policy debate concerning the procurement policy of Telegrafverket and other public institutions, which was coupled with the discourse regarding a new policy for science and technology and the electronic revolution. Those in favour of Nera-FFI, with the Minister of Industry, Kjell Holler, and FFI's Helmer Dahl in the lead, decided to confront Telegrafverket's procurement policy, by linking it to the challenges and possibilities offered by electronics. This section gives an account of the new norms related to innovation, by looking into the report of the “Committee for Electronics” (CE). Its

⁶⁴ The steam engine (late eighteenth century), railways (mid-nineteenth century), electricity (late nineteenth century), petrochemicals (early twentieth century) and information technology/electronics (mid-twentieth century). Christopher Freeman and Carlotta Perez: “Structural Crises of Adjustment: Business Cycles and Investment Behaviour.” 1988.

⁶⁵ Arrow 1962.

task was to “present propositions on what steps should be taken to stimulate the development of the electronics industry in Norway.”⁶⁶ Then it gives an account of the establishment of Televerket's R&D institute in 1967.

Norway was, as most countries, caught in an electronics fever from the late 1950s. In an award-winning thesis on how to develop an electronic industry in Norway, Telegrafverket's Olav Skeie stressed that electronics was both an independent industry and a *key* industry “for several other industries”. As he claimed, there were “few, if any, processes in the industry, that cannot be guided or regulated by electronic equipment”.⁶⁷ Electronics was particularly important for automation, which was a buzzword at the time.⁶⁸ The “fundamental new thing with today's technique”, Skeie continued, “is that electronics gives more and flexible possibilities for programming and regulation”.⁶⁹ Still, the economic implications of electronics were overshadowed by its key position in the society: “Electronic equipment has the same role in society as nerves and sensory organs in the body”, said the CE, and “accordingly, the right use of electronic equipment will have a big impact on how well a society functions, and how fast the material growth proceeds”.⁷⁰

Among the proponents of an offensive science and technology policy, it was common to stress that Norway was too dependent on hydroelectric power; that it needed to develop an industry based on knowledge and technology.⁷¹ To some extent, this was a battle between the traditional economists in the Ministry of Finance, known as the *power-economists*, and the *modernists*, who had strong allies among the military technicians from the FFI camp. Skeie wrote: “Today we float on low cost electrical energy, (which) may be a danger to our independence and prosperity.”⁷² His mes-

⁶⁶ The Committee for Electronics' report (Innstilling fra NTNFs Utvalg for Elektronikk), p. 1. (Fremlegge forslag om hvilke skritt som bør tas for å stimulere utbygging av den elektroniske industri i Norge.)

⁶⁷ The Norwegian Engineering Society arranged a thesis competition in 1958, on how to develop an electronics industry in Norway. One of the two winners of the competition was Telegrafverket's Olav Skeie. Skeie published his award winning thesis from 1958, in 1960, Olav Skeie: *Verdensmarked - Scientific management*, 1960p. 28-29.

⁶⁸ Kjell Holler, the later Minister of Industry and Director General of Televerket wrote a popularised book on electronics and automation, Kjell Holler: *Automatisering. Spøkelse eller realitet?*, 1957.

⁶⁹ Skeie 1960, p. 28.

⁷⁰ Innstilling fra NTNFs Utvalg for Elektronikk, (De elektroniske hjelpemidler spiller samme rolle i samfunnet som nerver og sansorganer legemet. (...) På samme måte vil den rette bruk av elektroniske hjelpemidler være av stor betydning for hvor godt et samfunn fungerer og hvor hurtig dets materielle vekst går frem).

⁷¹ Jensen 1989, p. 84.

⁷² Skeie 1960, p. 45.

sage was bold and desperate: the Norwegian electronics industry had to “expand or die”.⁷³ The modernists argued that knowledge-intensive industry; and first and foremost electronics, would be the industry of the future.⁷⁴ This reasoning gained ground in the late 1950s, in line with the international development. What is more, Norwegian economists were at the forefront of research concerning the residual factor’s impact on economic growth.⁷⁵ This, and the development of semiconductor technology, formed the background for Kjell Holler’s request to the Norwegian Research Council for Science (NTNF*) to set up a Committee for Electronics.

Besides praising electronics in general, CE’s main agenda was that public offices should play an active role in stimulating the Norwegian electronics industry through a national procurement policy and by giving development contracts to the industry. Kjersti Jensen claims that Holler and Dahl had decided to use the CE to substantiate the criticism of Telegrafverket’s procurement policy.⁷⁶ Thus, the report was very critical of Telegrafverket, both for its lack of competence and for not using its procurement power to stimulate Norwegian industry. The background to this criticism was Telegrafverket’s reluctance to procure Nera-FFI’s radiolink. The «military technicians» dominated the CE, which was headed by Helmer Dahl.⁷⁷ The overwhelming majority of members of the CE had taken a strong stance in the radiolink conflict. The main message was that Telegrafverket lacked an R&D unit, which would have enabled it to appreciate the benefits that Nera’s broadband radiolink provided.⁷⁸ The CE also accentuated that the import of electronic goods was high, and that the bulk of the imports was telecom equipment from ITT and LME.⁷⁹ Thus, Telegrafverket did not take on its role as an industry provider, by using its unique posi-

⁷³ Skeie 1960, p. 27.

⁷⁴ Olav Wicken: “Stille propell i storpolitisk storm. KV/Toshiba-saken og dens bakgrunn.” *Forsvarsstudier nr. 1/88 Institutt for Forsvarsstudier*, p. 13, her etter Jensen 1989, p. 3.

⁷⁵ Odd Aukrust and Juul Bjerke: *Realkapital og økonomisk vekst 1900-1956*, 1958. Here after Jensen 1989, p. 128.

* Norwegian abbreviation for Norges Teknisk- Naturvitenskapelig Forskningsråd.

⁷⁶ Jensen 1989, p. 94.

⁷⁷ The only member that did not count among the military technicians was Skeie. Telegrafverket was content to have him in the committee, but he was headhunted by EB before CE’s report was completed. CE’s other members were CEO Vebjørn Tandberg, Tandberg Radiofabrikker, Director Leif Gaudernack EB, R&D-director at FFI Karl Holberg, Chief engineer at Nera E. Kulvik, Colonel Rørholt, CEO Willy Simonsen, Simonsen Radio. Jensen 1989, p. 96.

⁷⁸ *Elektronikkutredningen* 1964, p. 116.

⁷⁹ The annual value of the Norwegian production in electronics amounted to NOK 200 million, which was about the same as the total value of the import of electronic goods. Jensen 1989, p. 109.

tion in Norway as a procurer of technology. Independent R&D was regarded as a necessary requirement for taking on such a role.

Telegrafverket had considered the research question in line with Skeie's memorandum of 1957, which had asked for better planning and coordination of Telegrafverket's business.⁸⁰ Håkon Nymoene, a laboratory engineer, was sent to Sweden in 1958, to study the Swedish PTO's R&D. His report stressed that it was imperative that Telegrafverket conducted independent R&D.⁸¹ Rynning-Tønnesen, however, did not want to get carried away by the "present research mania".⁸² Nevertheless, an internal committee was formed in 1959 to consider the R&D issue. The committee's report was finished in 1961, and it accepted Telegrafverket's modest *modus operandi*, due to financial constraints, and the lack of qualified personnel. Thus it advocated a laboratory, closely attached to Telegrafverket's everyday problems. It maintained, however, that the company needed "a more distinct research and development activity, to satisfy the demand society is entitled to put on Telegrafverket".⁸³ Little came out of laboratory report in 1961; the initiative was with the military technicians.

The CE did not recommend that Telegrafverket should carry out research in accordance with the science-push model. On the contrary, it accepted that big countries would lead the way in electronics, "but to think that one can exploit research results, without participating actively, is based on a misunderstanding".⁸⁴ R&D was essential to enhance the absorptive capacity, the CE claimed, and thus, it turned Arrow's free-rider argument upside down: to be a capable free-rider, one needs to undertake R&D. These issues were at the core for the CE, since Norwegian firms were small, there were few corporate R&D units, and the linkages to the public R&D institutes were weak. R&D was regarded as too academic, with modest commercial interest for business.⁸⁵ It was crucial to engage in independent R&D, mainly to be able to assess and exploit the R&D results of others. Besides, the committee tried to combat the linear perception of technological development, by stating that innovations that

⁸⁰ The Norwegian Telecom Museum, Ingar Hansen's delivery, 003.4 Telegrafstyret 1958-72: "Om utbygging, eventuelt reorganisering av de tekniske avdelinger ved Telegrafverket, Av O. Skeie II.F.15/12-57".

⁸¹ Oland 1993, p. 56 f.

⁸² Rynning-Tønnesen at telephone-engineer meeting in 1959, *Teletronikk* 1959: 81 and 85; here after Espeli 2005, p. 420.

⁸³ Innstilling fra Telegrafstyret laboratorieutvalget av 1961, here after Oland 1993, p. 60.

⁸⁴ Elektronikkutredningen 1964, p. 123, (men å tro at man kan utnytte forskningens resultater uten selv å følge aktivt med, bunner i en misforståelse).

⁸⁵ Jensen, 1989, p. 131; Bjørn Ole Helsing Lossius: *MARSAT - Prosjektet. Om utviklingen av teknologi og industri for maritim satellittkommunikasjon*. 1991.

took place in the production process, had economic significance, and that R&D would stimulate this sort of innovation. Consequently, the theoretical origins of the system of innovation approach are traceable in the CE's report.

A focal point of the system of innovation approach, emphasised by Bengt-Åke Lundvall, is that innovation takes place through interaction, and interactive learning, between users and producers of technology.⁸⁶ Fridlund's study of the Swedish PTO and LME is based on this assumption.⁸⁷ The CE's report was in accordance with these ideas, and praised the close cooperation between the PTOs and national equipment suppliers in Sweden and other countries, which, according to the report, contributed to industrial growth and a modern telecom network.⁸⁸ CE advocated a similar role for Telegrafverket, and asked for a two-step development: Telegrafverket should upgrade its competence through R&D, and then it should engage in cooperation with the industry in the early stages of product development. Moreover, Telegrafverket should finance parts of the industry's R&D costs through development contracts.⁸⁹ The aim was to establish relations between Telegrafverket and the industry, to spur innovation. Based on its competence acquired from R&D, Telegrafverket should act as a demanding customer, and engage in interactive relationships with its suppliers.

The CE asserted that when Telegrafverket preferred to procure equipment from foreign companies, it was because of its meagre competence. Even if it was a greater risk to procure equipment from domestic suppliers than from large multinationals, Telegrafverket was not able to consider this risk. Moreover, even if foreign equipment would be beneficial for an isolated project, in the short run, Telegrafverket lacked the proficiency to assess this question. The CE argued that it would be better, in the long run, to establish relationships with domestic equipment suppliers. In procuring from domestic firms, the concrete interaction would be established. This was in accordance with Lundvall's assertion that "long-term interactive learning is most easily organised in a setting where there are few linguistic and cultural constraints for the transfer of tacit knowledge and where a

⁸⁶ Lundvall 1988; Lundvall (ed.) 1992. Close relations between suppliers and customer have given rise to a great deal of research in the so-called IMP group (International Marketing and Purchasing Group). confer for instance Håkan Håkansson and Ivan Snehota: *Developing Relationships in Business Networks*, Routledge 1995.

⁸⁷ Fridlund's study is a part of a book edited by Charles Edquist, one of the founding fathers of the system of innovation approach.

⁸⁸ *Elektronikkutredningen* 1964, p. 55.

⁸⁹ Collett 1984, p. 7.

cultural constraints for the transfer of tacit knowledge and where a multilateral system of trust relationships can most easily be organised”.⁹⁰

For a committee for *electronics*, it is noteworthy how little attention was paid to electronics technology in the CE’s report. The committee’s main concern was the public procurement policy in Norway; therefore Eirik Oland is right in asking if this was merely a request for protectionist measures, due to the European integration and Norway’s membership in EFTA* from 1960.⁹¹ When the CE report was circulated to concerned parties for comment, the NTNF was asked to produce a national dossier on general R&D.⁹² The NTNF decided that the CE’s report should function as the section on electronics in the general R&D dossier, with an additional R&D report on electronics. The R&D report from 1964 was in line with the CE’s report, stating that it was critical for Telegrafverket to establish an R&D department, in order to function as a locomotive for the electronics industry in Norway.⁹³

Telegrafverket’s board of directors formed a working committee in December 1964, and agreed on “a close cooperation between FFI and Telegrafverket in the research work”.⁹⁴ The Director General from 1962, Leif Larsen, and FFI director, Finn Lied agreed that Telegrafverket’s R&D unit ought to be located alongside FFI’s main office at Kjeller outside Oslo. Sharing expensive equipment and favourable areas were arguments that were put forward, but the main reason was to detach the R&D unit from Telegrafverket, and to put it under FFI’s influence. Telegrafverket’s technical environment was regarded as so conservative, according to Knut Endresen, who worked for FFI at the time, that it was considered a necessity to separate the R&D unit from it.⁹⁵ Telegrafverket was a hopelessly backward organisation; according to Ole Petter Håkonsen, who worked for ELAB at the time and later became technical director at Televerket, “only jerks would start to work there”.⁹⁶ It was

⁹⁰ Lundvall et. al. 2002, p. 219-220.

* European Free-Trade Association.

⁹¹ Oland 1993, p. 85. In 1959, The Ministry of Industry asserted that protectionist measures were necessary to preserve the Norwegian telecom industry, and that a significant amount of hard currency would be saved. St. meld. 1959 nr. 4 Om statens innkjøp, here after Oland 1993, p. 45.

⁹² The initiative came from two Labour-MPs, who thought that too much of the government’s R&D funding was allocated to nuclear research. Interview with Director of NTNF, Robert Major, in *Forskning nr. 2 1996*. Nuclear research used 15 % of the government’s R&D funding according to Major. Conf. also Oland 1993, p. 103.

⁹³ NTNFs Forskningsutredning 1964, and Oland 1993, p. 105-106.

⁹⁴ Telegrafverket’s Styremøte 11.12.64. (Det var enighet om et nært samarbeid mellom FFI og Telegrafverket i forskningsarbeidet.)

⁹⁵ Knut Endresen in interview with Oland 1993, p. 147.

⁹⁶ Ole Petter Håkonsen and interview with Oland 1993, p. 147.

regarded as necessary to let FFI direct the development during the first years, before it could stand on its own feet.⁹⁷ In July 1965, Telegrafverket decided to set up an R&D unit at Kjeller, and “as soon as possible to build up Telegrafverket's research team”.⁹⁸

Telegrafverkets Forskningsinstitutt (TF) was established in 1967, alongside FFI at Kjeller.⁹⁹ Telegrafverket chose Nic. Knudtzon as the R&D-director, at the expense of Håkon Nymoen, who became second in command.¹⁰⁰ Knudtzon belonged to the FFI camp; Helmer Dahl was his supervisor while he wrote his graduate thesis at the Norwegian Institute of Technology (NTH*), and he worked at FFI's telecom department for two years. Unlike most others, however, he had spent considerable time overseas, first two years at MIT* in 1948 and 1949, and at SHAPE* in The Hague from 1957 to 1968.¹⁰¹ One of the first things Knudtzon did was to change the R&D unit's name from Laboratory, as it was called in the preparatory reports, to Research Institute. He thought laboratory was too “equipment-oriented” and wanted to signal a higher level of ambitions for the TF.¹⁰² Knudtzon said he wanted the TF to assist Telegrafverket in its procurement of equipment, and to function as Telegrafverket's watchdog towards the industry. Still, he did not want the TF to get caught up in Televerket's day-to-day business. Knudtzon's fear was in line with most other PTOs' R&D units, and followed a “classic blueprint for the organization of corporate R&D in the Telecoms Industry” in keeping “an arm's-length relationship with the company's businesses”.¹⁰³ Thus, it is indicative that long-term planning was not far-reaching enough for Knudtzon, so he replaced the phrase with distant-time planning.¹⁰⁴

⁹⁷ Knut Endresen in interview with Oland 1993, p. 147.

⁹⁸ Telegrafverket's Styremøte 20.07.65, (så snart som mulig å bygge opp et Telegrafverkets forskningsteam).

⁹⁹ Actually it moved to Kjeller after a few months, in November 1967.

¹⁰⁰ Telegrafverket's “Styremøte 8. mars 1967, 55. Innstilling av forskningssjef”.

* Norwegian abbreviation for Norges Tekniske Høyskole.

* Massachusetts Institute of Technology.

* Supreme Headquarters Allied Powers Europe.

¹⁰¹ Thus, he did not start at Telegrafverket before 1968. Interview with the former Head of TF, Nic. Knudtzon; Collett and Lossius 1993, p. 36 f.

¹⁰² Collett and Lossius, 1993, p. 43.

¹⁰³ The blueprint “was published in 1971 by Dr. Jack A. Morton, who became vice president of Bell Laboratories” Jack A. Morton: *Organising for innovation: A Systems Approach for Technical Management*, McGraw-Hill, New York 1971. Here after Martin Fransman: *Telecoms in the internet age: from boom to bust to....?*, 2002, p. 218-219.

¹⁰⁴ Collett and Lossius, 1993, p. 43.

An essential part of the rationale behind the TF was the anticipation of a fully digitised telecom network. Knudtzon gave a speech in 1970 that illuminates the TF's cognitive landscape at the time: "We must not believe that we are only just now living through an information explosion, which soon will pass. The fact is, that we are subjected mercilessly to an accelerating law and are only at the initial phase of a massive explosion."¹⁰⁵ There were three technological areas in particular into which the TF wanted to channel its resources: firstly, digitising the transmission network by Pulse Code Modulation (PCM); secondly, data communication, and thirdly, switching.¹⁰⁶ An important area, encompassing these three fields, was "network planning", that was to develop means to monitor the whole telecom network day-by-day, and to plan the future digital network. Another important area for the TF, detached from the digital network, was (maritime) satellite communication. Even if it was not dependent on digital technology, it pointed towards a central technological field for the forthcoming ICT revolution, namely wireless communication.

Knudtzon had ambitions to assist Telegrafverket in modernising the network, but also on pressing technical issues and in procuring equipment, the TF wanted to be a watchdog towards the industry. Last but not least, it wanted to contribute to industrial development. It was to play a national and integrating role for R&D activities in the Norwegian telecom industry. Knudtzon said the TF was to be the spearhead of a triangle, consisting of the TF, other relevant R&D institutes, and the industry.¹⁰⁷ The obstacle for use of development contracts, however, was the lack of nationally owned companies in the telecom industry. The Norwegian authorities were in line with most governments in giving preference to national industry in their industrial policy. The governmental *Development Fund** was established in 1964 to support Norwegian industry in general, and the Norwegian electronics industry in particular. STK was granted a loan for developing a "self-deadened" telecom-line, but the foundation supported mainly nationally owned companies.¹⁰⁸ When the chairman of the Development Fund, Erik Brofoss, talked of *key companies* in the electronics industry, it went without saying that these were nationally owned. These included Kongsberg Våpenfabrikk, Simrad and Tandberg.¹⁰⁹

¹⁰⁵ Quoted from Lossius, 1991, p. 131.

¹⁰⁶ Nic. Knudtzon: "Perspektiver for teleteknikken og status for televerkets forskning: foredrag Norsk telefoningeniørmøte, Rauland, 9.-11 juni 1972" 1972, Collett and Lossius, 1993, p. 61.

¹⁰⁷ Interview with the Nic. Knudtzon; Collett and Lossius, 1993, p.94.

* Utviklingsfondet.

¹⁰⁸ RAUii: "Referat fra Utviklingsfondets styremøte 24.02.70, sak 224 STKs selvdpende linjer"; and "STK til Utviklingsfondet 07.08.70".

¹⁰⁹ Sogner 1994, p. 35.

The TF, however, argued that national ownership would be an impossible criterion in the telecom industry, as there were no Norwegian companies of any significance. One had to exploit the subsidiaries, i.e. STK and EB, both for their industrial competence as large companies, and their access to LME and ITT's knowledge and R&D network. The Department of Industry accepted that foreign-owned subsidiaries could sign development contracts, but required that the results of the contract were utilised in Norway.¹¹⁰ An important mission for the TF was to promote the subsidiaries' position within LME and ITT. Knudtzon argued that by use of R&D contracts, the TF could help STK and EB "win the internal MNC competition among the subsidiaries, so resources and mandate could be allocated to Norway with possibilities for export".¹¹¹

This line of reasoning - that TF/Telegrafverket should assist STK in its internal competition within ITT - pins down the essence of this thesis, i.e. STK's room for strategic manoeuvring in the telecom industry, within Norwegian society and ITT's corporate structures. It highlights the four theories or approaches this thesis applies, namely the significance of government and industry relations; systems of innovation; MNCs' global strategies and corporate governance. The corporate governance perspective is pertinent, in as much as TF/Telegrafverket and the government challenged ITT and LME's positions as sovereign stakeholders in STK and EB, respectively. In the new system of innovation, and/or changing negotiated environment, it was not obvious that STK's main obligation was to serve ITT; it might as well be to contribute to developing a Norwegian high-tech industry. Thus, the new R&D system that came with the TF reinforced STK's schizophrenia, of being a small subsidiary within ITT, and a large Norwegian high-tech company. At the same time, however, as national actors raised their status as STK's stakeholders, so did ITT. When the electronic revolution swept across the United States, ITT fronted a financial revolution, helmed by Harold S. Geneen.

Geneenism

Behn's standing in the US press was not high at the end of his tenure in the late 1950s; ITT was dubbed a "non-profit organisation".¹¹² Its strategy and structure were blurred, and the trouble related to the 8B and Pentaconta had not passed unnoticed.¹¹³ The New York head office lacked control and influence over the European

¹¹⁰ Collett and Lossius, 1993, p. 90.

¹¹¹ TF's annual report 1970, here from Lossius 1991, p. 91.

¹¹² "Stig M. Eriksson's memorials from his time in the Swedish ITT house Standard Radio & Telefon AB" in http://www.iclinvia.se/veteran/99q4/itt_hist.htm (1999-09-22).

¹¹³ Schoenberg 1985, p. 126.

subsidiaries, which provided the bulk of the revenues and profits. It was said that “every year”, the subsidiaries “delivered a bag of money to New York - maybe”.¹¹⁴ The board wanted a leader who could perform financial control, and they could not have found a better man than Harold S. Geneen, who was regarded as a financial wizard. He became ITT's top man in 1959, and used it as a vehicle for creating one of the largest conglomerates in the world, guided by a financial logic. ITT's turnover rose from some \$765 million in 1960 to \$14.6 billion in 1976.¹¹⁵ It was said that Geneen “acquired 350 businesses in 80 countries”, often, “after inspecting a company's books for no more than ten or 20 minutes”.¹¹⁶ By the end of the 1960s, telecom accounted for only one third of ITT's sales, and the domestic business dominated ITT sales - if not profits.¹¹⁷

Geneen's main argument for ITT's domestic growth policy was that the share of revenues from the United States, the domestic market, was too small. “Our real problem”, Geneen claimed, “was that some 80-85 percent of (...) earnings came from abroad and were subjected to the particular economic conditions and political vicissitudes in these countries”.¹¹⁸ Fidel Castro, for instance, expropriated ITT's Cuban subsidiary in 1960; ITT had also lost six subsidiaries in the Eastern European bloc, and was constantly worried about the “weak currencies in Western Europe in relation to the strong American dollar”.¹¹⁹ Behn had also pursued growth through a merger and acquisition strategy, but he sought to diversify within ITT's field of knowledge, i.e. in the electronics industry and communication business.¹²⁰ Geneen, however, also sought to capitalise on ITT's industrial and technical knowledge, but it was the financial aspects that mattered in his growth strategy.

Geneen was regarded as a financial genius, and he thrived in the economic boom in the 1960s. This has been called the decade of conglomerates, and ITT is a prime example among giants like Textron, Litton and Gulf & Western. Conglomeration, or unrelated diversification, denotes large corporations with companies in unrelated

¹¹⁴ Schoenberg 1985, p. 109.

¹¹⁵ “Rand Araskog redeploys ITT: high tech is the guiding light” in *International Management Europe*, February 1985.

¹¹⁶ “Tyrants, Statesmen, and Destroyers (A Brief History of the CEO)”, in *Fortune Magazine* 18.11.02.

¹¹⁷ “Foreign sales (outside North-America) of \$2 billion represented 36 percent of the conglomerates total but generated 45 percent of the profits.” Stephen A. Allen: “Case 5-1 - International telephone and telegraph corporation”, 1979, p. 279.

¹¹⁸ Geneen and Moscow, 1984, p. 201.

¹¹⁹ Geneen and Moscow, 1984, p. 201.

¹²⁰ Sobel 1982, p. 190 f., Geneen and Moscow, 1984, p. 202.

industries and sectors, where the economies of scope or synergy are negligible.¹²¹ A motive was to balance the cycles of the incumbent companies. This was for instance Nokia's argument when merging with two other companies in 1966.¹²² Others have claimed that the CEOs were motivated more by the building of corporate empires than by increasing profits. Still, there was a logic behind the conglomerates, as by sharing administrative costs and instigating financial control and modern business standards, one could fulfil the profitable potential of companies. ITT's ownership advantages during its conglomeration were its ability to carry out financial control and managerial streamlining of acquired companies. Geneen epitomised what Neil Fligstein perceived as essential in the financial conception of the firm, namely that "firms are viewed as collections of assets earning differing rates of return", rather than "as producers of given goods".¹²³

There were numerous grounds for the conglomeration process. First, the US anti-trust laws put restrictions on horizontal and vertical integration, thus firms that sought external growth opted for unrelated diversification, in order to avoid prosecution.¹²⁴ A second precondition for the merger wave was the bullish stock market in the United States during the 1960s, which encouraged companies to finance acquisitions by stocks.¹²⁵ Another significant condition for the conglomeration in the 1960s, lay in the US management tradition, in the belief that a manager could manage anything.¹²⁶ After Peter F. Drucker's seminal book *The Practice of Management*, published in 1955, skilled managers were perceived as a vital and a scarce resource, along with other economic factors. Hence, if one could allocate "skilled

¹²¹ The distinction between *related* and *unrelated* diversification will often be a matter of opinion. While CEOs in acquiring firms often will claim that there are synergies, critics will argue that managers are raising their own prestige, rather than the shareholder's value. In the last decades, the term conglomerates has become an insult to a company, and core competence has been the credo. (Conf. Gary Hamel and C. K. Prahalad: "The Core Competence of the Corporation", 1990 and Gary Hamel and C. K. Prahalad: *Competing for the Future*, 1994). Still, it might be that the financial logic behind the conglomerations in the 1960s was sound, while it is not today. Most large companies today have implemented modern management principles and better financial control, hence there are less margins to be reaped by doing this.

¹²² Martti Häikiö: *Nokia - The inside story*, 2002, p. 49. The three companies were in the rubber, wood, and cable business, and started with electronics in the 1960s.

¹²³ Fligstein, 1990, p. 15.

¹²⁴ Fligstein, 1990, p. 28.

¹²⁵ The effects might have been reciprocal: the bull market might have been a result of the financial conception of the firm. This led to greater focus on things that increased the stock price, such as short-term profit. Fligstein, 1990, p. 28.

¹²⁶ Haldor Byrkjeflot og Tor Halvorsen: "Institusjonelle forutsetninger for faglig og profesjonell ledelse - industriedelse i Tyskland og USA" 1997, p. 107f.

management” better within a conglomerate, one could capitalise on it.¹²⁷ The MBA education focused on strategy, management and finance, which were necessities in every industry. These qualifications implied a stronger focus on standardisation and financial performance, and less on craftsmanship and industrial development. In as much as the distinction is noteworthy, companies were more interesting as producers of profits, than of products.

A normal way to enhance the profitability of an acquired company was to perform what ITT called “defensive football”, i.e. retain the line of the business that contributed sufficient return, and cut of the rest.¹²⁸ Geneen increased margins by striving constantly for better resource allocation. In a sense, ITT's conglomeration was a matter of renovating and modernising the acquired companies. Consequently, Geneen aimed to exploit existing capabilities, or ownership advantages, rather than to create new capabilities. His abovementioned meeting with Maurice Deloraine at Orly Airport, supports this. Peter Young cites two technological conditions that were crucial for ITT's growth: the “electronic computer and the jet engine”. While the computers “kept track of the mass figure”, the jets allowed ITT staff to “fly to potential trouble spots”.¹²⁹ This gave ITT the nickname of “International Talking & Travelling Corporation!”¹³⁰ It furnished an infrastructure for Geneen's regime, with rigorous reporting and five-year business plans from all companies. “Harold Geneen likes facts. His whole corporate structuring of ITT was geared to rooting out the facts.”¹³¹ His obsession with facts went hand in hand with a centralised management philosophy, in which all major decisions had to be analysed and evaluated by the head office and Geneen himself.

¹²⁷ Peter F. Drucker: *The Practice of Management*, Pan Books: New York, 1954. The book was written for General Electric, and the conclusion - that a manager could manage anything - was allegedly ordered by GE, in order to legitimise its conglomeration. Michael Goold and Kathleen Luchs “Why diversify? Four decades of management thinking” in 1993.

¹²⁸ “Hand in hand with such reorganization goes a technique that (John) Lobb and his managers call «defensive football.» Normally, they have found that only 20 percent of an acquired company's products contribute as much as 80 percent of its profits. «We believe,» says Lobb, «that if a product line doesn't return 8 percent after taxes on the capital employed, you should get the hell out of that business.»“ Allen 1979, p. 276.

¹²⁹ Young 1983, p. 142.

¹³⁰ “Stig M. Eriksson's memorials from his time in the Swedish ITT house Standard Radio & Telefon AB”, in http://www.iclinvia.se/veteran/99q4/itt_hist.htm (1999-09-22).

¹³¹ “How Harold Geneen Managed It: His Way”, *The Washington Post*, 11.11.84.

*“I want to know what’s going on. I don’t want some proud guy get into his own Vietnam and then suddenly hand me his resignation. Hell, his resignation can’t bring back the \$10 million he’d lose. (...) That’s why I make everyone tell me about red-flag areas-spots where trouble may be brewing.”*¹³²

Managers were summoned to ITT's headquarters every month, except August and December, to present reports and plans, and to be cross examined by ITT's top management and their equals. These managerial showdowns became a trademark of ITT and Geneen.¹³³

Geneen's principles and management style were regarded as extraordinary in the United States, but the real task was to implement Geneenism in the overseas companies. The European subsidiaries were among ITT's cash cows at the beginning of Geneen's tenure. Merrill Lynch claimed, “You could do nothing at the top of ITT and still make some money.”¹³⁴ Still, the profit ratio in Europe was not impressive compared to assets or sales. “Behn's concept of management,” according to a former aide, “was simply to organize to take advantage of all the tax laws - particularly European laws on dividend”.¹³⁵ His strategy of national responsiveness rendered any form of integrated strategy for the European ITT companies impossible. Yet, this meant that the potential returns from rationalising, streamlining, financial control, and not least increased coordination and cooperation between the European companies were very large.

To instigate coordination and cooperation among the European companies, Geneen set up ITT-Europe.¹³⁶ The managerial meetings in Brussels took “the physical form of a monthly invasion”.

¹³² Allen 1979, p. 296.

¹³³ One of several cited scenes, appears as follows: Geneen: “John, what have you done about that problem?”; John: “Well, I called him, but I couldn't get him to make a decision.”; Geneen: “Do you want me to call him?”; John: “Gosh, that's a good idea. Would you mind?”; Geneen: “I'll be glad to. But it will cost you your pay check.”; A flustered John: “Never mind, I'll call him again myself.” Allen 1979, p. 272.

¹³⁴ Schoenberg 1985, p. 108.

¹³⁵ Robert F. Chasen in Schoenberg 1985, p. 109.

¹³⁶ The headquarters were located in Brussels, to avoid offending the national pride of the Germans or French. Schoenberg 1985, p. 123. At first the European management did not take Geneen's efforts seriously. Both his predecessors, Harrison and Leavy, had tried to rationalise and integrate the European business, but were unable to circumvent the national interest of each company and host country. The Europeans realised Geneen was serious when he spent “about 25% of his time in Europe”, as did “much of his staff”. Schoenberg 1985, p. 124.

On the last Monday of every month, a Boeing 727 takes off from New York to Brussels, with sixty ITT executives aboard (...). For four days they stay in Brussels, still insulated in their special ITT world: many of them keep their watches on New York time. Most of their time is spent in the marathon meetings which are the core of the system".¹³⁷

When Geneen reviewed the reports and plans of the managers "he made them think even more", so they could "understand the financial implications and inconsistencies in front of their colleagues".¹³⁸ Some European managers were replaced by Americans, and the rest had to learn "a new language: the meaning of terms like cash flow, return on assets, and key ratios."¹³⁹ Allegedly, the managers "acquired new attitudes: that they were businessmen rather than engineers, that there were no compulsion to be in a technology if it was no business".¹⁴⁰

Geneen succeeded in implementing new attitudes, and in introducing a financial vocabulary and a rigorous report system in Europe.¹⁴¹ He also succeeded in introducing some co-ordination and cooperation among the European subsidiaries.¹⁴² His efforts to avoid duplication of production, internal competition and to stimulate cooperation among the European subsidiaries were natural, given his focus on efficient resource allocation. It was difficult, however, for most MNCs to coordinate the subsidiaries' functions and allocate resources according to locational advantages. If MNCs wanted access to markets with trade barriers, they had to comply and produce in the host countries.¹⁴³ The MNCs' response, according to Robert Pearce, was "separate manufacturing subsidiaries operating in each important national market".¹⁴⁴ As a consequence, the subsidiaries were miniature replicas of the parent

¹³⁷ "A meeting is a wierd spectacle, with more than a hint (as one of them complained) of Dr. Strangelove. About 120 people are assembled in the specially equipped fourth-floor room, with cool air-conditioning, soft lighting and discreet microphones. The curtains are drawn against the daylight and a big screen displays endless tables of statistics. Round a big horse-shoe table sit the top men of ITT from America and Europe, like diplomats at a conference. In the middle, swivelling and rocking to and fro in his armchair, surveying the faces and gazing at the statistics, is an owlsh figure behind a label saying Harold S. Geneen." Anthony Sampson: "The last Tycoon" in *Business Observer*, 7/9/72.

¹³⁸ Young 1984, p. 143.

¹³⁹ Young 1984, p. 143.

¹⁴⁰ Young 1984, p. 143.

¹⁴¹ STKA: STKs Business Plan 1967-1971, 1968-1972 and 1971-1975, ITT Scandinavia Business Plan 1970-1974.

¹⁴² An observer to one of the first meetings "could sense the gasp spreading around the table. The French couldn't conceive of giving the Germans information, the Germans giving the British information, etc. This was a whole new ball game". Sobel 1982, p. 187.

¹⁴³ Pearce 1999; Joseph R. D'Cruz: "Strategic management of subsidiaries", 1986, p. 132.

¹⁴⁴ Pearce 1999; D'Cruz 1986, p. 132.

company, replicating the mother company, only on a smaller scale and, mainly, in a more inefficient way.

Geneen sought to combat the subsidiaries' character as miniature replicas, and he did succeed, in industries other than telecom. ITT's European subsidiaries also had interests outside the telecom business before Geneen's period, mainly in other fields related to electronics. The size of the non-telecom industries increased substantially under Geneen, since he brought the merger and acquisition wave to Europe. Thus, the product portfolio of the subsidiaries was enlarged, to include domestic appliances, TV, and radio. A large part of ITT's European business, however, such as Sheraton and Avis, was not managed by the incumbent subsidiaries. To a certain degree, Geneen managed to structure the European business according to national advantages. An important instrument was the introduction of Product Line Managers (PLM), residing in New York.¹⁴⁵ Geneen was cautious, however, not to provoke the national managers, and started off by supporting them against the PLM.¹⁴⁶ "Having first "gained the Europeans' confidence and respect", he switched tactics and "gradually sided with the PLMs when it came to commercial and consumer products, where national considerations did not intrude."¹⁴⁷ The exception from this was telecom - where national considerations did intrude.

Miniature replicas were especially common in the telecom industry, due to governments' procurement power and the national interest attached to the sector. Thus, Geneen had to follow along Behn's line of national responsiveness in this business. If ITT confronted a national manager, it ran the risk of provoking national governments and PTOs. The PTOs "could withhold enough business to erase profits if Geneen trifled with their friend, and countryman, the general manager".¹⁴⁸ The country managers were not interested in losing prestige by giving up business to other ITT houses, or by laying off people. They wanted to uphold the character of miniature replicas. Furthermore, an inevitable outcome of ITT's efforts to rationalise its European subsidiaries was to reduce the workforce, which it did in other lines of business. But, if ITT laid off workers in the telecom industry, it would renounce one of its main bargaining cards in the negotiated environment the industry operated in.

¹⁴⁵ Schoenberg 1985, p. 124.

¹⁴⁶ "Geneen would handled those European managers with incredible finesse and softness and guile and skill." Schoenberg 1985, p. 124.

¹⁴⁷ Schoenberg 1985, p. 124.

¹⁴⁸ Schoenberg 1985, p. 122.

Hence, even if Geneen wanted to erase duplication and internal competition, and encourage cooperation in ITT-Europe, he did not want to alter the oligopolic setting in the industry. The close relations between the PTOs and the equipment supplier had two sides, one of monopsony and one of oligopoly. It was the monopsony, i.e. the PTOs' procurement power, which hindered integrating of ITT-Europe's telecom business. The other side of the coin was the market's character of oligopoly, which provided the equipment suppliers lucrative margins. The prices of European telecom equipment were supposedly 60 to 100 per cent higher than in the United States.¹⁴⁹ One interesting example is the French market, which was called the "golden cage" by ITT. In order to stimulate national equipment suppliers, the French PTO paid generously for telecom equipment, "a concomitant result", says Doz, "being wind-fall profits to the ITT subsidiaries".¹⁵⁰ Thus, Geneen had to balance responsiveness and efficiency, whereas STK had to balance the interests of its US shareholder and its Norwegian stakeholders.

Foreign subsidiaries

During the 1960s, both STK and EB tried to amend the governmental concession, to increase ITT and LME's ownership respectively. ITT wanted to augment its dividend base and make it easier to pay higher dividends by taking over Kreditkassen's 25 per cent share. The bank held preference shares, which only were entitled to 6 per cent dividends, so it resembled a bond loan. Thus the bank was keen on selling its share, as the yield was low, and it had to participate in expensive share extensions to keep the concessionary limit on 25 per cent of the share capital.¹⁵¹ Its only reason for keeping the shares, was to maintain its business relationship with STK. LME, on the other hand, wanted to increase its ownership from 40 per cent to 50 per cent in 1961, as it feared losing control over EB. Moreover, a majority ownership would allow LME to consolidate EB in its accounts, which would increase LME's credit-worthiness. When LME was obliged by the Norwegian authorities to reduce its ownership in EB from 75 to 40 per cent in 1928, managing director Albert Kvaal bought 10.3 per cent of the shares. The shares were placed in a holding company LME controlled; thus, LME had a controlling ownership in EB all the time. Kvaal's successor, Victor Harboe Lund, "inherited" the shares, and his widow wanted to sell

¹⁴⁹ Nguyen 1985, p. 98.

¹⁵⁰ Doz 1979, p. 69.

¹⁵¹ STKHA: J. B. Hjort's memo from meeting with Kreditkassen's Director Dedichen, 04.11.66. If the bank's stake in STK was transformed into a bond loan, STK could write off the interest it paid from its profit, instead of having to pay tax on the dividend. At the time, there was a "double tax" on dividends: the corporation that paid dividends and the beneficiary had to pay tax.

these shares to LME in 1961, which led EB to apply for a new concessionary charter.¹⁵²

There were fairly positive attitudes towards foreign ownership in the early 1960s. Whereas the sentiments towards foreign ownership in the early post-war years were marked by national inferiority, claims Tore Grønlie, this changed in the early 1960s.¹⁵³ Foreign companies were welcomed if they contributed to industrial growth and prosperity.¹⁵⁴ A sign of this was when Trygve Lie, former Secretary General of the UN, acted as a “dollar ambassador”, trying to attract US investment for industrial projects. Lie also served as a member of STK's board, replacing Bache-Wiig who retired in 1966. The wish for national ownership was applied mainly to core industries. Being a small, and relatively poor country, most actors recognised that foreign presence was inevitable. The handling of EB's concession in 1962 showed that telecom was an area where the Ministry of Industry was content to depend on foreign firms, “since we do not have specific advantages” in this field.¹⁵⁵

Knut Sogner has showed how the increased attention and activism from the government in industrial issues, for instance through the Development Foundation, moved strategic arenas from the companies' management, into a semi-public sphere of managers and bureaucrats.¹⁵⁶ The government took a keen interest in supporting *key companies* in the electronic industry. Erik Brofoss said it was imperative “to pick some growth-companies and give them specific advantages”.¹⁵⁷ STK and EB were not assessed as key companies in the 1960s, because they were foreign-owned. Moreover, telecom was not regarded as a key industry that the governmental apparatus was to support; instead it was an industry where foreign ownership was welcomed. An indication of this was how little the ministry knew of STK's relationship with ITT, which became evident when handling the concession in 1966.¹⁵⁸

¹⁵² The 3000 LME shares were in a holding company called A/S Tao, which was created to prevent the sale of Kvaal's shares on the open market after his death in 1954. LME had 12 out of 30 shares in Tao, and a negative control, which meant that LME controlled the majority of the shares in EB all the time. Mrs Lund wanted to sell her husband's shares, which would have given LME formal control over Tao, and thus formal majority over EB. RA-EBi. Grønlie 1989, p. 322.

¹⁵³ Grønlie 1989, p. 322; Christensen 2001, p. 103 f.

¹⁵⁴ RA-EBi: EA/LM Notat 04.08.62: “AB Aulis - konsesjon på erverv av aksjer i A/S Elektrisk Bureau.”, handwritten comments on the document dated 10.08.62 and signed Skj.

¹⁵⁵ Sogner 2002, p. 27.

¹⁵⁶ Sogner 1994, p. 35.

¹⁵⁷ RA-S57: Statsselskapsavdelingens notat 22.08.66 HLD/LM.

Braaten sent a PM to the Ministry of Industry “about STK's cooperation with ITT”.¹⁵⁹ ITT's General Agreement, regulating the business within the multinational, demanded a corporate R&D fee from all of the subsidiaries, 3% of the turnover, which was re-allocated to R&D projects that were deemed to be worthy of support.¹⁶⁰ The agreement also stated that all technical knowledge developed within the company could be exploited freely among other units. Thus, there were no internal intellectual property rights within ITT. The disadvantage of this agreement was that it was difficult for small subsidiaries to develop into a lead house, and manufacture for export. If small subsidiaries, like STK, developed a product that was attractive for a customer from a large company, it was likely that the local ITT unit would prefer to manufacture it, instead of importing it from STK. The benefit was that STK had access to all technical information within ITT, and could thus function as a mediator in the diffusion of ITT's technology in Norway.

This partly explains the different strategies of STK and EB when they applied for a new concession. STK stressed its independence as a Norwegian company, but first and foremost it praised the value of being a member of ITT, and the technology and competence to which it had access. Braaten gave a newspaper interview with the title “American capital gives the industry large benefits”.¹⁶¹ He pictured Norway as a small and poor country unable to manufacture and carry out research that could measure up to US standards, thus industrial cooperation with the United States was necessary. He accentuated how STK had prospered since ITT had saved SKG in the 1930s; it had 3000 employees, of which 300 were engineers. The main reason for STK's success, said Braaten, was that it benefited from the work of 25,000 engineers in the service of ITT. Finally, he praised the “favourable influence one gets from the Americans’ management and effective mercantile organisation”, and how this would benefit Norwegian business in general.¹⁶²

EB, in contrast, emphasised its independence from LME, stressing that it was an autonomous Norwegian company, with a licensee agreement with LME. EB was more “Norwegian” than STK, both in terms of ownership, and because it had a pre-war tradition as an independent company. Hence, it was easier for EB to depict itself as a Norwegian company, and it had an identity to preserve. Still, EB claimed fur-

¹⁵⁹ STKHA: “Pro Memoria - om STKs samarbeid med ITT”, 18.10.66, sent from Braaten to Rostoft.

¹⁶⁰ Interview with Carl-Edward Joys, who had leading positions in STK, related to Metaconta 1970-82 and System 12 1982-1995..

¹⁶¹ ”Amerikansk kapital gir industrien store fordeler” in *Morgenbladet*, 30.08.66.

¹⁶² ”Amerikansk kapital gir industrien store fordeler” in *Morgenbladet*, 30.08.66.; and STKHA: “Pro Memoria - om STKs samarbeid med ITT” 18.11.66.

ther integration with LME was beneficial, since it would allow EB to attain a mandate over products and areas. LME did give EB permission to develop and produce equipment for wireless communication in 1961, but this resulted from pressure from the Norwegian government.¹⁶³ When the Minister of Industry, Kjell Holler, visited LME's headquarters and plant in Stockholm in 1962, he was told that LME's policy "was to decentralise manufacturing in different ways".¹⁶⁴ EB's chairman G. Ring Amundsen argued along the same lines, stating that EB had a mandate in certain technical areas and that it had been granted export orders from Ericsson.¹⁶⁵ This is true, in as much as elementary production and assembly were put out to subsidiaries with spare capacity, while LME took care of the advanced production.¹⁶⁶

In his study of EB's relationship with LME, John Petter Collett finds that EB's role as a sub-supplier clearly underscored its subordinate role, and was a sign of its industrial and technological dependence on LME.¹⁶⁷ Besides, it was called "lease-production", indicating that it was not on a permanent basis. Furthermore, it was not a part of an integrated LME strategy, in terms of exploiting locational advantages in host countries. EB, for instance, produced parts for LME's XY switch, an outdated switch from the interwar period, which Televerket had ceased to order.¹⁶⁸ There was little progressive or promising in manufacturing this when the electronic revolution had transformed the telecom industry. EB did not engage in R&D either: LME's R&D was centralised in Stockholm, and according to LME's centennial history, only "limited tasks has been solved abroad".¹⁶⁹ It is interesting that EB's managing director, Eilif Bjørnstad, contradicted the claims of EB's chairman Amundsen in a meeting with Jens Johansen from the Ministry of Industry, a former employee of EB. Bjørnstad stressed that EB was subject to LME, and had only modest autonomy. This undermined Amundsen's depiction of the company. The chairman's attempt to dress up realities only made him look like LME's "servant".

¹⁶³ Collett 1986, p. 11. Hence, it was not a result of positive locational advantages in Norway, but negative locational advantages.

¹⁶⁴ NTM-EBi: LMEs Svein Åberg to Eilif Bjørnstad 11.09.62 about Holler's visit to Ericsson. (vår politik i LME är att decentralisere produktionen på olika håll.)

¹⁶⁵ RA-EBi: Letter from EB's chairman G. Ring Amundsen to Ministry of Industry, 12.03.62: "Konsesjonsøknad fra AB Aulis, Stockholm, om kjøp av aksjer i A/S Tao Investering".

¹⁶⁶ Collett 1986, p. 6.

¹⁶⁷ Collett 1986, p. 6, Interview with Kjell Kveim, Managing Director in Elektrisk Bureau 1972-1983.

¹⁶⁸ NTM-EBii: Letter from Tc to Txc 20.09.64: "Tilvirkning av XY-velgere ved EB"; Note 08.12.64: "Produksjon av XY-velgere".

¹⁶⁹ Attman et al. 1976b, p. 265.

Bjørnstad told Johansen that EB was strictly controlled by LME, with no possibilities for export, and that the terms for LME's internal sales to EB "were rather harsh", portraying them as it "hidden dividends".¹⁷⁰ Perhaps Bjørnstad did not want LME to get a majority, or maybe he thought it futile to try to deceive the former EB employee Johansen, on the subject of how LME looked upon EB. Johansen, who remembered how the "big Swede" dominated, wanted to reject LME's application. He suggested that the government, *and EB*, used access to the Norwegian market as a bargaining card towards LME, in order to increase the Norwegian influence. Odd Chr. Gøthe, an influential bureaucrat, also saw it as an important political task to strengthen EB. He wanted to turn the Norwegian majority in EB into a block, starting with the shares that were up for sale. He proposed that Elektro-Union should buy the shares, and that it could form the basis of a Norwegian group at EB's General Assembly.¹⁷¹ Elektro-Union was a sister company of Nera, owned by Bergen Industriinvestering (BII). Gøthe thought the government's 20 per cent ownership in BII would strengthen a potential shareholder bloc in EB.

Nothing came out this, as Elektro-Union declined. However, Gøthe's proposal is interesting in several ways. Firstly, because Gøthe thought it natural to use state ownership to secure national control in EB; secondly, because Elektro-Union, as we will see in chapters 5 and 7, came to play an important part in EB's history; and, finally, because Gøthe's initiative shows how keen some of the bureaucrats in the Ministry were to shore up EB's national identity. STK's application in 1966 did not receive a fraction of the attention that had been paid to EB's application in 1962. Nevertheless, LME was allowed to secure a majority ownership in EB, in exchange for increasing investments in Norway, while STK's request to increase ITT's ownership was rejected by the Conservative government in 1966.¹⁷² It was satisfied to learn of STK's relationship with ITT, but never considered allowing 100% ownership by ITT. Despite the meagre practical importance of Kreditkassen's 25 per cent share, it said that certain decisions required an 80 per cent majority in STK's General Assembly. It also mentioned the symbolic value, and that it would restrain ITT from extracting excessive dividends.¹⁷³ An important aspect in this relationship was

¹⁷⁰ RA-EBi: Memo 24/8-1962 JJ/MF (Jens Johansen): "Konsesjonssøknad fra A.B. Aulis, Stockholm, om kjøp av aksjer i A/S Tai Investering, Oslo". ("var temmelig harde" and "skjult utbytte").

¹⁷¹ Odd Chr. Gøthe's handwritten comments, 10.08.62 on EA/LM Notat 04.08.62: "AB Aulis - konsesjon på erverv av aksjer i A/S Elektrisk Bureau."

¹⁷² STKHA: Rostoft to STK 13.08.1967.

¹⁷³ STKHA: J. B. Hjort's memo from meeting with Rostoft 7.12.1966.

that STK exported very little, and thus ITT dividends were almost exclusively derived from the Norwegian market.¹⁷⁴

When Braaten exalted STK's relationship with ITT since the 1930s, it was because he felt that STK had an independent identity and integrity. The positive picture he gave in the interview, however, was a matter of public relations; it diverted attention from his opposition to the prevailing Geneenism in ITT. STK was, as ITT's other subsidiaries, subjected to Geneen's meticulous policy of accounting, reporting and planning. Braaten was sceptical about this, stating that the "increasing requirements from Area and World Headquarters as to current and special reports" were among STK's "main problems".¹⁷⁵ He was in favour of sound accounting, reporting and planning, but the "swamping flow of papers reduces time available for attacking real and pressing problems".¹⁷⁶ It was not that Braaten feared such control: his experiences from the Managerial meetings in Brussels were good, and Geneen never reprimanded him.¹⁷⁷ Mainly because STK's business in general was sound, ITT did not mind that much as long as the subsidiary in question made money.¹⁷⁸ "The burden related to complying with ITT reporting procedures", complained an internal STK document, "is becoming a serious problem".¹⁷⁹

Moreover, Braaten had misgivings about Geneen's efforts to integrate the subsidiaries, feeling that the national identity of STK was under threat. He regarded it as a Norwegian company that was a member of an international group, and he was first in line to accentuate STK's national traditions and obligations. He was a classic Managing Director within ITT, in that he was a "figure of national consequence", hence he did not accept being shuffled around by ITT or ITT-Europe.¹⁸⁰ Geneen said once that Braaten was the most stubborn man he had met, which probably earned him Geneen's respect.¹⁸¹ Braaten did not provoke any formal confrontations

¹⁷⁴ RA-S57: "Til Regjeringens medlemmer fra Industriministeren 13.06.67 - Notat til regjeringskonferanse".

¹⁷⁵ STKA: STKs Business Plan 1968-1972.

¹⁷⁶ STKA: STKs Business Plan 1968-1972.

¹⁷⁷ Interviews with several STK aides.

¹⁷⁸ Interview with Jest Braaten. Some also suggest that Norwegians had a mentality for order and planning, implicating that ITT companies from other nations had far more trouble accommodating to the «Geneenism».

¹⁷⁹ "Too much of management's time and attention is diverted to completion of reports instead of the daily run of the business. The considerable expansion of our activity together with a very tight personnel situation is already a great strain on our management." STKA: STKs Business Plan 1971-1975. These paragraphs are signed by Braaten in the Business Plan.

¹⁸⁰ "they might work for Geneen, but he could not just order them about. They were too powerful, to entrenched." Schoenberg 1985, p. 121-122.

¹⁸¹ Interview with Jest Braaten.

with ITT. It seems that he did not care too much about how ITT was managed, as long as it did not interfere with STK's business and its national identity. Geneen's call for coordination and time-consuming reporting did this. The establishment of ITT-Scandinavia was the last straw for Braaten.

This was established in 1968, as a part of the establishment of ITT-Europe. The idea was to coordinate ITT's activities in Scandinavia. First and foremost, it was an attempt to get a larger share of the Scandinavian market, by using STK as Scandinavian headquarters.¹⁸² Braaten was sceptical about this construction, first because the time-consuming reporting "intensified following the introduction of the Scandinavian organization".¹⁸³ He also felt it threatened STK's national identity. The Board of Directors supported Braaten, stating that "caution" was required so STK "does not lose its integrity as a Norwegian company". It stressed that STK had to sustain its status and position towards Norwegian stakeholders - government, customers, the Norwegian public in general, and employees.¹⁸⁴ This was a reaction to Geneen's integrating efforts, but it also reflected the fact that STK had to take into account the changing attitudes towards ITT and LME, which were perceived as powerful multinationals, which profited on public procurement in Norway, without investing too much in the country.

Three years after the concession application was rejected, STK's national status was put on the agenda again, when it applied for a concession to acquire Emaljeverket, a refrigerator company. "The Government rejection was a clear discrimination," reported Braaten to ITT.¹⁸⁵ The Emaljeverket case stirred up a debate regarding US multinationals. A newspaper wrote that ITT had ordered STK to double its turnover and profit within five years, and that this was in accordance with other American big firms' intrusion in the western European countries.¹⁸⁶ ITT and LME were subjected to criticism, for not reinvesting enough in Norway, but just skimming the

¹⁸² "The object of the Scandinavia cooperation is to improve the overall results for ITT. To obtain a rational and efficient use of available resources, similar and equal solutions to the switching networks in the Scandinavian countries should be applied as far as possible. The main engineering focus will therefore be concentrated at STK where the available resources are greatest. The other switching companies may draw on the larger capacity of know-how there." in STKA: ITT Scandinavia Business Plan 1970-1974.

¹⁸³ STKA: STKs Business Plan 1971-1975.

¹⁸⁴ STK's Board meeting, 28.10.68. (det må vises varsomhet, slik at Standard Telefon og Kabelfabrik A/S ikke mister sin integritet som norsk selskap, men opprettholder denne status og den posisjon selskapet har vis a vis myndigheten, kundene og offentligheten forøvrig. Det ble spesielt påpekt at konsesjonsvilkårene ikke måtte krenkes og at selskapets forhold til norsk lovgivning, institusjoner, ansatte o.s.v. måtte opprettholdes uforandret).

¹⁸⁵ STKA: ITT Scandinavia Business Plan 1970-1974.

¹⁸⁶ Editorial in *Dagbladet* 08.03.69.

cream of public investments in telecom and electricity.¹⁸⁷ Thus, Braaten “noticed a change in the Public Opinion as regards ownership of Norwegian Industry”. “In order to meet this exposure”, he claimed, “STK must seek, to as large an extent as possible, to identify itself as a national enterprise”.¹⁸⁸ Moreover, drawing “attention to the feelings of our employees to foreign ownership”, he advised it “would be wise to strengthen and support the local management”.¹⁸⁹ One way of doing this was to establish a local, i.e. national, research department.

The military technicians around FFI, and other supporters of Nera, stressed that ITT and LME obstructed Norwegian initiatives in the important high-tech industry that telecom had become.¹⁹⁰ To meet this criticism, STK reported to ITT that it had to “secure development contracts” and inform the “authorities and public about local (STK's) development activities financed by ITT development funds.”¹⁹¹ Torbjørn Brataas, the first Research director in STK, emphasises ITT's - and thus STK's - poor standing in the late 1960s, particularly among military technicians, such as Helmer Dahl and Fredrik Møller.¹⁹² Another opponent of ITT was the businessman Gustav A. Ring, author of the book *Who shall own Norway?* Published in 1969, and inspired by French Gaullism, Ring addressed the need for national control in the electronics industry.¹⁹³ Brataas is certain that these attitudes were decisive for the establishment of STK's Research Department. Telegrafverket and TF also put pressure on STK to conduct R&D, and Braaten and technical director Arne Rambøl welcomed this pressure, as they were happy to use this in their stance towards ITT.¹⁹⁴ Thus, for ITT it was a matter of national responsiveness when it allowed STK to establish a research department in 1968. It had to respond to Norwegian sentiments.

¹⁸⁷ “The government and authorities expect that capital available at STK be utilized as much as possible to the benefit of the country because the capital has been earned in Norway.”

STKA: STKs Business Plan 1971-1975.

¹⁸⁸ STKA: STKs Business Plan 1971-1975.

¹⁸⁹ STKA: STKs Business Plan 1971-1975.

¹⁹⁰ Interview with Torbjørn Brataas, first director of STK's Research Department (FA), later employed in STK's defence business, Thomson and Thales.

¹⁹¹ STKA: STK's Business Plan 1967-1971.

¹⁹² Interview with Torbjørn Brataas.

¹⁹³ Gustav A. Ring: *Hvem skal eie Norge?*, 1969; Interview with Torbjørn Brataas.

¹⁹⁴ Interview with Torbjørn Brataas.

Norwegian high-tech companies

STK's Research Department (FA*), which was established August 1st 1968, did not come out of the blue. First, STK had a *Technical Department* of some significance, which carried out development work. The Annual Reports show that the funding for research, development and engineering (RDE) increased from around 2% of the turnover in 1965 to 4% in 1967.¹⁹⁵ The number of engineers with higher education increased during the 1960s, and the technical department alone employed over 250 in the late 1960s. The main RDE activity in electronics/telecom was to study established products from ITT, in order to be able to adapt and install them in the network. STK had been engaged in independent technology and product development, most notably maritime radio and cryptology for the military, in its *Technical Laboratory*, and later the Division for *Technical Electronics*. Still, due to the emphasis on *research*, the FA changed the perception of STK as a company, as it was no longer a mere importer of ITT's products; it was to take part in the development of telecom equipment, and it was a high-tech company.¹⁹⁶

Maritime communication was an important business in Norway, due to the large merchant fleet and the fisheries. Oslo was an international centre in this field in the 1930s, when several MNCs placed their radio business in Norway.¹⁹⁷ Both EB and STK had substantial business directed towards the maritime segment, as did Simrad and Nera.¹⁹⁸ STK had been in this business since the 1920s, and it grew after the war, but never amounted to any significance compared to cables and telecom in STK's books. The electronic revolution led to bold visions for the maritime sector in Norway, and the company Norcontrol worked with nuclear-driven and unmanned vessels.¹⁹⁹ STK took an active part in this milieu. "A substantial part of STK's present and future business activity", reported Ivar Ørbeck to ITT in 1969, "is and will be devoted to marine electronics such as radio, navigation and ship automation."²⁰⁰ But maritime electronics remained a minor business within STK, as the company did not succeed in obtaining important contracts in this field.²⁰¹ The maritime trajectory became more important for EB and Nera than for STK, as EB and Nera became

* Norwegian abbreviation for Forskningsavdelingen.

¹⁹⁵ STK's Annual reports 1965, 1967 and 1968.

¹⁹⁶ Interview with Torbjørn Brataas and Ivar Ørbeck, former Technical Director in STK.

¹⁹⁷ Sogner 1997, p. 19.

¹⁹⁸ Ivar Mo: "Prosjektet Narolf", 1998; Wasberg 1965, p. 148 f.; Skogaas 1983, p. 157 f.

¹⁹⁹ Signy Ryther Overby: "Etableringen av norsk skipsautomatiseringsindustri", 1993.

²⁰⁰ IØA, Box: "Div artikler Rapporter 1968-74 I. Ørbeck": "Computer applications onboard ship", 28.11.69.

²⁰¹ Lossius 1991, p. 101 f.

key players in developing maritime satellite communication in Norway. For STK, the links with FFI and Great Britain proved more influential.

Several STK engineers were engaged in “illegal” activities during the war, some in establishing radio contact with London, others in tapping into the Germans’ communications. STK’s ‘control’ over the Oslo network was an important asset in this sense.²⁰² Some fled to the UK, and after the war, many more visited STK’s laboratory, the Standard Telecommunication Laboratory (STL) in Harlow outside London.²⁰³ The head of the Technical Laboratory, Kåre R. Meisingset, had worked under Helmer Dahl on radar technology in the UK during the war.²⁰⁴ He started as a radio engineer at STK in 1946; and from 1952 he concentrated on cryptology, with FFI, and Rørholt from the FFSB. Rørholt “approached STK with an idea on how to mass produce random key information suitable for encryption of teleprinter signals”.²⁰⁵ Meisingset and Rørholt patented digital “Electronic equipment for «creation» of a cipher-key”.²⁰⁶ STK manufactured a cipher machine for encrypting and decryption for use with teleprinters, and sold several thousand machines to other NATO countries in the 1950s and 1960s.²⁰⁷ The export success was remarkable, and formed the future defence business of STK. Still, the crypto-business was always somewhat detached from the rest of the company, partly due to the required secrecy.

In many ways, the STL functioned as STK’s mother company in R&D issues; it was regarded as one of the best telecom centres in the world, second only to Bell Laboratories.²⁰⁸ STK’s engineers were welcomed warmly at the STL, and encouraged to ask all kinds of questions.²⁰⁹ This was very different from ITT’s French R&D centre, the Laboratoire Central de Télécommunications (LCT) in Paris. Apart from the language barrier in France, STK’s people did not experience the same openness in France, thus there was little knowledge and technology transfer from LCT to STK,

²⁰² Wasberg 1965, p. 101 f.; Obituaries of Salve Staubo *Aftenposten* 02.02.89. and Bjørn Rørholt *Aftenposten* 13.05.93. Karl Hanssen was central in STK’s surveillance of German communication during the war. Salve Staubo: “Rapport fra sambandsjefen” in http://www.maritimt.net/jps/salvestaubo_files/SalveStaubo.pdf.

²⁰³ Interview with Torbjørn Brataas, and Ivar Ørbeck.

²⁰⁴ “Dagens Navn” in *Aftenposten* 02.09.86; Njølstad and Wicken 1997, p. 34.

²⁰⁵ Ivar Mo: “Teleprinter Crypto machines with one-time key tape”, 2002.

²⁰⁶ Mo 2002.

²⁰⁷ It was called the ETCRRM - Electronic Teleprinter Cryptographic Regenerative Repeater Mixer. It was not sold to the United States, as it operated with a secret system, Mo 2002.

²⁰⁸ Interview with Torbjørn Brataas and Ivar Ørbeck.

²⁰⁹ Torbjørn Brataas, Ivar Ørbeck and Knut Berg all went to STL, and confirm this impression. Interview with Torbjørn Brataas, Ivar Ørbeck, and Knut Berg. Berg was in FA from 1968-1980, Director of System 12 1980-1990.

quite opposite to the situation with the British R&D unit.²¹⁰ A main mission, said Brataas in presenting FA in 1968, was to develop and enhance STK's absorptive capacity, so it could tap into ITT's knowledge and technology base.²¹¹ A related activity was to adapt ITT's technology to Norwegian surroundings. This was in accordance with STK's perception of itself as a telecom company, i.e. a main mission was to diffuse technology developed within ITT. This reasoning was fundamental for the FA's first development contract.

The first development contract TF offered was for a trial installation of PCM, digital transmission, in the Norwegian network.²¹² This was natural pilot project for TF, as Knudtzon's graduating thesis from the NTH was about PCM, and he had continued to work on this field afterwards.²¹³ Even though the tender for the PCM contract was open, there was never any doubt that STK would receive it. This was because of STK's close ties with the STL, which was at the frontier in this technological field, as the STL's Alec Harley Reeves had invented PCM in 1938.²¹⁴ STK used the STL for what it was worth in fulfilling its contract with TF. Representatives from TF joined the trips to the STL, and they too benefited from the STL's knowledge. Hence, STK became a door opener for TF and Televerket into ITT and the STL. On the other hand, it was valuable for the STL and ITT to use Norway as a test case for PCM.²¹⁵

The development contract was a positive experience for both TF and STK. Brataas and Knudtzon claim that it laid the foundation for a fruitful relationship between TF and the FA. Moreover, the PCM contract, and STK's old-time competence in cryptology, paved the way for a new large contract with FFI in 1973, for creating a mobile digital switch with a digital network - "the nodal-switch" for the Norwegian military.²¹⁶ This was the main project in the FA's history. The nodal switch remains

²¹⁰ Interview with Torbjørn Brataas; Ivar Ørbeck; Knut Berg.

²¹¹ TBA: Torbjørn Brataas's address to the "Cable Club" at STK 24/10-68.

²¹² STK's annual report 1969 and 1970; Collett and Lossius 1993, p. 48.

²¹³ Collett and Lossius, 1993, p. 33; Nicolay Heinrich Knudtzon: "Theoretical comparison of fluctuation noise characteristics for various modulation methods with special view to multi-channel system planning" DDRE report ; no. 20, Oslo, 1957.

²¹⁴ Chapuis and Joel 1990, p. 293; Bjørhovde 1990, p. 40. "PCM (...) is a good example of an invention that came too early. (...) When PCM was patented in 1938 (...) I knew that no tools then existed that could make it economic for general civilian use. It is only in the last few years, in this semiconductor age, that its commercial value has begun to be felt." Alec H. Reeves: "The Past, Present, and Future of Pulse-Code Modulation" 1964 in http://more.btexact.com/millennium_issue/yesterday/bottom/1965.pdf.

²¹⁵ Interview with Torbjørn Brataas.

²¹⁶ TBA: Torbjørn Brataas: "Knutepunkt virksomhet 1973-93 Et industrielt 20-års jubileum", 1993.

the technological and commercial base for the Norwegian subsidiary of the international defence company Thales even today. Hence, it proved how a subsidiary, by tapping into its mother company's technology base and adapting the technology to local requirements, could develop sustainable business. A necessary requirement for STK for doing this, however, was that the development was financed by other sources, so STK did not have the intellectual property rights. Thus it could not be exploited by other ITT units. Hence, it is no coincidence that the intellectual property rights of STK's two successes on the export market, the nodal switch and the crypto-machine, were held by the Norwegian armed forces.

ITT's General Agreement and its dominating ownership of STK explain why STK preferred to stress that it was one of several partners within ITT, rather than to emphasise its autonomy from it. Hence, the FA's main mission was to diffuse technology and products from ITT to Norway. By enlarging STK's absorptive capacity, it was to be a more effective technology and knowledge diffuser in Norway, and able to engage in fruitful interaction with Norwegian R&D milieus. Technical Director, Arve Rambøl, argued along these lines in trying to position STK towards the NTNf and the Ministry of Industry in 1972. He said that STK's access to ITT technology and know-how would be of great importance to the Norwegian R&D system. "In this relation I would like to refer to the enclosed study «Technology transfer by multinational companies»."²¹⁷ STK's focus on the benefits of multinationals, and its own mediating role, was very different from EB's strategy, which also was subjected to pressure from Ericsson and the Norwegian milieu. Bjørnstad also told LME that "we have detected a significant shift in the government attitudes toward EB after LME increased its share above 50 per cent, STK has been granted advantages, formerly EB was regarded as partly Norwegian, while we now both are regarded as foreigners".²¹⁸

Like STK, EB had a sizeable business in domestic appliances and other types of electrical equipment, but Ericsson's decided to divest itself of this in 1965.²¹⁹ This business had been important in giving EB a sense of independence from Telegrafverket. In protesting to LME, it stated that after the divestiture, 75 per cent of its sales would be to Telegrafverket, and "it will then be evident for everybody what profit EB extracts from the PTO, and the situation before the next price negotiations

²¹⁷ RA-STKi: STK to NTNf and Ministry of Industry 04.01.72. James Brian Quinn: "Technology transfer by multinational companies - Effective flow of technology among countries is perhaps the most important single factor in the worldwide economic development." in *Harvard Business Review*, November-December 1969.

²¹⁸ Eilif Bjørnstad to Bjørn Lundvall 01.12.67, here after Collett 1986, p. 13.

²¹⁹ Meurling and Jeans, 2000. p. 232; Skogaas 1982, p. 111.

will not be pleasant”.²²⁰ Another damaging thing was a ‘share coup’ by LME. EB’s share price gained 88 per cent in 1967, mainly due to the favourable long-term agreement.²²¹ LME arranged a share issue in EB, and sold most of the B-shares, with only a 1/1000 voting right, to Norwegian investors. This was another way to extract money from the subsidiary, while still emphasising that LME was not extracting large dividends from EB.²²² As the *Arbeiderbladet* complained, the “Swedish share coup costs us 10 million”, and was paid for “by Norwegian telephone subscribers”.²²³ It provoked the Ministry of Industry, not least because LME or EB did not inform them properly; the issue was even discussed between the Swedish and Norwegian cabinets.²²⁴

The complaints regarding LME’s «share coup» happened at a time when Televerket and TF demanded and expected more R&D and a more active role in the evolving system of innovation in telecom.²²⁵ LME took a more positive stance towards EB’s ambitions of developing its own products. It was not allowed, however, to establish a separate R&D unit, but it was to develop maritime products outside the license agreement. Its main project was to be the development of maritime satellite communications, in close cooperation with Nera and TF. In a meeting with LME and EB’s top management in 1970, it was stated that it was in both companies’ “interest that EB develops own product areas outside the traditional license areas”.²²⁶ Collett claims that this was a new policy initiated by LME’s CEO from 1965, Björn Lundvall.²²⁷ The main reason, however, was that it would give “EB the necessary standing with public authorities and research and development institutions”.²²⁸ Thus, when LME finally allowed EB to pursue an independent strategy, it was as a result from pressure from Norwegian authorities. It was not to exploit Norway’s positive locational advantages, but rather to comply with negative locational advantages.²²⁹

²²⁰ Collett 1986, p. 12.

²²¹ *Næringsrevyen* Nr. 2 - 12.01.68.

²²² Collett 1986, p. 14.

²²³ “Svensk aksje-kupp koster oss 10 mill. - Gevinsten betalt av norske telefonabonnenter?” in *Arbeiderbladet* 08.02.69.

²²⁴ Collett 1986, p. 17.

²²⁵ The Minister of Industry, Rostoft, also put pressure on LME in a meeting with its CEO Björn Lundvall in 1968. Rostoft said he intended to increase the support for the Norwegian electronics industry, and to encourage “public offices to place orders that could advance the development of Norwegian industry”. NTM-EBi: LME’s Björn Lundvall to EB’s Eilif Bjørnstad 09.01.68 about Lundvall’s meeting with Rostoft 3. January 1968.

²²⁶ NTM-EBi: Minute from meeting between LME and EB’s management 11.05.70.

²²⁷ Collett 1986, p. 16.

²²⁸ NTM-EBi: Minute from meeting between LME and EB’s management 11.05.70.

²²⁹ Lundvall stressed in 1970 that EB’s main task was to supply Televerket with telecom equipment, and its “second large task - but after its main task - was to develop its own prod-

Thus, STK and EB's increased R&D from the 1960s was mainly to accommodate demands from Norwegian stakeholders.

Conclusion

The 1960s were pregnant with changes for the Norwegian telecom industry. First, STK's sales and profits increased as a result of the long-term agreements.²³⁰ The oligopolic grip was not particularly important in relation to this, as Telegrafverket never intended to change suppliers. Still, the employment card was a significant argument when Telegrafverket increased its orders. The main reason for the increased orders, however, was to eliminate the telephone queues. There was a noteworthy change in the oligopolic grip, however, in that Telegrafverket's responsibility as an industry provider was heightened. Still, a more striking change was the highlighting of STK and EB's responsibilities in contributing to industrial development, in the wake of the electronic revolution, and the increased apprehension of multinationals in general, and American multinationals in particular. As such, we may say that Doz' negotiated environment was intensified. The negotiated environment differed from the oligopolic grip, in that both parties, governmental bodies and the industry, were more even standing, i.e. both had effective bargaining cards.

STK's, or ITT's, main concession in the intensified negotiated environment, was the establishment of the FA. This was motivated by several interrelated factors. *Firstly*, it was a response to the more critical attitude towards multinationals, particularly those in high-tech industries, which lived off public procurement. In this sense, it was a concession to Norwegian stakeholders, not least, the evolving Norwegian system of innovation in telecom. As such, the FA was a concrete response to the establishment of the TF. *Secondly*, due to the electronic revolution, STK had to upgrade its competence to preserve its position as an equipment supplier. *Thirdly*, it was a result of the good economy in STK's telecom business. *Finally*, it was a response to the long-term agreements, in which it was a more or less tacit demand that STK and EB should undertake R&D. Even though the new R&D system in telecom was linked to the procurement regime through this tacit obligation, it was detached from the main products and technology in telecom, switching and cables.

In this sense, the new R&D system diverted from a main characteristic of the system of innovation approach, namely that innovation takes place through user-producer interaction. Of course, there was such interaction with the development contracts,

ucts", (andra stora uppgift - men efter huvuduppgiften - är att utveckla egna produkter), NTM-EBi: LME's Bjørn Lundvall to EB's Eilif Bjørnstad 02.11.70.

²³⁰ As Telegrafverket ordered more equipment, and enabled STK to produce more efficiently

such as PCM, but there was a difference. In the system of innovation literature, innovations are often described as incremental, a result of learning by doing, and trial and error.²³¹ The activity, however, is not aimed at innovation in itself, but is a part of normal business activity, i.e. generating higher quality, lower cost products. “Innovation” is a label that is attached to the new processes afterwards, often by scholars or policy makers. In the Norwegian R&D system, however, innovation was the aim, in order to lay the foundation for future business, which could generate higher quality, lower cost products in a competitive manner. Thus, the new R&D system was designed to promote innovation, and thus perhaps it should be called the Norwegian system *for* innovation in telecom?

Thus, the bulk of STK’s telecom business was not affected by the increased focus on R&D. So, the new institutional setting for telecom-related R&D was separated from the traditional procurer relationship. Thus around 1970, two institutional settings existed side by side: a procurement relationship, characterised by the oligopolic grip, and an institutional setting designed to promote innovation through R&D, characterised by the negotiated environment. This separation, let us say between operational telecom activities and R&D activities, was sharpened throughout the 1970s. The later chapters show that it contributed to divergent policies on the part of governmental bodies. Moreover, the separation was reflected in antagonisms between R&D units and operational units within STK, EB and Televerket.

Still, STK’s involvement in the R&D system through the FA bore fruit, not least through the PCM contract, which was also important in shaping STK and TF’s perception of multinationals. It was a prime example of how a subsidiary and a host country could tap technology and knowledge from a multinational, and how the subsidiary could develop independent capabilities based on this. Perhaps Knudtzon’s credo, of helping the subsidiaries in the internal MNC competition, was inspired by the PCM contract?²³² STK stressed that multinationals were central in developing and diffusing technology, and that STK played an important role in mediating technology and knowledge between ITT and Norway. The FA was set up, it was argued, to make STK more able to tap into ITT’s technical resources and adapt the technology to the Norwegian environment, rather than to free STK from ITT’s dominance. EB, in contrast, played down its relationship with LME, and stressed its freedom to develop ‘Norwegian’ products, such as wireless communication, which later underpinned its maritime satellite communication activities in the

²³¹ Lundvall et. al. 2002, p. 219-220.

²³² The PCM contract was signed in 1969, and Knudtzon’s statement about helping subsidiaries was made in 1970.

Chapter 3 STK as a foreign high-tech company

1970s. The difference between STK and EB was reinforced by the appointment of new managing directors in the early 1970s, which will be elaborated in chapter 5.

During the early 1970s, STK supplied Televerket with two new kinds of switches, one it had developed alone, and another delivered by BTM. In the latter, the multinationals functioned as diffusers of technology, in line with STK's preferred perception. With the first switch, STK tried to attain a lead-house position within ITT, as an independent switch manufacturer. Both projects contributed to significant changes in STK's relationship with Televerket and ITT, as well as in the oligopolic grip, which is what the next chapter will address.

Chapter 4 STK's telecom business in pain

Introduction

In the early 1970s, electronic switches made their way into the Norwegian telecom network, and had a significant impact on Norwegian telecom. STK embarked on one of its largest-ever development projects in telecom, namely the finalising of a semi-electronic switch, the Metaconta 11B, on behalf of ITT. Thus, the project was perceived as a potential launch pad for future engagement in electronic switching, and thus becoming a fully-fledged telecom company. By taking advantage of its newly founded Research Department, STK hoped to attain a leading position in ITT's switching business, by exporting the 11B on the world market. Based on these assumptions, STK invited Televerket to participate on the project. Televerket welcomed STK's initiative, as the 11B was designed to automate rural areas, which was one of the major tasks Televerket had to embark on in the 1970s.

Televerket had two other major challenges around 1970. Firstly, it was to resolve the problems in the Oslo network, which practically broke down in 1968. Secondly, it was to finalise the national automation, so one could make long-distance calls without assistance from an operator. The 8B switch seemed to create more problems than it solved, so Televerket decided to meet these two challenges by installing computerised, or Stored Program Control (SPC), switches in Oslo. In connection with this, Televerket amended its procurement routines by using competitive tenders between STK and EB. Televerket also arranged tenders for other switching projects, and it started to inspect STK and EB's books, to control the cost-based prices in the long-term agreements. This shows that the oligopolic grip had loosened. Thus, the chapter addresses how STK and Televerket met the early stages of digitalisation and liberalisation, not least in adjusting to new relations.

The 1970s were a decade of closer cooperation between the PTOs and the equipment suppliers in Europe; LME and the Swedish PTO formed a development pair, through the switching-development company, "ELLMTEL".¹ Close cooperation also took place in France, Britain and Germany.² The European "development pairs" were formed to engage in the international competition to develop electronic and later digital switches. The electronics revolution created a window of opportunity, an opportunity to create new players in the international telecom industry. Some succeeded, like France with Alcatel, while others failed, particularly the United

¹ Fridlund 2000.

² Noam 1992 and Chapuis 1990.

Kingdom with its prestigious TXE project.³ A central theme in this chapter is how STK and Televerket adapted themselves to handle these new challenges, and how a new relational setting was created in Norwegian telecom. The first sections present the development of SPC switches.

Electronic switching - ITT's Metaconta

John von Neumann's stored program technique had a tremendous impact on computer development from the mid-1940s, and on telecom from the mid-1960s. It implied that a computer could be programmed to do different tasks and operations, regardless of its hardware. This meant that instructions could be reprogrammed according to new tasks, but also, which was essential in telecom, according to different - and changing - surroundings. The SPC principles laid the ground for AT&T's Stored Program Control (SPC) switch No. 1 ESS, introduced in 1965. According to Chapuis and Joel, SPC is "recognized as the single most important contribution to electronic switching".⁴ It constituted the common feature for the new electronic switches that were developed from the mid-1960s to the early 1970s.

Some hesitated, however, to label these switches electronic, preferring to call them quasi- or semi-electronic. The reason was that the contact was still mechanical. Telecom switches may be divided into two main parts: the control unit and the contact system. The control part "monitors calls, identifies the caller, establishes contact with a free channel, holds the contact during the conversation, opens it when it is finished and measures the number of pulses to be charged".⁵ The contact system establishes the physical link between the lines. In the SPC switch, the control part is computerised, whereas the contact is mechanical, which means that the signals transmitted are still analogue signals, i.e. electrical impulses.⁶ This is called *space division* switching. In the next generation of digital switches, from the late 1970s, the contact was computerised. This is *time division* switching, in which the com-

³ In France it resulted in the E10 switch, Alcatel's launching pad in the telecom industry. The German joint project for developing a SPC switch was considered a disaster, as it took too long, and was not finished before the arrival of digital switches. "Minister Kurt Geschedle pulled the plug on the development program. He declared that technical development hit the Bundespost and its suppliers like a «natural catastrophe» but that the Bundespost had learned from its mistakes, and as a result, it would now closely follow technical developments in the international telecommunication market. The large losses in the project were borne chiefly by the equipment supplier." Noam 1992, p. 84-85.

⁴ Chapuis and Joel, 1990, p. 154.

⁵ Nguyen 1985, p. 100.

⁶ The "ferreed" relay provided the technological bridge between the "high speed electronics and slower speed mechanical contact movements." Chapuis and Joel 1990, p. 167.

puter translates the analogue signals into digital signals.⁷ Thus, the important distinction between electronic and digital switches is whether the contact is computerised or digital, i.e. between analogue space division and digital time division.⁸

Still, SPC represented a major improvement. The control, capacity and reliability increased substantially compared to earlier generations. A major improvement was that whereas electro-mechanical switches needed several controls “divided into groups by functions such as for originating and terminating traffic”, SPC reduced this to one control unit.⁹ The main point, however, was that it could be programmed to handle and manage different networks, with different features and idiosyncrasies.¹⁰ The SPC switch required less floor space, which was important for the metropolitan switches. It increased the capacity of the switching stations; adjustments, such as adding or removing new subscribers, were a matter of reprogramming the software, not rewiring as with the electro-mechanical switches. Finally, it allowed for new services and equipment, such as push-button phones, automatic re-direction, wake-up calls, speed dialling (one button dials a complete number), and so forth.¹¹

It had a major impact on the industry. It manifested the convergence between IT and telecom, thus, the use of electronics (IT) in telecom and the use of the telecom network for data communication made it difficult to distinguish between communicating and processing information. SPC changed switching development from hardware to a software project; computers facilitated modernisation as new software was released, and thus allowed greater flexibility in use. Being less labour-intensive, and more knowledge-intensive, skilled labour replaced manual labour. Hence, it contributed to the *coming of the post-industrial society*, which Daniel Bell described in 1973.¹² Furthermore, it was easier to create international standards, thus reducing the technological barriers that halted competition among the equipment suppliers. Finally, the R&D costs of the computerised switches were very high. AT&T's No. 1 ESS was the first SPC switch in the world; it was one of Bell Labs biggest R&D

⁷ Nguyen, 1985, p. 100.

⁸ Nguyen, 1985, p. 100.

⁹ Chapuis and Joel 1990, p. 53.

¹⁰ Not one network was alike; all had different types of switching and transmission equipment, and often “self-made” solutions to make the different technologies work together. We will return to these issues later, since the programming of the SPC switches for the Norwegian network plays a central part in this analysis.

¹¹ Some point to the fact that some of these services, such as wake-up calls and re-direction, re-appeared, since they were available with manual switches, the operators were given instructions. Thus, in a sense the intelligent switch returned with the SPC switch. Bestorp 1990, 230.

¹² Daniel Bell: *The coming of post-industrial society: a venture in social forecasting*, 1973.

projects ever, lasting over 10 years, and costing \$500 million (1965).¹³ AT&T was probably the only telecom company that could have engaged in such a project. The rest of the industry, except LME, was busy developing crossbar switches, when AT&T embarked on its SPC project in the 1950s. But, after AT&T had carried the initial costs, the rest of the industry followed the SPC path for the next generation of switches.¹⁴

ITT strove to unite the subsidiaries' efforts to create a single SPC switch, as the company was anxious to avoid the hazardous internal competition that had occurred with the crossbar generation. ITT's annual report for 1966, the year after AT&T had presented its SPC switch, stated that one of the firm's main objectives was "the development of an integrated-circuit, computer-controlled, quasi-electronic exchange", with the "promise of being competitive in price with present electromechanical systems, while offering new service features, increased reliability and low maintenance costs".¹⁵ The report referred to a single system, which was difficult to achieve, according to Chapuis and Joel, as the various research centres of the groups involved had "made several differing approaches towards achieving that objective".¹⁶ They were engaged in domestic projects, initiated and funded by their national governments.

In France, the PTO and the national centre for telecom research, the Centre National des Études Technologiques (CNET), launched several R&D projects in this period, and the French ITT subsidiaries were involved in these.¹⁷ The STC, together with five other British equipment suppliers, developed switches in the "Joint Electronics Research Committee".¹⁸ Still, the many national projects made important contributions to "an entire family of ITT systems".¹⁹ In total, ITT had five different versions of the SPC switch. Consequently, the results of ITT's SPC efforts were not too

¹³ Chapuis and Joel 1990, p. 40 and 49.

¹⁴ Chapuis and Joel 1990, p. 246.

¹⁵ Quoted from Chapuis and Joel 1990, p. 226. The term "quasi electronic" refers to the fact that the SPC switch had mechanical devices, and was thus not purely electronic.

¹⁶ Chapuis and Joel 1990, p. 226.

¹⁷ They were called Plato, Aristotle, and Pericles. The Plato project resulted in the E10, the first time-division switch in the world that was put into service. "In January 1970 the world's first digital switch was put into service in France, the Plato (later version of which became known as the E10), developed by CNET". Martin Fransman: *Japan's Computer and Communications Industry*, 1995, p. 52.

¹⁸ Chapuis and Joel 1990, p. 227.

¹⁹ Chapuis and Joel 1990, p. 227: "10AX and 10BX, on which research had been conducted in Paris since 1960 by LCT and CGCT respectively; 10CX, developed at Antwerp by BTM; 10CXM, developed at Madrid by SESA; ZF-2, studied at Stuttgart by SEL."

different from the crossbar efforts. In Germany, Siemens's SPC switch was preferred at the expense of SEL's version. BTM and the French subsidiaries operated with different versions. However, this time the French and Belgian versions had so much in common, "that a single generic name - Metaconta - was assigned to them all".²⁰

It is an open question whether ITT's ability to present one "generic family" of the SPC switch on the world market, should be ascribed to ITT's efforts to integrate R&D efforts of the European subsidiaries, or if the SPC technique made such integration easier. The competition between the 8B and the Pentaconta had national overtones, but it was also a rivalry based on technology. This was never the case with ITT's different switching projects in the 1960s; AT&T had set the standard with the store program control. In principle, any SPC switch could be used in any network: the switch handled the idiosyncrasies of each network, i.e. communication, signalling, billing and so forth, by programming the software.²¹ SPC had turned switching into a software business, which was easier to coordinate and integrate from ITT-Europe's headquarters in Brussels. An example of the integration of efforts was that the French ITT laboratory, LCT*, developed the processor used in ITT's SPC switches.

Nevertheless, the common features that allowed for the common name applied only to the Metaconta No. 10 series. ITT would not have been ITT, if a competing version - No. 11 - did not materialise.²² Once again, it was the French subsidiary, CGCT, which insisted on using its own technology. It was the electro-mechanical contact system that differed. The Metaconta 10 series, supported and developed by BTM, used reed-relays for contact, whereas the Metaconta 11 used mini-crossbar, or mini-bar, which was developed by CGCT.²³ Hence, CGCT and BTM continued to

²⁰ Chapuis and Joel 1990, p. 227.

²¹ This, however, is only broadly speaking, since the complexity of programming, which included debugging the software, was a huge task.

* Laboratoire Central de Télécommunications.

²² Chapuis and Joel say: "As sometimes happens, there must have been «a miscarriage» since the numerical series of the different generations of ITT systems jumps from 8 to 10 and the authors have been unable to ascertain what was or should have been identified by the number 9." The explanation is that the Pentaconta - CGCT's crossbar-switch - was number 9, although it rarely described as such. It received another number than 8B, as it used another selector. Interview with Carl-Edward Joys. This is probably the only time where the author is able to supplement Chapuis and Joel's knowledge on switching rarities.

²³ "The mini-crossbar or miniswitch which characterized the series 11 Metaconta exchanges (...) was designed in Paris by CGCT engineers. (...) was offered as a competitor of matrices consisting of reed relays". Chapuis and Joel 1990, p. 228. The 11A was produced by CGCT

struggle for supremacy within ITT's telecom business. CGCT sold its Metaconta 11A, a large urban SPC switch, to the French PTO, whereas BTM sold the Metaconta 10C, first in Belgium in 1968. A major international breakthrough for BTM's 10C came in 1969, when it beat LME to win an open "tender for a large transit exchange" to handle international telephone traffic in Australia.²⁴ The Metaconta became one of the largest SPC systems in use, and by 1975, it was installed on 7.5 million lines in different countries, including Norway.²⁵ STK and Televerket played a major role in developing the Metaconta 10C through the installation in Oslo, as will be described later. STK had higher hopes, however, in developing a smaller - rural - version of the Metaconta, using the CGCT contact system. The next section investigates how STK became engaged in its largest-ever telecom project - the Metaconta 11B.

The 11B - STK's largest telecom project

Most of the Norwegian cities had automatic networks in the 1960s, but the rural networks were still operated by manual switches. Thus, to complete the automation of the national network, Televerket, like most European PTOs, had to automate the rural areas. It was a shared understanding in the 1960s that the SPC switches would be economical only for urban areas. The fixed costs, particularly of the processor, were too high for small switches.²⁶ Moreover, an important saving with the SPC switch was that it required less floor space, but this was less pertinent for smaller switches.²⁷ Hence, the "existing crossbar system" would "be able to withstand competition from electronic exchanges for a longer period", claimed STK in 1968, and in "an intermediate period the miniaturization of electromechanical systems might show advantages in price".²⁸ The telecom industry and the PTOs had to make a strategic choice, either to upgrade the conventional crossbar switches with modern electronic equipment, or to introduce a new generation of electronic switches.²⁹

The Lillehammer agreement had favoured STK, since it allocated most of the large cities to STK, and most of the rural districts to EB. This was in line with ITT and

and installed in Morocco, the 11E was installed in Austria, and the 11F throughout France. Interview with Ivar Mo; Chapuis and Joel 1990, 227-228.

²⁴ Meurling and Jeans, 2000, p. 274.

²⁵ 6.3 million "mainlines" and 1.4 million trunk circuits. Chapuis and Joel 1990, p. 232.

²⁶ In 1963 an ITT aide in Holland said: "studies made at Bell Laboratories, showing that «full» processor controlled logic is justified only in case of very large office units". ITT 1974, p. 25.

²⁷ "For small and medium exchanges the space-requirements are not so important", STKs Business Plan 1968-1972.

²⁸ STKA: STKs Business Plan 1968-1972.

²⁹ Knudtzon 1972, p. 50; Jon B. Riisnæs: "Markedssituasjonen i Norge" in Ivar Mo 2000, p. 8.

LME's relative strengths: LME's rural switches were acclaimed. The Swedish PTO had manufactured its own urban switches, so LME had developed a global strategy for marketing rural switches, first the XY switch in the 1930s, and then the rural crossbar switch (KV), which was regarded as world class.³⁰ ITT, on the other hand, had focused on large urban switches, and lacked a competitive rural switch. The French PTO's orders for crossbar switches in the late 1950s illustrated this: ITT's Pentaconta was chosen for the urban networks, while the French variant of LME's KV was chosen for the rural networks. Moreover, LME developed an electronic rural switch in the second half of the 1960s, the AKK50, for which EB was given some manufacturing responsibility.³¹

Televerket was reluctant, however, to leave the rural market to EB, as it wanted to force down prices by introducing limited competition. The problems of interaction between different types of switches still halted the possibility of introducing competition. The rural switches did not overcome this, i.e. switches installed as an extension of a local switch had to be from the same company as the "mother" switch. It was possible to make switches from LME and ITT work together, but this was regarded as too expensive. Thus, such rural switches were to be pre-allocated through the long-term agreements. However, the switches that were directly linked to the national network, through transit switches, could be either of LME or ITT make, so such projects could be put out for competition.³² Transit switches routed calls between switches, whereas local switches, or end switches routed calls to the subscriber. Some local switches functioned as "mother" switches, routing both to subscribers and smaller rural switches. The "competition projects" would serve as price setters for the pre-allocated projects. In order to achieve competition, Televerket encouraged STK to come up with a rural switch.³³

STK started a search for a rural switch so it could compete with EB for deliveries. An important point was that BTM did not develop rural switches; as Belgium was so densely populated, urban switches - the Pentaconta and later the Metaconta 10C - operated the entire national network. Thus, STK's traditional patron had no rural

³⁰ The author of Ericsson's centenary book, Ulf Olsson, claims that "Ericsson (...) produced the best finished (crossbar) product" in

http://www.ericsson.com/about/publications/kon_con/contact/cont06_01/c06_20.shtml.

Ericsson's rural KV -switch from the late 1950s was the ARF 10. Jacobæus 1976, p. 114-115.

³¹ NTM7: File: About EB's AKK50: "EB to Telegrafstyret 15.01.68" memo fra meeting about AKK50.

³² The 11B and AKK50 could interact with other equipment on a "group/transit switch level". NTM7-11Ba: "Nye automatsentraler 11B og AKK50, Notat til direktørmøte 10. januar 1975".

³³ Mo 2000.

switch to offer. STK's response was to try to develop an 8B district-switch. An STK engineer, Arne Ruud, spent a year at BTM doing this. It was installed in some areas, but proved too heavy, complicated and expensive, especially for areas that required less than 100 lines.³⁴ Moreover, it was an end-switch, which could operate only with support from a main 8B switch. Thus, it could not be used in the “competition projects”. Then STK presented a small Pentaconta switch, the PC-32, developed in France, which Televerket also rejected.³⁵ From the late 1960s STK took a keen interest in a Swedish ITT project, to develop a semi-electronic rural switch, an electronic switch without a stored program, using a wired logic. LME followed the same strategy, with its AKK50.

After an abortive attempt from the German SEL, to develop a rural switch with reed-relay contact, the Metaconta 10F, ITT-Europe wanted to exploit the Swedish competence in this field.³⁶ ITT's Swedish subsidiary, Standard Radio & Telefon (SRT), was based mainly on intercom systems.³⁷ Nonetheless, encouraged by ITT, SRT started a “small exchange working party” in 1965. ITT was eager to develop a competitive rural switch, because several European countries went through the same process as Norway, i.e. an increased demand for automatic rural switches.³⁸ Several engineers from the British ITT subsidiary, STC, followed the Swedish ITT project, because the UK was regarded as the largest potential market. Sweden was an impossible market to penetrate due to LME's dominance; hence the project was moved to STC, to East Kilbride in Scotland, in 1967. STK followed the project closely in its search for a rural switch, and an STK engineer moved to Scotland in 1967. STC, however, had to abandon the project in 1969, because it won a large contract from the British PTO to develop an electronic switch, the TXE4.³⁹

ITT had a problem. Having spent five years on the 11B, it did not want to drop the project. The company had “a half finished system that needed a home”, and the project had turned into a “hot potato”.⁴⁰ ITT-Europe pushed STK to host the completion of the Metaconta 11B.⁴¹ STK's management was reluctant to take on the

³⁴ Mo 2000, p. 6.

³⁵ Bergen District ordered a PC32, without a permit from Teledirektoratet. It concealed the order from CGCT in the budget by “placing it under” an order for PABX; Riisnæs 2000, p. 6.

³⁶ Mo, 2000., p. 4.

³⁷ Mo 2000, p. 4. SRT was established and owned by STK in the 1930s, and sold to ITT, or International Standard Electric Corporation, in 1948; STK's Annual Report 1938 and 1948.

³⁸ ITT 1974, p. 25.

³⁹ Young 1983, 169.

⁴⁰ Mo 2000, p. 8.

⁴¹ Interview with Ivar Mo.

11B, but welcomed the opportunity to gain experience in electronics.⁴² STK's telecom division wanted to receive such a project. The long-term agreement provided a sound economic base for the division, and STK was in critical need of a rural switch. Moreover, some hoped that it could provide STK with export orders.⁴³ BTM warned STK that the 11B concept would never function. BTM's scepticism reflected the fact that the 11B used a mini-crossbar as a selector. Still, Ivar Mo, who had a switching degree from NTH, and eventually helmed the 11B project, was very keen on "cutting his teeth on the 11B".⁴⁴

The 11B was the largest development project STK had considered.⁴⁵ Braaten and Rambøl doubted its ability to handle a project of such a magnitude, but they agreed with the telecom division that it was important for STK to develop the capability of running such projects. The reasoning followed the same line as that for the establishment of the R&D department. STK had to undertake R&D in Norway, to avoid being criticised for simply extracting revenues on behalf of ITT. In this respect, it was important that ITT promised that it was prepared to market the 11B worldwide on behalf of STK.⁴⁶ Hence, STK tried to gain product responsibility within ITT, i.e. to be a lead house in this market segment. STK had tried this in more peripheral market segments, such as cryptation for the military or maritime electronics, but the 11B stood out, since switching development was at the core of the telecom industry. Thus, the project was perceived as a potential launch pad for becoming engaged in electronic switching, and thus becoming a fully-fledged telecom company.

STK was eager to receive approbation from Televerket, and invited the PTO to Scotland to look at the project in 1969.⁴⁷ The Head of Televerket's Switching Office, Nils Jonsson, was told that the 11B was the switch ITT-Europe would go for in this market segment. This was important for Televerket; still, it did not put too much emphasis on such promises, bearing the 8B in mind. Jonsson thought the project was promising, not least because the 11B could interact with different kinds of switches, and this was important if Televerket wanted to escape the technological deadlock that underpinned the Lillehammer agreement.⁴⁸ Jonsson wanted to make an agreement for a trial switch, granted that STK would meet Televerket's requirements in general, and that "interaction with our Norwegian specialty 8-B must be

⁴² STK's Annual Report 1971, p. 3.

⁴³ Interview with Ivar Ørbeck.

⁴⁴ Interview with Ivar Mo.

⁴⁵ NTM7-11Bb: Letter from STK to Teledirektoratet 20.10.71.

⁴⁶ Interview with Ivar Mo.

⁴⁷ NTM7-11Bb: Memo from Nils Jonsson til "Linjeteknisk direktør" 24.04.69.

⁴⁸ NTM7-11Bb: Memo from Nils Jonsson til "Linjeteknisk direktør" 24.04.69.

arranged in satisfactory manner".⁴⁹ Thus, Televerket ordered an 11B trial switch for Engelsrud, in Asker outside Oslo.⁵⁰

Claiming that the 11B "is one of the largest development projects in telecommunication" in Norway, STK invited Televerket to participate in the 11B project on a broader basis, for example inviting them to take part in several 11B committees.⁵¹ Televerket did participate in such meetings, but never got carried away by STK's references to the project's significance for the Norwegian telecom industry.⁵² In its communication with STK regarding the 11B, Televerket focused only on its role as a service provider, not as an industry provider. The 8B experience had vaccinated Televerket against such a role. Televerket's order for the 11B in 1970 arose from very different conditions to those when it was turned into a guinea pig with the 8B in the 1950s. The 8B problems in the Oslo network piled up in the late 1960s, and STK's reputation as a switching supplier diminished, as it proved unable to solve the problems.⁵³ Televerket learned that STK was too small to handle problems of a certain magnitude. Thus, it is not surprising that Televerket handled STK's 11B offer on a market or arm's-length basis. These factors concerned Televerket's relationship with STK in particular, but there were other broader developments that had improved Televerket's qualifications as a procurer of switches.

The network as "a weed flora"

Televerket had gone through a process of modernisation and corporatisation in the 1960s, as it grew into one of the largest concerns in Norway.⁵⁴ When the telephone queues were eliminated in 1968, the new Director General, Per Øvregard, broadened the managerial scope, compared to Leif Larsen's old mantra of doing away with the waiting lists. An organisational investigation laid the foundation for reorganising the PTO. In 1969, Telegrafverket was changed to Televerket, and Telegrafstyret to Teledirektoratet. A board of external directors replaced the meetings of the in-house directors. The organisational structure was changed: the Economy Department was strengthened, among other things, through the establishment of an

⁴⁹ NTM7-11Bb: Memo from Nils Jonsson til "Linjeteknisk direktør" 24.04.69. (samkjøringen med vår norske spesialitet 8-B må ordnes på en tilfredsstillende måte).

⁵⁰ NTM7-11Bb: Letter from Teledirektoratet to STK 30.10.70.

⁵¹ NTM7-11Bb: Letter from STK's Riisnæs to Teledirektoratet 17.12.70 and STK til Teledir 20.10.71. (ett av de største utviklingsprosjekter innen telekommunikasjonssektoren i landet).

⁵² STK invited Televerket to participate in monthly meetings regarding the 11B, but it does not seem that Televerket participated. NTM7-11Bb: Letters from STK to Teledirektoratet 17.12.70 and 20.10.71.

⁵³ TBD 15.10.69 and 03.12.69.

⁵⁴ Espeli 2005, p. 424.

independent section for procurement and supply.⁵⁵ Consequently, STK was facing an ever-more professional and demanding procurer in the first half of the 1970s. An important thing that enabled Televerket to be a more demanding procurer was the process of installing equipment for national automation.

National automation implied that one could call long-distance without assistance from a manual operator. It entailed national specifications on signalling, billing, transmission and directing. It also required a different kind of switch, which could route calls between local switches. Such switches were called transit or trunk switches. As an example, if a subscriber was to make a phone call from Sverresborg in Trondheim, to Stabekk outside Oslo, the request would be noted at Sverresborg's local switch, which would route the call to Trondheim's transit switch; this would route it to Oslo's transit switch, which would in turn route it to Stabekk's local switch, which would send the call to the receiving subscriber. The transit switches could interact with equipment from different suppliers: this was necessary to allow for an automatic call to be made from "EB-land", as Trondheim was in, to "STK-land", which included Oslo and Stabekk. Thus, there were smaller technological barriers to using competitive tenders in the procurement of transit switches, or, which is important in this chapter, local switches that were to be linked with a transit switch.

There was a rapid increase in international and long-distance calls during the 1960s, which affected the PTOs' relationship with the switching industry. The number of international calls rose tenfold between 1950 and 1970.⁵⁶ This growth required international cooperation to agree on specifications, mainly in signalling. The increasing international cooperation, within CCITT* and CEPT*, was crucial in loosening the industry's oligopolic grip on the switching market. Firstly, because cooperation, together with the new electronic and digital technology, eased the problems of technological interfaces, and secondly, because the international telecom organisations became important sources of information and knowledge for Televerket. This was particularly important for switching, which reappeared in the international

⁵⁵ St.prp. 30 (1971-1972): "Om ny administrativ oppbygging av Televerkets sentraladministrasjon - Teledirektoratet".

⁵⁶ Billed minutes to and from Norway rose from 4670 in 1950, to 53,258 in 1970, St.prp. 30 (1971-72).

* Comité Consultatif de International Telegraph et Telephone (The International Telephone and Telegraph Consultative Committee).

* CEPT: Conference of European Posts and Telegraphs.

forums in 1960, after having been absent between 1920 and 1960.⁵⁷ Hence, the equipment supplier no longer had a monopoly on knowledge and information regarding the development of switching technology.

The increased R&D was also important in enhancing the PTOs' competence. There was a fruitful interaction between R&D and internationalisation. On the one hand, R&D increased the absorptive capacity of the PTOs, so they were able to comprehend and utilise the information and knowledge from the international cooperation. On the other hand, the international cooperation was important in setting R&D agendas. Helge Godø argues convincingly how the international cooperation, due to the need for common technological standards, stimulated innovations in telecom in the 1980s.⁵⁸ There is every reason to believe that such fruitful interaction took place from the 1960s, and contributed to the increased competence of the PTOs. TF's role in terms of switching competence is disputed, however, as several actors claim that it contributed little in this field.⁵⁹ Nevertheless, TF was important in providing Televerket with confidence in its meetings with the industry and in placing better planning on the agenda.⁶⁰

The most important development, however, was the national automation. Moreover, it turned the national network into one integrated technological system, which could no longer be seen as several local networks, bundled together by Televerket. It entailed technological standards, particularly in signalling, which were decisive for transmission and billing. Another factor was that Televerket achieved full monopoly as a national operator: it took over the last private operator in Andebu in 1972.⁶¹ The permanent temporality had ended, and Televerket had total monopsonic procurement power towards the suppliers. The monopoly and the national automation were the main reasons for centralising procurement of switches in Teledirektoratet. The responsibility for procuring switches before the long-term agreements was unclear. Telegrafstyret had the formal responsibility, in as much as it sanctioned the districts' decisions, but it did not seem to have interfered much.⁶² From around 1970, invest-

⁵⁷ As mentioned in chapter II, CCITT undertook switching studies at its first meeting in India in 1960. Chapuis 1982, p. 190.

⁵⁸ Helge Godø: *R&D and technological innovations telecommunication: Innovation regimes*, 1995; Helge Godø: "Innovation regimes, R&D and radical innovations in telecommunications", 2000.

⁵⁹ Several of the central managers in Televerket's Technical Department play down TF's role in switching. Interview with Bjørn Gladsø; Magnhild Slettbak, STK's Carl-Edward Joys fully supports this view.

⁶⁰ Slettbak points to the confidence TF gave Televerket.

⁶¹ Espeli 2005, p. 276.

⁶² Interview with Bjørn Gladsø; Magnhild Slettbak; Ivar Mo; Jon B. Riisnæs; Carl-Edward Joys.

ments in the network were made according to a national plan, accommodating several factors, among them national automation. A natural consequence was that the monopsonic procurement power increased. The national automation called for more planning and control, and competence in switching, as did the developments within electronic switching.

The electronic switches also required strategic forecasting, Televerket had to come up with a technological strategy, and it was a matter of choosing the right technology at the right time. Nils Jonsson visited LME and several ITT units (BTM, CGCT and LCT) to study SPC switches, STC in London to study PCM switches, and East Kilbride to examine the 11B.⁶³ After his return, in 1969, Televerket's Switching office produced a report that mapped the switches in the Norwegian network. The document shows that Televerket had realised that switching - not transmission - was the essential component in the telecom network.⁶⁴ The main message from the station office was that the network was "a true weed flora of equipment variants, which creates problems both for planning and operations."⁶⁵

The first generation of automatic switches was half a century old, and accounted for about 200,000 lines in the Norwegian network, in addition to some 100,000 lines from the Rotary 7D, installed in the 1930s. It is evident that the Norwegian network was not up to date, but it is worth mentioning that even in the US network, the first generation of automatic switches dominated as late as 1973.⁶⁶ Nevertheless, these switches had "to be scrapped" within 10-20 years.⁶⁷ Maintenance was labour-intensive, 4-5 times as much as modern switches; the network provided poor service; and would not be able to handle the expected increase in traffic in the 1970s. Thus, between 15,000 and 20,000 lines needed to be replaced each year, in addition to the annual extension of lines. It was a puzzle to decide which switches should be replaced first; this had to be done according to estimated increase in traffic, the national automation, and the competence of Televerket's personnel. Moreover, the interface problem existed as long as there were electro-mechanical switches. Fur-

⁶³ NTM7-11Bb: "IL.S. 69/Nj Draft for letter from Telegrafstyret to Ministry of Communication 12.02.69".

⁶⁴ RA-LTP37a: "R-Direktoratets org.unders. i Teledirektoratet; Bidrag til innstillingen fra Teledirektoratets kontorer; Innst. fra Arbeidsgruppe E - Langtidsplanlegging 20/8-69".

⁶⁵ RA-LTP37a: Innst. fra Arbeidsgruppe E - Langtidsplanlegging 20/8-69, (en sann ugrasflora av utstysvarianter skaper problemer både for planlegging of drift).

⁶⁶ "Step-by-step switches served a peak of 24.4 million Bell System lines in 1973, fifty four years after the Bell System began using them. At that time more Bell System lines were served by Step-by-step switches than any other type of switch." Gerald W. Brock: *The Second Information Revolution*, 2003, p. 128.

⁶⁷ RA-LTP37A: Innst. fra Arbeidsgruppe E - Langtidsplanlegging 20/8-69.

thermore, electronic switches were “very sensitive to external influences”, and had to be modified to interact with old equipment.⁶⁸ This raised the question of where modern, or old, switches would function best.

A final complicating element was to assess the lifespan of the new switches. STK's 11B and EB's AKK50 were hybrid switches, belonging both to the crossbar and the electronic generation. It was a matter of time before a less expensive processor would rule out the wired logic. This might explain why the 11B was a “hot potato” for ITT-Europe, and that no other subsidiary wanted to host the project. At this time, around 1970, other telecom companies, like Nokia for instance, was fully engaged in SPC switches, and CIT-Alcatel launched its digital switch in 1970; so 11B was not a very futuristic project.⁶⁹ Another issue was when the future generation of switches would make its mark. Digital switches were expected in the foreseeable future. The report noted that PCM was used in transmission, “but an integration with the contact function seems to offer big advantages”.⁷⁰ It raised the question of bandwidth, to account for new services, such as data transmission and picture telephony. This had to be taken into consideration, according to the report, when the introduction of new switching equipment was to be planned.

These arguments about digital switching and new services were raised throughout the 1970s by the TF's director, Nic. Knudtzon. He was a member of the committee that wrote the report.⁷¹ Knudtzon paid more attention to the new services a digital network could provide, than to Televerket's problem with standard telephony. It is fair to call him a *futurist* in this context, as he wanted to replace the term “long-term-planning” with the alternative “distant-time-planning”.⁷² His focus on other modern services caused a rift between the TF and Televerket's *Technical Department* (TA*). The TA was more concerned with present problems, than with distant-time possibilities.⁷³ It wanted the TF's support in its day-to-day challenges, but felt that the TF was too concerned with theoretical and abstract planning for a future digital network. A vision behind the TF's reflections was the seamless digital network, abundant with new services. A seamless network was far-fetched for the TA,

⁶⁸ RA-LTP37A: Innst. fra Arbeidsgruppe E - Langtidsplanlegging 20/8-69, (De nye systemer basert på elektronikk er svært følsomme for ytre påvirkning).

⁶⁹ Häikiö, 2002, p. 57.

⁷⁰ RA-LTP37A: Innst. fra Arbeidsgruppe E - Langtidsplanlegging 20/8-69, (Foreløpig er (PCM) i bruk for samband, men en integrering av koplingsfunksjonen synes å by på store fordeler).

⁷¹ Several LPC-meetings.

⁷² Collett and Lossius, 1993, p. 43.

* Norwegian abbreviation for Teknisk Avdeling.

⁷³ RA-LTP, several meetings; and interview with Bjørn Gladsø.

which had to cope with a network that looked like a “weed flora”. This was especially true for the Oslo network, which practically broke down in 1968.⁷⁴

The Oslo problem

The Oslo network was of particular significance to Televerket, because it was the hub in the national network. The bulk of the long-distance calls and all the international calls went through Oslo. Hence, not only Oslo's citizens, businesses and institutions depended on a functioning network, but the whole country did too. It was important in an organisational perspective, since Oslo District, which incorporated the suburban communes, was by far the strongest district within Televerket. It had gained substantial autonomy because of its size, but it was important for Teledirektoratet to have influence on the national hub. Oslo was also vital to STK, being the sole supplier of equipment to the capital's network. STK's telecom department developed very close relations with Oslo District. It functioned as a showcase for the company, and it was the first procurer of Rotary switches in the 1920s, 8Bs in the 1950s, and was to inaugurate the new generation of SPC switches in the 1970s.

Oslo had been an overarching problem for Telegrafverket in terms of telephone queues, as nearly 50 per cent of the applicants for telephones belonged to the Oslo network, and the problem peaked in 1957, with over 27,000 people waiting for telephones. Televerket and Oslo District reached a milestone in 1968, when it finally eliminated the queues.⁷⁵ The celebration did not last long; as the network nearly broke down the same year, the main problem was that the subscribers lost the dialling tone. One reason for the problem was that the installation of new lines, to get rid of the queues, had been at the expense of investments in equipment to handle the increased traffic.⁷⁶ The 8B switches, in particular, were pushed to their limits in terms of numbers of lines to operate.⁷⁷ Still, it was rather the increased traffic on existing lines that created the trouble.⁷⁸

⁷⁴ TBD 01.08.69, and Bestorp 1990, p. 179.

⁷⁵ Bestorp 1990, p. 373.

⁷⁶ An example was the concentrators that were used in the switching-stations. All subscribers could not phone at the same time, so before “arriving” at the switch, subscribers went through a concentrator, thus sharing incoming lines. The normal quota was 10:100, i.e. 100 subscribers to a concentrator with 10 incoming lines. This quota was increased to 20:100, thus making the network more vulnerable to a breakdown during intense traffic.

⁷⁷ Interview with Ivar Mo.

⁷⁸ The bulk of the new lines was installed on the outskirts of the city. The problem in the late 1960s originated in the centre of the city, where few lines had been installed the preceding years. Bestorp 1990, p. 179.

There were several reasons for the breakdown.⁷⁹ The switches in the city centre were mostly old Rotary switches, covering over 120,000 lines or more than 50 per cent of the city's lines, and these were not capable of operating "traffic intense" business subscribers.⁸⁰ Another problem was an 8B transit switch, installed in 1965 for automating national and international calls. The increased traffic on this switch created problems, as it was constantly being upgraded as the number of lines increased from 2000 to 8600 lines in 1971.⁸¹ Due to signalling and direction, all the traffic to the transit switch was routed through a special switch, which became a bottleneck. Another bottleneck was a tandem switch that "interpreted" the traffic between all Rotary and 8B switches. Finally, from the late 1960s Televerket started to pay the price for being a lonely rider with the 8B, and complaints relating to the 8B are standard in Televerket's documents from that time.⁸² Other PTOs gained from what Brian W. Arthur has called *increasing returns*, meaning that "technologies become more attractive - more developed, more widespread, more useful - the more they are adopted".⁸³ With standard switches, the upgrading costs were shared with other countries, or were used in larger networks, and so the costs were smaller per line.⁸⁴

A central problem with the 8B was the multi-switch, which was made out of plastic to make it economical. It broke several times and caused much trouble. Another technological problem was the selenium diodes, which had rusted in Brazil. There were ten thousands of such components in each 8B switch. STK wanted to replace the selenium diodes, but "our demand", Mo recalled, "was too small to make any semiconductor manufacturer interested in developing an entirely new kind of diode".⁸⁵ STK had to develop its own circuits, to replace the matrices of the selenium diodes. This was expensive, and only applicable in new switches; STK had many problems in providing selenium diodes for the replacement of old switches. A similar problem arose when the semi-conductive material in the 8B's transistors had to be changed from germanium to silicon. At first, the problems of the 8B were seen as initial weaknesses, but "proved after some years to be a wide, never-ending array of

⁷⁹ This is based on Bestorp (1990, p. 192); his arguments are in line with the sources, conf. TBD from July 1969 to 1970; NTM8: File: "Nord 3 Fremdrift - sluttoppgjør": Bestorp to Teledirektoratet 25.09.72: "Utskifting av 8.000 nummer Nord 3/10C/ITT1600"; NTM9b: "T.IIS. 28/3-72: Innstilling om ny datamaskinstyrt fjernsentral til Oslo".

⁸⁰ NTM8: I.I.S. Skinnes 6.10.71, "Innstilling (nr. 1) om Ny Lokalautomatsentral Nord 3".

⁸¹ Bestorp 1990, 161.

⁸² NTM7-11Bb: Memo from N. Jonsson til "Linjeteknisk direktør" 24.04.69. TBD 15.10.69.

⁸³ Arthur 1988, p. 590.

⁸⁴ Arthur 1988, p. 590.

⁸⁵ Mo 2001. (Men vårt behov var for lite til å gjøre halvlederprodusenter interessert i å utvikle en helt ny diodetype).

technical faults”, says Helge Godø.⁸⁶ The consequences were damaging,, “most of all, in the public image of the NT (Televerket) as an incompetent public utility”.⁸⁷ Thus, being a futuristic switch in the 1950s, the 8B suffered from its use of premature semiconductor components, and the small Norwegian network had to finance the upgrading costs.

Some STK aides claim that the real problem was not the 8B switch, but the lack of systematic routines for reporting, maintenance and repair at Oslo District.⁸⁸ The fact that the other cities using the 8B did not experience so much trouble lends weight to this argument. One of STK's switching directors in the 1970s, Carl-Edward Joys, stresses that Oslo District relied too much on STK, due to the spatial proximity, i.e. it was easier to call Økern than to fix the problem.⁸⁹ Still, the many different switches turned the Oslo network into a patchwork of switches, and it was difficult to train personnel. Specialist craft skills were required for monitoring and repairing this system, which STK possessed but Oslo District lacked.⁹⁰ This meant that Oslo District and Teledirektoratet were very reliant on STK.

After several committees had analysed the problem, Oslo District and Teledirektoratet decided to start replacing the old Rotary switches, mainly because these switches demanded so much maintenance, and were thus costly in terms of wages. Each Rotary line cost 53 kroners per line, whereas each 8B line required only 19 kroners.⁹¹ Other European cities that went through this process around 1970, i.e. replacing the first generation automatic switches from the interwar years, and generally did this with crossbar switches that were only a decade old. Neither Teledirektoratet nor Oslo District wanted to install more 8B switches than necessary, considering that the 8B was a main cause of Oslo's problem, and thought it futile to rely on this system.⁹² An upgrading of the 8B was considered too expensive, as Televerket would have to cover all development costs.⁹³ In a Board Meeting in June 1970, Teledirektoratet decided to install two SPC switches in Oslo; a local switch to re-

⁸⁶ Godø 1995, p. 107.

⁸⁷ Godø 1995, p. 107.

⁸⁸ Interview with Carl-Edward Joys.

⁸⁹ It is true, as Joys says, that Bergen District had few problems with the 8B, but Bergen also had fewer lines and did not function as a national hub. Moreover, it is fair to view Joys' appraisal of Bergen in the light of local and family patriotism, in as much as his father, Lorentz Angell Joys, was director of Bergen District for many years. Kåre Aarvik: *Makt og avmakt: om organisasjon og ledelse i Televerket : fra "væsen" til "verk"*, 1993, p. 40.

⁹⁰ Interview with Gunnar Tidemann; Knut Berg; Carl Edvard Joys; Gladsø.

⁹¹ Bestorp 1990, p. 193.

⁹² TBD 15.10.69.

⁹³ Bestorp 1990, p. 231.

place Rotary switches in the town centre, at “Nord 3”, and a transit switch to replace the 8B transit switch from 1965.⁹⁴ This was very early in a European context, and was a consequence of the troubles with the 8B. Thus, Televerket was a pioneer with SPC switches, since its pioneering role with crossbar switches was a failure.⁹⁵

The lucrative long-term agreements

Teledirektoratet wanted competition for the two deliveries, but it realised, however, that BTM's 10C and LME's versions were the only realistic alternatives.⁹⁶ Still, this was to be the first time Televerket arranged a real competitive tender. In the first long-term agreement, in 1966-69, STK and EB competed for the installation of switches in Ålesund and Larvik, in 1966 and 1968, respectively, but the competition was not genuine. Both the projects were in STK areas, and STK won both, even though EB's prices were lower. The reason was that “direct traffic between two suppliers' automatic systems creates problems that burden Telegrafverket”.⁹⁷ It was possible to handle the interface problem, but it was expensive, particularly the issue of making EB's switches work with the old Rotary switches. Thus, it would be more expensive and troublesome to run the local telecom networks if there were two equipment suppliers involved.⁹⁸ It required personnel who could handle both systems, and an STK switch was a safer bet in terms of avoiding communication problems with the incumbent switches. The same arguments were put forward for future deliveries, that future installation of STK switches would be more expensive to install if EB were chosen.⁹⁹ Thus, these tenders did not escape the logic of the Lillehammer agreement.

⁹⁴ TBD 09.06.70. Still, “Since there was a relatively long delivery time for computer-controlled switches, it will probably be necessary to order some 8-B equipment to extend Oslo's trunk switch in 1971 to cover the increase in traffic” (Da det er relativt lang leveringstid for datamaskinstyrte sentraler, vil det trolig bli nødvendig å bestille en del 8-B utstyr til utviding av Oslo fjernsentral i 1971 for å dekke trafikkveksten).

⁹⁵ Televerket wanted to wait until BTM and LME's SPC switches had been tested in other countries. “In Oslo, however, we have to order equipment for several switches. The alternative is to order 8B equipment and this we will advise against.” NTM8: ”I.I.S. Skinnes 6.10.71, “Innstilling (nr. 1) om Ny Lokalautomatsentral Nord 3” and ”I.I.S. Skinnes 30.11.71: Innstilling nr. 2 om Ny Lokalautomatsentral Nord 3 I Oslo”.

⁹⁶ LME's local SPC switch was called the AKE, while its transit SPC switch was called the ARE.

⁹⁷ NTM-Å: Jonsson's Innstilling to avd. direktør Lagset fra I.I.S. 18.01.68. (direkte samtrafikk mellom to leverandørers automatsystemer skaper problemer som belaster Telegrafverket).

⁹⁸ NTM-Å: Jonssons innstilling til avd. direktør Lagset fra I.I.S. 18.01.68.

⁹⁹ NTM-Å: Jonssons innstilling til avd. direktør Lagset fra I.I.S. 18.01.68.

EB's offer at Ålesund was recommended in Televerket's first evaluation, but a later evaluation denounced EB's offer as dumping, since it did not use the fixed units prices from the long-term agreement.¹⁰⁰

“The present offers ascertain that if both offers were based on unit prices, EB's offer would be ½ million kroners more expensive than STK's offer. In later extensions at Ålesund we must expect to pay «normal» price, and then EB is more expensive than Standard, even if the first installation is offered at reduced price.”¹⁰¹

The purpose of the competitions at Larvik and Ålesund was to compare STK and EB's unit prices in the long-term agreement, and how these affected the prices of complete switches.¹⁰² There is no doubt that EB violated the conditions, but it is noteworthy that Telegrafverket did not try to use EB's offer to reduce the unit prices in the long-term agreements. An explanation for the behaviour might be that Telegrafverket's procurement was dominated by engineers, and thus the technical aspects, rather than economic conditions, prevailed. So, accusing EB of “dumping” might have been a substitute argument, to try to avoid mixing equipment from STK and EB.

Consequently, the tenders for the SPC switches in 1971 were to be the first real competition. This was partly a result of external pressure. Besides an increased public interest in how Televerket's resources were allocated, the Auditor General stands out as a key institution. It started to inspect Telegrafverket in 1962, before that, the Ministry of Communication was responsible for its control. The Auditor General had several complaints throughout the 1960s, particularly regarding Televerket's lack of control of its stocks of equipment and capital.¹⁰³ Another recurrent issue was Telegrafverket's payment routines; they were not under sufficient control, and not in accordance with the books. Still, Telegrafverket continued its slack bookkeeping, and managed to avoid action from the Auditor General. It is remarkable, says Harald Espeli, how Telegrafverket was able to impede and obstruct

¹⁰⁰ NTM-Å: Jonssons innstilling til avd. direktør Lagset fra II.S. 18.01.68.

¹⁰¹ NTM7, File: “Ny sentral Larvik 1966/67”: Jonsson's Innstilling til avd. direktør Lagset fra II.S. 18.01.68. (De foreliggende tilbud slår fast at hvis begge tilbud var basert på enhetsprisene ville EB's tilbud være ½ mill. kroner dyrere enn STK's tilbud. Ved senere utvidelse av Ålesund må vi regne med å betale "normal" pris og da faller EB dyrere enn Standard, selv om det ved første utbygging er tilbudt til redusert pris.)

¹⁰² Interview with Bjørn Gladso.

¹⁰³ Riksarkivet's information on the archive from the Auditory General (Riksrevisjonen). <http://www.riksarkivet.no>; The Auditor General's report to Stortinget 1969; St. f. 5. dokumenter (1970/71), Samferdselsdepartementet 1969, III Televerket.

the Auditor General's call for better control.¹⁰⁴ A reason why the Auditor General's influence was stronger from the late 1960s, was that its mandate towards state-owned industries, not only the state administration, increased from 1965, and that it extended its control function from account revision, to the revision of procurement routines, contracts and administration.¹⁰⁵

The long-term agreements were very lucrative for STK and EB, since they reaped the benefits of rationalising in production.¹⁰⁶ Telegrafverket ordered more equipment from STK and EB than the long-term agreement for 1965-69 prescribed, and requested if this could lead to a price reduction. It resulted in a total discount of NOK 11 million, without any further documentation from the companies.¹⁰⁷ The Auditor General was sceptical about this discount, because the "price reductions seemed (...) modest" and because there were no calculations substantiating it.¹⁰⁸ The Auditor General suspected that STK and EB overcharged Televerket in the existing procurement regime, and called for more competition.¹⁰⁹ The Ministry instructed Televerket to invite tenders from foreign equipment suppliers whenever possible. Furthermore, limited competition was to be introduced between STK and EB. Another element that might have induced Televerket to decide on open tenders was a growing doubt of STK's abilities, since it proved unable to help Televerket sort out the problems in Oslo. An accompanying element was that Teledirektoratet and others felt that Oslo District was in the hands of STK.

The Oslo tenders

To arrange tenders, the procurer needs sufficient competence about the products offered. Televerket recognised that it lacked this, and there was "an urgent need" to acquire "better competence and insight in computer-controlled automatic switches", as its Board admitted, "by placing engineers for training with potential suppliers of such equipment, to avoid being too dependent on the suppliers".¹¹⁰ 'Suppliers' in

¹⁰⁴ Espeli 2005, p. 454.

¹⁰⁵ Espen Thompson: *Revisjon og politikk: Riksrevisjonen og fremveksten av forvaltningsrevisjon etter 1945*, 2001.

¹⁰⁶ This is the impression from STK's accounts, and is verified by most of the interviews, especially Fredrik Thoresen, Jens Gjerdsjø, who was director in Televerket's Procurement office 1973-82. Espeli 2005, p. 405.

¹⁰⁷ St. f. 5. Dokument nr 1. (1970/71), Samferdselsdepartementet 1969, III Televerket.

¹⁰⁸ St. f. 5. Dokument nr 1. (1970-71), Samferdselsdepartementet 1969, III Televerket.

¹⁰⁹ The Auditor General's report to Stortinget 1969-1973.

¹¹⁰ TBD 09.06.70. (påtrengende behov), (bedre kompetanse og innsikt i datamaskinstyrte automatsentraler), (ved å få plassert ingeniører til opplæring hos potensielle leverandører av slikt utstyr, slik at vi ikke blir for sterkt avhengig av leverandørene.)

this context did not mean the Norwegian subsidiaries, but LME and BTM. Johs Skinnes and Bjørn Gladsø from Teledirektoratet went to LME in Stockholm, and Alf Marhaug from Oslo District and Leiv Hanesand from Bergen District went to BTM in Antwerp. Televerket's engineers had visited the STK and EB headquarters before, when inspecting switches. Still, the two projects were more complex than the earlier procurements: firstly because the switches involved were to handle a large amount of traffic, and in a complex networks, and secondly, because the tender was competitive, Teledirektoratet had to compare the strengths and weaknesses of BTM and LME's switches.

STK and EB were invited to hand in offers for the two projects in 1971.¹¹¹ The invitations stipulated that the computer switches "should be understood as Stored Program, as opposed to wired program".¹¹² It was a matter of great prestige to win the projects. The transit switch was to be the largest switch in Norway and the national hub, routing all international calls, and all long-distance calls passing through Oslo. It was to handle one million calls per day from the start, rising later to 4.5 million calls. The local SPC switch was to be the largest-ever local switch in Norway, with a final capacity of 20,000 lines, operating in the large and complex Oslo network. Moreover, even if it was not stated, it was assumed that the winner of the local SPC contract would deliver further SPC switches to the Oslo network. This was because it would be too expensive to train Televerket's personnel in two switching systems. Televerket stressed that it was not obliged to accept any of the offers.

Televerket rejected both of the first offers for local SPC switch for "Nord 3" in October 1971. It rejected LME's ARE because of the excessive delivery time, the limited services offered, and modest experience with the processor. The 10C was considered too expensive, and with insufficient traffic capacity. Televerket asked both companies to return with better offers. EB had to inform Televerket about other PTOs that had expressed interest in LME's local SPC switch, as the ARE switch was yet to be produced, and Televerket was cautious about a new 8B situation. STK was asked to reduce the price, and come up with a new solution that increased the capacity; it was not able to meet the requirements of a final capacity of 20,000 lines. It does not seem as if Televerket regretted turning down the offers and the resulting delay, as it was eager to get the best system. It was the first time Televerket used its

¹¹¹ Decision at Televerket's Board Meeting 25.01.71.

¹¹² The following is based on NTM8: "I.L.S. Skinnes 6.10.71: Innstilling (nr. 1) om Ny Lokalautomatsentral Nord 3"; (Med datamaskinstyrte forst as "Lagret program" - [Stored program] i motsetning til "Kablet program" - [Wired Program] styring.)

procurement power in a concrete situation, by setting the equipment suppliers against each other. In an internal meeting, its Director General “praised the working group for the fine work it had done”.¹¹³

Televerket chose STK/BTM's 10C as the local switch in the second evaluation in November 1971. An important reason was that STK lowered the price by 10 per cent. Moreover, in their new offer, STK/BTM had replaced the ITT-1600 computer with the ITT-3200, which had larger capacity.¹¹⁴ Whereas the ITT-1600 could handle only 86,000 calls per hour, the ITT-3200 could operate 200,000, and the latter computer's storage capacity could be upgraded. The 10C was initially designed as a SPC switch, whereas LME's ARE was, in reality, only an upgraded crossbar switch. Thus, the 10C had “more facilities for the subscribers and in particular for administrative measures”, which was regarded as preferable.¹¹⁵ There are no signs in the report that the 10C was chosen because the rest of the Oslo network used BTM switches. It was important for STK to win the contract, to hold on to Oslo as its main market. As the report stated, the 10C order for Nord 3 “must be viewed as the choice of the 1970s local-switch system for Oslo”.¹¹⁶

LME's electronic switches were developed in cooperation with the Swedish PTO, first in an “electronics council”; the next generation of digital switches was developed in a joint venture with the PTO, known as “ELLEMTEL”.¹¹⁷ The “electronics council” did not succeed in presenting a competitive local SPC switch; it actually argued that SPC switches were only economical for transit switches, not local switches.¹¹⁸ The “electronics council” did, however, develop a competitive transit

¹¹³ TBD 22.10.71., (Generaldirektøren komplimenterte arbeidsgruppa for det gode arbeidet den hadde gjort).

¹¹⁴ The following is based on NTM8: ”I.S. Skinnes 30.11.71: Innstilling nr. 2 om Ny Lokalautomatsentral Nord 3 I Oslo”.

¹¹⁵ NTM8: ”I.S. Skinnes 30.11.71: Innstilling nr. 2 om Ny Lokalautomatsentral Nord 3 I Oslo”. (mener vi at 10C, som har flere fasiliteter for abonnentene og spesielt for administrative formål vil være å foretrekke).

¹¹⁶ NTM8: ”I.S. Skinnes 30.11.71: Innstilling nr. 2 om Ny Lokalautomatsentral Nord 3 I Oslo”. (bestillingene av 10 C-utstyr til Nord 3 også må sees som et valg av 70-årenes lokalsentralsystem i Oslo).

¹¹⁷ “ELLEM” was based on the pronunciation of “LM” in “LM Ericsson” and “Tel” in Televerket, Fridlund 2000, p. 146.

¹¹⁸ Meurling and Jeans say that “Ericsson had also learned that the current generation of SPC, as it existed in the late ‘60s, was expensive and complex - worthwhile in major national and international transit centres, but not obviously cost-effective for local exchanges in large numbers over wide areas. The disadvantages were above all in the high cost of handling - design, testing, modification, fault-correction, production, installation, and operation and maintenance.” Meurling and Jeans 2000, p. 278. Interview with Carl-Edward Joys.

switch in the SPC generation. Despite the loss to the Metaconta in Australia in 1969, LME's AKE13 was to be installed in Rotterdam, Copenhagen, Finland, and, needless to say, Stockholm. This broad acceptance was a main reason why Televerket chose the AKE13 as the transit switch for Oslo in March 1972. Televerket emphasised the possibilities of inter-Nordic cooperation on the AKE13.¹¹⁹ This was at a time when the cooperation between the Nordic PTOs, on data communication and mobile telephony, took off.¹²⁰

Televerket regarded the AKE13 as a more advanced transit switch than the 10C.¹²¹ Moreover, the 10C was more expensive, both in terms of the actual equipment, but mainly because LME/EB offered future service and reprogramming free of charge. Repairs and troubleshooting in the Oslo network were among the main sources of revenues for STK's telecom business, and, thus, a major expenditure for Televerket.¹²² It was a central part of the intimate relationship between STK and Oslo District that Teledirektoratet wanted to revamp through competitive tenders. EB was well aware of this, and thus knew the value of offering service free of charge.

A noteworthy thing is that the engineers visiting BTM, Marhaug and Hanesand, came from Televerket's *Districts*, districts that used ITT/BTM systems. Hence, one may think that BTM won the local contract, since those inspecting BTM had a particular interest and insight in this. On the other hand, the engineers visiting LME, Skinnes and Gladsø, came from Teledirektoratet, and had more interest in and insight into national automation and transit switches. Nonetheless, it was the first significant break in the Lillehammer agreement, and as such it was a serious blow for STK. It is probably no coincidence, however, that it was a transit switch that broke the cartel agreement. Most of the open tenders during these years, as in Australia and Ålesund, were for transit switches that routed long-distance and international calls between local networks. The problems of signalling were somewhat smaller, but most importantly these switches had to accommodate different switching systems anyway, thus, interaction was no hindrance for competition.

¹¹⁹ NTM9b: "T.IIS. 28/3-72: Innstilling om ny datamaskinstyrt fjernsentral til Oslo".

¹²⁰ Gard Paulsen: "Samarbeidets protokoll - Utviklingen av et nordisk datanett, 1971-1981", 2004.

¹²¹ AKE13 was modularised switch, which made it easier to locate and isolate errors.

Moreover, two computers work parallel on each operation, if one fell out, the other replaced it. This was common for BTM's local SPC switch, but was for some reason not chosen for the trunk switch. NTM9b: "T.IIS. 28/3-72: Innstilling om ny datamaskinstyrt fjernsentral til Oslo".

¹²² Interview with Gunnar Tidemann, Carl-Edward Joys.

STK was very disappointed, since Oslo was considered as its *heartland*. The Director of STK's Telecom Department, Ernst Berentsen, was furious over Televerket's choice. He played a central role in forming the relationship between STK and Televerket in these years, not least since STK's managing director from 1972, Fredrik Thoresen was a "cable man", with modest knowledge of the field. Berentsen had an engineering degree from the University of Iowa, and started in STK's switching business in 1954, and replaced Sverre Ramstad as Director of the Telecom Division in 1964.¹²³ Berentsen wrote a memo to Televerket, expressing disapproval of the evaluation report, particularly its depiction of the AKE13 as more reliable and advanced than the Metaconta transit switch. He claimed this revealed that Televerket did not understand how BTM's transit switch operated and functioned.¹²⁴ Underlying Berentsen's statements was an allegation that Televerket lacked competence in computer-controlled switches in general.¹²⁵ In a meeting with STK, Televerket rebuffed all of STK's complaints and allegations, clearly irritated by Berentsen's attitude, and concluded that the meeting had yielded "no information... that could in any way alter the conclusion (...) concerning the choice of a computer-controlled transit switch for Oslo".¹²⁶ It was not the last time Berentsen provoked Televerket.

Televerket stressed the potential for Nordic cooperation, claiming that a "common Nordic effort" should yield "substantial advantages in terms of more economical program development, personnel and greater competence".¹²⁷ The Nordic argument was promising for EB, because of LME's strong position in these countries, but it was threatening to STK's future prospects. Berentsen tried to kill off the Nordic argument by reinstating the logic of the Lillehammer agreement. He accepted that Nordic cooperation had some advantages, but only for international calls, and claimed that local and national requirements were far more significant, as "the local and national software" would "always be larger than the international software".¹²⁸ Berentsen added that Oslo District would meet "huge technological and economical

¹²³ Ernst Berentsen 70 year in *Aftenposten* 24.08.99.

¹²⁴ NTM9a: Memo from Ernst Berentsen on "Oslo Fjern- og utenlandssentral FS 3" 17.04.74.

¹²⁵ Interview with Carl-Edward Joys.

¹²⁶ NTM9a: "T.II.S. 17.04.72" - Minute from meeting between STK og Televerket, (På møtet kom ikke fram opplysninger som på noen måte kan endre den konklusjon som er utformet i innstillingen om valg av datamaskinstyrt fjernsentral til Oslo).

¹²⁷ NTM9b: "Dok. 79/72 Til styremøte 20. april 1972 Sakslista post 5: Ny datamaskinstyrt fjernsentral til Oslo". (Felles nordisk innsats (...) vesentlige fordeler i form av billigere programutvikling, personalbesparelse og større samlet kompetanse.)

¹²⁸ NTM9a: Memo from Ernst Berentsen on "Oslo Fjern- og utenlandssentral FS 3" 17.04.74. (Den lokale og nasjonale programvaren programvare vil alltid være større enn den internasjonale programvaren.)

problems in relation to maintenance, personnel, training, storage of parts, and documentation by choosing one system for local switches and another for transit switches".¹²⁹ The consequence of Berentsen's argument was to abandon competitive tenders all together. It goes without saying that this was unacceptable for Televerket.

The competitive tenders for the SPC switches were a mixed experience for STK. The loss of the transit switch was acute for STK, partly because it lost its dominant position in Oslo, and because the Nordic argument was a serious threat to the company. Thus, LME/EB had most reason to celebrate, not least because EB was about to achieve a prominent standing as a high-tech company in Norway. It was expected that STK/BTM would win the tenders for a local SPC switch. Even though Televerket did not admit as much, it was obvious that the costs of installing a local LME switch, among the older ITT systems in the Oslo network, would be very high. Moreover, LME lacked a local SPC switch that could offer fair competition with the 10C, hence, it seems that the main purpose of the open tender was to put pressure on STK/BTM's offer. In as much as there was anything noteworthy in this competition, it was that Televerket rejected STK's first offer. At first sight it might seem that Televerket's choice of the 10C cemented the intimate relationship with STK. Later we will see that the 10C project led to frequent and intimate contacts between Televerket and BTM, which altered the relational setting between Televerket and the industry. A pertinent question is why STK did not invest greater resources in building up competence in SPC switches. One reason was the magnitude of the 11B project, which the next sections look into.

The 11B - an expensive experience

Based on Televerket's order of a trial switch at Engelsrud, and pressure from ITT-Europe, STK decided to take over the 11B project from STC in 1971. Since the whole project was considered too big for STK, a part of the project was sent to SEL's office in Berlin.¹³⁰ Several STC engineers, who had worked on the project, came to Oslo to support STK. ITT-Europe sent Dave Fisher, who was in charge of ITT-Europe's switching operations. He was very anxious to complete the 11B project, which had been running for five years without any tangible results, but ITT-Europe was reluctant to cover more than \$2 million of the project. It did not think

¹²⁹ NTM9a: Memo from Ernst Berentsen on "Oslo Fjern- og utenlandssentral FS 3" 17.04.74. (store tekniske og økonomiske problemer i forbindelse med vedlikehold, personale, opplæring, lagerhold av deler, og dokumentasjon ved å velge et system for lokalsentraler og et annet system for fjernsentraler).

¹³⁰ Mo 2000, p. 9.

ITT's headquarters in New York would approve of a higher budget. Together with Ivar Mo, who was in charge of the project, Fisher cut down the budgets to exactly \$2 million. This proved to be unrealistic, as the total costs of the 11B project, according to Mo, amounted to \$6 million. It was a heavy burden for STK to cover the additional costs, and resulted in substantial deficits for STK's Telecom Division from 1974 to 1976.¹³¹

There were several reasons for the high costs and problems with the 11B project.¹³² Firstly, ITT-Europe persuaded STK to budget too optimistically, to “save its own skin” from the New York head office. Secondly, the system specifications were far from completed, as promised, when the project was moved to Oslo. The initial prognoses were also too modest in terms of costs and required material, like circuits and development tools. Thirdly, STK lacked experience in running large development projects, and it was difficult to organise STK's individualistic engineers. Mo was impressed when he witnessed the routines and plans SEL and STC worked according to, and the support they had from databases and libraries. STK lacked a corporate infrastructure for such projects. Furthermore, the wired logic entailed far more decoding than had been expected initially. STK had to design and manufacture key electronic components themselves; a larger project could have ordered these from suppliers. Finally, delays and time shortage increased the costs.¹³³ It is worth recalling that this was the only switching project STK was engaged in, in which BTM did not participate.

Still, STK gained valuable experience from handling such a large project. Firstly, in coordinating the work of 100 engineers, from different countries, in Norway.¹³⁴ In gathering information from other ITT subsidiaries, STK engineers established valuable contacts with colleagues in Europe. The most significant, however, was the knowledge and understanding STK acquired in electronics and computer technology, and in “CADEM (computer aided design, engineering, manufacturing)”.¹³⁵ Another important aspect was that in installing the 11B in EB's districts, STK attained knowledge and experience from these areas, which proved valuable in work-

¹³¹ “The telephone business will also run with deficits in 1975, since the development and start of the 11B still burdens the department.” (Telefoni-linjen vil også i 1975 gå med underskudd idet utvikling og oppstarting av 11B fortsatt tynger avdelingen) Thoresen's orientation at STK's Board meeting 05.11.75. The telecom problems in general, and the 11B in particular, were discussed at every board meeting throughout 1976.

¹³² This is based on Mo 2000 and interview with Ivar Mo.

¹³³ Mo 2000, p. 13.

¹³⁴ STK's Annual Report 1972.

¹³⁵ STK's Annual Report 1971, p. 3.

ing out the tenders for digital switches in 1982.¹³⁶ As STK's former telecom director, Sverre Ramstad, recalled, “we lost money on the 11B, but we were left with market shares and a bunch of trained telecom engineers”.¹³⁷ It benefited STK in terms of increased knowledge in telecom and electronics; on the other hand, it had a crowding out effect on the R&D department's budget. At one point, the 11B project took up 24 per cent of FA's funds.¹³⁸ The problems and costs of the 11B had another significant consequence, which we will return to later: it contributed to Fredrik Thoresen's scepticism towards telecom-related R&D.¹³⁹

STK had hoped that its engagement with the 11B would provide the company with export orders, but only one trial switch was sold to a Finnish private operator; and things were not much better on the national market. Sales were hampered by long delays from STK, and the high price. The trial switch at Engelsrud was ready for testing in May 1974, two years late; at that time Televerket changed its installation programme, due to the high cost of the 11B switch.

Competition and inspections

The procurement and installation of rural switches was on the agenda in 1973, when Televerket negotiated a new long-term agreement with STK and EB for 1974-77. A central topic in the negotiations was the request to inspect the books of STK and EB. It was too difficult and costly to achieve competition between STK and EB's crossbar switches, since these were installed mainly as extensions of automated networks. To secure fair prices, the Auditor General wanted to introduce cost-contracts, where the price was based on the companies' costs and a reasonable profit, combined with a right to inspect the equipment suppliers' books. Such contracts were normal in the armed forces, as well as in other countries.¹⁴⁰ STK and EB tried to avoid such contracts and inspections by all means. STK claimed that cost-contracts would remove the incentive to rationalise production, and that “it was not desirable to lay out STK's books to the public gaze”.¹⁴¹

¹³⁶ Interview with Ivar Mo.

¹³⁷ Interview with Ivar Mo (Vi tapte penger på 11B, men vi satt igjen med markedsandeler og en gjeng garvede telefoningeniører).

¹³⁸ For example, STK abandoned a large project on loudspeaking PABX due to the 11B project. RAUi: STK's Berentsen to Utviklingsfondet 07.01.74. Interview with Ivar Ørbeck.

¹³⁹ Interview with Fredrik Thorese, Ivar Ørbeck, Torbjørn Brataas.

¹⁴⁰ The Auditor General's report to Stortinget 1969, 1970, 1971 and 1973.

¹⁴¹ STK-LTA: Minute from meeting between STK and Teledirektoratet 27.06.73., (Det er ikke ønskelig å legge fram STK's bøker til almen beskuelse).

To avoid an inspection, STK sought assistance from ITT-Europe in Brussels, asking if this was normal in other countries, and what measures ITT-Europe advocated to avoid it.¹⁴² It also consulted the Federation of Norwegian Industries, together with EB's Olav Skeie.¹⁴³ In a meeting with Televerket, Berentsen argued along constitutional lines, claiming it “was a matter of principle between government and industry” that Televerket could not decide itself, and that the issue should be forwarded “to higher instances”.¹⁴⁴ Televerket said that it wanted inspections where competition was impossible, but as Berentsen complained, “both inspection and competition would be too much to ask”, as the company “could not operate only at marginal prices”.¹⁴⁵ At first, this assertion seems awkward, that STK, operating in a market economy, should reject doing business based on marginal prices. Thus, the inspection issue is interesting in as much as it illuminates the prevailing conceptions of the industry and sector at the time.

One interpretation of Berentsen's statement is that STK needed some cash cows, to be able to invest in R&D. He sincerely believed that the long-term agreements implied a duty for STK to conduct R&D, that this was an integral part of Televerket's procurement regime.¹⁴⁶ Another possible explanation is that STK had enjoyed lucrative margins throughout its history, and that Berentsen simply did not accept that Televerket, or other public bodies, could close every loophole in STK's sales relationship with Televerket. Berentsen was perceived as a tough negotiator, and somewhat arrogant.¹⁴⁷ He did not seem impressed by Televerket's newly acquired competence in switching, and he had problems adjusting to Televerket's new role as a demanding customer. He claimed that there was a sufficient degree of competition in the equipment market, using a negative definition of competition, i.e. that the supplying company did not set the price entirely by itself.¹⁴⁸ This suggests that Ber-

¹⁴² STK-LTA: Telegram from STK's Chris Harper to ITT-Europe's S.L. Simons 29.06.73.

¹⁴³ STK-LTA: Memo from meeting between EB's Olav Skeie, STK's Harper and Jan Didriksen from Federation of Norwegian Industries 05.07.73. The Federation contacted the Ministry of Industry, and supported the subsidiaries for a few months, but then STK thought the support for their case was shallow. Memo from Harper to Thoresen 28.09.74.

¹⁴⁴ STK-LTA: Minute from meeting between STK and Teledirektoratet 08.08.73., (Det gjelder en prinsipp sak mellom stat og industri, (...) og det må være høyere instansers sak å bestemme hvilken som her skal følges).

¹⁴⁵ STK-LTA: Minute from meeting between STK and Teledirektoratet 08.08.73., (både innsyn og konkurranse ville være for meget forlangt, bedriften kan ikke utelukkende basere seg på marginalpriser).

¹⁴⁶ NTM7-11Ba: Televerket's report from meeting with STK about 11B, 03.07.74 “Ø/5.7.1974/Jon”.

¹⁴⁷ It is pertinent to emphasise that most of the interviews give a favourable impression Berentsen, despite his toughness and arrogance.

¹⁴⁸ STK-LTA: Draft of letter to Federation of Norwegian Industries, undated.

entsen was out of touch with realities, not least the fact that Televerket was constantly subjected to criticism from the Auditor General and the public. These interpretations are not conflicting; hence, all the factors probably played a part.

Televerket's stance is also interesting, in that it refused to take an independent standpoint, telling STK and EB that inspections were a part of the negotiations because the Ministry and the Auditor General insisted on them.¹⁴⁹ Why did Televerket not argue for this, after all, reasonable claim - the right to inspect STK's and EB's real costs in market segments where competition was impossible? Did it also have problems accommodating to its new role as a demanding customer? Maybe it simply was not used to playing the role as a monopsonist, and needed time to adjust to its new role towards the equipment suppliers, which had had the upper hand towards the PTO since the 1930s. Or maybe Televerket just pushed the Auditor General out in front as a matter of negotiating tactics. Nevertheless, it is interesting that Televerket did not formulate an independent standpoint, or at least articulate it in meetings with the industry.¹⁵⁰

This seems to support the notion that it was the Auditor General that induced a change in Televerket's procurement policy, which is in accordance with Riisnæs's version of STK's 11B story. He claims that it was an inspection at STK and EB that halted Televerket's procurement of the 11B.¹⁵¹ The sources do not support this view. Televerket signed a one-year agreement for 1974 with STK and EB in 1973; the four-year agreement was postponed for one year, as was the clause about inspection.¹⁵² Televerket's procurement of the 11B was amended in the first half of 1974, and the inspections did not take place before 1975. In STK's contract for 1974, 50 per cent of the 11B switches were pre-allocated, and the rest were "competition projects", for which STK and EB handed in closed offers on the 11B and

¹⁴⁹ Televerket did not counter STK's arguments against inspection, just referred to the Auditory General and the government. STK-LTA: Minute from meeting between STK and Teledirektoratet 27.06.73., 08.08.73.

¹⁵⁰ This trait reappeared latter in the 1970s, when the Ministry of Industry asked Televerket to include industrial considerations when procuring, and the Auditory General and the Ministry of Finance asked the PTO to follow the rules for public procurement. These conflicting signals from the government gave Televerket room to manoeuvre, but it declined to take advantage of this.

¹⁵¹ Riisnæs 2000, p. 8.

¹⁵² STK-LTA: Letter from STK to Federation of Norwegian Industries 02.11.74; "Prolongasjon av Langtidsavtale datert 20. november 1969 mellom Televerket og Standard Telefon og Kabelfabrik A/S (STK) om leveranser under Televerkets langtidsplan 1970-73" The original agreement is dater 08.03.74.

AKK50.¹⁵³ Both switches could interact with other equipment on a “group-switch/transit-switch level”.¹⁵⁴ The 11B could interact directly with local 8B and Rotary switches. It was considered too expensive, however, to make the AKK50 able to interact with local 8B and Rotary switches. Thus, the installation of rural switches in 8B and Rotary networks was pre-allocated to the 11B.¹⁵⁵ The “competition projects” were for automating rural networks that were directly linked to the national network through transit switches.

The prices STK offered for the 11B were very volume-sensitive, as prices per line increased more than 20 per cent, if the orders were halved.¹⁵⁶ Nevertheless, regardless of volume, the 11B did not stand a chance in the “competition projects”; it was far more expensive than EB's semi-electronic rural switch, the AKK50. Moreover, Televerket found that EB's old crossbar switch, the KV, was far more economical for rural areas than the AKK50.¹⁵⁷ This was mainly due to the high development costs for the 11B and AKK50, and the KV was produced on a large scale in Sweden. In addition, the variable costs were higher for the 11B, as it used twice as much electricity as the AKK50, which meant that provision of electricity and ventilation was much more expensive. The AKK50, however, used three times more energy than the KV. The 11B and AKK50 required constant power consumption over 24 hours, whereas the KV did not consume without traffic. Televerket concluded that the KV was substantially more economical in all the “competition projects”.

The 11B was an alternative only in “typical” STK areas such as “Bergen, Drammen, and Tønsberg”. In these cases the 11B was “more reasonable than the 8B and in addition a considerably more advanced and trustworthy system”.¹⁵⁸ This reflected the low status the 8B had within Televerket at the time, rather than the 11B's competitiveness. Still, STK did not have sufficient orders for the 11B to be able achieve

¹⁵³ STK-LTA: “Prolongasjon av Langtidsavtale datert 20. november 1969 mellom Televerket og Standard Telefon og Kabelfabrik A/S (STK) om leveranser under Televerkets langtidsplan 1970-73” The original agreement is dater 08.03.74.

¹⁵⁴ NTM7-11Ba: “Nye automatsentraler 11B og AKK50, Notat til direktørmøte 10. januar 1975”. (gruppesentral/fjernsentralnivå).

¹⁵⁵ NTM7-11Ba: ”TAp 25.02.76.Lel, Notat Nj.: Bestilling av utstyr for konkurranseprosjektene på Langtidsavtalen 1975-77”.

¹⁵⁶ STK-LTA: “Prolongasjon av Langtidsavtale datert 20. november 1969 mellom Televerket og Standard Telefon og Kabelfabrik A/S (STK) om leveranser under Televerkets langtidsplan 1970-73” 31.01.74.

¹⁵⁷ NTM7-11Ba: TAP/74/Bld, 7/6-74: ”Valg av automatsystemer for bestilling i 1974”. The remainder of the paragraph is based on this.

¹⁵⁸ NTM7-11Ba: ”Teknisk direktør, ta 74/Nj, 20/6-74”.; (11B faller her billigere enn 8B og er i tillegg et betydelig mer avansert og tillitvekkende system).

reasonable economies of scale.¹⁵⁹ A report produced by and for Televerket's Technical Department (TA*), warned against reducing the procurement from STK. The combination of this, and that the new systems, the 11B and 10C, were less labour-intensive, had hit STK hard. The report stressed Televerket's desire "that both suppliers secure a volume of production that is large enough to underpin rational production", and the "creation and maintenance of system competence" and "system development".¹⁶⁰ Thus, TA repeated the equipment suppliers' traditional arguments against competition, i.e. employment and competent equipment suppliers, to give STK a chance to adjust its prices.¹⁶¹

Televerket's Economic Department protested against TA's wish to negotiate with STK, as a comparison of the offers showed that "all competition projects should be given to EB."¹⁶² The Economic Department claimed that the Auditor General was bound to react, since the reasons for re-negotiating with STK were related to employment and industrial policy, not to the price and quality of the product that the government was paying for. Moreover, since the competition was based on closed offers, it was unfair towards EB that only STK was allowed to adjust its offers through a re-negotiation. The Economic Department concluded that the Ministry of Communication had to be consulted before further negotiations with STK took place, since they were grounded on things other than price and quality. Director General Øvregard supported this conclusion. The Ministry accepted Televerket's request, however, to re-negotiate with STK.¹⁶³ Thus, STK was summoned to a meeting in July 1974 to discuss the 11B problems.

¹⁵⁹ NTM7-11Ba: "Teknisk direktør, ta 74/Nj, 20/6-74". "If we only buy 11B equipment in those cases where the 8B is a worse alternative, the volume of the 11B, allegedly, will be too small for STK to attain fairly rational production, i.e. the system will be too expensive." (Dersom vi kjøper 11B-utstyr bare i de tilfellene 8B er et dårligere alternativ, vil volumet av 11B angivelig bli for lite til at STK kan få en noenlunde rasjonell produksjon, dvs. systemet blir for dyrt).

* Norwegian abbreviation for Teknisk Avdeling.

¹⁶⁰ NTM7-11Ba: "Teknisk direktør, ta 74/Nj, 20/6-74". (Televerket er interessert i at begge leverandører får et produksjonsvolum som er stort nok til å danne grunnlag for rasjonell produksjon, oppbygging og vedlikehold av systemkompetanse samt systemutvikling).

¹⁶¹ TA's preliminary re-negotiation with STK was focused on flattening out the volume-dependent price curve, so Televerket could justify giving STK more orders. STK and Berentsen's confident tone, while refusing to modify the original price curve, is noteworthy. "STK has not been willing to flat out its volume-dependent price curve before, and has not indicated any accommodation on this point." (STK har tidligere ikke vært villig til å flate ut sin volumavhengige priskurve og har heller ikke nå antydnet noen imøtekommenhet på dette punkt). NTM7-11Ba: "Teknisk direktør, ta 74/Nj, 20/6-74".

¹⁶² NTM7-11Ba: "Økonomisk direktør, ØFK 26/6-74/Jeg". The following is based on this.

¹⁶³ NTM7-11Ba: Televerket's report from meeting with STK about 11B, 03.07.74 "Ø/5.7.1974/Jon".

Televerket started the meeting by informing STK that the 11B was so much more expensive than EB's AKK50 “that it was not competitive”, but Televerket was willing to give STK some of the “competition projects” if STK would reduce its price by “around. 7 million Kroners” (around 12.7 per cent) compared to STK's original price curve.¹⁶⁴ Berentsen called this an ultimatum, but Televerket said it was “an offer, a helping hand to STK”.¹⁶⁵ Berentsen said it was a shock that the 11B was not competitive with the AKK50, and that Teledirektoratet should have informed STK before. Televerket replied that it was impossible to do that before the offers had been submitted. Berentsen could not conceive of the price difference, and accused LME of dumping in the Norwegian market. Televerket responded that EB's prices were in accordance with previous offers. Berentsen wanted a larger share of the “competition projects”. When Televerket refused, he demanded that the issue be forwarded to the Ministry of Communication so it could “decide whether Televerket should procure Norwegian-produced equipment (11B) or Swedish-produced (AKK)”.¹⁶⁶

Then Berentsen claimed that “STK had sacrificed money on developing the 11B system” only after Televerket has encouraged it to do so.¹⁶⁷ He stressed that “during the negotiation on the long-term agreements for 1966-69”, Televerket had demanded, “that STK should conduct R&D.”¹⁶⁸ Televerket replied that it never had encouraged the 11B project; it was ITT that sent the project to Norway. Televerket stressed that in 1965, it had asked STK to “develop system competence on the 8B”, and added that STK had “evidently failed” to do so.¹⁶⁹ Berentsen said that STK had made a mistake in opening for “competition projects” in the prolongation agreement for 1974. After further more deliberation, STK was asked to respond to Televerket's offer. Berentsen wanted to await an answer, but STK's Director of Economics, Svein Falck-Pedersen, said that STK accepted the offer, adding that he fully under-

¹⁶⁴ NTM7-11Ba: “Ø/5.7.1974/Jon”, (ikke var konkurransedyktige) and (ca. 7 mill. kroner [ca. 12,7% prisreduksjon]).

¹⁶⁵ NTM7-11Ba: “Ø/5.7.1974/Jon”, (men et tilbud og utstrakt hånd til STK).

¹⁶⁶ NTM7-11Ba: “Ø/5.7.1974/Jon”, (avgjort om Televerket skulle kjøpe norskprodusert utstyr [11B] eller svenskprodusert [AKK]).

¹⁶⁷ NTM7-11Ba: “Ø/5.7.1974/Jon”, (Berentsen hevdet at det var etter tilskyndelse fra Televerket at STK hadde ofret penger på å utvikle 11B-systemet).

¹⁶⁸ This demand was mentioned in chapter 3, NTM's EB-archive: Long term-agreements: Larsen/Telegrafstyret to EB 08.05.65 (Han henviste her til Televerkets krav under forhandlingene om langtidsavtalen 1966-69 om at STK måtte drive forskning og utviklingsarbeid).

¹⁶⁹ NTM7-11Ba: “Ø/5.7.1974/Jon” (1965 var at STK skulle utvikle sin systemkompetanse når det gjaldt 8B-utstyr. Og dette har STK åpenbart ikke klart).

stood Televerket's point of view, and thanked Televerket for its "offer". Berentsen still hesitated, but after STK's representatives had re-grouped, Berentsen accepted as well.

STK was given the allocated projects from the 1974 contracts, and some of the "competition projects", after the re-negotiations with Televerket. The Auditor General protested, as did TF's Knudtzon.¹⁷⁰ He said that ITT had troubles selling the 11B abroad, and feared the 11B could be "a new and unfortunate peculiar system in Norway".¹⁷¹ Øvregard asked for a thorough memo regarding the 11B, and stressed that "we ought not to preoccupy ourselves with any considerations regarding industrial policy while comparing the 11B with other solutions".¹⁷² Nils Jonsson wrote the memo, and warned that Televerket could be the only user of the 11B, but maintained that the 11B was competitive in the 8B and Rotary areas, and some other areas.¹⁷³ Televerket and STK hoped that the 11B would be more reasonable after the production reached some scale and maturity, and this was an argument for providing STK with some of the "competition projects". However, the inspections of the books of STK and EB ruined all these hopes.

In the negotiations for the long-term agreement for 1975-1978, the Ministry of Communication ordered that STK and EB had to accept inspection on products that were not sold on a competitive basis.¹⁷⁴ These included the crossbar switches, the 8B and KV. The Armed Forces Procurement Department (KRK*), with considerable experience in this respect, conducted the inspections. Televerket had good contacts there, since the head of the newly established Supply Office, Kjell Arvidsen, and his second in command, Jens Gjerdsjø, were both recruited from supply offices in the armed forces.¹⁷⁵ The inspectors concluded that STK's price for the 8B was fair, but EB was severely criticised for overcharging for its KV switch.¹⁷⁶ As they stressed, "EB had set the prices of the KV much higher than the costs and a reasonable profit

¹⁷⁰ NTM7-11Ba: "T, 18.12.1974, Pm. Fortsatt kjøp av 11B".

¹⁷¹ NTM7-11Ba: "Memo from Knudtzon til Øvregard og Jonsson 16.12.74. - 11B-sentraler"; (et nytt og lite heldig særssystem for Norge).

¹⁷² NTM7-11Ba: Øvregard til Avd. T, 19.12.74 - Televerket bestilling av 11B-utstyr; (Vi bør neppe tillegge oss sjøl særlig industripolitiske vurderinger når vi sammenlikner bruk av 11B med andre løsninger).

¹⁷³ NTM7-11Ba "Nye automatsentraler 11B og AKK50, Notat til direktørmøte 10. januar 1975".

¹⁷⁴ RA-28: Ministry of Communication to Televerket 12.11.74.

* Norwegian abbreviation (Forsvarets felles Materielltjeneste), Kontraksrevisjonskontoret.

¹⁷⁵ Interview with Jens Gjerdsjø.

¹⁷⁶ Mo 2000., 8, BGA: Riksrevisjonen to Teledirektoratet 25.10.76.

implied".¹⁷⁷ The KV was not more expensive than the 8B, but it was an established switch in LME's portfolio, hence, the marginal costs were driven down to a minimum, in sharp contrast to STK's 8B.

Consequently, EB was blamed for not offering Televerket a fair price, at the level of EB's and LME's manufacturing cost, and for tampering with the price calculations. EB was ordered to lower the price of the KV switch by 40 per cent.¹⁷⁸ This did not affect future installations of the 8B, since its market segments were protected by the logic of the Lillehammer agreement, i.e. technological interfaces. A serious effect for STK, however, was that the 11B became comparatively more expensive than the KV, and did not stand a chance in the forthcoming "competition projects" for the rural areas. Televerket noted the emergence of "a totally new situation", and concluded that if the "price pattern we now have is correct and durable, then we have plotted the wrong course with our equipment procurement during the last years".¹⁷⁹

The KV won every "competition project" for the next long-term agreement in 1975-1977. Thus, the 11B was installed only in 8B and Rotary areas, which could not even cover the development costs. Televerket reaped the benefits of standardising its rural switches, by using the KV. It was more economical and easy in terms of training and allocating personnel, and made the final automation projects much easier. STK maintained that the 11B was a good product, and argued that it needed a home market to succeed on the export market.¹⁸⁰ However, the time horizon for semi-electronic switches was shortened by the development of digital switches. A key element in the choice of the electro-mechanical KV was that Televerket expected the arrival of digital switches in the 1980s. It did not make sense to modernise the rural networks with expensive semi-electronic switches, which would be outdated within a decade.¹⁸¹ The aforementioned reason for developing the 11B was that the expensive processor in the SPC switches was not economical in rural areas; it cost STK dearly to learn that the same could be said of the 11B.

¹⁷⁷ NTM7-11Ba "TA 12/3-76. Nj.: Bestilling av automatstyr etter langtidsavtalen 1975-77", (Regnskapsinnsynet visste at EB hadde satt prisene på KV meget høyere enn kostnadene og en rimelig fortjeneste skulle tilsi).

¹⁷⁸ NTM7-11Ba: "TA 12/3-76. Nj.: Bestilling av automatstyr etter langtidsavtalen 1975-77".

¹⁷⁹ NTM7-11Ba: "TA 12/3-76. Nj.: Bestilling av automatstyr etter langtidsavtalen 1975-77", (helt ny situasjon er oppstått. Dersom det prismønster vi nå har fått er korrekt og varig, har vi lagt opp til feil kurs med våre utstyrsinnkjøp i de senere år).

¹⁸⁰ NTM7-11Ba: "T.20.04.76/Pm: Kort notat fra møte med STK 9. april 1976 om 11B-problemet.

¹⁸¹ Mo 2000., 8, Interview with Jon B. Riisnæs; NTM7-11Ba: "TA 12/3-76. Nj.: Bestilling av automatstyr etter langtidsavtalen 1975-77".

STK's telecom business in pain

The mid-1970s were a painful period for STK's telecom business, and it was more than a question of losing money. Berentsen's behaviour in meetings and negotiations with Televerket had been an irritant for a long time, and the 11B meeting in July 1974 was the last straw. Director General Øvregard made a phone call to Thoresen, and asked him to fire Berentsen. Thoresen says that when he became a part of STK's management in 1968, he realised how poorly the telecom department was managed. Berentsen was a good telecom engineer, Thoresen recalled, but he did not know the first thing about running a plant.¹⁸² Hence, Thoresen had already planned to remove Berentsen, before Øvregard asked him to do so. Berentsen was replaced by the head of STK's Cable Department, Gunnar Tidemann.¹⁸³ STK had developed a serious image problem as far as Televerket was concerned, so Tidemann put a lot of effort into turning STK's telecom department into a more service-minded institution. It needed to accommodate itself to Televerket's new role as a demanding customer.¹⁸⁴

A strike by the telephone installers in 1974/75 worsened the situation; this was the first industrial conflict at STK since the interwar period.¹⁸⁵ The installers' union was controlled by the Workers Communist Party (AKP*),¹⁸⁶ and caused much trouble for STK and Televerket. Televerket had to pay the workers twice as much as it paid its own installers.¹⁸⁷ This also caused a lot of trouble for STK, which as an ITT company was an attractive whipping boy for the union. A phrase from a song composed by the strikers is indicative: "Who dares to defy the ones that strike down everything that threatens the super-profit with its salaried murder army? Who dares to defy ITT?"¹⁸⁸ The climate for solving the conflict was worsened by STK's employment situation. Due to reduced orders for the 11B and the labour-intensive 8B, the telecom department faced laying off 400 out of 1200 workers.¹⁸⁹ This time the situation was serious, and thus it was more than a bargaining card in the negotiations. STK

¹⁸² Interview with Fredrik Thoresen.

¹⁸³ Interview with Bjørn Gladsø, Gunnar Tidemann.

¹⁸⁴ Interview with Gunnar Tidemann.

¹⁸⁵ Fjeldbo 1983; STK's Annual Report 1974; Board meeting Televerket 03.01.75.

* Norwegian abbreviation for Arbeidernes Kommunistiske Parti.

¹⁸⁶ The reason for AKP's control, allegedly, was that since the installers were not located at Økern, but travelled around to install switches, it was easier to take control over the union.

¹⁸⁷ RA-LTP37b, Minute from meeting in the LP-komiteén 3/4.9.73.

¹⁸⁸ Fjeldbo 1983, p. 147 (Hvem våger trosse den som slår ned på alt som truer superprofitten med sin betalte morderarme? Hvem våger trosse ITT?).

¹⁸⁹ NTM7-11Ba: "TA 26/3-76 Nj.: Bestilling av automatstyr etter langtidsavtalen 1975-77".

seriously considered producing KV equipment for EB, as an emergency solution for the employers.¹⁹⁰ Instead it managed to get more orders for its PABX - the Minimat.¹⁹¹

It was one thing that the telecom department's image was harmed in terms of customer relations, but another problem was that STK was caught up with 8B and 11B, which were soon to be outdated. Moreover, Televerket questioned STK's technical competence. Firstly, because the delivery of the 11B switches ordered in 1974 was highly delayed,¹⁹² and then because of the recurrent problem with the Oslo network and the 8B. Teledirektoratet, Oslo District and STK had worked with the 8B problems since the late 1960s, without finding a solution. In 1972 TF initiated a project, called ARON, to rectify the 8B switches.¹⁹³ It was huge project, engaging 20 people from Oslo District, TA and TF. It was a prestige project for Knudtson and TF. Knudtson was personally engaged, wanting to prove that TF was useful for solving Televerket's concrete problems, and wanting to refute the accusations that he was too 'futuristic' in his thinking. A mathematician was engaged to solve the problem through traffic theory, but without any success.¹⁹⁴ The project lasted for 3 years, and cost millions, but neither TF nor STK was able to solve the problems. It was an important project, in as much as it shaped TA's relationship with and attitude towards TF for years. For TA, it was the ultimate proof of TF's inability to help Televerket with its pressing day-to-day problems.¹⁹⁵ ARON was important also in forming TA's attitude towards STK: it proved that the company was not able to upgrade and maintain its own switches.

As mentioned above, there was a clear pattern of intensified cooperation between PTOs and the equipment suppliers in the 1970s.¹⁹⁶ TF followed the same pattern in Norway, cooperating closely with STK, EB and Nera. Televerket and TA chose a different route. The mid-1970s had demonstrated that STK and EB were not ideal partners to manage the technological transition. The relationship with EB was harmed by moral hazard, since EB had overcharged Televerket for years, and STK

¹⁹⁰ NTM7-11Ba: "TA 26/3-76 Nj.: Bestilling av automatstyr etter langtidsavtalen 1975-77".

¹⁹¹ NTM7-11Ba: "TAA 19.03.76. Hli.: Behovet for hussentraler av typen Minimat" and "Dok 47/76 til styremøte 29.03.76: "Bestilling av automatstyr etter langtidsavtalen 1975-77"; Ivar Mo: "Historien om Minimat", 2000a.

¹⁹² NTM7-11Ba: "TAP/77/Bld, 14/6-77, Notat teknisk direktør".

¹⁹³ ARON was an abbreviation for **A**nalyse og **R**egistrering av **O**slo **N**ettet.

¹⁹⁴ Interview with Bjørn Gladsø and Magnhild Slettbak.

¹⁹⁵ Helge Godø claims that TF was able to come up with substantial improvements in "1980-81 (so) "the 8-B was radically improved", Godø 1995, p. 109. Ivar Mo, Carl-Edward Joys and Bjørn Gladsø refutes this.

¹⁹⁶ Fridlund 2000, Llerena 2000, Noam 1992, p. 84f. and 128.

had proved that it lacked competence to support Televerket. Thus, TA had to find other partners to work with in modernising and upgrading the network, and in coming to grips with the technological development of electronics and computers.

Televerket - BTM

After the contract for STK's local SPC switch in Oslo, the Nord 3, was signed, BTM invited Televerket to send personnel to Antwerp, to be trained in installing and operating the Metaconta 10C, and also to cooperate on programming and accommodating the switch for the Oslo network. Televerket had had contact with BTM since the instalment of Rotary switches in the 1920s. Still, the visits regarding the SPC switches were different, as they inaugurated an independent relationship between Televerket and BTM. Hence, Televerket established a relationship with BTM, which was not reliant on STK.

There were different reasons why this contact was established. Televerket simply wanted to learn about the product it was considering, and felt it could do this best by visiting the companies that had developed and manufactured the products. In this sense, it did not differ from Televerket's previous liaisons with LME and BTM when procuring the 8B and EB's KV. The SPC switches differed from the older mechanical switches, however, in that they were more knowledge-intensive.¹⁹⁷ The computer programming required a new sort of competence that Televerket lacked. The same went for STK: their best man in the area, some would claim their only man, was Carl-Edward Joys.¹⁹⁸ He had spent three months at BTM while finishing his thesis on electronic switching at NTH. He started at STK in 1970. After three months tuition at Økern with Ivar Mo, he was sent to Antwerp to join the 10C team there.¹⁹⁹ Why did STK not send more people to BTM to learn about the SPC switches in general, and computer programming and software handling in particular? This was, after all, expected to be the future of telecom. Thoresen accepted that Televerket wanted direct contact with the "source", and probably considered the cost to be too high for STK. Televerket, however, invested heavily in this field.

¹⁹⁷ One should hesitate to call them more complex, in some ways it was quite the contrary; the SPC switch reduced the number of control units, and changing instructions was only a matter of reprogramming the software, not rewiring physical links.

¹⁹⁸ Interview with Ivar Mo; this opinion is confirmed by Alf Ivar Nilsen. Nilsen had leading positions in Televerket's Technical Department, most notably Station (switching) office. 1971-, member of the INDIG-team.

¹⁹⁹ Interview with Carl-Edward Joys.

Kjell Christensen and Alf Ivar Nilsen both graduated from NTH in 1971, in telecom-related fields. They started at Televerket the same year. After a year's internal training, they were sent to Antwerp in 1972 to work on the Nord 3 project. There were several other engineers from Televerket in Belgium at the time, but only Christensen and Nilsen stayed for a consecutive 18 months. They cooperated closely with Oslo District's Alf Marhaug and Nils Maurtvedt, and became as much affiliated with Oslo District as with Teledirektoratet. An essential aspect of Christensen and Nilsen's stay in Antwerp was that they had access to BTM's best switching personnel. This was in contrast to Televerket's experience with LME. A shared impression from those who visited Ericsson's headquarters in Stockholm was that the feeling that they were bothering LME's people. As Knudtzon remarked, "it was difficult to dance with LME".²⁰⁰ Christensen and Nilsen duly acknowledge the Belgians' hospitality, and the respect with which they were treated. Nilsen's social skills helped to make the Antwerp stay a success.²⁰¹ The Nord 3 project was important for BTM as well, since it would be a showcase for the Metaconta 10C.

The essential element in this partnership was to be able to program all relevant features of the Oslo network into the 10C software. The program possessed no artificial intelligence, so even minor mistakes could cause trouble, and it was generally difficult to locate the origins of the problem when the program failed.²⁰² Thus, Televerket had to systematise and register all general and specific traits and features of the network. Such specifications, concerning signalling, billing, transmission and directing, had been worked out for the mechanical switches in the local networks, and were hand-written schemes.²⁰³ The specification work was further developed with the national automation, and the investigations following the breakdown of the Oslo network. The "mechanical" specifications, which the telecom engineers used as instructions for wiring and rewiring switches, had to be transformed into manuals the computer engineer could use for programming the software in the SPC switches.

Thus, the old "mechanical" handbooks had to be transformed into manuals for computer programming. A key figure in this work was Televerket's Johs. Skinnes.²⁰⁴ Skinnes had worked with transmission, and at Televerket's laboratory in the early 1960s. He became Televerket's guru in signalling, and acquired substantial knowl-

²⁰⁰ This is actually Knudtzon's phrase, but is shared by TA's people.

²⁰¹ Interview with Magnhild Slettbak and Kjell Christensen. Christensen had leading positions in Televerket's Technical Department, most notably the Station (switching) office. 1971-20???. Member of the INDIG-group.

²⁰² Interview with Bjørn Gladsø, Alf Ivar Nilsen, and Kjell Christensen, Fridlund 2002, p. 153.

²⁰³ Interview with Alf Ivar Nilsen.

²⁰⁴ Interview with Alf Ivar Nilsen, Kjell Christensen, and Magnhild Slettbak.

edge of computers and programming as well. He had no education, and thus he was an autodidact in both signalling and programming. Most of the engineers Televerket recruited in the 1970s, started their tenure with a visit to Skinnes, and he became the door opener to Televerket's world. Theoretical knowledge of how electronic switches operated in an optimal and seamless network had meagre value for Televerket in this phase. The real task was to implement electronics in the Norwegian "weed-flora". Thus, Skinnes played an important role in introducing the young academics to Televerket's concrete challenges.²⁰⁵ TF's approach to SPC-switches was different, they sent a mathematician to BTM. His attempt to comprehend SPC switches through mathematics did not bear many fruits according to the informants.²⁰⁶

Skinnes was dominant in forming Televerket's transition from mechanical, via electronic, to digital technology.²⁰⁷ The term 'dominant' gives a wrong impression, as he was very shy, and something of a loner. Alf Ivar Nilsen was instrumental in including and socialising Skinnes, so Televerket got the best out of him.²⁰⁸ Nilsen describes Skinnes as Televerket's "lighthouse", i.e. one that stood out in comparison with the rest. One thing was that Skinnes tutored the personnel, preparing them for the technological transition; another thing was that he was essential in the actual technological transition, i.e. in "translating" the old mechanical specifications into specifications for computers. He knew the Norwegian network "to his fingertips", says Nilsen, and was "quite a sight at BTM, when the large schemes were scattered over the table, and all the data were to be plotted into the 10C - he never lost track".²⁰⁹ This might be one of the most concrete signs and examples of the computerisation, or digitalisation of the Norwegian network and society, i.e. Skinnes standing at the table in BTM's office, explaining to Televerket and BTM engineers how to translate the electro-mechanical specifications into manuals for programming the computer software.

Conclusion

The 11B had the potential to be an important project for STK. It could have incorporated the Research Department's activity into STK's role as an equipment supplier. Moreover, it could have merged the two relational settings in the Norwegian

²⁰⁵ Interview with Magnhild Slettbak.

²⁰⁶ He wrote a dissertation on the subject, that Joys, who many will consider an expert in the field, did not understand the meaning of. Interview with Carl-Edward Joys.

²⁰⁷ Interview with Alf Ivar Nilsen, Kjell Christensen, and Magnhild Slettbak.

²⁰⁸ Interview with Kjell Christensen, Magnhild Slettbak.

²⁰⁹ Interview with Alf Ivar Nilsen.

telecom industry, i.e. the R&D system and the procurement regime. So, when STK invited Televerket to take an active part in the 11B project, the move could - in a theoretical perspective - have been seen as an invitation to create an innovative user-producer relationship. This would have differed from the 8B relationship, which did not contain any noteworthy user-producer interaction, as Televerket - especially Oslo District - simply relied on STK's craftsmanlike competence. Televerket declined the invitation, because it wanted to maintain the freedom to reject the switch in the future, something it eventually did. Moreover, Televerket did not want a "cosy" relationship with the Norwegian subsidiaries. In the same period, however, other European PTOs created more or less formalised "development pairs" with national suppliers. Why did Norway stand out in this respect, i.e. why did Televerket prefer an arm's-length relationship with its suppliers?

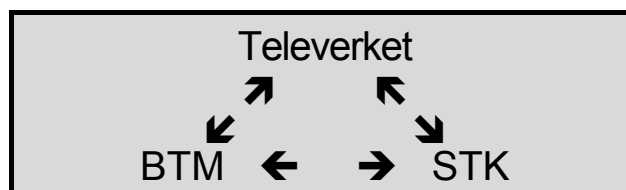
Firstly, it was apprehensive of the equipment suppliers' opportunistic behaviour. The apprehension was proven well founded when the cost-inspections showed that EB had over-charged Televerket, and there was no reason to suppose that this was a one-time accident. The ironic consequence, however, was that EB, by automating of rural areas with its KV switch, increased its market share from 33 per cent in 1970, to 67 per cent in 1978. Secondly, STK did not stand out as an attractive partner in terms of competence. The delays and high costs of the 11B, and the failure to upgrade the 8B, injured STK's relationship with Televerket, particularly with the TA. Moreover, 11B incurred great losses for STK's telecom business. There are unfortunately no sources available to illustrate the magnitude of the losses, only minutes from the Board of Directors, which in November 1975 stated that "the telephone business" would still be in deficit for this year as "the development and start of the 11B still burdens the department".²¹⁰ Thus, STK's telecom business was in pain this period. The troubles related to Berentsen's behaviour and attitude contributed to this, this also prompted Televerket's eagerness to free itself from the oligopolic grip, and rely on other partners.

Televerket's arm's-length strategy was also brought about by a weaker oligopolic grip. If digitalisation and liberalisation were in an embryonic stage in the 1960s, we might suggest that they were in their infancy in the early 1970s. Electronic switches eased the problem of interfaces between different kinds of equipment, which in turned weakened the oligopolic grip. The demand for transit switches also

²¹⁰ (Telefoni-linjen vil også i 1975 gå med underskudd idet utvikling og oppstarting av 11B fortsatt tynger avdelingen.) Thoresen's orientation at STK's Board meeting 05.11.75. The telecom problems in general, and the 11B in particular, were discussed at every board meeting throughout 1976.

spurred competition. Moreover, the political authorities made Televerket focus more on cost efficiency in its procurement. This was not a token of liberalisation, rather a matter of wariness of the resource allocation within public utilities. Nevertheless, it made Televerket adopt a more demanding and competitive approach towards its suppliers. Moreover, Televerket attained better control and oversight over its own network, which was a key finger in the oligopolic grip. The process related to national automation strongly contributed to this, as did the ever more extensive planning and mapping of the telecom network. The cooperation with BTM, regarding the SPC switches, took this a step further, and eventually positioned Televerket as one of the most demanding PTOs in Europe.

STK, for its part, experienced a paradoxical development in the early 1970s. On the one hand, it became more of a large national high-tech company with substantial R&D in electronics and telecom. At the same time, its patron BTM replaced it as Televerket's partner in switching, not least in handling the large and complex Oslo network. It was one thing that Televerket disapproved of STK's ability to handle its system responsibility with the 8B and 11B, another was that STK lacked the capability and capacity to assist Televerket in installing computerised switches in Oslo. Its CEO, Fredrik Thoresen, had no intentions of enhancing STK's standing in this field, and he did not consider it a problem that Televerket wanted to go directly to the source, i.e. BTM. Hence, the electronic revolution enabled STK to become a Norwegian high-tech company in terms of R&D projects for the TF and FFI, but the same revolution's impact on switching, i.e. SPC switches, diminished STK's role as a switching supplier. Its lucrative role, as a mediator between BTM and Televerket in a linear relationship, was threatened by Televerket's independent link with BTM. The linear relationship was replaced by a triangle, in which all three parties had contact with each other.



STK did not attain a lead-house position in the relational setting, and instead Televerket became BTM's lead market for the Metaconta 10C, and later for the System 12 in the 1980s. The reason for this was the fact that Televerket had such control over its network and such well-documented specifications, which were essential for a successful inauguration of a computer-based switch. STK, however,

Chapter 4 STK's telecom business in pain

had little to do with Televerket and Norway's developing into BTM's lead market. Regarding the different perceptions of multinational companies, as discussed in chapter 3, Televerket looked upon ITT, i.e. BTM, as a diffuser of technology and competence, to be exploited for its own means. The next chapter returns to the issues raised in chapter 3, that is STK and EB as high-tech companies in Norway, and how multinationals and their subsidiaries were perceived by Norwegian policy makers.

Chapter 5 STK as an innovative enterprise

Introduction

Despite STK's problem with the 8B and 11B switches, it had no plans to give up switching as a main line of production. STK's most prestigious R&D project in the 1970s was a digital switch for the armed forces, the nodal switch. STK won ITT's Geneen Award for the switch in 1982.¹ It still forms the technological and commercial basis for the Norwegian subsidiary of the international defence company Thales.² In 1998, many old-timers from STK, the TF and FFI gathered to celebrate the 25th anniversary of the nodal switch, one of the few industrial achievements in Norwegian telecom. STK's former CEO Fredrik Thoresen was asked to give the after-dinner toast. Even on this occasion he considered it opportune to stress how expensive the nodal project had been, and that the money invested had never paid off.³ He had always been hostile towards R&D in telecom, and sceptical about the ambitions to create a Norwegian Ericsson. He felt that a small country like Norway ought to rely on multinationals in this field. This chapter asks how STK developed as an innovative enterprise, as a subsidiary of a multinational, and as a Norwegian high-tech company in the late 1970s.

STK's relational setting, between ITT and Televerket, was about to change when Televerket decided to install BTM's computerised switches in the Oslo network. Other governmental bodies tried to influence the relational setting of the telecom industry. This was part of an interventionist policy towards the Norwegian electronics industry. The main rationale behind this policy was to lay an institutional and corporate foundation for a more R&D-intensive electronics industry. Hence, this chapter takes up the theme from chapter 3; i.e. how the relational setting evolved. More precisely, it elaborates on the roles of STK and EB as foreign high-tech companies in Norway.

STK and EB operated with different conceptions of multinationals, and used these conceptions towards Norwegian policy makers. EB's strategy, i.e. accentuating its independence from LME, was politically sanctioned and rewarded in 1976, when EB was picked as one of three *cornerstone* companies in the electronics industry. The chapter seeks to explain why EB was chosen, and not STK. The cornerstone plan was not all that important, but the issue is well-suited for comparing STK and

¹ "Heder til STK-utvikling" in *Ingeniør-Nytt* nr. 80/83.

² In 2003, Thales' Jens Gjerløw received another award for his central role in developing the «nodal switch». "Ærespris til Jens Gjerløw" in *Teknisk Ukeblad* 12.06.03.

³ Interview with Jest Braathen; Fredrik Thoresen.

EB, and sheds light on the Norwegian telecom industry in the second half of the 1970s. The comparison is on the personnel level, between the managing directors of STK and EB, Fredrik Thoresen and Kjell Kveim; on the company level, as foreign high-tech companies in Norway; and on a multinational level, comparing the different impact ITT and LME had on the two companies. An important issue is divergent corporate governance systems.

The development in the 1960s nurtured two competing corporate governance systems, and STK had to balance between the two in the 1970s. The establishment of the Research Department (FA) in 1968, and the 11B project in 1969, were concessions to national stakeholders. They were responses to a system of innovation in telecom and the TF, the lucrative long-term agreements, and the criticism of multinationals in general and of ITT in particular. These developments nurtured a stakeholder variant of corporate governance, with a technological and long-term perspective on business, and so did the governmental development contracts, based on Arrow's underinvestment rationale and Solow's residual factor. The many R&D projects STK took part in augmented the number and importance of the national stakeholders.⁴ Then again, ITT's Geneenism promoted a shareholder corporate governance system, with a financial and short-term perspective on business. Hence, it was not only the importance of the national stakeholders that increased, but the prerogative of STK's owner, ITT, was also strengthened. And STK made a very important concession to ITT.

Thoresen - STK's managing Director

Around 1970, STK was looking for Amund Braaten's successor. During these years, a new generation took up leading positions in the electronics industry in Norway. Kjell Kveim became EB's Managing Director in 1973; Peder Th. Hiis was appointed Nera's CEO in 1971; Nic. Knudtzon became Director of TF; Torbjørn Brataas became STK's first Research Director in 1968 and Ivar Ørbeck became STK's Technical Director in 1974. This generation was too young to have any corporate experience from before the war, and its education and competence was based on scientific breakthroughs from World War II, such as the radar, radiolink and sonar.⁵ All of them had engineering degrees, mainly from the Norwegian Institute of

⁴ Alf Chaiton et al. suggests that the "«globalization of competition» fosters a shareholder perspective, while the «localization of competitive advantage» fosters the stakeholder view". Alf Chaiton et. al.: "The Schizophrenic Corporation: Corporate Governance in a Clustered World" *A paper presented to The Competitiveness Institute, 3rd Annual Conference, Clusters in the New Millennium, (Glasgow, Scotland, October 4-6, 2000)* (<http://www.competitiveness.org/00ac/Papers/achaiton.pdf>)

⁵ Wicken 1993; Njølstad and Wicken 1997, p. 242f.

Technology (NTH*); several had started their careers as research assistants in institutions like FFI, ELAB, NTH and Kongsberg Våpenfabrikk.⁶ Braaten wanted a replacement in line with this; his candidate was STK's Technical Director, Arve Rambøl.⁷ He was recruited from FFI, where he had worked with radiolink. He had every qualification to guide STK through the electronic and digital revolutions. This would also have been a breach with STK's tradition of choosing a cable man for the top position. ITT stepped in, however, and chose Fredrik Thoresen as STK's new managing director.⁸

Thoresen completed a degree in Chemical Engineering from Birmingham University in 1953; he had several top positions in STK's Cable Division, before he became assistant Managing Director in 1971.⁹ Thoresen's capabilities in cables were important for ITT's choice; he had a leading role in STK's own development of rubber while he headed the chemical office in the late 1950s.¹⁰ Nevertheless, it appears for ITT, his key qualification was his ability to implement ITT's corporate principles. He was very much in favour of Geneen's principles, and shared his doctrine that "business was not about making products, but money".¹¹ While Braaten complained about the time-consuming report system, Thoresen was first in line to praise Geneen's fact-based management.¹² Thus, in Fligstein's terminology, Thoresen shared Geneen's financial conception of the firm.¹³ The differences between Braaten and Thoresen must not be exaggerated, but were only a matter of nuances. Still, Thoresen was an exception among the other managers in the telecom industry, as he had little knowledge and understanding of electronics and telecom, and he was also rather sceptical of prestigious and costly R&D projects.

It is important to bear in mind, however, that he was a cable man, STK's most profitable line of business. He had great ambitions for STK in submarine cables, and succeeded in this. STK won a large contract for laying a cable across the Skagerak

* Norwegian abbreviation for Norges Tekniske Høyskole.

⁶ Sogner 1994.

⁷ Former Legal Director Christopher Harper, and Braaten's son Jest Braaten, both claim Braaten preferred Rambøl as his successor. It is important to emphasise, however, that Braaten had the highest regard for Thoresen, and never had any problem accepting him as his successor.

⁸ Thoresen says it was a German ITT man, working for ITT Scandinavia, who recommended Thoresen to Geneen. Interview with Fredrik Thoresen.

⁹ Interview with Fredrik Thoresen, and STK's Board meeting, 25.02.71.

¹⁰ Interview with Fredrik Thoresen.

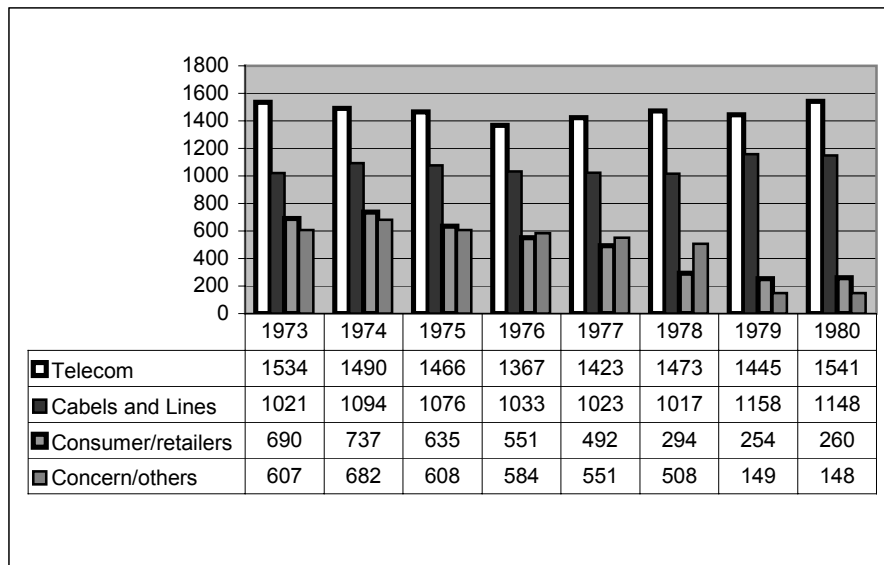
¹¹ Interview with Fredrik Thoresen.

¹² Fredrik Thoresen in *Norges Industri No. 4 1973*, "Ingen ulempe å være utenlandsk bedrift i Norge."

¹³ Fligstein 1990, p. 226.

in 1973, which was the longest and heaviest sea-cable ever laid.¹⁴ It was a major technical achievement, and won praise for STK around the world. On this basis, STK became a lead house in ITT for submarine cables. In 1976, STK, with Pirelli, won a contract for laying the Vancouver Cable, which underlined STK's position as a world leader in this business. It was the largest export contract any Norwegian company had attained and fulfilled outside the oil business at the time. Thoresen was well respected in ITT for STK's accomplishments in cable. At a general meeting in Brussels, he was criticised by Rand V. Araskog, ITT's CEO since 1979, for buying a cable ship, without requesting permission. When Araskog asked, "Why did you buy the boat?" Thoresen simply replied: "Because I needed it!" The answer was not standard procedure, but Araskog smiled and accepted.¹⁵ Thoresen standing in ITT allowed him to respond in such a manner. Despite this success in cables, the telecom business had become STK's largest in terms of employees.

Table 5.1: STK's employees, 1973-1980.



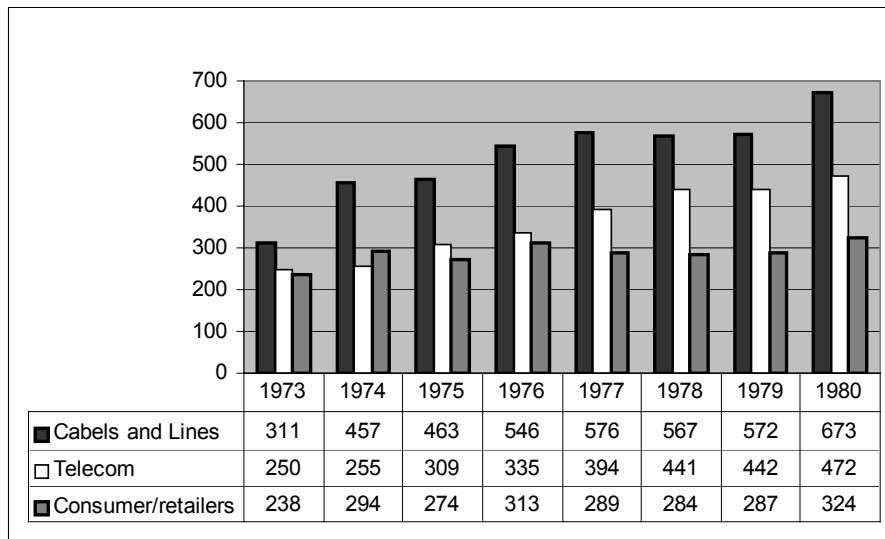
Source: STK's annual, reports 1977-1980.

¹⁴ Information on STK's cables business in general and submarine cables in particular is based on Bjørhovde 1990, p. 18 and 28; Interview with Fredrik Thoresen, Gunnar Tidemann, and Ingvild Myhre. Myhre was head of Alcatel Telecom Norway until 2000, when she became head of Telenor Mobile.

¹⁵ Interview with Hans Jørgen Blomseth, who worked at ITT-Europe in Brussels 1976-83, was Director of finance at (Alcatel) STK 1986-1992.

It is important to note that in the above table, “Telecom” includes technical and maritime electronics, and that “Cables and Lines” includes tele-cables. Thus, in one form or another, more than half of STK's employees were engaged in telecom. Nevertheless, cable still dominated in terms of sales.

Table 5.2: STK's sales, 1973-1980 (NOK millions)



STK's annual reports, 1977-1980.

Even if we do not have figures for net income for each product line, we know that the telecom division lost money in the mid-1970s, particularly on the 11B. Moreover, STK's supply of the Metaconta 10C also incurred losses, as this was severely delayed and STK had to pay penalty fines to Televerket.¹⁶ Thus, from the outset, Thoresen experienced troubles with the telecom business. The development projects were one thing; another was the fact that Berentsen had not been able to turn STK's manufacture of equipment into an efficient line of business. Production was halted frequently due to poor logistics and the lack of vital components, resulting in heavy financial costs.¹⁷ A main reason for this, probably, was the high margins the telecom department had on supplies to Televerket the oligopolic grip created few incentives for greater efficiency and productivity. Even if Gunnar Tidemann was able to shore up some flaws, according to Thoresen, he was never able to eliminate the slack and relaxed attitudes in STK's telecom department. The state of affairs in the telecom

¹⁶ NTM8: File: "Nord 3 Fremdrift - sluttoppgjør": Memo signed "TA 22/11-74"; NTM7-11Bb: Memo signed "TA/79/Nj 20.09.79". Interview with Nils Kåre Myklebust; STK's Research Department 1971-76, worked on Metaconta 1976-80.

¹⁷ Interview with Fredrik Thoresen.

division stood in stark contrast to the cable unit, Thoresen claims, thus he was constantly reminded of the loss-making telecom business.

Thoresen's regard of telecom-related R&D was not much better. He did not see any profitable business coming out of all the efforts, just the money they required. This was in contrast to the cable business, where STK carried out important innovations in developing long-distance submarine cables.¹⁸ STK's largest development project, the 11B, was not a success. It drained STK of financial resources for several years, and absorbed much of the FA's resources and personnel that could have been allocated to other R&D projects; it served STK badly in terms of its relationship with Televerket, and finally, it contributed strongly to Thoresen's scepticism towards telecom-related R&D.¹⁹ Thus, Braaten and Rambøl's ambitious hopes, that the 11B, being a switching project, could turn STK into fully fledged telecom company, failed.

The PCM contract with TF from 1969, however, was a positive experience for STK and for TF. As already mentioned, it paved the way for a large contract with FFI in 1973, for creating a mobile digital switch - "the nodal-switch".²⁰ The digital competence STK developed through the PCM contract was essential for the «nodal-contract». Another important asset was STK's long cooperation with FFI in military communication, particularly on cryptation from the 1950s.²¹ We shall not follow the development of the nodal switch; it was launched in 1977, and was, according to Brataas, the first digital network in Europe.²² It became STK's most prestigious and successful R&D project. Thus, TF's PCM contract was one of the few contracts that led to sustainable business, through the Norwegian subsidiary of the defence company Thales.

The nodal switch also formed the technological basis for STK's Digimat 2000, a Private Automatic Branch Exchange (PABX). In a simple form, it was merely a private switchboard; in an advanced form it became a key product in establishing an intelligent network within a company or an organisation. While discussing the future digital network in the mid-1970s, one scenario was to let the PABX give access

¹⁸ Interview with Fredrik Thoresen.

¹⁹ Interview with Fredrik Thoresen, Ivar Ørbeck, and Torbjørn Brataas.

²⁰ TBA: Torbjørn Brataas: "Knutepunkt virksomhet 1973-93 Et industrielt 20-års jubileum" 1993.

²¹ Mo 2002.

²² Interview with Torbjørn Brataas; STK's annual report 1977.

to future digital services, most notably data communication.²³ It was regarded as an important product and market for STK and EB, and for other subsidiaries that did not develop public switches; it was a sort of a switching-light industry. In general, the mother companies let the subsidiaries enter this area, thus it more or less became a zero-sum game in terms of export. It was also the first market segment in the telecom industry that was liberalised, and the first large product segment in which the PTOs did not dominate as the customer. The Digimat was STK's warhorse in this market segment, and was sold to most of the Norwegian oil companies operating in the North Sea, thus reflecting Knut Sogner's point about the oil industry's significance for the Norwegian electronic industry.²⁴ STK won an award for the Digimat, recalls Thoresen, "but we never made any money on it".²⁵

In addition to these two technologically successful projects/products, the nodal switch and Digimat, there were numerous other activities in STK's Research Department. It employed 39 engineers in 1978, and STK's technical departments employed 400, who worked closely with the FA. The R&D investments accounted for NOK 87 million in 1979, 6.7 per cent of STK's total sales.²⁶ The bulk of the projects were in telecom, so, more than ever, STK could be termed a high-tech company. STK did play a significant role in cooperating with TF, not only on PCM, but on data communication, "network planning", and other areas as well. As such, it did function as a door opener to ITT's technology and competence on PCM, in TF's quest to prepare Televerket for digitalisation. Notwithstanding, STK's R&D activities suffered from a lack of a technological strategy, or an overriding principle. One reason was that the projects did not develop as a result of business strategy, but as a result of funding.

Most of the FA's projects were detached from STK's cash-generating business, and conducted according to varying rationales. Some of the projects were market-oriented, seeking either incremental improvement of established products, developing new products, or upgrading STK's competence as an equipment supplier. There was also a national rationale, of contributing to technological and industrial development in Norway. In line with this, it was a strong element of political economy, i.e. to secure STK's position as an equipment supplier. The motives and ration-

²³ RA-LTP 23.-24.03.76. "that new facilities and services for instance can be put into PABXs" (at nye faciliteter og nye tjenester f.eks. legges inn i PABXer).

²⁴ Mo "Historien om DIGIMAT 2000", 1999; "STK vil satse på telekommunikasjon" in *Dagens Næringsliv* 01.10.88; Sogner 2002, p. 62.

²⁵ Interview with Fredrik Thoresen.

²⁶ IØPA; Box: "Div. Notater 1975-82 I. Ørbeck" (IØPAi): "STK RDE expenditures B.P. 1979" STK 3.11.79" and "STK er en produksjonsbedrift" 28.2.78.

ales for most projects were a mixture of the above-mentioned. Moreover, there was little cooperation across the different R&D projects. Different fractions developed within the FA, where the “nodal group” was particularly strong, and isolated from STK's other telecom activities.²⁷ The same holds for other R&D projects in the FA, but the tendency was especially strong within switching. STK had three switching camps: the “nodal group”, the analogue group, the 11B group, and later the System 12 group. As Knut Berg recalled, when he left the nodal project to lead the System 12 project in 1979, he felt excluded by his old “nodal friends”.²⁸

A characteristic feature of STK's R&D, or RDE (research, development and engineering) as STK and ITT called it, was the meagre communication and interaction between the projects. A reason for the fragmentation was that Thoresen and Tide-mann were both cable men, and neither had the capability to pull together the many switching projects, which would have allowed valuable spillovers. They lacked the sufficient technological insight to monitor and manage the differing telecom projects according to a technological strategy.²⁹ Consequently, STK's R&D efforts lacked *organisational integration*, which William Lazonick, based on Mary O'Sullivan's work, highlights as the “critical determinant of the success of an innovative strategy”.³⁰ His main focus is the vertical or hierarchical integration within the firm, i.e. between top management, middle management and workers. Still, I find his point applicable to STK's research activity, especially given that Lazonick sees this as “a set of social relations that provides participants in a complex division of labor with the incentives to cooperate in contributing their skills and efforts toward the achievement of common goal.”³¹ Such social relations and incentives were missing in STK, Thoresen's attitudes and the nodal group's rejection of Berg shows this.

The second social condition is *strategic control*, which is crucial in transforming individual learning into organisational learning. It is derived from the uncertain character of innovation. This is different from the financial perspective, where “optimal resource allocation” accepts technological and market constraints, and tries to optimise within these limits. This is in contrast to “strategic decisions”, claims O'Sullivan, which “are a creative response to existing conditions.”³² The main point

²⁷ Interview with Ivar Mo, and Knut Berg.

²⁸ Interview with Knut Berg.

²⁹ Interview with Gunnar Tidemann, and Ivar Ørbeck.

³⁰ Lazonick 2002, p. 14.

³¹ Lazonick 2002, p. 14.

³² O'Sullivan 2000, p. 409.

here is the uncertainty, as O'Sullivan claims: "there are no objective guidelines for making these decisions".³³ Still, the uncertainty can be reduced by attaining knowledge of markets, politics, and technology. Such strategic control was absent in STK's telecom business and R&D activities. The lines of responsibility were blurred in the FA. Different directors led different projects, some in cooperation with the British ITT laboratory STL, some with BTM, some with TF and others with FFI. Neither Thoresen, nor Brataas or Tidemann pulled the strings together; so there was no overarching strategy behind the projects. Even if STK did not have strategic control, it definitely had financial control. All projects were, in line with Geneen's principle, subjected to punctilious and meticulous control, reporting every delay and exceeding of budgets. One consequence was that Thoresen was reminded constantly of the costs related to R&D, and what he perceived as a lack of financial understanding from the researchers.

The researchers lacked economic sense, says Thoresen, and the management did not have technological understanding.³⁴ Even if Brataas recognised the problem, he did not have sufficient authority to stop "dead end" projects, according to Thoresen. This leads us to Lazonick's third condition for an innovative enterprise: *financial commitment*, which is derived "directly from the cumulative character of the innovation process."³⁵ Such commitment was blurred, as most of STK's projects were a means to an end, an end often unrelated to the innovation process. Lazonick's reasoning encapsulates a main reason why STK's R&D projects did not materialise in a different way. TF and FFI had no troubles cooperating with STK's engineers, and the ones that were responsible for any given project. But STK's heart and soul, Thoresen and its financial commitment to ITT, were not in it. "He did not comprehend the technical issues", Ørbeck recalls, "he just saw the money that drained away."³⁶ Thoresen's understanding of telecom was in stark contrast to his understanding of cable. In the management meetings, he excelled when cable was on the agenda. He asked detailed questions, and mastered the cable area, whereas he was rather passive and hesitant when telecom was discussed.

Thoresen maintains that development contracts rarely pay off, as he stressed at the celebration of the nodal switch. He claims that the researchers had problems in seeing the relationship between the development costs and the commercial possibilities. Thus, his assessment of R&D was product-oriented, financial and limited to the

³³ O'Sullivan 2000, p. 409.

³⁴ Interview with Fredrik Thoresen.

³⁵ Lazonick 2001, p. 20.

³⁶ Interview with Ivar Ørbeck.

boundaries of the firm. He was caught up in what Martin Fransman calls the R&D Conundrum: “Why allocate scarce company resources to R&D, whose benefits are uncertain and only accrue in the future?”³⁷ Thoresen did, or does, not recognise the broader rationale for conducting R&D: that it has benefits other than the business possibilities of any concrete projects. It also increases the absorptive capacity of the firm,³⁸ and potentially, it equips a management with technological understanding that can be indispensable while trying to navigate a company in uncertain surroundings. It is often a key condition for performing what Lazonick calls strategic control.

Thus, when Thoresen did not put more resources into building competence in computer-controlled switches, and programming and software handling, it was because he did not see any products coming from STK at the other end. The company's lack of computer capability had cost dearly with the 11B, and it was going to cost them even more with System 12. Another reason was that there were rather unrealistic ambitious goals within the FA, particularly the nodal camp, of turning the nodal switch into a public digital switch.³⁹ For these influential engineers, it seemed almost unpatriotic to engage in foreign switches, as Joys and Berg did. It is illuminating that when STK spent time and money on the nodal switch, Nokia decided to start development of a digital switch, as they considered it decisive to stay in the telecom business.⁴⁰

Still, Thoresen accepted that R&D in telecom was compulsory to combat the criticism directed towards ITT and STK in the 1970s, but it was a concession to Norwegian stakeholders he did not like to give. Still, it is important to distinguish between two sorts of stakeholding: the responsibility to contribute to national technological and industrial development, and the responsibility for social issues, such as the welfare of employees. Even if Thoresen adhered to Geneenism, and did not consider the future of Norwegian high-tech industry as his prime responsibility, he did care very much for the wellbeing of STK's employees. He invested heavily in different forms of industrial relations efforts. In fact, a major reason for why STK was designated company of the year in 1982 was the good industrial relations it had established, which among other things ensured one of the lowest sickness absence rates in Norway.

³⁷ Fransman 2002, p. 215-216.

³⁸ Wesley M. Cohen & Daniel A. Levinthal, “Absorptive Capacity: A New Perspective on Learning and Innovation”, 1990. Cohen and Levinthal define absorptive capacity as the “ability to recognize the value of new information, assimilate it, and apply it to commercial ends”. (p. 128).

³⁹ Interview with Ivar Mo.

⁴⁰ Häikiö 2002, p. 57.

Nevertheless, our main point here is that Thoresen regarded telecom related R&D first and foremost as a necessary activity for preserving STK's position as Televerket's equipment supplier. For EB's Managing Director Kveim, it was just the opposite: the main reason for him and EB to supply Televerket with Ericsson's equipment, was to finance R&D and innovation, to fulfil the strategy of turning EB into an independent Norwegian (tele)communication company.⁴¹ The next section looks at EB's ambitions in this matter.

Kveim, EB and Nera

Kjell Kveim replaced Eilif Bjørnstad as Managing Director in 1973. Kveim's academic credentials and technological competence were impeccable, so he was expected to be the right man to take EB through the digital transition that the industry was about to enter.⁴² As a former researcher he had intimate knowledge of the R&D system in electronics. He faced big challenges, however, as EB's expansion during the 1960s had almost led to a breakdown in manufacturing in 1970, with 30% of the deliveries hampered by delays or faults. An internal memo concluded that the bottleneck was not in the market, but in EB's ability to produce.⁴³ LME's CEO, Bjørn Lundvall, thought the reason was that Bjørnstad had focused too much on *own* product areas.⁴⁴ He stressed that EB's main task was to supply Televerket with telecom equipment, and its "second large task - but after its main task - was to develop its own products".⁴⁵ Lundvall stressed that EB had to succeed in the main area to be able to develop independently. Kveim learned that he needed to serve both LME and Televerket close to perfection, in order to develop a Norwegian telecom company.

Shortly after taking the helm of EB, Kveim contacted Knut Getz Wold in the Norwegian Central Bank about a new share issue to double EB's share capital. Kveim was anxious not to provoke the government, as LME and EB had done with the "share coup" in 1967. Wold said that he did not want EB to issue B-shares, but only shares with full voting rights. If LME wanted to hold to its majority position, it would have to invest in EB, and if they "wanted to sell them to Norway, it would

⁴¹ Interview with Kjell Kveim.

⁴² Interview with Kveim, and with Stenberg.

⁴³ LEBA: LTP meeting 11.02.72, in.

⁴⁴ NTM-EB: LME's Bjørn Lundvall to EB's Eilif Bjørnstad 02.11.70.

⁴⁵ NTM-EB: LME's Bjørn Lundvall to EB's Eilif Bjørnstad 02.11.70. (andra stora uppgift - men efter huvuduppgiften - är att utveckla egna produkter).

not meet any objections”.⁴⁶ LME did not need a majority position to consolidate EB in its accounts anymore, Wold claimed, as it had become normal to do this on an “equity basis”, where the firm consolidated the figures from the subsidiaries in proportion to the ownership share.⁴⁷ Wold concluded that “L. M. Ericsson control” over EB did not “rest primarily on its share majority, but on its know-how and its patents”.⁴⁸ Wold wanted to eliminate EB's B-shares, giving them full voting rights, which would reduce LME's majority share in EB to around 43 per cent. He noted that Kveim was content with this conclusion, even though it was evident that his mission from LME was to seek other solutions.⁴⁹ Thus, Wold thought Kveim was keener on strengthening the Norwegian influence in EB, than on fulfilling his obligations towards LME.

LME agreed to convert the B-shares into A-shares, thus reducing its ownership to 40 per cent, which sanctioned EB's strategy of loosening its ties to LME.⁵⁰ Collett presents this as a requirement from Kveim, who saw it “as one his first tasks to try to reduce LME's share to below 50 per cent”.⁵¹ Kveim, on the other hand, says that there was no drama in this, and that Wallenberg simply wanted to “give him a flying start”.⁵² It was not as if LME was forced to reduce its share in EB, and allow such an autonomous strategy for EB. Surely, it recognised that it had to loosen its grip on EB, but LME also saw a golden opportunity to turn EB into the major telecom company in Norway. LME's acceptance was a matter of strategic national responsiveness, in a changing «negotiated environment». Even if LME allowed EB to pursue its own strategy, it was not allowed to do this within the license area, within the core of telecom. Hence, LME did not pursue an integrated strategy; it did not want EB to intrude into LME's domain with its autonomous strategy. EB should develop “Norwegian” products, based on locational advantages, but not in LME's main area.

EB's economic performance was poor during the early 1970s, due to the production problems and high costs of the Norwegian products.⁵³ The only products with prof-

⁴⁶ RA-EBi: Memo from Knut Getz Wold's meeting with Kveim - 31/10-73 KGW/SAn Knut Getz Wold: “Aksjeutvidelse i Elektrisk Bureau”. (solgte dem til Norge, ville dette ikke støte på noen innvendinger.)

⁴⁷ RA-EBi: 31/10-73 KGW/San.

⁴⁸ RA-EBi: 31/10-73 KGW/San: (L. M. Ericsson's kontroll med Elektrisk Bureau hviler for øvrig ikke primært på aksjemajoriteten, men på den know-how og de patenter).

⁴⁹ RA-EBi: 31/10-73 KGW/San.

⁵⁰ Collett 1986, p. 18; Kveim supports Collett's interpretation of this.

⁵¹ Collett 1986, p. 18.

⁵² Interview with Kjell Kveim.

⁵³ RA-EBi: LME's Bjørn Lundvall to EB's Eilif Bjørnstad 02.11.70; LEBA:: LTP meeting 11.02.72; Collett 1986, p. 17f.

its were those within the license agreement with LME.⁵⁴ Its greatest losses were in ship radio, largely due to competition with Nera.⁵⁵ Despite the problems, both Skeie and Kveim meant that maritime electronics were destined to be the core area in EB's emancipative strategy from LME. It had to increase its export of maritime products to bear the high development and fixed costs. In trying to attain a mandatory position within LME, in 1972 EB proposed to set up "Ericsson marine" in Oslo. LME turned the request down, but allowed EB to take over LME's sales office in Hamburg and establish an office in London.⁵⁶ Despite Kveim's marketing and sales efforts, the maritime products burdened EB's sheets. EB's board said it was "vital that these products are made profitable" and wanted "new efforts to coordinate prices among other producers and suppliers".⁵⁷ This meant starting talks with Nera, aiming at a market agreement for ships' radios, or even a broader cooperation within maritime electronics. To comprehend this development, a closer look at Nera is necessary.

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Nera suffered from economic problems in the 1960s. Being interested in its radio-link technology, Ericsson and EB tried to acquire the only Norwegian-owned telecom company in the late 1960s.⁵⁸ The government never considered this, wanting a Norwegian solution to the problems. To enhance its R&D capacity, Nera recruited Peder Th. Hiis from FFI, and he became Nera's CEO in 1971.⁵⁹ Many considered that Norwegian high-tech companies were too small, and lacking the scale to conduct R&D. Thus, there were several attempts to merge Nera with Simrad. The two companies' joint offer to win a contract within maritime satellite communication fuelled aspirations to create *Norwegian United Electronics*.⁶⁰ TF's Knudtzon doubted Nera-Simrad's capacity to pull through such a large project, and wanted them to cooperate with STK and EB.⁶¹ He thought it was necessary to involve the

⁵⁴ Collett 1986, p. 17.

⁵⁵ LEBA: Minutes from EB's board meeting 09.03.72.

⁵⁶ LEBA: Minutes from EB's board meeting 09.03.72.

⁵⁷ LEBA: Minutes from EB's board meeting 25.09.73., (det er vitalt for disse varegrupper at de kan gjøres rentable. (...) gjøre nye tiltak for å koordinere prisene blant aktuelle produsenter og leverandører.)

⁵⁸ Lundvall had had conversations with chairman of the board in Nera, Bernt Ingvaldsen, who also was Stortinget's President, concerning cooperation between EB and Nera. NTM-EB: LME's Bjørn Lundvall to EB's Eilif Bjørnstad 09.01.68 about Lundvall's meeting with Rostoft 3. January 1968.

⁵⁹ Johannes Ripman: *Bølger - Glimt fra NERAs historie*, 1997, side 21.

⁶⁰ Sogner 1994, p. 51.

⁶¹ TF's annual report 1970, here from Lossius 1991, p. 91.

large subsidiaries.⁶² Nera-Simrad refused to cooperate, as the other two belonged to multinational concerns with their own “business and market policies”.⁶³ STK and EB handed in a joint offer, which was turned down, in favour of Nera-Simrad’s *national* offer. Knudtzon’s doubts regarding Nera-Simrad were proven correct, as it had to give up the contract, and the ambitions to create a large national unit in electronics faded away.

Simrad's influential CEO, Willy Simonsen, left the company in 1967 because he did not feel that the Mustad family, which controlled Simrad, gave him enough freedom. He established Simonsen Elektro.⁶⁴ Nera became part of another holding company when its owner, Bergen Industriinvestering, was taken over by Investa in 1970.⁶⁵ Investa was an investment company from Bergen, known for its financial orientation, and was influential in introducing the shareholder value principle in Norway. The restructuring was coordinated with the Ministry of Industry, and included the creation of a holding company, Elektro Union, which was to own and organise Investa's companies in the electronics and electrical fields. The ambition was to create a robust Norwegian concern in the strong current area, trying to offset the disadvantage of the small-scale industry.⁶⁶ The restructuring did not offset Nera’s economic problems, but saddled the company with owners that did not accept loss-bringing business, not least the draining competition on ships’ radios with EB. Investa's Oskar A. Munch was CEO of Elektro Union and chairman of Nera; he invited EB to merge the ship radio units of the two companies in the autumn of 1973.⁶⁷

The climate for the EB-Nera negotiations was good; Kveim and Hiis were friends from NTH, and Munch and EB's chairman Halvdan Bjørum were acquainted from business and social life. It was the first of several encounters between these persons and companies, but the only meeting where the parties were on equal footing.

⁶² Knudtzon genuinely believed a development contract could earn STK and EB a mandatory position in satellite communication in ITT and/or LME.

⁶³ Lossius 1991, p. 204.

⁶⁴ Sogner 1994, p. 50.

⁶⁵ Investa increased its ownership in BII from 30 per cent to 100 per cent. Investa was regarded as the hub in Bergen’s bourgeois, and Einar Falck, the CEO was called the godfather of Bergen’s business. ”Vesta vinden har stilnet” in *Dagens Næringsliv*: 05.11.94, Obituary for Einar Falck. and “Av de harde negler i næringslivet” in *Aftenposten* 20.01.91. Conf. Fritz W. Loy: *Vesta i vekst gjennom 100 år : 1880-1980*, Bergen Vesta-Hygea 1980.

⁶⁶ St. prp. 107 1972-73: ”Om Elektro Union A/S, Elektro-Generator Aksjeselskap (EGA), A/S National Industri og A/S Nera.”; Sogner 1994, p. 52.

⁶⁷ Interview with Oskar A. Munch, who had leading positions in Bergen Industriinvestering/Elektro Union/Investa, Chairman of the Board in Nera and Elektrisk Bureau 1986-1989.

United Marine Electronics was established in 1974, and was located at EB's new headquarters, at Billingstad outside Oslo. Nera's 51 per cent stake secured Norwegian ownership.⁶⁸ It was no coincidence that the name did not include the term *communication*; the plan included ship automation, and in many ways it replaced the old plans for Norwegian United Electronics.⁶⁹ The vision was to create "a maritime electronics group that was a global leader".⁷⁰ Thus, EB had a national institutional arrangement as a launching pad for its independent strategy. Knudtson was also satisfied, as the joint company allowed EB to become the dominant industrial partner in the project for maritime satellite communication. It became EB's main R&D project in the 1970s. The satellite technology was regarded as suitable for EB's national strategy, as it would equip EB with valuable competence and capability for the future.⁷¹

United Marine Electronics did not resolve Nera's financial problems. Its Oslo division, which did license work for RCA and included broadcasting and instrument landing systems, constantly lost money.⁷² Therefore, Hiis was dismissed in 1975. "He was a fine engineer", Munch recalls, but given the lack of financial understanding, he was "unable to lead a company in a crisis".⁷³ One of the applicants for the top job in Nera Oslo was Kjell Almskog, who had been with Simrad and STK, and with Proctor Gamble in the United States, a company with its own strict variant of Geneenism.⁷⁴ Almskog did not impress Munch much at first, but when he was asked to come up with a solution for Nera Oslo, he impressed Munch. Almskog's solution was to "shut it down".⁷⁵ Munch liked the idea, and hired him. His solution was im-

⁶⁸ Nera-A; Box: "21: Nera II": "Nera til Industrifondet 5.9.74", Sogner 1994, p. 51.

⁶⁹ The appointment of Erik Gjeruldsen from Norcontrol underscores this, Lossius, 1991, p. 95 f. In an application to the Industry Fund, Nera put forward a vision of maritime electronics packages. In this, satellite communication and new control systems for ships would lead to an integrated electronics system onboard. Ship constructors or shipping companies would prefer to procure an integrated system from a single responsible supplier. Thus, UME said it would work towards a merger with Simrad and Norcontrol. Nera-A; Box: "21: Nera II": "Nera til Industrifondet 5.9.74"

⁷⁰ Nera-A; Box: "21: Nera II": "Nera til Industrifondet 5.9.74", (en maritim elektronikkgruppe som vil bli den ledende i verden.)

⁷¹ Interview with Harald Erichsen, director in Nera..

⁷² It had an accumulated deficit of 24 million NOK between 1972 and 1975. Nera-A; Box: EUN - 1975: "Meeting I 10.11.75 referat fra AD-møtet."

⁷³ Interview with Oskar A. Munch.

⁷⁴ Interview with Kjell Almskog, who held leading positions in Nera and Elektro Union. He was Managing Director of Elektrisk Bureau in the mid-1980s, and later in ABB's Norwegian subsidiary.

⁷⁵ Interview with Oskar A. Munch.

possible, however, due to the economic crisis, employment issues, the strength of the unions and a revitalised and radicalised Labour Party.⁷⁶

Nera's problems continued, though Televerket did give the company some extra orders to help. In considering giving Nera a development contract for radio transmitters for the Norwegian Broadcasting Corporation (NRK*), Televerket complained that the company had not provided it with information, as requested, which would verify that such a contract from Televerket “would save the company, and not merely lead to a postponement «of the funeral»”.⁷⁷ TF participated in the attempt to establish Nera as dominant actor in Norwegian telecom, and in 1976 Nera received development contracts worth NOK 7 million, twice as much as EB, and three times as much as STK.⁷⁸ Nera's problem had another significant consequence, namely that it had to cancel a contract for developing 150 mobile telephones. This was given to Willy Simonsen's company instead, Simonsen Elektro. Thus, Nera was in crisis, and Munch was destined to solve the problem on behalf of the demanding owner, Investa.⁷⁹ One alternative was to sell Nera to EB, but this required that EB be nationalised, which happened in 1976, when EB was selected as a «national champion» by the Labour government.

The cornerstone plan

In December 1976, the Ministry of Industry announced its *cornerstone plan* for the Norwegian electronics industry. It was the influential Labour member, Jens Chr. Hauge, who came up with the idea and saw it through. Hauge, who held leading positions in Norwegian politics and industry, operated as a consultant for the Minister of Industry, Bjartmar Gjerde.⁸⁰ Hauge picked out three cornerstone companies: EB, Tandbergs Radiofabrikker and Kongsberg Våpenfabrikk. He wanted to concentrate public resources on these companies, and hoped they could benefit through cooperation. After several meetings with the companies, he said they were “moti-

⁷⁶ Tonje Tveite: “Forvaltningsselskap for statsindustri?” in Grøndahl og Grønlie (ed.), 1995, p. 153 f.; Christensen 2003, p. 111 f.; Harald Espeli: *Industripolitikk på avveie*, 1992.

* Norwegian abbreviation for Norsk Rikskringkasting.

⁷⁷ RA, Teledirektoratets archive: RA-28: ØF. 26.11.75 To The Director General: “Ad etasjefmøte hos Samferdselsministeren 1. desember 1975 - pkt. 2 i departementets brev av 10 ds. (fra Televerket (NRK) vil redde bedriften og ikke bare føre til en utsettelse ‘av begravelsen’).

⁷⁸ Thue 2006.

⁷⁹ Interview with Oskar A. Munch.

⁸⁰ Jens Chr. Hauge was leader of the leadership of the Norwegian resistance movement “Milorg”, Minister of Defence 1945-52, Minister of Justice in 1955, chairman of the Norwegian part of Scandinavian Airlines System and Statoil, and member of Kongsberg Våpenfabrikk's Board.

vated to join in committed cooperation on development, marketing and manufacturing”, and “that joint efforts (...) could yield significant results”.⁸¹ The plan can be seen as a continuance of the vision of creating Norwegian United Electronics, or an *electronics* variant of Elektro Union, trying to attain scale and scope for smaller industries through cooperation. It was a response to the crisis in the electronics industry at the time, which was documented in a Public Report (NOU*) on the industry from 1976.⁸² This section does not analyse the general background to the plan, but only why EB was chosen, rather than STK.

An important consequence, and pre-condition for choosing EB, was that Ericsson's ownership in EB was reduced from just below 50 per cent to 25 per cent. Thus, a main reason for picking EB, and not STK, was that ITT's ownership was too high in STK.⁸³ Unlike EB, it seemed unrealistic to acquire a national majority in STK. Thoresen wanted STK to be a part of the plan, and told Hauge that ITT would accept a reduced ownership in STK, but Hauge declined, saying it “was not natural to include the company in a national group”.⁸⁴ Hauge and Gjerde advised STK to contact the chosen companies, and said that such an approach would “clarify to what degree STK could cooperate with national companies”.⁸⁵ ITT did consider buying back Kreditkassen's preference share in STK, and sell it as ordinary shares on the Norwegian market in 1977. Nothing came out this, however, as the Norwegian stock market was down, leaving little to gain for ITT. Moreover, the Labour gov-

⁸¹ Nærings- og Handelsdepartementets arkiv, 464 Elektrisk Bureau, File: ”Lån i utlandet (1977-): Memo from Jens Chr. Hauge 12.10.76: ”Samtale med Industriministeren om mitt arbeide med strukturen i elektronikkindustrien 11.07.76.”, (motivert til å inngå et forpliktende samarbeide som dekker utvikling, markedsføring og produksjonssamvirke. Det er klart at et samarbeide som både felles tiltak og arbeidsdeling vil kunne gi betydelig resultater). Here from Gard Paulsen's private archive, his copy of this document is borrowed with permission from Nærings- og Handelsdepartementet.

* Norwegian abbreviation for Norsk Offentlig Utredning.

⁸² NOU 1976: 30 *Elektronikkindustri. En perspektivanalyse for norsk elektronikkindustri*; Sogner 1994, p. 65.

⁸³ Nærings- og Handelsdepartementets arkiv, 464 Elektrisk Bureau, File: ”Lån i utlandet (1977-): Memo from Jens Chr. Hauge 02.11.76 from Meeting with Permanent Secretary (Departementsråd) Oluf C. Müller. Here from Gard Paulsen's private archive, he a copy of this document, with permission from Nærings- og Handelsdepartementet.

⁸⁴ RA-STKii: Minute from meeting between STK, Minister of Industry Bjartmar Gjerde, Jens Chr. Hauge, and Ivar Jachwitz, ”14.1.77 IJ/bj” (ikke vært naturlig å ta denne bedriften med i en nasjonal gruppe).

⁸⁵ RA-STKii: Minute from meeting between STK, Minister of Industry Bjartmar Gjerde, Jens Chr. Hauge, and Ivar Jachwitz, ”14.1.77 IJ/bj” (en tilnærmedelse her ville bidra til å belyse i hvilken grad STK kan samarbeide med nasjonale selskaper).

ernment did not want ITT to buy “cheap” preference shares from Kreditkassen, and profit from floating them.⁸⁶

EB stood out as the healthier and more potent company in 1976, not least in telecom. Hauge negotiated with LME's main owner, Marcus Wallenberg, and arranged for LME to reduce its ownership in EB from just below 50 per cent to 25 per cent.⁸⁷ An important background to this negotiation was the Nordic cooperation on data communication. LME was given a large contract in relation to this in May 1976, despite the opposition of Televerket and Ministry of Communication, but the Ministry of Industry supported it in exchange for LME reducing its holding in EB.⁸⁸ These negotiations created an opportunity, but were not alone sufficient to induce the wish to nationalise EB.

Another factor, explaining why EB was picked as a cornerstone, was that LME was Swedish. It was easier for the Norwegian authorities to get in contact with LME's management and owners to discuss industrial issues. The Norwegian authorities had several meetings with Wallenberg, concerning EB and other topics, whereas there are no records of such meetings with ITT.⁸⁹ Even if the apprehension of Swedish dominance was clear, there were also several attempts to induce industrial cooperation between Sweden and Norway in these years.⁹⁰ The cornerstone plan was actually presented as a part of a plan to induce cooperation between Norwegian and Swedish firms.⁹¹ Kveim asserts that when Wallenberg accepted the need to reduce LME's stake in EB, it was because he understood and had sympathy with the desire to create and promote a Norwegian telecom industry.⁹² Moreover, LME welcomed EB's role as a cornerstone company, and felt that it affirmed LME's strong position in Norway.⁹³ It probably hoped that it had taken a major step towards securing the Norwegian market for the next generation of digital switches.

⁸⁶ STKJA; Box 57; File: Lov 13 STK Eierforhold: Correspondence between STK and ITTE in 1977, regarding a stock listing of STK in Norway.

⁸⁷ The insurance company Storebrand Norden, Kongsberg Våpenfabrikker and Årdal Verk bought the shares. It is uncertain whether the government considered taking a stake as well, in order to assure national ownership.

⁸⁸ RA-28: Dok 11/77 to Televerket Board of Directors 21.01.77; Odd Chr. Gøthe: *Ærlig Talt! Om industriskandaler, statsråder og annet*, 1988. p. 133; Paulsen 2004.

⁸⁹ NTM-EB: LMEs Svein Åberg to Eilif Bjørnstad 11.09.62 about Holler's visit to Ericsson; LME's Bjørn Lundvall to EB's Eilif Bjørnstad 09.01.68 about Lundvall's meeting with Rostoft 3. January 1968.

⁹⁰ An example was the abortive “Volvo-agreement” in 1978.

⁹¹ RA-EBii: Press release 03.12.76 “Uttalelse fra industriministeren i forbindelse med prinsippavtalen om samarbeid mellom Elektrisk Bureau, Kongsberg Våpen og Tandberg Oslo”.

⁹² Interview with Kjell Kveim.

⁹³ Interview with Kjell Kveim.

The cornerstone plan was also a rescue plan; Hauge hoped it could save Tandberg, which was in severe trouble.⁹⁴ Another integral part of the plan was that Kongsberg Våpenfabrikk took over Norcontrol, which was in a crisis of its own.⁹⁵ Moreover, EB was to save Nera. Investa wanted to sell Nera, and a nationalised EB was regarded as suitable to take over Nera.⁹⁶ EB and Elektro Union negotiated the sale of Nera in the first months of 1977. Munch tried to get some money out of the sale, but Kveim refused. EB paid only NOK 1 for Nera, but took over NOK 124 million of Nera's debt.⁹⁷ The government remitted NOK 13 million of Nera's public debt, and assisted EB in financing the takeover. In hindsight, Kveim denies that the acquisition was a result of political pressure, as EB had craved Nera's radiolink business for decades.⁹⁸ If this is true, then Kveim was in opposition to his board, which stated that it did not see any "profit possibilities in buying Nera", and considered it a "rescue operation".⁹⁹

Operating in a politicised business, the board concluded that EB did not have a choice: "it would be very unwise to go against the government's strong wish", even if it "opposed strongly with what a business consideration would suggest".¹⁰⁰ A few months later, EB found more skeletons in Nera's closet. Kveim wanted Elektro Union to compensate for this, but Munch refused, claiming it was EB's problem that it did not know how to perform a due diligence.¹⁰¹ Some would conclude that Kveim and Munch had different codes of morals, though others might suggest they had different degrees of naiveté.

Kveim put considerable efforts into integrating Nera into EB, and nurturing its technical milieu. He thought its main problem was that it had been drifting without proper management. He was certain of Nera's technological and commercial potential, and felt it only needed to be released. One of the first things he did was to give Nera a 'present', by financing a new site for the radiolink division in Bergen. "This

⁹⁴ Knut Sogner: *Veksten mot idealfabrikken: Tandberg radiofabrikk i 1970-årene*, 1989.

⁹⁵ Sogner 2002, p. 71.

⁹⁶ Interview with Oskar A. Munch.

⁹⁷ RA-EBiii: EB to Ivar Jachwitz in the Ministry of Industry 16.03.77. The acquisition included a comical and paternalistic touch from Kveim, who, during the final meeting, pushed the coin over the table to Munch, Interview with Kjell Kveim.

⁹⁸ Interview with Kjell Kveim.

⁹⁹ LEBA: EBs first board meeting 1976, (fortjenestemulighet ved å kjøpe Nera (...) redningsaksjon).

¹⁰⁰ LEBA: EBs first board meeting 1976, (det ville være uklokt å gå imot myndighetenes sterke ønske (...) meget imot hva en forretningsmessige vurdering skulle tilsi).

¹⁰¹ Interview with Oskar A. Munch.

was to show that EB appreciated and backed Nera's employees", Kveim recalled.¹⁰² Moreover, it was to stimulate innovation, as Kveim thought innovative capability depended on a good environment and facilities. It goes without saying that Kveim became very popular in Bergen, and the 'gift' helped create an image of him as a "white knight".¹⁰³ It said something about his economic orientation, as the costs of the 'present' were far greater than Nera, with any reasonable forecasting, could be expected to bear. Thoresen was never conceived as a "knight", or as a generous spender. Thus, there were clear differences between Thoresen and Kveim.

Both STK and EB were engaged in R&D and innovative activities in the 1970s, but while these were essential in Kveim's strategy, they were only a means to an end for Thoresen. The two men operated with different conceptions of their companies,¹⁰⁴ and also with different corporate governance principles, or more precisely, with different regard for their respective stakeholders. Thoresen was raised in Geneen's corporate school, in which R&D was only one of several methods of pursuing a profit. For Kveim, however, it was essential for EB to develop "Norwegian" products, and contribute to industrial development in Norway. It is fair to say that for Thoresen, technology and innovation were subordinated to finance, while it was the opposite for Kveim. Besides, EB was perceived as more nationally oriented than STK, and the Ministry of Industry said it needed proof of STK's willingness to cooperate with Norwegian companies.¹⁰⁵ Thus, the difference between Thoresen and Kveim, and between STK and EB as innovative enterprises mattered in explaining why EB was given political preference. In turn, these differences were to a large degree a consequence of the different natures of ITT and LME.¹⁰⁶

ITT vs. LME

ITT differed from LME in that it did not pursue a leadership based on technology or a technological strategy. ITT-Europe in Brussels did try to coordinate the business and R&D of the European houses, but was not very successful, as the need for national responsiveness was too important. Thus, instead of pursuing a technological strategy, ITT was very attentive to the subsidiaries' day-to-day business, including

¹⁰² Interview with Kjell Kveim.

¹⁰³ Interview with Harald Erichsen, and Jon Erik Stenberg.

¹⁰⁴ Niel Fligstein talks of different conceptions of the firm, where each conception, i.e. manufacturing, sales and marketing, and finance, has had its strong periods in the 20th century. Fligstein, 1990, p. 18.

¹⁰⁵ RA-STKii: Minute from meeting between STK, Minister of Industry Bjartmar Gjerde, Jens Chr. Hauge, and Ivar Jachwitz, "14.1.77 IJ/bj"

¹⁰⁶ Both in the sense that Thoresen and Kveim were chosen as Managing Directors, and in the sense that ITT and LME shaped them as managers.

R&D. ITT demanded strict reports and evaluations, before giving approval to participate in R&D projects. Ongoing projects had to report monthly, and as soon as a problem arose, the subsidiary concerned had to post a «red flag» in its report to ITT.¹⁰⁷ In principle, a subsidiary could enter any project it liked, as long as the plans were financially sound. So, while Geneen did not want ‘proud guys entering their own Vietnams’, he limited only the financial freedom of the subsidiaries. “We could make cars if we wanted and held the budgets” says a BTM aide.¹⁰⁸ This was very different from LME, which operated with a more lenient financial control, but restrained what technological areas EB was to enter. LME would, for instance, not have allowed EB to enter a switching project like the 11B, and perhaps not a project like the nodal-point switch either. It paid less attention, however, to EB’s “own” projects, like maritime communication, because these were not core areas in telecom.

With considerable assistance from LME, Kveim succeeded in making EB’s supply of equipment to Televerket much more efficient in the 1970s.¹⁰⁹ He invested heavily in better planning, rationalising, and organising production, and lowering capital costs. He linked this to a comprehensive strategy process. This was necessary to manage EB’s growth during these years, when sales rose from NOK 400 million in 1973 to NOK 1 billion in 1977. The key figure in turning around EB’s telecom business was Tor Egil Holte, who came to EB in 1973.¹¹⁰ He was director of production until 1982, when he became director of telecom. His strong character helped EB achieve greater efficiency in manufacturing and better control over the capital stock. Two camps developed at EB: one product-oriented group lead by Holte, and one R&D-oriented, which allegedly lacked any sense of budgetary discipline. The groups operated with different corporate understandings. Kveim never succeeded in reconciling the groups, or in introducing a sense of financial understanding to the R&D group.¹¹¹

A swift look at EB’s financial figures in the 1970s illuminates the point. EB’s export of Norwegian products rose from 10 per cent to 30 per cent during the 1970s, and thus, in this sense, Kveim was fairly successful with his strategy.¹¹² The economic results in EB’s own areas, however, were disastrous. According to EB’s former di-

¹⁰⁷ Interview with Fredrik Thoresen.

¹⁰⁸ Interview with Rudy Scholliers.

¹⁰⁹ Interview with Kjell Kveim, Jon Erik Stenberg, and Peter Pay. Pay held leading positions in EB telecom business from 1970-1989, leading positions in Telenor from 1993-2000.

¹¹⁰ Interview with Peter Pay.

¹¹¹ Interview with Peter Pay.

¹¹² Collett 1986, p. 18.

rector of human relations, Jon Erik Stenberg, it had an annual deficit of NOK 20 million between 1974 and 1978.¹¹³ Taking into account that EB's net profits in 1974 and 1977 were 16 million and 20 million NOK, respectively, these were big deficits.¹¹⁴ These figures were not revealed in EB's annual reports, thus the profits obtained from sales to Televerket were also concealed. So, the large margins EB enjoyed as an equipment supplier subsidised the other lines of business, and gave LME a good profit. Within this regime, Kveim could allocate resources to risky R&D projects with a long-term horizon, such as maritime satellite communication, as long as this did not interfere with LME's technological strategy. STK, on the other hand, had to evaluate the realism in every project. In this sense, STK had less "financial" room to pursue ambitions of autonomy within ITT, while EB had less "technological" room within LME.

This difference between ITT and LME corresponds to a diverse dividend policy. LME took out a modest dividend from EB. LME's income was based on licence payments,¹¹⁵ and EB's acquisition of equipment from LME. As mentioned before, Kveim's predecessor, Eilif Bjørnstad, called these "hidden dividends".¹¹⁶ High dividends were not good for public relations, thus, LME often emphasised in its dealing with the Norwegian authorities that it received only small dividends from EB.¹¹⁷ Moreover, by channelling the dividends through royalties or revenues from internal sales, LME did not have to share them with other shareholders.¹¹⁸ This was very different from ITT, which pursued a policy of high dividends from STK, sometimes demanding 50 per cent of STK's net operating profit.¹¹⁹ It is very difficult to compare the level of dividends for companies, however, for all practical purposes; 50 per cent of net income was very high in a Norwegian business context, and added to the picture of ITT as the epitome of a capitalistic enterprise, and STK as its Norwe-

¹¹³ Interview with Jon Erik Stenberg. Stenberg checked these numbers in an unofficial account. Peter Pay did not confirm the exact numbers, but fully supported the impression Stenberg gave.

¹¹⁴ That is after taxes and amortizations, EB's annual report 1977.

¹¹⁵ "Comparing the major firms, STK and EB, we see that EB had much higher license payments than STK." in Bjørn L. Basberg: "R&D performance in Norwegian electronics companies, 1960-1975", 1986, p. 32.

¹¹⁶ RA-EBi: Memo 24/8-1962 JJ/MF (Jens Johansen): "Konsesjonssøknad fra A.B. Aulis, Stockholm, om kjøp av aksjer i A/S Tai Investering, Oslo".

¹¹⁷ LME's CEO Bjørn Lundvall, in a memo concerning LME's activities in Norway 08.04.69, here from Collett 1986 p. 14.

¹¹⁸ After its financial crisis in the 1930, LME pursued a strategy of financing the subsidiaries in the host countries, and thus there was a substantial block of minority owners in LME's subsidiaries.

¹¹⁹ STKA; Board Meetings: Letter from STK to STK's Board of Directors 25.09.72; Board Meeting 19.02.76.

gian cash-cow.¹²⁰ Moreover, it was well known that Thoresen was the best-paid executive in Norway, and that the managerial salaries were far higher in STK than EB.¹²¹ This did not give STK the required legitimacy to be a national champion in telecom.

It is important not to exaggerate the differences between Thoresen and Kveim, or STK and EB. Kveim was dedicated to innovation, but he was very attentive to manufacturing, sales and finance. And even if Thoresen adhered to Geneen's financial conception of the firm, it did not dominate STK totally. Some members of the management had other priorities, such as innovative or industrial conceptions of the firm, and some regarded Norwegian industry or TF/Televerket as STK's main stakeholders.¹²² Moreover, the positions of Thoresen and Kveim were reinforced by their endorsement of conflicting conceptions and corporate governance systems; hence, the cornerstone plan further cemented these positions. When it failed to become a part of the plan, STK chose to fight the whole idea. One of the things STK regretted was the plan's discriminatory aspect, meaning that the government would favour selected companies in different ways. It was very much like the nurturing and fostering of «national champions», which was so much in vogue in the 1970s, particularly in France. Hauge made no secret of the French inspiration behind his plan.¹²³

Colbertism vs. ITT

The French “policy was directed towards the development of an autonomous technological capability in the field of telecommunication” and the creation of a «national champion».¹²⁴ The policy has been labelled "Colbertism high-tech".¹²⁵ The basic idea of Colbertism is “that some knowledge was more valuable than other.

¹²⁰ A radical lexicon - Pax - wrote that most of STK's profit came from sale in Norway, and that a major part of this profit was sent out of the country as dividends to ITT. “In 1977 the dividend was 33%, and not many Norwegian companies can present anything like it.” in <http://lotus.uib.no/norgeslexi/palex/alfabetet/s/s20.html>.

¹²¹ Interview with Ivar Ørbeck; ”Bjarne Aamodt ny STKsjef” in *Aftenposten* 27.08.87, The difference in salary among STK and EB might also reflect that ITT operated with US standards in salaries, while EB and LME adhered to the Scandinavian tradition.

¹²² This variation corresponds to STK's lack of organisational integration that was asserted above.

¹²³ RA-STKii: Minute from meeting between STK, Minister of Industry Bjartmar Gjerde, Jens Chr. Hauge, and Ivar Jachwitz, ”14.1.77 IJ/bj”.

¹²⁴ Llerena et al. 2002, p. 204.

¹²⁵ Élie Cohen's: *Le colbertism "High Tech", Économies des Telecom et du Grand Projet*. Jean-Baptiste Colbert (1619-1683) was King Louis XIV's minister of finance, known for his focus on improving French manufacturing, by subsidising industries and importing technology and craftsmen.

Consequently, it was in the interest of the State to create and protect such knowledge.”¹²⁶ This allowed for selective government policies, selecting technological fields (electronic), industries (computer and telecom) and companies (CGE/Alcatel). Moreover, the policy was based on a rather negative perception of multinationals, that they obstructed national industrial development, and that one could not base a country’s future on imports of technology and products from multinationals. It is illuminating that Servan-Schreiber’s book, *The American Challenge*, starts with a Chinese proverb: “If you give a man a fish, he will have a single meal. If you teach him how to fish, he will eat all his life.”¹²⁷

The conglomerate CGE was central to this eco-politico game. Its telecom activities were organised under the subsidiary, the Compagnie Industrielle de Télécommunication (CIT), and it started to acquire other French telecom companies in the 1960s.¹²⁸ In 1965 it took over the cable and telecom activities of a French conglomerate, Hispano-Alsacienne, which included the original Alcatel.¹²⁹ Thus was created CIT-Alcatel, which cooperated closely with the national R&D institute in telecom, the Centre National d’Etudes des Télécommunications (CNET), “in the design and development of the first fully digital switch, the E10, ready for service in 1970”.¹³⁰ Besides improving the French economy, it was also a matter of Gaullism. President Valéry Giscard D’Estaing warned that “the American domination of telecommunications and computers” was a threat to France’s independence.¹³¹ While procuring SPC switches for urban areas in 1976, the French PTO pressured ITT to sell one of its subsidiaries, Le Matériel Téléphone (LMT), and persuaded Ericsson to sell its French subsidiary to Thomson. This was to get rid of the foreign dominance, but also because the PTO wanted Thomson as a “major force” which would “provide a competitive spur to Alcatel”.¹³²

¹²⁶ Erik S. Reinert et al.: “Exploring the Genesis of Economic Innovations: The Religious Gestalt-Switch and the Duty to Invent as Preconditions for Growth.” 1997.

¹²⁷ Kuan Tzu, here after Servan-Schreiber 1968. Another version of the quote goes like this: “If you give a man a fish, he will be hungry again tomorrow, but if you teach him to fish, he becomes prosperous and teaches others to fish. Giving a man a fish creates dependency, whereas teaching a man to fish brings him the lasting happiness of being a producer.”

¹²⁸ It acquired Télec (Téléphone Industrielle and Commerciale) in 1965.

¹²⁹ Alcatel was an abbreviation for “Société Alsacienne de Constructions Atomiques, de Télécommunications et d’Electronique.”

¹³⁰ Sally 1993, p. 69.

¹³¹ Cats-Baril et al., “The French videotex system Minitel: A successful implementation of a national information technology infrastructure”, 1994.

¹³² Sally 1993, p. 69.

Colbertism and the nationalisations in France were an interventionist industrial policy, based on selection, i.e. on “picking winners” or creating «national champions». This was at the heart of the cornerstone plan. EB had proved a willingness to liberate itself from LME, and Hauge hoped it could develop into a Norwegian telecom company of significance. When STK failed to become a part of the plan, it mobilised arguments against it, saying it did not believe in a strong national telecom company in Norway. The country was too small to foster anything like Ericsson, as there were insufficient resources, and the home market was too small.¹³³ Ørbeck wrote a memo praising the importance of multinationals in general, and ITT in particular. He stressed that Norway was not self-sufficient, either in consumer goods, or in know-how. Norway had to exploit the world’s technological innovations, instead of developing its own technology and capability; the country had to “surfride the technological tides”.¹³⁴ Instead of protecting national companies, he claimed Norway ought to induce international flows of technology and competence, and this entailed the presence of MNCs in Norway.

“Multinational corporations play a significant role”, claimed Ørbeck, “in spreading technology across the national borders.”¹³⁵ And ITT was a prime diffuser of technology, not least because it did not have a traditional head office in a home market. Thus, ITT's trait as a freestanding company was an advantage: “We are not a filial of a larger concern” said Ørbeck, “which has its main business in a large industrial country, and which has as its intention to sell or reproduce this country’s products.”¹³⁶ Hence, there was no national agenda behind ITT. There is little doubt that Ørbeck implied that EB was a filial, LME the large concern, and Sweden the large industrial country. Therefore, Ørbeck regretted the fact that STK was regarded as less Norwegian “than those companies that might have a larger Norwegian share of ownership” than STK.¹³⁷ He claimed STK, as opposed to EB, was one of several “equally autonomous companies” within ITT.¹³⁸ ITT was to be regarded as a confederation of independent companies, which pooled their competence and technol-

¹³³ IØPAi: “STK - norsk deltager i det verdensomfattende multinasjonale selskapet ITT”, 27.09.78; Interview with Fredrik Thoresen, Ivar Ørbeck, Torbjørn Brataas.

¹³⁴ IØPAi: Ørbeck 27.09.78. (drive surfriding på de teknologiske tidevannsbølger).

¹³⁵ IØPAi: Ørbeck 27.09.78. (De moderne multinasjonale selskaper spiller en vesentlig rolle i spredning av teknologi over landegrensene.)

¹³⁶ IØPAi: Ørbeck 27.09.78. (Vi er ikke filial av et større konsern som har sin hovedaktivitet forankret i et enkelt større industriland, og som har til hensikt å selge videre eller reprodusere dette lands produkter.)

¹³⁷ IØPAi: Ørbeck 27.09.78. (enn de bedrifter som kan ha en større norsk eierandel enn det vi opererer med.)

¹³⁸ IØPAi: Ørbeck 27.09.78. (STK et av mange likestilte autonome bedrifter).

ogy, and as a member on an equal footing, STK was a vital importer and adapter of technology for Norway.

A central argument for the cornerstone plan was the fear of losing the results of R&D projects to foreign companies, and Ørbeck had observed that STK had been given fewer development contracts because of this fear. He thought this was a futile way of approaching the issue. The essential point was that when STK got a development contract, it could utilise ITT's R&D results to fulfil its contract. Through this "the Norwegian companies and institutions with which we cooperate shall receive technology".¹³⁹ Moreover, Ørbeck thought the authorities exaggerated this issue; there were limits to what a small company like STK could equip the larger ITT companies with. "The relation between what we can hand over, and what we are given the opportunity to make use of, suggests a clear competence drain to Norway."¹⁴⁰ STK's fruitful relationship with the STL, ITT's British R&D Laboratory, underpinned his argument. Many of FA's engineers started their tenure with a learning period at the STL, and the PCM contract, as well as STK's work on fibre optics in the 1970s, was based on this relationship.¹⁴¹ STL's policy towards STK was in line with British attitudes towards foreign direct investment and multinationals, which was quite different from French policy.¹⁴²

The French ITT laboratory, LCT, was much more reluctant to share with STK.¹⁴³ It did not want to share knowledge and technology with other ITT subsidiaries, which is interesting in light of the nationalisations that took place in the 1970s. Nationalisations of companies are often triggered by transitions of ownership advantages from mother companies to subsidiaries.¹⁴⁴ This was the case with the French nationalisation of the ITT and LME subsidiaries in 1976; France had developed independent competence in telecom, not least with its digital switch, the E10. This puts the policy of LCT, of not sharing technology and knowledge with its sister companies within ITT, in an interesting perspective: it did not want to share its ownership advantages with others. Thus, to make a suggestive point: while STK and STC saw ITT's confederate structure as an opportunity to share and diffuse competence and

¹³⁹ IØPAi: Ørbeck 27.09.78. (de norske bedrifter og institusjoner vi samarbeider med, skal tilføres teknologi).

¹⁴⁰ IØPAi: Ørbeck 27.09.78. (Forholdet mellom det vi selv kan avgi og det vi har anledning til å anvende, tilsier en klar kompetanse-"drain" til Norge.)

¹⁴¹ Interview with Ivar Ørbeck, Torbjørn Brataas, and Knut Berg.

¹⁴² Jones 1996, p. 270-271 and 277 f.

¹⁴³ Interview with Ivar Ørbeck, Torbjørn Brataas, and Knut Berg.

¹⁴⁴ Christensen 2003, p. 91.

technology, the French saw it as a weakness to be exploited for national interests, eventually leading to the formation of Alcatel.

Another interesting point is that such a transfer of ownership advantages did not precede the nationalisation of EB, as the company was to rely on LME's switching technology. This partly explains why so little came out of the nationalisation of EB. Moreover, little or nothing came out of the cornerstone plan. The three chosen companies did sign an intentional agreement to cooperate, but they rarely met.¹⁴⁵ An important reason why the plan never had any significant impact on EB was that it had little effect on Televerket's procurement policy.

Public procurement policy

Televerket had nothing to do with the cornerstone plan, or the nationalisation of EB, and neither did the Ministry of Communication. In fact, Televerket protested when it had to procure the data communication equipment from Ericsson, which opened up the way for the nationalisation of EB.¹⁴⁶ Televerket wanted to procure this from STK and Siemens instead, as they thought Ericsson's equipment was technologically inferior. Thus, political considerations outweighed technological issues, and Televerket was forced to be an industry provider, rather than a proficient service provider. Furthermore, several managers, among them Knudtzon, complained that it was “unclear who had the last say when it comes to the policy regarding the telecom industry in this country”¹⁴⁷ They felt shuffled around by the Ministry's industrial planners, who did not know the first thing about telecom.

When Televerket's procurement policy was accentuated in the report from the Committee of Electronics in 1964, it never really caught the interest of people outside the R&D system; this was different in the mid-1970s. One reason was that it became evident to most people that electronics was a key industry and a general-purpose technology. Another was the economic crisis, which had caused employment problems, not least in the electronics industry. The NOU documented that income and debt-equity ratios in the industry were very poor.¹⁴⁸ The Association of

¹⁴⁵ RA-EBii: ”Prinsippavtale mellom A/S Elektrisk Bureau (EB) A/S Kongsberg Våpenfabrikk (KV) og Tandberg Radiofabrikk A/S (TR)” 30.11.77; and Memo from meeting Ministry of Industry and Kjell Kveim: ”Orientering om hjørnesteins-samarbeidet” 27.04.77.

¹⁴⁶ Paulsen 2004, p. 95 f., and RA-28: Knudtzon to Øvregaard 02.08.76: “Norsk teleindustri-politikk”.

¹⁴⁷ RA-28: Knudtzon to Øvregaard 02.08.76: “Norsk teleindustri-politikk”, (uklarhet om hvem som har det avgjørende ord når det gjelder teleindustri-politikk her i landet).

¹⁴⁸ NOU 1976, here after Sogner 1994, p. 65.

Electronics Industry called for more support, not least for a national procurement policy from Televerket.¹⁴⁹

Televerket was prepared to take industrial and national considerations into account in its procurement policy, but it wanted clear directives from the political authorities, and it did not receive these. In 1974, the Ministry of Communication demanded more price-conscious procurement routines, with international competition whenever possible, and, if not, inspections of the suppliers' books.¹⁵⁰ In 1975, the Auditor General sent a letter to Televerket to enjoin these rules, while later the same year, the Ministry of Communication asked Televerket to take greater account of national considerations.¹⁵¹ While the Ministry of Industry wanted Televerket to act as an industry provider, the Ministry of Finance wanted a price-oriented procurement policy.¹⁵² A reason for these conflicting instructions was that the public bodies had diverging interests and responsibilities; another was that there were different issues at stake. On the one hand, Televerket had to make sure that foreign companies did not dump prices; a normal way was to exclude development costs in the prices, which would make it impossible for Norwegian firms to compete.¹⁵³ On the other hand, it seemed obvious that STK and EB had charged Televerket too much in the long-term agreements.¹⁵⁴ Thus, Televerket was caught in crossfire: accused of being in the hands of the industry, while at the same time it was condemned for not using its procurement to support Norwegian industry.

It was one thing for different issues to be at stake, but such ambiguities were normal in most countries. Competition in public procurement was a means to achieve low and fair pricing, but it was also important to depict the national market as open, so domestic suppliers could export. For instance, if Televerket bought radio link equipment only from Nera, Norway would have a hard time arguing that other countries should open their market to Nera's equipment. One mode of public procurement, which allegedly was normal in Germany, was to arrange open tenders, but to

¹⁴⁹ RA-28: Elektronikkindustriens Bransjeforening to Televerket: Forholdet mellom Televerket og Norsk Teleteknisk Industri, 09.03.76. Minutes from meeting between the Ministry of Industry, Televerket and Elektronikkindustriens Bransjeforening 15. and 24.06.76.

¹⁵⁰ RA-28: Ministry of Communication to Televerket 12.11.74.

¹⁵¹ RA-28: Dok 11/77 to Televerket Board of Directors 21.01.77.

¹⁵² RA-28: Øvregard to Finn Lied, vice-chairman of Televerket's Board of Directors: 06.01.77: "Forholdet mellom norsk industri og Televerket".

¹⁵³ It was recognised that foreign suppliers, mainly Siemens, operated with higher prices in their home markets than abroad, so the development costs were covered in the home market.

¹⁵⁴ RA-28: Elektronikkindustriens Bransjeforening to Televerket: Forholdet mellom Televerket og Norsk Teleteknisk Industri, 09.03.76. Minutes from meeting between the Ministry of Industry, Televerket and Elektronikkindustriens Bransjeforening 15. and 24.06.76.

make the technical specifications so distinct, that only the national supplier, i.e. Siemens, could win the contract.¹⁵⁵ The trick was to depict the national market as open, but to continue protecting and nurturing national industry. One way of achieving this was to let the procuring bodies, like the PTOs, handle the delicate situation. The PTOs could always find reasons for procuring national equipment, and still claim that the market was open. The ambiguous political signals Televerket received should also be seen in this light.

Thus, the Ministry of Industry and Communication gave Televerket room to manoeuvre, to interpret the rules for itself. It could either perform industrial statesmanship by being an industry provider, it could strive to be a proficient service provider, or it could have different roles in different product segments, i.e. support Nera's transmission equipment, but let STK and EB compete fiercely on switches. Televerket had never appreciated such a role, and had always asked for unambiguous political signals regarding procurement. Ever since the radio link issue in the 1950s, it demanded transparent guidelines from the political bodies. Øvregaard complained to the Board of Directors in 1977, that Televerket received “conflicting guidelines” regarding public procurement from the ministries.¹⁵⁶ Several meetings were held with different political bodies, all wanting Televerket to interpret the guidelines itself, and to support Norwegian industry within this framework of these guidelines.

Televerket refused to play such a role, and wanted clear instructions. It was possible to avoid the rules for public procurement, i.e. to prefer a Norwegian firm even in the face of a better foreign offer, but this required a written statement from the political bodies. As Televerket complained, “everybody speaks about procuring from Norwegian suppliers”, but the appropriate authorities were not willing to “put anything down on paper”.¹⁵⁷ Televerket reasoned that if the ministries were not willing to provide a written statement, then it was not willing to run the risk of acquiring expensive and low quality equipment, and maybe incurring the wrath of the Auditor

¹⁵⁵ Interview with Harald Erichsen and Håkon Otterlei. Otterlei was Director of Elektrisk Bureau's activities in maritime satellite communication.

¹⁵⁶ RA-28: Øvregaard to Finn Lied 06.01.76 ”Forholdet mellom norsk industri og Televerket”; Minutes from Meeting of Televerket's Board of Directors 26.08.76.; Dok 11/77 “ Forholdet mellom industrien og Televerket”, document for Meeting of Televerket's Board of Directors 21.01.77.

¹⁵⁷ RA-28: ØF. 26.11.75 To The Director General: “Ad etasjefmøte hos Samferdselsministeren 1. desember 1975 - pkt. 2 i departementets brev av 10 ds., (Saken er at alle snakker om kjøp fra norske leverandører, men de myndigheter som har fullmakt til det, vil ikke sette noe på papiret).

General. The issue was never resolved; Televerket's procurement of Norwegian equipment remained based on ad hoc initiatives.

The whole question of Televerket's procurement policy was obscured by the dubious identity of STK and EB; were they Norwegian or not? The perception of nationality varied according to product lines, when STK sold its Digimat, it was regarded as Norwegian. When it sold the Metaconta, it was foreign, and when it sold the 8B and 11B, it was both. Nevertheless, it was difficult for Televerket to relate to STK and EB in these issues. As the companies had very high margins on their supply to Televerket, particularly EB, it also appealed to Televerket's stakeholder responsibilities when it had employment problems.¹⁵⁸ EB asked Televerket for support to avoid laying off workers in 1973, but at the same it operated with bogus costs on its KV switches. Thus, it was difficult for Televerket to ascertain if it was a straight game when STK and EB played their "employment card". These things are difficult to analyse, but the next chapter clearly shows that Televerket, and particularly TA, was starting to get fed up with STK and EB as switching suppliers.

Conclusion

This chapter has explained why EB was chosen as a cornerstone company in the telecom industry, and not STK. The main precondition was that it was possible to attain a Norwegian majority in EB, while the most important industrial reason was to save Nera. Nevertheless, EB's willingness to pursue an independent national strategy, i.e. freeing itself from LME, was the main reason. EB was willing to develop into a Norwegian telecom company of consequence, while STK never believed in this vision of creating a large Norwegian telecom company. A vital factor was the different conceptions Thoresen and Kveim had of the telecom industry, particularly how they looked upon R&D and strategies for innovation in telecom. For Thoresen, STK's R&D activities were above all a means to preserve its position as an equipment supplier to Televerket. For Kveim it was exactly the opposite: its supply of telecom equipment was above all a means to engage in R&D and innovation.

Still, little came out of the cornerstone plan. "Hauge's plan in the second half of the 1970s", says Olav Wicken, signified the end of a technocratic rationality in the indus-

¹⁵⁸ EB asked for an increased supply of equipment in 1973, fearing unemployment, RA-28: Dok 11/77 to Televerket Board of Directors 21.01.77; STK held several meetings with the Televerket and the government regarding employment problems, for instance RA, Ministry of Industry; Box: St 273; File: Standard Telefon og Kabelfabrik tidsrom 1969-77: Minutes from the meeting between STK and the Ministry of Employment "7.10.75 IJ/BJ".

trial policy.¹⁵⁹ Moreover, it was based on substantial public funding, to save Tandberg, Norcontrol and Nera, and such policies, based on public expenditure, were soon to go out of fashion.¹⁶⁰ Thus ‘Colbertism high-tech’ had a short and insignificant history in Norwegian telecom, unlike in France. A main difference was that the French based their telecom policy on developing a digital switch. In 1978, one year after the cornerstone plan was launched, Nokia formed a joint venture with the state-owned telecom equipment supplier, Televa Oy, to develop a digital switch. Nokia's CEO, Kari Kairamo, said that developing a digital switch was a “question of whether Nokia wanted to be in the telecommunication business in the long run”.¹⁶¹ It is agreed that history proved this assertion to be correct. Thus, in hindsight it seems evident that the cornerstone plan was futile for telecom, without a digital switch underpinning it. Then again, Ørbeck's perception of multinational companies did prevail in Televerket, as demonstrated by the TA's close cooperation with BTM. This pattern will be documented further in the next chapter.

This chapter also suggests why so little came out of the substantial R&D STK conducted; namely that Lazonick's conditions for an innovative enterprise were lacking. The most important, perhaps, was the lack of strategic control that could have pulled the many projects together. This part of the analysis is by no means comprehensive, only suggestive. The analysis of Thoresen's impact on STK's telecom business, however, purports to be conclusive. The next chapters will demonstrate how Thoresen's corporate governance principles and lack of telecom knowledge had wide-reaching implications for the development of the Norwegian telecom industry.

¹⁵⁹ Wicken 1993, p. 246-272.

¹⁶⁰ Sogner 2002, p. 65.

¹⁶¹ Häikiö 2002, p. 58.

Chapter 6 Digitalisation and liberalisation

Introduction

From the mid-1970s, most telecom actors were preoccupied with strategies regarding digital switches, and Televerket, STK and BTM/ITT were no exceptions. Moreover, these strategies were formed by the liberalisation that swept over the western hemisphere. The telecom sector was a key target for Ronald Reagan and Margaret Thatcher's liberal policies in the 1980s. In Norway, the digitalisation and liberalisation of the telecom industry were manifested through Televerket's tender for digital switches in 1982. Foreign suppliers were invited to participate in the tender, and only one company was to win the contract for installing over 500,000 digital lines. The decision to order only one system was dramatic, since either STK or EB had to lose. The open tender, i.e. inviting foreign suppliers, was also controversial as both STK and EB could lose out. Furthermore, it was the largest industrial contract on the Norwegian mainland until that time, and had the potential to create radical changes in the Norwegian telecom industry.

The tender came about as the telecom industry's oligopolic grip on Televerket had lost its strength. This chapter shows how former path dependencies and stakeholding had lost their weight. Nevertheless, an interesting question is why Televerket was a frontrunner in digitising its network, and liberalising its procurement policy. In many other countries, the government used its procurement power to restructure its national telecom industry. Televerket considered this before arranging the tender, and invited STK and EB to take part in such discussions. The chapter looks into why such a policy did not materialise in Norway. Another reason why the oligopolic grip loosened earlier in Norway than in other countries was the competence and standing Televerket had attained. This was not least due to its relationship with BTM on the further development of the Metaconta 10C, which earned it a rank as a lead market for ITT's System 12. Hence, Televerket had made the transition from being BTM's guinea pig in the 1950s to being ITT's lead market in the 1980s.

Nevertheless, taking the negative impact of the 8B switch into account, it is surprising that Televerket chose to be the first installer of ITT's System 12. Moreover, EB was regarded as the more likely candidate to win the tender, with its large market share for switches, and its status as a cornerstone company. A decisive factor was that different corporate governance principles underpinned the actions of Thoresen and STK on the one side, and Kveim and EB on the other. In line with Geneenism, Thoresen was loyal to the strategy of his main shareholder, ITT, whereas Kveim

stuck to the stakeholder variant of the corporate governance system, which he thought had been sanctioned by EB's role as a cornerstone company.

Before we embark on the analysis, we need to make some introductory comments regarding digital switches, and why they were superior to the old electro-mechanical and analogue switches.¹ Firstly, digital switches increased the capacity tremendously, and were thus able to eliminate the telephone queues. The network would be much more economical, because digital switches cost much less per line, and because a digital - seamless - network was more efficient to operate than the old "weed-flora". Finally, they would allow for and facilitate a whole range of new services. Some related to telephony, but equally important was the fact that they would enable non-voice transmission, leading eventually to the Integrated Service Digital Network (ISDN). Being more like a computer than an old-fashioned telephone switch, the digital switch was one of the most important outcomes of the convergence between communication and information technologies. In service, digital switches became one of the major facilitators of the same convergence.

As mentioned before, digital switches differ from SPC switches in that the contact system is computerised. Thus, in this generation, there is no electromechanical component; there is only hardware and software as in any other computer. This implies that these switches are even less labour-intensive, and more R&D- and knowledge-intensive. Another key element is that the transmitted signals are digital. First, this increases the capacity substantially, by use of time-division switching; one medium can provide several channels simultaneously, by sending digital signals in different time-slots. Digital switching also means that non-voice transmission is accommodated in a better way. There were different generations of digital switches: some, like ITT's System 12, were totally computerised, exploiting the most modern achievements in microelectronics. Others were semi-digital, like the first versions of LME's AXE, which had digital contact only on the group-selector, thus it was a physical link that connected the local subscriber. Hence, in the latter half of the 1970s, the distinctions between SPC switches and digital switches were not crystal clear. Nevertheless, the computer-based equipment made Televerket reconsider its procurement policy.

A dual regime

Chapter 4 demonstrated how the PTOs in general and Televerket in particular attained more control and knowledge over their own networks. This process of com-

¹ This based mainly on Chapuis 1990, p. 369f.

petence building continued in the 1970s. An important forum for expanding and diffusing this knowledge within Televerket was the “Long-term Planning Committee” (LPC). This was set up after the reorganisation(s) around 1970 “to strengthen planning and develop a long-term perspective”.² One should not exaggerate the LPC's influence on Televerket's decision making, but it was important as it initiated several projects, which laid the foundation for future actions and policies. The TF and TA had important roles and were engaged in several projects concerning how the future network would be. The TA produced a large report in 1974, on how the network would be in 1982; this contained a thorough mapping of all the switches and features in the network.³ The LPC praised the document, which suggested that Televerket had finally attained control over its own network, and stressed its pedagogical value. The document was accordingly distributed throughout the entire institution.⁴

The only critic of the report came from Oslo District's Bestorp, who “feared that the 8B was given a too favourable account in the report - the historical verdict must not be that the 8B was a good system.”⁵ Bestorp was also anxious that Televerket had installed too many different kinds of electronic switches, which made it difficult to train personnel.⁶ This was an argument for standardising the switches in the network, which would have consequences for the procurement policy. Another factor was the presumed economy of scale with electronic and digital switches: The “Norwegian market is too small to be shared by two suppliers”, said one aide, “there will therefore be large savings by opting for one supplier.”⁷ This was a controversial issue: “To state it extremely”, said another “one could ask: Which of the suppliers should be ousted.”⁸

In 1976, Televerket's Technical Director, Per Mortensen, said it would be difficult to get in a position with only one supplier, because “it would be unfortunate if STK

² LPC-A: Box 38, File: 012.513, 3. “Foredrag av O. Skaalen, leder av LP-sekretariatet, på Telesjefmøte, Sør og Øst distrikt 1974.” (styrke planleggingen og utvikle langtidsperspektivet.)

³ LPC-M 2-3.9.74: “Beskrivelsene av sentralene i det automatiske telefonnettet i Norge frem til omkring 1982” and “Beskrivelse av det automatiske telefonnettet i Norge omkring 1982”.

⁴ LPC-M 2-3.9.74.

⁵ LPC-M 2-3.9.74. (Han var redd 8B-systemet var gitt for god omtale i rapporten - historiens dom må ikke bli at 8B var et godt system.)

⁶ LPC-M 2-3.9.74.

⁷ LPC-M 2-3.9.74. A problem with one supplier, however, was that Televerket would have to establish a rigorous control system to avoid moral hazard from the chosen supplier. (Det norske marked er for lite til å deles på leverandører. (...) Det vil derfor være store besparelser å hente ved å satse på én leverandør.)

⁸ LPC-M 2-3.9.74. (Satt på spissen kan en stille spørsmålet: Hvem av leverandørene skal ut?)

were to close down its telecom department”, and with the industrial democracy that was introduced, it would be difficult to lay off 500 employees.⁹ Hence, Mortensen, and many others, took it for granted that EB would be the selected supplier. A much-debated alternative was to merge STK and EB, or at least make them cooperate closely. One line of thought, in accordance with the cornerstone plan, was to create a strong Norwegian telecom company. It could for instance have license-agreements with LME and/or ITT, like the former French subsidiaries of ITT and LME did.¹⁰ This gave rise to the question of a Norwegian development of digital switches. Nic. Knudtzon had stressed, since the establishment of TF in 1967, that Norway was too small to develop a digital switch; he repeated this at an LPC meeting in 1975.¹¹

Televerket's old switching expert, Nils Jonsson, also ruled this out: “It must be clear that the Norwegian market in itself is too small to form an economic foundation for the development and rational production of a complete automat system of a modern kind”.¹² But, then, how could Nokia develop a digital switch in Finland, which was no bigger than Norway? A key condition for Nokia, was that unlike other potential new entrants into the telecom industry, it had a large and fairly secure market in the Soviet Union.¹³ Moreover, not being owned by foreigners, it had complete strategic control. In 1980, it succeeded in halting Ericsson's strategic move into its sphere of influence. First, Ericsson tried to obtain an export license to the Soviet Union through its Finnish subsidiary, but Nokia was instrumental in stopping this. Second, it stopped Ericsson from acquiring its state owned partner, Televa Oy; Nokia itself acquired a majority stake in Televa in 1981, “and bought the state out altogether in 1987”.¹⁴

STK and EB were not in a position to take such steps. However, Norway's small size did not have to mean modest ambitions, as shown by the quest for automatic and nuclear-driven ships, Nera-FFI's radio-link endeavour, Norsk Data's attempt to be a global manufacturer of mainframe computers, and Tandberg's ambitions to

⁹ LPC-M 23-24.3.76. (det ville være uheldig om STK skulle velge å nedlegge sin telefondivisjon.)

¹⁰ LPC-M 23.-24.3.76: TA 20/2-76 Nj: Anskaffelse av automatstyr - alternative strategier“.

¹¹ Knudtzon in LPC-M 11-13.3.75.

¹² LPC-M: 23.-24.3.76: TA 20/2-76 Nj: “Anskaffelse av automatstyr - alternative strategier“.

The lifespan of modern switches was expected to be very short, thus to be able write off the high costs, modern switches required large sales volumes. (Det må være klart at det norske markedet alene er for lite til å gi økonomisk grunnlag for utvikling og rasjonell produksjon av et komplett automatsystem av moderne type.)

¹³ Palmberg 2002, Häikiö 2002, p. 68.

¹⁴ Häikiö 2002, p. 59.

produce television sets for the world market; most notable of all was the establishment of the state-owned oil company, Statoil, in 1972, which was to embark on huge technological and commercial endeavours. Yet, the reservations are not surprising taking into account how difficult it was to export telecom equipment. It is worth mentioning, however, that Televerket rejected the possibility time and time again in the 1970s, when there was a technological window of opportunity.¹⁵ Another main reason was that it would require a close cooperation with STK and EB; Televerket did not think the subsidiaries, voluntarily and wholeheartedly, would engage in such a partnership with Televerket.¹⁶

Jonsson's main argument against Norwegian digital switches was that: "Televerket has few good experiences with maintenance and upgrading of special Norwegian types".¹⁷ Thus, once again the formative character of STK's 8B and 11B is illustrated. Accordingly, Jonsson stressed that a supplier must be part of an international concern, and that the equipment used is a standard commodity, used in markets other than Norway. At the same time, he refused to invite other suppliers than STK and EB in a tender, since Televerket's main problem was too many different systems in the network. Consequently, Jonsson could not conceive of a procurement regime without EB and/or STK. Still, changes were needed; his main message was that history had taught Televerket that it was "expensive to entrust the suppliers to hold the competence".¹⁸ One thing was that STK, for instance, was not able to solve the problems with the 8B switch, another was that Televerket was vulnerable in contractual issues. It constantly suffered price increases, delays, and poor quality and uncompleted systems.

The use of fines for delays had helped, and had compensated for the losses, but it was emphasised that Televerket needed to be much tougher in contractual relations.¹⁹ Televerket's problem was that it lacked competence to decide whether the surcharges on equipment were a result of inflation or the suppliers' tampering with

¹⁵ Several others besides Knudtzon rejected the idea of Norwegian development and manufacturing of digital switches at the LPC-M of 11-13.3.75. One aide said it was "off target"; see also LPC-M: 23.-24.3.76: TA 20/2-76 Nj: "Anskaffelse av automatutstyr - alternative strategier"; and Dok LP: 13/80 for LPC-M 9.-11.9-80.

¹⁶ LPC-M: 23.-24.3.76: TA 20/2-76 Nj: "Anskaffelse av automatutstyr - alternative strategier".

¹⁷ LPC-M: 23.-24.3.76: TA 20/2-76 Nj: "Anskaffelse av automatutstyr - alternative strategier". (Televerket har da også mindre gode erfaringer med hensyn til systemvedlikehold og oppdatering av særnorske utgaver.)

¹⁸ LPC-M: 23.-24.3.76: TA 20/2-76 Nj: "Anskaffelse av automatutstyr - alternative strategier". (dyrt å overlate til leverandørene å sitte med kompetansen)

¹⁹ LPC-M 7.-8.9.76.: Dok LP. 8/76: TA: "Televerkets situasjon og hovedproblemer i dag. Teknisk sektor".

price calculations.²⁰ Moreover, it needed increased knowledge to assess the causes for the delays, the poor quality and/or shortcomings, as the equipment suppliers often claimed it was Televerket's own fault.²¹ It was not enough to be at the suppliers' competence level, said Jonsson, Televerket had to be beyond this. Jonsson, and most of the LPC -delegates, had experience with the supply of electro-mechanical switches from STK and EB. In this regime, Televerket suffered from being in the supplier's hands. The skills required for installing and repairing electro-mechanical switches, were craft skills involving tacit knowledge, which was difficult to codify and standardise. If a problem surfaced in the network, STK and EB would often fix it with some "home-made" solution.²² Televerket's dependence on the suppliers in this regime was very expensive.

Thus, Jonsson's anxiety was understandable for the 8B and KV, but the 1970s were a transitional phase in the relationship between Televerket and STK, as there was a dual regime. STK had the upper hand with the 8B, while Televerket had the same with the new SPC switches. Thus, what Jonsson had called for - tougher contracts and more competence from Televerket - was already on its way, with the installation of the Metaconta switches in Oslo. Based on its contact with BTM, international bodies, and in-house studies, Televerket's expertise in computerised switching went beyond that of STK. Alf Ivar Nilsen and Kjell Christensen led the installations on behalf of Televerket. They had spent considerable time at BTM, studying the Metaconta 10C, and reached an agreement with BTM to install it in Oslo in 1977. Nils Kåre Myklebust was responsible for the installation on behalf of STK; he says BTM pushed a half-finished product on Televerket. Another way of looking at it, and the one that BTM emphasises, was that Televerket and Norway was chosen as a lead market. The BTM aides participating in the installation characterise Televerket as one of the most professional and demanding PTOs in Europe in the late 1970s.²³ Jonsson and BTM's conflicting depictions of Televerket are both true, given the dual regime.

Christensen and Nilsen worked closely with Alf Marhaug and Nils Maurtvedt from Oslo District in installing the first 10C in Oslo, a Medium Local switch at "Nord 3".

²⁰ LPC-M 7.-8.9.76.: Dok LP. 8/76: TA: "Televerkets situasjon og hovedproblemer i dag. Teknisk sektor".

²¹ NTM8, File: "N4 og C7 10CLL tilbud kontrakt m.m.": TAP/72/Nj, comments to Personal letter from Thoresen to Øvregaard 07.09.73.

²² Interview with Gunnar Tidemann, Knut Berg, and Jon Stenberg.

²³ Interview with Hugo Wuyts, Ludo Pignet, Toon Govers, and Rudy Scholliers. All four had leading positions in BTM's switching business, and worked with Metaconta and System 12 in Norway.

This was ordered in 1971, and should have been completed by 1974, but was delayed until 1976. After this, the four worked on installing the 10C Large Local at “Nord 4” and “Centrum 7”, and they set up very demanding specifications and tough contracts for STK and BTM. One important aspect was the centralised control system at Nord 3, so all Metaconta switches in Oslo could be controlled from one centre; this became an important feature in the later System 12 network. Moreover, Televerket wanted all the features of the SPC switches up and running, like automatic re-direction, wake-up calls, and speed dialling.²⁴ Along with meeting the many specifications in the network, this required intense programming and increased memory on the Metaconta computer. STK's Myklebust thought Televerket's priorities were awkward, as why would someone expend resources on speed-dialling and wake-up calls when Televerket had problems providing the dialling tone.²⁵

Bjørn Gladsø sanctioned these priorities; it was as much about learning and studying SPC switches, as it was about providing new services. Instead of focusing on the problems with the 8B, the TA wanted to become experts on the future generations of switches; preparing themselves for the digital revolution and meeting Jonsson's quest to not be in the hands of the suppliers. BTM, on its side, was happy with Televerket's demands, reasoning that Oslo was a perfect place to test the Metaconta in practice. In this sense, and according to BTM, Televerket was a pioneer with the Metaconta 10C, as it had been with the 8B. The Large Local switch installed at “Centrum 7”, had the equivalent of 60,000 lines, and was the largest switch BTM had ever delivered.²⁶ After this, in 1980-81, BTM/STK installed Metaconta switches in Bergen, Ålesund and Drammen. Televerket and BTM developed the switch further during the actual installation, by trying out new solutions and modes of solving problems. Hence, this is a good example of learning by doing, and innovation through trial and error.

STK was allowed to raise the price per line somewhat compared to its initial offer on the 10C in 1971.²⁷ Still, it lost money on the projects, as it was not able to meet the deadlines and specifications, and had to pay a considerable amount of money in fines.²⁸ Thoresen saw this as just another sign of the telecom department's inability;

²⁴ Interview with Nils Kåre Myklebust.

²⁵ Interview with Nils Kåre Myklebust.

²⁶ Interview with Kjell Christensen, and Carl-Edward Joys.

²⁷ NTM8, File: “N4 og C7 10CLL tilbud kontrakt m.m.”: Memo from Nils Maurtvedt MAU 06.02.75”.

²⁸ NTM8, File: “N4 og C7 10CLL tilbud kontrakt m.m.”; and Interview with Nils Kåre Myklebust and Carl-Edward Joys.

Myklebust, on the other hand, says Televerket squeezed STK with these contracts. He claimed it wanted to pay low prices, as for commodity products, but it did not want to pay for the customisation of the product.²⁹ As a result, STK paid for the customisation. BTM was more than happy, having a professional partner to cooperate with on its switch. The large cable revenues covered STK's financial losses on the Metaconta installations.³⁰ There was a human price to be paid for the squeezing as well, as Myklebust left STK in distress in 1980, returning home to Bergen. Christensen and Nilsen also left Oslo, as the work with the Metaconta had taken too much time, and their wives demanded to see more of them. So they moved back to their university town, to have more relaxing jobs with Televerket in Trondheim District. The work in the LPC, however, continued with little reference to the Metaconta projects in Oslo.

*

The largest project in the Long-term Planning Committee was: "Which automatic (switching) technique should Televerket aim for in the future?"³¹ In 1978, it concluded that Televerket should install digital switches, and that this should commence in 1984-85.³² Teledirektoratet endorsed the decision, and decided that 1982 would be the first year of ordering digital switches for use in the network.³³ In order to prepare this, to learn about the equipment suppliers' systems, test prices and see how Televerket's employees coped with the new technology, Teledirektoratet decided to set up a trial network in Porsgrunn, in 1979. STK and EB were asked to submit tenders for a digital switch. In addition, the TA and TF were asked to come up with a series of clarifications and reports on the issue.³⁴ The reports dealt with many aspects: where and when to install switches; traffic planning, routing and traffic direction; questions related to digital services; consequences for Televerket's personnel; and not least, related to procurement, or the "supplier-situation".

In November 1978 Jonsson wrote a document for Televerket's Board of Directors, discussing different factors regarding Televerket's procurement of digital switches from STK or EB. One factor was that Televerket would be dependent on the old

²⁹ Interview with Nils Kåre Myklebust.

³⁰ Interview with Nils Kåre Myklebust.

³¹ LPC-M 3-4.9.73. (Hvilken automatteknikk skal Televerket ta sikte på i fremtiden?)

³² LPC-M 15-16.3.77. An important item of advice from the group was that Televerket had to be assured that it was not left alone with a switching system, but should order a system only after it was in use by other PTOs.

³³ TBD 06.11.78.

³⁴ Minute from LPC-M 15-16.3.77.

switches from STK and EB for a long time after ordering digital switches.³⁵ Televerket was more reliant on STK, since it was the only company with system competence on the 8B and 11B, whereas EB's KV could be supplied and maintained by LME. Another problem with one supplier was to secure fair pricing. The main issue, however, was related to industrial politics. Jonsson assumed that it was unreasonable that EB, after being chosen as a Cornerstone Company, could be excluded from supplying digital switches, which was a key technology in its sector. Thus, there were two solutions, EB as the sole supplier, or EB and STK - which would give two systems. Jonsson was crystal-clear, however, that we "must avoid two systems".³⁶ The reason was not the traditional one of problems with interfaces, i.e. interaction between ITT and LME's equipment. It was due to economics, as there were sinking marginal costs with digital switches, and the problems related to keeping Televerket's personnel up to date on two systems.

Based on this, there was no room for a competitive tender; EB would have to be given the order. One could secure reasonable prices through inspections, which after all had proved more effective in reducing prices than the attempts to have tenders between STK and EB. The TA was sure that the AXE would meet Televerket's requirements, and an order from LME could contain a demand that EB was given a role in the future development and manufacturing of the AXE. Maybe the TA was inspired by the Australians' procurement of the AXE in 1977. LME's Australian subsidiary had contributed significantly to the development of the AXE.³⁷ It was backed by the "government in Canberra" that "insisted on a strong local technical capability as a condition for access to market".³⁸ We do not know whether Jonsson reasoned along these lines, or if it was just lip service to the Board of Directors. The TF, allegedly, wanted to use Televerket's procurement to secure Norwegian system development. This issue is hard to decide, however, since there is a blurred line between Norwegian development and Norwegian manufacturing. We do not know the TA's stance in this issue at all times, but after a while, it developed a clear position against demanding Norwegian system development, settling for Norwegian manufacturing.³⁹

³⁵ NTM5: TA/78/Nj.: "Innføring av digitale sentraler. Leverandørsituasjonen", Memo from TA to TBD 15.11.78.

³⁶ NTM5: TA/78/Nj.: "Innføring av digitale sentraler. Leverandørsituasjonen", 15.11.78, (Vi må unngå to digitalsystemer.)

³⁷ Fridlund, 2000, p. 148.

³⁸ C. A. Bartlett and S. Ghoshal: "Tap your subsidiaries for global reach" in *Harvard Business Review*, 1986 64(6), 87-94.

³⁹ Interview with Thor A. Halvorsen, who held leading positions in Televerket's Technical Department, most notably Station (switching) office. 1973-, Member of the INDIG-group.

Jonsson asked the board to contact the Ministry of Communication to clarify the industrial issues, and he recommended starting negotiations with EB. In this relation, it is important to note that the TA contained of several people who reflected the dual regimes that existed in the 1970s. Jonsson was brought up in the old electro-mechanical regime, in which STK had proved its incompetence, and he thus saw EB as a natural choice for digital switches. On the other hand, Gladsø and Skinnes had experienced a fruitful relationship with BTM. Little came out of Jonsson's document; instead, Televerket prepared itself for setting up a trial digital network in Porsgrunn, where STK and EB were to hand in offers for a digital switch. EB was to offer LME's AXE, whereas STK would offer ITT's System 12. Before we follow the digitalisation process in Televerket further, we need to look into how the System 12 came into being, which entails a closer look at ITT's situation in the 1970s.

The System 12, ITT's last rope

From the mid-1970s, ITT entered a crisis, in the sense that its previous business strategies, the supply of telecom equipment to foreign markets and conglomerations, ceased to furnish adequate returns. One explanation for this development is that the ownership advantages that had underpinned ITT's business strategies had either evaporated or no longer proved profitable. The poor macro-economic development, as well as the fact that «Geneenism» had become almost standard managerial procedure in many firms, undermined ITT's conglomerate structure. As a result of ITT's weak financial development, the stock's poor performance, and Geneen's age, ITT had a change of leadership. After leading the company for 21 years, Geneen stepped down as CEO in 1977, and after a short interregnum, Rand V. Araskog became CEO and President in 1980.⁴⁰ He started the process of divesting companies, and positioning the telecom business for a new era, and for the whole time had to fight off corporate raiders.

We will return to ITT's general problems, i.e. its conglomerate structure and corporate raids, in the next chapter, for now we will concentrate on its telecom business. ITT's initial ownership advantages, as stated in Chapter 1, were based on the American superiority in telecom in general, and Western Electric's technological capability in particular. An additional ownership advantage was Sosthenes Behn's personal qualifications, which allowed him to get access to foreign markets, most notably the French market with Western Electric's Rotary switch in the 1920s. Behn and ITT's

⁴⁰ Lyman Hamilton became CEO after Geneen, but had to step down after being outmanoeuvred by Geneen in a power struggle, which gave way for Araskog.

ability to perform a policy of national responsiveness, i.e. allowing its subsidiaries to operate with substantial national identity, had proved lucrative for the freestanding company. These ownership advantages, however, were diluted by digitalisation and liberalisation.

ITT had already struggled with increased R&D costs for the SPC switches, and this problem was much bigger with digital switches, where the R&D costs rocketed compared to the earlier switching generations. Most of the companies that developed digital switches, AT&T, LME, CIT-Alcatel Siemens and Nokia, did this in cooperation with their domestic governments, within the framework of national systems of innovation, with a secure home market, and last but not least, with substantial governmental funding of R&D. ITT did not benefit from any of these vital factors, and it lacked a domestic PTO to cooperate with. The other competitors engaged in close cooperation with their domestic PTOs while developing digital switches, thus benefiting from the user-producer, or buyer-supplier, interaction. In the literature on national systems of innovations, this has been accentuated as a major source of innovation.⁴¹ The biggest concern were the high costs related to developing, designing and eventually manufacturing these switches. For ITT, which was burdened by a high debt, increasing interest rates and relatively poor cash flow from the mid-1970s, it was far from attractive to pour millions of dollars into uncertain switching projects.⁴² The financial aspect rendered it compulsory to facilitate cooperation between the European subsidiaries, in order to share the R&D costs.

The development of international standards in transmission, signalling and on technological interfaces facilitated international communication, but it also laid the foundation for increased competition between suppliers of telecom equipment. Hence, the process of digitalisation and liberalisation were closely intertwined. This standardisation loosened the oligopolic grip that the telecom industry had held on the national equipment markets, namely the difficulties of technological interfaces. The local differentiation had been one of the main sources of riches for ITT, and for LME for that matter. This dried up when telecom equipment went from being a local to a global product. Hence, lacking a mother company in telecom, ITT had to depend on cooperation between the European subsidiaries to manufacture global

⁴¹ Edquist et al. (ed.) 2000 - *Public Technology Procurement and Innovation* - analyses such relationships and projects, and the development of LME's AXE, Nokia's DX 200 and the French E10 is analysed in this perspective.

⁴² ITT had a "debt equity ratio of 40:60 and interest payments of \$686m in 1980, which was 68% of ITT's net income". "The Financial Times has been looking at the change in management styles at ITT since Mr Rand Araskog succeeded Mr Harold Geneen. . . ." *Financial Times* 05.01.82, Araskog 1989, p. 6.

products. Even if it succeeded in this, ITT would suffer from lack of a coordinating head office, and the lack of public funding of R&D from a supportive home nation.

Another vital consequence of the digital switches was that the need for manual labour was reduced substantially compared to the electro-mechanical switches. Thus, the telecom industry had more difficulty using employment as a bargaining card in the negotiated environment. Liberalisation, i.e. the increased use of tenders for the procurement of telecom equipment, implied lower margins and reduced market shares for ITT. The transition to digital technology in switching was a paradigmatic shift, and was, thus, a window of opportunity for new companies, mainly the «national champions», encouraged by their governments, to enter the telecom industry. The most notable example was CIT-Alcatel with its E10 switch in the early 1970s, Nokia with its DX 200 digital switch, and the Canadian offspring of the Bell System, Northern Telecom (later Nortel) with its DMS 100, both in the late 1970s. Thus, on the one hand, technological change encouraged some PTOs to act as keen *industry* providers, taking pains to foster a national telecom industry, at the expense of ITT. On the other hand, liberalisation also paved the way for those PTOs that took pride in being better *service* providers, by being very demanding customers. Although the liberalisation process seriously threatened ITT's telecom business, it also held possibilities, in as much as the hegemony of AT&T and Western Electric in the US was challenged.

When ITT bought International Western Electric Company from AT&T in 1925, there was a tacit understanding that ITT would stay out of the US market, and AT&T out of the overseas market. Geneen did try to enter the US equipment market several times. He attempted to buy small operating companies to get a foothold in the equipment business, but was allegedly blocked by the other suppliers, including AT&T.⁴³ A former ITT aide even claims that this caused Geneen's conglomeration strategy.⁴⁴ In 1974, however, the dominant position of AT&T and Western Electric in the US was challenged by the Anti-trust division of the US Justice Department, which opened up an investigation of AT&T, and in particular its relationship with Western Electric. The case was not settled for some years, but it seemed evident that ITT finally would get a chance to enter the US market for telecom equipment. To do this, it had to adapt its telecom equipment to the US network, which operated with different standards than the European countries. Thus, Northern Telecom from Can-

⁴³ Schoenberg 1985, p. 136.

⁴⁴ "I don't think that the concept of a conglomerate was present when Harold first took over the company," says John Jobb. "I think it evolved after it became obvious that it wasn't practical to build a system that could fight AT and T. ITT's domestic telecommunications never got off the ground, and it hasn't to this day." Schoenberg, 1985, p. 137.

ada was better positioned than ITT to get a piece of the market. Most importantly, however, ITT needed a digital switch.

ITT lagged behind its competitors in developing a digital system, and the situation was perceived as critical in the latter half of the 1970s. ITT's old and new competitors were well on the way with digital projects: LME with the AXE, Siemens with its EWSD, Philips with the PRX, the British with their System X, the already mentioned new entrants, CIT-Alcatel and Nokia, and the North Americans, Northern Telecom with the DMS 100 and AT&T with the 5ESS. BTM was busy continuing the development and marketing of the Metaconta switch, and thought the SPC switches would hold sway for a while. Thus, Doz is right in saying that ITT was "caught off guard by the success of digital switching".⁴⁵ A major warning for ITT was when LME's AXE beat the Metaconta for an Australian tender in 1977, the reason being that the Australian PTO wanted digital local switches.⁴⁶ ITT had several switching projects in the 1970s, all of which were based on the company's long-established competence in PCM and Time-Division switching.⁴⁷ It resulted in the development of three different PCM switches throughout the 1970s; one was based on the Metaconta architecture, but neither materialised as a public exchange.⁴⁸ Hence, despite their notable competence, ITT's European subsidiaries were not able to come up with a concept for a digital switch. Instead it came from the United States, from Bell Labs.

The genesis of the System 12 switch is difficult to uncover, as there is no written record of its history before the 1980s. Chapuis and Joel resort to telling a fairytale:

⁴⁵ Doz 1987, p. 103-104.

⁴⁶ Interview with Toon Govers, Fridlund 2000, p. 162.

⁴⁷ ITT was also a pioneer within time-division switching, as Maurice Deloraine gave birth to this idea during World War II. Several ITT subsidiaries, mainly the French LMT, patented on time-division multiplexing (TDM) before PCM was established, thus multiplexing analogue signals. It was the PAM-pulses (Pulse Amplitude Modulation) that were multiplexed. PAM-pulses are the result of sampling of the human voice to higher frequencies, but are still analogue signals, i.e. electrical pulses. Thus, ITT-Europe was in pole position with both PCM and TDM in the early 1970s, at the dawn of digitalisation. Chapuis and Joel 1990, p. 307.

⁴⁸ Chapuis and Joel 1990, p. 315.

“Once upon a time there was a little prince (System 12), the youngest child of high-born, rich and powerful family. His grandparents and parents had won great renown and their names - Rotary, Pentaconta and Metaconta - had spread to the four corners of the earth. (...) (H)is family had a taste for travel; so, no sooner had his mother given birth to him but he was trundled back and forth across the deep Atlantic”.*⁴⁹

The initial concept was developed at Bell Labs in Illinois in 1976.⁵⁰ The management at Bell Labs did not seem to take any interest in the path-breaking idea, which was to create a fully distributed digital switch, meaning that it was not to depend on one centralised computer. Due to this lack of interest, several engineers left for ITT, and formed the nucleus of a switching team at ITT's newly formed laboratory in Shelton, Connecticut, named the ITT Advanced Technology Centre. As the other projects in ITT's European subsidiaries failed to materialise, the New York headquarters decided to back the Shelton project, which it called the *Network 2000*.⁵¹ A central vision was that future networks would have to “integrate voice and non-voice services”.⁵²

The initial ambitions of the defectors from Bell Labs and ITT's headquarters were to penetrate the US market with the switch. The anti-trust process that started in 1974, against AT&T and its relationship with Western Electric, did not come to an end before 1983, but ITT took it for granted that the US market for telecom equipment would be liberalised. An application for a US patent was filed in March 1978, and was granted in 1980.⁵³ The System 12 became “my baby”, Araskog recalls. Having seen how LME attained market shares with the AXE, he stressed they “had to leap-frog their technology: Developing a better digital switchboard became a \$1 billion priority”.⁵⁴

* Chapuis and Joel do not mention the grand uncle - the 8B - who resided in the “fifth” corner of the world.

⁴⁹ Chapuis and Joel 1990, p. 415.

⁵⁰ Chapuis and Joel 1990, p. 415 Jeffrey N. Denenberg's was one of the patents holders for the System 12, and he left Bell Labs in Naperville, Illinois in 1976, to start in ITT. Denenberg's CV: <http://doctord.dyndns.org:8000/Resume.html>.

⁵¹ ITT's CEO, Lyman Hamilton, in a true ITT fashion, acquired two US companies, Qume and Courier in 1978, “because these companies provided needed products and expertise to augment ITT's System 12”, Sobel 1982, p. 367.

⁵² ITT: *Electrical Communication*, Vol. 56 No 2/3 1981 (The Technical Journal of ITT), p. 112.

⁵³ The System 12 patent was granted 06.05.80: <http://www.uspto.gov/>, United States Patent: 4,201,889, (also: <http://www.ffldusoe.edu/Faculty/Denenberg/Patents/4201889details.htm>).

⁵⁴ Araskog 1989, p. 175.

Representatives from the European subsidiaries came to Shelton, either to assist the research team, or to become familiarised with the project, so they could carry out preparatory marketing in Europe. Knut Berg from STK was in Shelton in 1979 to learn about the project.⁵⁵ Market access in the US was the motivating force for the project until 1980. Then Araskog decided to move the further development to ITT-Europe. The ambition to fight Western Electric in the US was still alive, but ITT reasoned that it was wiser to develop a European version first.⁵⁶ ITT-Europe set up the International Telecom Center (ITC) in Brussels, to coordinate the European efforts. The other subsidiaries had different responsibilities, and the German, Italian and Spanish units had decisive influence in the early years. Still, BTM was, even though it was not formalised, the strategic leader of ITT-Europe's System 12 project.⁵⁷

The System 12 was not based on any of ITT's former switches, originating in Bell Labs; it was no descendant of the Rotary, Pentaconta or Metaconta.⁵⁸ The switch was generated from outside ITT, and outside Europe, so there were no evolutionary aspects - neither the technology, nor the concepts, architecture nor the knowledge base had any roots in ITT. In leading the other European ITT units, BTM had nothing to build on, or to put it another way: any equipment supplier would be as qualified to do the job. The real «fairy tale» with the System 12, is how it came out of the blue to save ITT's telecom business. This thesis shows that the history of the telecom industry, perhaps more than any other history, is formed by path dependencies or technological trajectories, and the technical history is full of evolutionary aspects. In this evolutionary setting, at the dawn of digitalisation and liberalisation, when the new national R&D policies from the 1960s started to bear fruit, ITT seemed doomed in lacking a home market and a national system of innovation to operate in. In this setting, ITT was given a last rope to survive in the telecom business, when the System 12 appeared as a rare example of a science push from Bell Labs. But ITT was far from saved, as the System 12 was a long way from having proven itself in any network.

ITT-Europe and BTM had a huge job before them, in further developing and preparing the System 12 for the market. ITT acknowledged that the System 12 did not benefit from the “evolutionary approach (that) requires less development invest-

⁵⁵ Interview with Knut Berg.

⁵⁶ The reason was the lack of experienced and qualified telecom engineers, and the need for trial and testing capability that were developed in the European subsidiaries. Moreover, ITT wanted the project to be located nearer to familiar markets.

⁵⁷ Interview with Toon Govers.

⁵⁸ ITT 1981, p. 114-115.

ment” as ITT's former switches had done.⁵⁹ Moreover, it was regarded “as an excessively futuristic system”.⁶⁰ Everybody agreed that the theoretical concepts were exceptional, and that in theory it encapsulated five «Fs»: (1) a fully digital system, (2) a fully distributed system, (3) a fully safe system, (4) a future safe system, and (5) a full range system.⁶¹ Moreover, the System 12 was the first public telephone switch to accommodate non-voice transmission, and thus the Integrated Digital Service Network (ISDN).⁶² A common saying, however, was: “if it works it’s brilliant, but it will never work”⁶³

In addition to being futuristic in its use of the latest technology, it had a software-based architecture, which made it very laborious to adjust to the many facilities and features that each telecom network possessed before digitalisation was completed. It was impossible to get this work going in a realistic manner, without getting a first order from a telephone operator. To experiment with a trial network, and to get the software working properly in a real, and messy, network, were very different things. Consequently, the biggest and most important challenge for ITT and BTM was to find a first customer for the switch. One minor step in this direction, or perhaps not so minor, was the Norwegian Porsgrunn project.

One supplier or two?

The evaluation report on the Porsgrunn project, which was presented in August 1980, endorsed Jonsson’s conclusions from 1978, in as much as it preferred LME's AXE to ITT's System 12. It stated, however, that it was difficult to compare the two, since they were at different stages of development. The AXE had proven itself in service, while the System 12 was still at the developmental phase.⁶⁴ Despite this, if one took the potential and assured features into account, the System 12 was best on all points. The concept and technological status was more modern than the AXE, but it was an open question whether ITT would manage to realise its intentions. Thus, a key result of the Porsgrunn project was that the TA developed an inclination for the System 12. Even if the TA did not dare to recommend the System 12, it stressed that the system had such a positive impact, that it did not want to rule it out

⁵⁹ ITT 1981, p. 114-115.

⁶⁰ Chapuis and Joel 1990, p. 415.

⁶¹ Interview with Toon Govers, Chapuis and Joel 1990, p. 419.

⁶² Based on my interviews, it was unclear from what time the System 12 incorporated ISDN. Based on the written sources, however, it is evident that the System 12 was to allow non-voice services from the outset, and that the ISDN was used as a term when it became normal. ITT 1981, p. 112.

⁶³ Interview with Hugo Wuyts.

⁶⁴ NTM3: TA 15/8-80 Nj.: “Digital prøvesentral til Porsgrunn”, memo to TBD 22.08.80.

for future use, and suggested postponing the trial -project, as “this point of time is hardly the best for choosing our future digital DMS system”.⁶⁵ The TA suggested extending Porsgrunn’s network with analogue equipment, and letting Trondheim and Økern in Oslo be the location for the first digital switches in Norway. The TF wanted to go ahead with the AXE, but the TA prevailed within Televerket. Thus, in a sense, Porsgrunn saved STK and ITT, since the TA wanted to install “AXE equipment” before the Porsgrunn project in 1978, but to postpone the installation after Porsgrunn.

Another influential memo was produced the same month; this examined the effect of digitalisation on employment at STK and EB. The companies stated that the numbers of employees would be reduced substantially, while the engineering activities would increase.⁶⁶ STK had already faced these problems, as the 11B and Metaconta were less labour-intensive than the 8B. Both companies reckoned that by 1990, the workforce would be reduced to one third of the level in 1980.⁶⁷ Hence, the consequences would be radical for both companies, regardless of which company that became the sole supplier.⁶⁸ At the same time, however, the companies claimed that the prices on digital switches were less volume-dependent than the older switches, provided that the orders were over a certain limit. The engineering costs were independent of scale, but the prices on the much-used electronic components, such as circuit boards, were stable. Both STK and EB claimed that the discount their mother companies were able to achieve on these components was not dependent on scale. This meant that the economy of scale achieved on the engineering costs was minor compared to the cost of the electronic components, after reaching a certain number of lines, stated to be 40,000 per year.⁶⁹

It seems strange that this information was produced so suddenly, and Televerket was caught by surprise. The cost of digital switches was regarded as extremely volume-sensitive until 1980, but all of sudden; it was less volume-sensitive than older switches. The companies themselves provided the calculations, thus it is tempting to ask if they collaborated to preserve the market situation. This makes sense on STK’s

⁶⁵ NTM3: TA 15/8-80 Nj.: “Digital prøvesentral til Porsgrunn”, (er at tidspunktet neppe er det beste for valg av vårt fremtidige digitale DMS-system.)

⁶⁶ NTM3: EB to Teledirektoratet 26/6-80: ”Vurdering av markedsandeler”; STK til Teledirektoratet 7/8-80: “Vurdering av ITT 12240 produksjonsvolum ved STK”.

⁶⁷ These figures came about as result of extrapolating known factors, i.e. without taking technological change into account, which would have made “electronic production ever less labour-intensive”. (elektronikkproduksjon blir stadig mindre arbeidskrevende). NTM3: TA 15/8-80 Nj.: “Innføring av DMS-sentraler, Eneleverandør eller markedsdeling”.

⁶⁸ NTM3: TA 15/8-80 Nj.: “Innføring av DMS-sentraler, Eneleverandør eller markedsdeling”.

⁶⁹ NTM3: TA 15/8-80 Nj.: “Innføring av DMS-sentraler, Eneleverandør eller markedsdeling”.

part, since it had every reason to fear a market with one sole supplier, but not EB's, which was confident it would be chosen as the supplier anyway. One could speculate further, that perhaps the companies had set the prices on components too high, to maintain their traditional margins towards Televerket. There is no evidence of such collaboration on price, but Televerket was aware that STK and EB did not have Televerket's interest first in mind while suggesting continuing with two suppliers.⁷⁰ Still, the information was regarded as a blessing for Televerket. Based on the industrial considerations, Øvregard expressed relief over the fact that it was economically justifiable to continue with two suppliers.⁷¹ In addition to Televerket's stakeholder responsibilities, there was the aforementioned aspect that Televerket would be reliant on STK's supply of the 8B and 11B for years to come.

Deducing from both reports, Televerket decided to let STK install a System 12 switch at Økern, and EB an AXE switch in Trondheim.⁷² Kjell Holler, Chairman of Televerket's Board and Director General from 1980, endorsed the conclusions in October 1980, and was content to continue with the traditional sharing of the market. However, Finn Lied, the vice-chairman, was hesitant.⁷³ He feared that it would be too expensive for Televerket to attain sufficient competence on two digital systems. Moreover, he thought the traditional geographical split was unsustainable, and stressed that there was a 'now or never' chance to alter the relationship with the suppliers.⁷⁴ He wanted to exploit the situation to make STK and EB cooperate closely. Lied was a close ally of Jens Chr. Hauge, and had shared his vision for creating strong units in Norwegian high-tech industries. After the bankruptcy of Tandberg in 1978, however, Lied fronted a reorientation of the Labour Party's industrial policy. He led a public committee in 1979, which engaged in self-criticism over the state activism in industrial policy, not least the Cornerstone plan, and paved the way for a more market-oriented industrial policy.⁷⁵

Nevertheless, Lied wanted to use Televerket procurement power to restructure the Norwegian telecom industry. Around the turn of the year 1980/81 a series of meetings was held with STK and EB, in which Televerket asked them to come up with scenarios for their future business and employment, based on different market

⁷⁰ NTM5: EB to Egil Abrahamsen, Chairman of Televerket's Board, 09.04.81; STK to Abrahamsen 09.04.81.; Abrahamsen to Televerket's Vice-Chairman Finn Lied 14.04.81.

⁷¹ LPC-M 9-11.9.80.

⁷² TBD 16.10.80.

⁷³ TBD 16.10.80.

⁷⁴ NTM5: EB's minute from meeting with Televerket and STK 22.01.81.

⁷⁵ Conf. NOU 1979:35 "Strukturproblemer og vekstmuligheter i norsk industri"; Sogner 2002, p. 70; Espeli 1992, p. 191.

shares for digital switches. Also, they were asked to form a joint group to work out alternatives for the supply of digital switches, and a possible merger of the companies. Lied demanded that the suppliers loosen the ties to their mother companies to be able to export.⁷⁶

Televerket learnt two significant things through this process. First, that regardless of what alternative it chose for supply of digital switches, hundreds of jobs would be lost in the telecom industry anyway.⁷⁷ Second, in this particular issue, both STK and EB were guided purely by their own, and their mother companies' interests, not by those of Televerket or the future of the Norwegian telecom industry.⁷⁸ The companies had, for instance, not considered a merger, or producing the AXE and/or the System 12 on license.⁷⁹ EB did not fear a single-supplier situation, and STK was confident that Televerket would continue with two suppliers.⁸⁰ The impression of the companies was not improved when both turned around shortly after, using economy of scale as argument for getting a larger share of the market, only a few months after they had stated that the economy of scale was negligible.⁸¹ Moreover, a key argument for continued market sharing was that maintenance of the old switches was difficult for the supplier that lost out. STK and EB used this for what it was worth and said it was impossible for Televerket do this work itself and that BTM and LME respectively would not be able to do it. This was one of the initial reasons for the Lillehammer agreement, one of the fingers of the industry's oligopolic grip. STK and EB refused to loosen it.

There was no surprise that STK and EB pursued their own interest, and that of ITT and LME. In reality, however, by simply putting forward what served their own interest, they declined Televerket's invitation to participate in the formation of the future of Norwegian telecom industry. By May 1981, after these deliberations with STK and EB, Televerket's Board of Directors had changed its mind on the supply question, and was strongly in favour of ordering only one system of digital

⁷⁶ NTM5: EB's minute from meeting with Televerket and STK 22.01.81.

⁷⁷ NTM5: EB's Christian Westring to Teledirektoratet 05.01.81 and Thoresen to Abrahamsen 08.01.81.

⁷⁸ NTM5: Abrahamsen to Lied 14.04.81.

⁷⁹ NTM5: TA 23.04.81 Bld - "Avd. T's kommentarer til EB's og STK's utredning ...".

⁸⁰ "We expect that ITT 1240 will be selected for use in the Norwegian network together with LME's AXE system. NTA (Televerket) wants to standardize as much as possible and their plans with using both systems will entail a district or area split per system." STK-TC: File TEL 23 System 12 - tilbud Porsgrunn; Memo: Pricing strategy for follow-on business of System 12 in Norway, STK 15.01.80.

⁸¹ NTM5: EB's Christian Westring to Teledirektoratet 05.01.81 and Thoresen to Abrahamsen 08.01.81.

switches.⁸² It was the Chairman and Vice-Chairman of Board of Directors, Egil Abrahamsen and Lied, who had meetings with STK and EB; these two were instrumental in deciding on a single supplier.⁸³ The Board recognised the problem of the maintenance and upgrading of the old switches, but argued that the benefits of one system outweighed this. First and foremost, Televerket lacked the personnel to operate two systems. After another round of reports and evaluations, Televerket's Board of Directors concluded in August 1981, that it “will be most beneficial for Televerket to opt for one system family”.⁸⁴

The TA vs. the TF

One important lesson the TA learnt during the Porsgrunn project, according to Skinnes, was that the evaluation group needed to be united, and not comprised of people from different units within Televerket.⁸⁵ An underlying element in Skinnes's point was the mounting conflict between the TA and TF. There had been substantial differences between these two departments before; the TA felt that the TF did not assist it with its daily problems, for instance with the 8B in Oslo. This stemmed from their different responsibilities within Televerket, the TA's was to maintain and modernise the incumbent network, while the TF's role was to prepare Televerket for the digital revolution. The divergence is apparent in the documents from the LPC meetings. The TA accentuated how digital switches could be integrated into the existing network, i.e. how it would and could interact with electro-mechanical and analogue equipment. The TA stressed that a successful digitalisation process rested on the transitional phase, where the network consisted of both analogue and digital switches. This period would last for several years, thus, it was crucial that Televerket solved this in a satisfactory manner.

The TF, however, focused on the new services a future digital network could provide, thus the existing network played only a minor role in shaping its visions of a future network.⁸⁶ Thus, for the TF, prognoses and scenarios of service and technology had a stronger bearing on its planning than the incumbent network did. After Televerket decided to install digital switches in 1978, these differences became

⁸² NTM5: Internal note from Director General Kjell Holler to Technical Director Nils Jonsson 04.05.81.

⁸³ Abrahamsen to Televerket's Vice-Chairman Finn Lied 14.04.81.

⁸⁴ NTM5: Dok 130/81 “Innføring av digitale DMS-sentraler” for TBD 17.08.81, (vil være mest fordelaktig for Televerket å satse på en systemfamilie).

⁸⁵ NTM5: TAP 22/10-80/Skin: “Utkast til videre arbeid med Innføring av digitale DMS-telefonsentraler”.

⁸⁶ This is particularly clear in “Dok. LP 6/74: “Under lag for presentasjon av «Skisse for telenettet 1985 og 1995»”, from LPC-M 4-5.3.74.

crystallised, since the TA and TF were rivals over who should dominate the process. The TF claimed that the TA was caught in the old world of telephony,⁸⁷ whereas the TA thought the research institute was too theoretical in its approach, and stressed that if the future network did not provide decent telephony, nobody would care if the digital services were good. The conflict between the TA and TF was classic, first in that conflicts between operational departments and R&D departments are not uncommon in companies, second in that it reflected the dual motivations for digitalisation. One motive was to install a new telephony network that was more economical and easier to operate; the other motive was to provide new services, such as data communication.⁸⁸

The main difference in 1978 was that the TF wanted to start the process earlier than the TA, and that it wanted a more rapid digitalisation process.⁸⁹ An important reason was that the TF was anxious to offer digital services to business customers as soon as possible, to obstruct other potential service providers. An important theme in the TF's investigations was whether there should be two layers in the network, including a "first class" layer for users of digital services.⁹⁰ The TF's main project was about an overlaid digital network, ODIN.⁹¹ For the TF it was crucial to get the ODIN project on the move, and it called for prompt installation of digital switches. The TA, on the other hand was apprehensive of rushing the process, wanting sufficient time to prepare the installation process, claiming that Televerket needed to have a competent staff for the project. TA did not accept that digital services were the only motive for digitalisation; claiming they were "only one of various benefits that digital technology provides."⁹² What is more, the Porsgrunn project had convinced the TA that the digital switches would be improved substantially in the following years, and that this called for patience.⁹³ This was, as we recall, in opposition to the TF, which wanted to install AXE switches in Porsgrunn.

⁸⁷ Halvor Bothner-By to Lars Thue, Thue 2006. All the interviews with the members of the INDIG confirm this, that the TF claimed the TA was outdated.

⁸⁸ Ashoka Mody and Ron Sherman: "Leapfrogging in Switching Systems" 1990.

⁸⁹ LPC-M 19-20.09.78.

⁹⁰ LPC-M 23-24.03.76.

⁹¹ LPC-M 19-20.09.78 Dok LP.11/78: "Utredningsforutsetninger om innføring av digitale automatsentraler. Synspunkter fra Utviklingsavdelingen." ODIN was a Norwegian abbreviation: "Overlagret digitalt nett."

⁹² RA-14: A/Kro 19-10-78: "Utredningsforutsetninger om innføring av digitale automatsentraler" in (bare én av flere fordeler digital teknologi gir.)

⁹³ NTM3: TA 15/8-80 Nj.: "Digital prøvesentral til Porsgrunn".

The conflict was escalating in 1981, when the TA claimed that the TF's assistance did not take the digitalisation process any further.⁹⁴ Another TA document asserted that Televerket had been too caught up in theoretical issues, which was a clear criticism of the TF and its influence.⁹⁵ Knudtzon on his side was offended because he felt that he and the TF were sidelined in the process.⁹⁶ He left an impression that he wanted to take over the TA, because it was not competent.⁹⁷ In 1982, this had turned into an open conflict; the TF distributed a document highly critical of the TA's work, and the TA responded by accusing the TF of discrediting the whole project.⁹⁸ The TA won the internal battle, and had the confidence of the Director General and the Board. The group for the introduction of digital switches (INDIG*) was set up in 1982, and was headed by Gladsø from TA, and so the process was managed according to his and the TA's principles. Despite the conflict between the TA and TF, it is pertinent to mention that several people from the TF made valuable contributions to INDIG's work, particularly with programming, new services and quality control.⁹⁹

An important reason for organising it as a project was to avoid Televerket's bureaucratic decision making, and to have flexible working hours and salaries.¹⁰⁰ The group contained 15 young engineers, who had been recruited from NTH in the 1970s. These had little experience with the old electro-mechanical procurement regime, in which STK and EB had the upper hand. On the other hand, most of them had been tutored by Skinnes, and had been told that what they had learnt at NTH about a seamless or optimal network had few practical implications in the real world. Two influential members in the group were Christensen and Nilsen. It was probably no surprise that they were bored while working at Trondheim District.¹⁰¹ They thus started their own preparatory project, working out specifications on signalling and special services that would be useful in a tender for digital switches. In this work they were joined by Ingar Hansen, who became an influential member of INDIG. In late 1981, they had finished a preliminary specification for a tender for STK and EB.¹⁰²

⁹⁴ NTM5: TA 20/5-81 Nj. "Innføring av digitale sentraler".

⁹⁵ NTM5: TAP/24.6-81/Arh: "Strategi for innføring av digitale sentraler i Norske telenettet".

⁹⁶ NTM5: Knudtzon to Øvregaard 30.07.81 "Styredokument om digitalisering av telefonnettet"

⁹⁷ Interview with Thor A. Halvorsen.

⁹⁸ NTM3: Minute from meeting by Gladsø 04.05.82: "Møte mellom representanter fra TF, TA, ØRK vedrørende forespørsel og kravspesifikasjoner for digitale sentraler."

* Norwegian abbreviation for INnføring av DIGitale sentraler.

⁹⁹ Interview with Thor A. Halvorsen.

¹⁰⁰ Interview with Bjørn Gladsø.

¹⁰¹ Interview with Kjell Christensen.

¹⁰² Interview with Ingar Hansen, who had leading positions in Televerket's Technical Department, most notably Station (switching) office. 1973-, Member of the INDIG-group.

If the TF lost influence within Televerket, it gained it outside; Knudtzon became a dominant member in a National Tele-commission that was established in 1981. He insisted that he did not represent Televerket in the commission, but only himself. Making this point several times, he indicated that he shared the general impression of Televerket. This made him controversial within Televerket; several thought it disloyal to contribute to its bad image. The general sentiment was that Televerket was old-fashioned and bureaucratic. The telephone queues and the many problems with the network haunted Televerket, and gave it a terrible image.¹⁰³ Its employees were reluctant to reveal their occupation in social life, due to embarrassment and fear of harassment.¹⁰⁴ Christopher Sjuve cites an illuminating story from the first meeting in the Tele-commission. One of the members from Televerket fell off his bike on the way to the meeting, and looked bloody and beaten. When he arrived, he said: “You all understand where I come from!” The suggestion was that he had been beaten up by angry subscribers.¹⁰⁵ Thus, in the 1970s, like in the 1960s, Televerket was an important whipping boy for the critics of the Labour government.

Liberalisation

After the election in 1981, the non-socialist parties formed a majority in the Parliament, and the Conservative Party, Høyre, formed a new cabinet. This was a part of the conservative and liberal wind that swept over the western hemisphere in the early 1980s; apart from other things, it had strong effects on the telecom sector. The break up of AT&T and the privatisation of British Telecom in 1984 are depicted as integrated elements of Reaganism and Thatcherism. In Norway it was called the “Right-wave”. Televerket's problems and inefficiency became a token of the old-fashioned and bureaucratic Labour-state.¹⁰⁶

The Labour government had tried to meet this criticism by publishing Televerket's internal long-term plan as a Norwegian Public Report (NOU*) in 1980, to show that Televerket was hands on with the digital revolution.¹⁰⁷ But the non-socialist parties, and other groups, were not content with this, and made the Labour government

¹⁰³ Interview with Thor A. Halvorsen.

¹⁰⁴ Interview with Jens Gjerdsgjø.

¹⁰⁵ Sjuve 2002, p 80. (Dere skjønner vel alle hvor jeg kommer fra!).

¹⁰⁶ In the campaign for the parliamentary elections in 2005, the Conservatives tried to exploit the historical bad image of the name Televerket, warning that the center-left coalition would take Norway back to “Televerket-times”. *Morgenbladet* 07.04.05.

* Norwegian abbreviation for Norsk Offentlig Utredning.

¹⁰⁷ NOU 1980:10A Langtidsplan for Televerket.

establish a national Tele-commission. The commission's brief was to examine the main aspects of Televerket's business in the short - and long-term perspective.¹⁰⁸

Televerket felt it as a discredit that somebody else was to consider its future, not least because there was a general impression that the commission was to instruct Televerket. Moreover, there were rumours that the new Conservative government wanted to engage a consultant to administer the digitalisation process.¹⁰⁹ The conflict was bitter, and Holler and Ole Petter Håkonsen, the new technical director since 1982, had a hard time convincing the new Minister of Communication, Inger Koppernæs, that Televerket and INDIG were on the right track.

Even today, there is a widespread view that Televerket was not able to handle the digitalisation process, and that the Tele-commission was instrumental. As the Minister of Communication, Torild Skogsholm, stated in 2002: "It may sound weird today, but the Tele-commission actually found it pertinent to recommend (to Televerket) a strategy for replacing outdated equipment and implement new technology, as if that were not a matter of course."¹¹⁰ Skogsholm and others have tried to create a picture of how Høyre and the Tele-commission modernised Televerket.¹¹¹ The present analysis, together with Lars Thue's volume on Televerket's history, shows that such claims have little empirical evidence.¹¹² The modernisation of Televerket started long before 1981, and the digitalisation process began long before the Tele-commission was thought of.

Still, the commission played an important role in educating the public and the politicians about digital technology, and convincing them of the need to invest public resources in it. Televerket's poor public standing made the commission more able to set telecom issues on the political agenda.¹¹³ There were three reasons for investing heavily in digital switches: first, to get more economical equipment; second, smaller maintenance and upgrading costs; and third, new digital services.¹¹⁴ The commission did not put forward bold visions for an information society. These were not

¹⁰⁸ NOU 1982:2 Teleutvalgets utredning I; also confer St. meld. 11. 1982-83 "Om Televerkets situasjon og oppgaver I 80-årene".

¹⁰⁹ Interview with Thor A. Halvorsen.

¹¹⁰ Torild Skogsholm's talk at Norsk TeleForum, Lillehammer, 24. April 2002 (http://odin.dep.no/sd/norsk/aktuelt/taler/statsraad_a/028021-090006/dok-bn.html).

¹¹¹ Eli Skogerbø: *Omdanning av telesektoren - fra offentlig tjenesteyting til markedsstyring*, 2002.

¹¹² Thue 2006.

¹¹³ Sjuve 2002, p 79-80.

¹¹⁴ Sjuve 2002, p 81.

necessary in order to get the support and funding from the politicians, according to Sjuve, it was enough to say that the “digital switches were cheaper and more effective solutions to acute problems”.¹¹⁵ Still, an important point in the commission’s report, as well as in Televerket’s “Long-term Plan”, was the significance of communication and telecom for business and industry, something the Labour government in the post-war period had not appreciated. Moreover, even if the Tele-commission had a modest impact on Televerket’s digitalisation strategy, it had a significant say in the procurement question.

After having decided to order only one system of digital switches, Televerket wanted to invite STK and EB to a closed tender. Inviting other foreign suppliers would have entailed a lengthy and costly procurement process, in as much as Televerket was already acquainted with the AXE and System 12. Furthermore, if a foreign company won, Televerket would have to wait for it to set up manufacturing facilities in Norway, and the problems with maintaining old switches would escalate.¹¹⁶ A final argument was that a new foreign supplier would be troublesome in terms of security reasons.¹¹⁷ Televerket recognised, however, that several actors favoured an open tender. There was, in accordance with the «Right wave», a general inclination towards liberalisation, and thus an open tender. Inger Koppernæs asked, despite Televerket’s reluctance, for a serious consideration of an open tender.¹¹⁸ Televerket upheld its position, but Koppernæs did not relent, wanting to wait for a dossier from the Tele-commission before deciding.¹¹⁹ To justify the outcome, she informed Televerket that 12 out of 14 members favoured an open tender, and asked Televerket to prepare the tender documents in English.¹²⁰

¹¹⁵ Sjuve 2002, p 94.

¹¹⁶ NTM5: Dok 159/81 “Innføring av digitale DMS-sentraler” for TBD 07.10.81. The document refers to a meeting between Televerket’s management and Board of Directors and Koppernæs and her staff at Ministry of Communication 24.09.81; Abrahamsen to Ministry of Communication 22.10.81.

¹¹⁷ NTM3: Televerket to Ministry of Communication 24.03.82: “Innføring av digitale sentraler. Beredskapsmessige hensyn”.

¹¹⁸ NTM5: Dok 159/81 “Innføring av digitale DMS-sentraler” for TBD 07.10.81.

¹¹⁹ The National Telecom Commission was called Teleutvalget in Norwegian, NTM5: Abrahamsen to Ministry of Communication 22.10.81; and NTM3: Ministry of Communication to Teledirektoratet 25.01.82, and 02.02.82.

¹²⁰ NTM3: Ministry of Communication to Teledirektoratet 25.01.82, and 02.02.82. Koppernæs was, according to Gladsø, interested in a technology agreement with Japanese firms. This must have been of minor importance, since it is not mentioned in other sources. Interview with Bjørn Gladsø.

Televerket was also criticised for its relationship with STK and EB. A conservative MP said it was as if STK and EB “had become a part of Televerket.”¹²¹ These «cosy» relationships were seen as an integral part of the old-fashioned tele-regime, which needed revamping. Some perceived STK and EB “as two leisurely «fat cats» who had lain beside each other and produced some of the most expensive tele-products in the world”.¹²² An open tender would at least get the fat cats onto their feet. Accordingly, several perceived the international tender as a means to reduce the price, thinking that STK or EB would win anyway. Televerket's Abrahamsen did not want a quasi-open tender, and told Koppernæs that if it were to be an open tender, then Televerket would have to accept the best offer. He stressed that Koppernæs would have to bear the political consequences if a foreign supplier won the contract.¹²³ Obviously, Abrahamsen said this to put pressure on the minister, but it is worth noting that it was in line with Televerket's stance on procurement issues for years. It did not want to take political considerations into account in its procurement, without clear instructions from the political authorities. There are no signs, however, that Televerket's opposition to an international tender was based on principles, either stakeholder considerations or ideology. The stance was based on pragmatism.

Televerket hoped Koppernæs would disregard the Tele-commission's call for an open tender, and protested several times, particularly because of the delays this would cause.¹²⁴ The Labour and Socialist parties supported Televerket, fearing the loss of Norwegian jobs. They even claimed that a closed tender also would provide competitive prices, as STK and EB were members of multinational concerns. Høyre's Inger Lise Skarstein ridiculed the socialist parties' confidence in the multinationals, given that the multinationals ITT and LME had reaped oligopolic prices in Norway since the 1930s.¹²⁵ Consequently, it was a semi-open tender, meaning that seven suppliers were invited to participate, and it was made clear to all parties, that Televerket would assess only the price and quality of the offers, and stakeholder interests would not be taken into account.

Invitations were sent out in July 1982 to EB (LME), STK (ITT), CIT-Alcatel, Nippon Electric Company, Northern Electric, Siemens and Philips, asking them to hand in offers in December of that year. Siemens and Philips withdrew from the tender,

¹²¹ St. f. 1982-83 p. 3975, here after Sjuve 2002 p. 87.

¹²² “Standard Telefon og Kabel: Prisgitt Televerket”. in *Kapital nr. 20 1985*.

¹²³ NTM5: Dok 159/81 “Innføring av digitale DMS-sentraller” for TBD 07.10.81.

¹²⁴ NTM3: TBD to Inger Koppernæs 01.06.82.

¹²⁵ Inger Lise Skarstein in the Stortinget 28.05.82: St. f. 1982-83: Televerkets situasjon i 1980 årene”. In fact, the Cabinet invited these companies before the Stortinget had debated the issue, and thus it was confronted with a “fait accompli”. Sjuve 2002, p. 86.

so only five companies remained. The Tele-commission recommended installing slightly more switches than TA had proposed, so Televerket ordered 520,000 lines, with an option for another 200,000.¹²⁶ Thus, it was a huge contract that was up for grabs, the largest industrial contract on the Norwegian mainland ever - it was to be called “the contract of the century”.

The tender

An important reason why Televerket wanted a single supplier was that STK and EB refused to discuss alternatives for cooperation. In other countries, like Austria, the equipment suppliers cooperated and/or produced digital switches on license for other companies.¹²⁷ STK and EB refused to cooperate, STK because it was confident that Televerket would order two systems, and EB since it did not fear a single-supplier situation.¹²⁸ When the companies learnt that it would be only one system, Thoresen and Kveim decided to discuss future alternatives for their telecom businesses, not least because they wanted to prevent an open tender.¹²⁹ When the open tender was announced, the companies considered that a merged telecom unit would be difficult for the government to neglect in the tender.¹³⁰ STK was more eager than EB to create such a unit, since it thought EB had a better chance of winning the contract.¹³¹ STK received approval from ITT-Europe to negotiate with EB. ITT and BTM probably hoped that a merged unit would have a better chance of winning the contract for the System 12, than the STK alone.¹³²

The political authorities had encouraged STK and EB to cooperate in developing a Tactical Digital Communication System for the armed forces in 1978.¹³³ The first system was delivered in 1982. It was accompanied by substantial and positive press

¹²⁶ Sjuve 2002, p. 82.

¹²⁷ Llerena et al. 2000, Martin Husz: “On Implementing the Austrian Computerised Digital Switching System” 2000.

¹²⁸ TEL 23; File TEL 23 System 12 - tilbud Porsgrunn; Memo: Pricing strategy for follow-on business of System 12 in Norway, STK 15.01.80.

¹²⁹ STKJA: Box 57: Thoresen’s minute from meeting with Kjell Kveim 20.01.82; Harper’s minutes from meeting with EB 11.05.82.

¹³⁰ STKJA: Box 57 Jur. avd, File: Chris Harper “LOV 13 - STK-EB, samarbeid tilbud digitale sentraler”. Several reports from meetings between Thoresen and Kveim held between January and August 1982.

¹³¹ STKJA: Box 57: Thoresen’s minute from meeting with Kjell Kveim 20.01.82.

¹³² STKJA: Box 57: Thoresen to Jack W. Guilfoyle in ITT-Europe 16.06.82.

¹³³ RA-STKi: “Forskningskontoret - Statlig utviklingskontrakt” JAM/HE 1.2.78.

coverage, not least stressing the possibilities for export.¹³⁴ Moreover, Televerket put cooperation between STK and EB on the agenda by introducing a plan for a joint venture between the three companies in 1982. Norsk Bedriftskommunikasjon (Norwegian business communication) was to manufacture and sell equipment for business communication. It was an attempt to meet the new challenges and opportunities that the convergence of information and communication technologies created in the business market.¹³⁵ Knudtzon, Tidemann and Christian Westring from EB presented the proposal to establish Norsk Bedriftskommunikasjon in October 1982.¹³⁶ It is interesting how Televerket induced such a plan, at the same time as it arranged a very competitive tender for digital switches.¹³⁷ This was probably possible only because Knudtzon was the driving force within Televerket, so it was detached from INDIG work with the digital tender. Nevertheless, it made STK and EB feel that closer cooperation among the two would be welcomed by Televerket.

EB's Kveim talked of a "grand scheme", i.e. a full merger of the companies; if that was not viable, he wanted to take over STK's telecom business.¹³⁸ When STK learnt of these ambitions, it wanted only to negotiate shared production if one of their systems won, and/or how to present a joint offer. After the invitations were sent out, however, STK was advised by its lawyers that STK and EB had been invited as separate companies, and thus Televerket could reject a joint offer.¹³⁹ At this point, STK seemed desperate, and wanted to negotiate a merger with EB again. Thoresen met with Kveim again in August 1982, and suggested forming one cable and one telecom company. EB wanted to take over the telecom company, and leave cables to STK, but Thoresen insisted on a 40/60 split in each company. Kveim said it was impossible to own less than 75 per cent of the telecom company, because, if not, ITT would hold a larger share than LME. The parties were to consult their boards and mother companies before negotiations were to continue. Kveim concluded by saying that he thought EB would win the «digital contract», and thus would not participate in the debate regarding the open tender and the preference for Norwegian

¹³⁴ "TADKOM - fremtidens militære samband: Nytt revolusjonerende kommunikasjonssystem" in *Aftenposten* 25.01.84. and "EB og STK skal forene markedsføringskrefter" i *Aftenposten* 18.05.84.

¹³⁵ Collett and Lossius 1993, p. 132-133.

¹³⁶ Knudtzon's orientation in LPC-M 01.12.82.

¹³⁷ Televerket's board decided to invite STK and EB to discuss possibilities for a joint venture in February 1982. The issue was discussed at a board meeting in December 1982, the same month as the companies' offers for digital switches were to be handed in. LPC-M 01.12.82.

¹³⁸ STKJA: Box 57: Harper's minute from meeting with EB 11.05.82.

¹³⁹ STKJA: Box 57: Advokatfirmaet Bugge, Arentz-Hansen & Rasmussen memo 14.07.82: "Samarbeid mellom STK og EB i anledning anbud til NTA (Televerket)".

industry.¹⁴⁰ STK was less confident, and had appealed to the government's stakeholder responsibilities towards STK; and the employees went on strike over the cabinet's decision to invite foreign suppliers.¹⁴¹

In a meeting with Erik Ribu, the Permanent Secretary in the Ministry of Communication, in September 1982, Thoresen learnt that it was by no means certain that EB would win the contract.¹⁴² The Conservative government did not give any weight to EB's cornerstone status. On the contrary, such plans and policies were something the conservatives wanted to get rid of. Ribu confirmed that STK had been perceived as more reluctant towards the open tender than EB, giving an impression of poor self-confidence in telecom, and of being merely a cable company.¹⁴³ Ribu advised STK to go public with its competence and product, and belief in winning the contract. He said that Norwegian firms might have some «pricing advantage», some had mentioned 10 per cent, but advised STK to make a note of how keen the new government was on competition. From this time on, STK turned its full attention to winning the contract. The merger talks with EB were called off, and the plans for a joint venture in business communication came to nothing.¹⁴⁴ Was it the meeting with Ribu that made Thoresen change strategy from defense to offence? Or had he been offensive all the time, and used the meetings with Kveim and EB, to give an impression of inferiority, in order to boost EB's confidence? It is hard to ascertain, and the answer need not be one-dimensional. Still, taking Thoresen's personality into account, it is hard to believe that his humble attitude towards Kveim in 1982 was not calculated.

STK, and ITT still faced the problem that EB was 'more Norwegian', with the majority of its shares on Norwegian hands. This was perceived as a barrier to the System 12's chances in Norway. Therefore, old plans for transforming the 25 per cent Norwegian preferred shares into commons, and listing STK on the Oslo stock exchange, were taken up. Three things had changed: the stock market was revitalised in 1982, the Conservative government, appreciated a stock listing of STK more than

¹⁴⁰ STKJA: Box 57: Thoresen's minute from meeting with Kjell Kveim 25/8-82, dated 27.08.82.

¹⁴¹ In its comments to the National Tele-commission (NOU 1982 2 Teleutvalgets utredning I) EB did not object to a single system, while STK protested. St. meld. 11. 1982-83 "Om Televerkets situasjon og oppgaver I 80-årene"; Fjeldbo 1983, p. 169.

¹⁴² IØA, "Report from meeting with Permanent under Secretary Erik Ribu 13/9-82", to STK's management.

¹⁴³ This impression reflected realities, as telecom business had suffered during the previous decade, while the cable business had flourished, most notably due to the large contract for laying a submarine cable under the Skagerrak.

¹⁴⁴ Letter from Thoresen to STK's Board members 26.01.83.

the former Labour government had done, and ITT agreed to sell a part of its ordinary shares in STK.¹⁴⁵ It was decided to float 15 per cent of the company, and keep 25 per cent preference shares intact, thus, reducing ITT's stake to 60 per cent.¹⁴⁶ The stock listing and sale to Norwegian investors gave STK valuable publicity, and an opportunity to polish its Norwegian identity.¹⁴⁷ STK and ITT started to prepare the sale and stock listing in September 1982, shortly after the failure of the merger talks with EB and the informative meeting with Ribu.¹⁴⁸

ITT had sold stakes in several subsidiaries during the previous years, first and foremost to improve its financial situation, but also to enhance the national identity of the subsidiaries to improve their market position. This was Araskog attempt's to follow in Behn's footsteps, by reaffirming national responsiveness. ITT's Cabell Woodward told the *Wall Street Journal* of ITT's strategy in 1985, using STK as an example. ITT sold a part of STK "in Norway to the public. ITT later got «a nice contract from the government» to supply central office telephone switching equipment".¹⁴⁹ ITT sold shares worth NOK 311 million, which was very much needed back at the New York headquarters. The share issue was announced before Televerket decided on a digital system. Moreover, in January 1983, STK was acclaimed the Company of the Year in 1982.¹⁵⁰ Its development of ocean cables was highlighted, as was its good industrial relations, leading to low sickness absence. Araskog was sure that this "contributed to (Televerket's) confidence in the System 12."¹⁵¹ Still, the share issue and the award probably had only symbolic importance; the real matter was to put in the best tender.

STK put considerable resources into winning the tender. It set up a «tender team», led by Knut Berg, who had been in charge of the System 12 since 1978.¹⁵² 100 persons were involved in working out the tender, and 5000 hours of overtime and 15-20 man-years were put into the process. The team members were sent on courses, STK engaged several consultants with experience of submitting tenders, and some

¹⁴⁵ One of the Labour Party's leaders, Einar Førde, claimed in 1982 that investing on the Oslo Stock Exchange was like "feeding hay to a dead horse".

¹⁴⁶ STK's Board-meeting 02.05.83.

¹⁴⁷ It was given broad publicity in the media, for instance "ITT-sjef om salg av STK-andeler: «STK vet selv sitt eget beste»" in *Norges Handels og Sjøfartstidene* 10.10.83.

¹⁴⁸ STK's Board meeting 22.09.82.

¹⁴⁹ "ITT Is Planning to Sell \$1.7 Billion Of Its Assets in Streamlining Move" in *The Wall Street Journal* 17.01.85.

¹⁵⁰ Bjørhovde 1990, p. 88.

¹⁵¹ CHA1: Telex from Rand V. Araskog to Fredrik Thoresen, 20.06.83.

¹⁵² The information regarding STK's tender team is based mainly on the interview with Knut Berg.

of the consultants were hired. Berg was given an office next to Thoresen, on the top floor at STK's headquarters at Økern, indicating the priority of the tender, but also to secure complete secrecy around the team's work. It was a closed tender, in the sense that all the bidders handed in closed offers, after which Televerket was to have secret negotiations with each bidder before choosing a winner.

Thus, information about the other companies' offers, i.e. price level, would be crucial. So, an important part of the tender team's work was intelligence, i.e. figuring out the price of the other bidders, and it was as important to avoid leakage from STK's own process. To avoid price leakages, STK operated with fake figures in its preparatory calculations and held off setting the final price to the very end. It seems that STK was able to keep the price secret, while on the other hand, it knew - or claimed to know - the price of all the other bidders.¹⁵³ STK's managers emphasise that Televerket was extremely professional in the process, but that the other bidders did not take secrecy seriously.¹⁵⁴

Knowing the price of the others, it was an open tender for STK, as opposed to the others, and it could set its price just below the others. As it happened, CIT-Alcatel, with its E10 offer, was 10 per cent lower than STK. STK accepted this because CIT-Alcatel's product was regarded as technically inferior, and Thoresen probably had Ribu's statement in mind, that Norwegian bidders would be given a 10 per cent price advantage.¹⁵⁵ Eventually, when all the factors were taken into account, CIT-Alcatel's offer was found to be more expensive for Televerket.¹⁵⁶ Northern Telecom's price offer was double that of STK, and NEC was also much higher, and its digital switch was regarded as inferior. Thus, only CIT-Alcatel, EB and STK were seriously considered in the final rounds. Most important of all, regarding price, was that EB's initial offers were over 40 per cent higher than STK's. After a renegotiation with Televerket in May 1983, EB reduced its price, but it was still 33 per cent higher than STK's System 12 offer. This amounted to a considerable sum of money, and INDIG estimated EB's final price to be around NOK 700 million, compared to STK's price of NOK 528 million. The price difference of NOK 170 million was big for Televerket, and the difference was in reality even bigger, as it was taken for granted that Televerket would increase the order.

¹⁵³ Interview with Fredrik Thoresen, Knut Berg, and Tidemann.

¹⁵⁴ Interview with Fredrik Thoresen, Gunnar Tidemann, and Knut Berg.

¹⁵⁵ IØA: "Report from meeting with Permanent under Secretary Erik Ribu 13/9-82", to STK's management.

¹⁵⁶ NTM3: INDIG's final evaluation of the tender: "Innstilling om Digitalt telefonsentralsystem for det offentlige nett" 06.06.83. The following information about the tenders is based on these documents.

How was this possible? How could EB misjudge the situation completely, and why was STK able to set the price so low? An important factor was Thoresen and Kveim's different corporate governance systems, or their different ranking of stakeholders. Kveim perceived his prime responsibility to be the safeguarding of EB's interests, not LME's switching market. In this relationship, it is important to bear in mind that LME held only a minority share in EB after the Cornerstone Plan. Accordingly, EB was very anxious about losing money on the project. We know that EB's delivery of LME's telecom equipment financed its Norwegian products, hence if it lost money on installing digital switches, the whole company would falter. Thoresen, on the other hand, was loyal to ITT's interests, and was willing to risk losing money on the project, to accommodate the interests of ITT. In hindsight, Thoresen thought the price was fair; it would be tough for STK to make money with such a price, but not impossible. He considered that it would be good for STK's telecom department to have tighter margins, so the organisation could be straightened up. Hence, Thoresen wanted to get his lazy fat cat up and running.

Kveim considered that his stakeholder responsibilities towards developing EB as a «national champion», and thus contributing to a Norwegian high-tech industry, were, in a sense, equally binding on the government; that the government had a responsibility to support EB's and Kveim's industrial ambitions.¹⁵⁷ EB's management did not believe that the cornerstone status had any significance for the Conservative government, but it considered EB to be the national solution and the natural solution. EB was too confident, and it never conceived of losing the bid.¹⁵⁸ Some say that EB operated with a 10 per cent “confidence tariff” on its offer.¹⁵⁹ EB was not alone in thinking it would win, as “everybody” thought so.¹⁶⁰ Besides its national ownership, it had attained 70 per cent of the Norwegian switching market. Its KV switches were less expensive and had only minor technical problems, whereas STK's telecom business had been riddled with problems throughout the 1970s. Thus, one might assume that the open tender was not so much to make sure that STK lowered its price, but to make sure that EB did. In any case, the “threat” did not work. One thing is that EB's price was too high; another was that the actual tender was put together in a poor fashion, at least compared to that of STK.¹⁶¹

¹⁵⁷ Interview with Jon Stenberg, and Peter Pay.

¹⁵⁸ Interview with Fredrik Thoresen, Knut Berg, and Gunnar Tidemann; the members of the INDIG group confirm this impression.

¹⁵⁹ Interview with Gunnar Tidemann.

¹⁶⁰ All the interviews confirm this. Televerket's Chairman, Egil Abrahamsen, also thought so.

¹⁶¹ NTM3: INDIG's final evaluation of the tender 06.06.83.

Televerket had specified its requirements on one side of the page in the tender documents, and on the other side there was a blank section for the suppliers to fill in how they would meet each requirement. After almost a decade of installing Metaconta switches, STK had learned to respect the TA's competence and not least the significance of very meticulous specifications. Thus, STK had no problems in recognising the importance of accommodating Televerket's rigid tender profile. EB, however, had not worked with the TA on local SPC switches, which required such detailed specification and programming.¹⁶² This explains how EB could oppose several of Televerket's, i.e. the INDIG-group's, requirements. This was a misjudgement of Televerket's competence in the field. Besides, EB offered more lines than Televerket asked for. This might have suited EB from the industrial point of view, according to Bjørn Gladsø, but it was "regarded as extremely arrogant".¹⁶³ A result of EB's mistake was that it had not given a proper price offer, and it thus had to submit a new offer. Televerket asked the other bidders if they accepted this; in reality, Televerket was asking the other companies if they wanted to exclude EB from the tender. This happened in April 1983, and by this time STK was fairly confident of the result, and allowed EB to adjust its offer.¹⁶⁴

EB was perceived as somewhat arrogant, not least its telecom director, Tor Egil Holte. After years with lucrative margins in telecom, STK had made Berentsen the man he was, and the same can be said of EB and Holte. This was not, however, merely a mistake by EB, as LME also misjudged the situation. One result of this was that EB, or in reality LME, did not comply with the requirements of Norwegian production in the same manner as STK did.¹⁶⁵ Moreover, LME's misjudgement of realities is also evident from its 125-year history. The author, John Meurling, was a key player in developing the AXE, and he writes that the worst loss for the AXE, was to ITT in Norway in 1982, "so near Ericsson's home". He rightly points to the fact that "ITT had no commercial System 1240 installations in service".¹⁶⁶ He also says that LME "lost to a system which Ericsson believed to be inferior to AXE".¹⁶⁷ This is the only place, in empirical sources or literature, where anyone suggests that

¹⁶² In the evaluation report, INDIG praises the good experience from installing the Metaconta with STK, and regretted they had had no such cooperation with EB, since the SPC switches EB delivered were not local switches, and thus required fewer specifications.

¹⁶³ Interview with Bjørn Gladsø.

¹⁶⁴ STK-TC: File: "TEL 23 - Televerket - Digitale hovedsentraler", Televerket to STK 12.04.83 and other documents; Interview with Gunnar Tidemann.

¹⁶⁵ NTM3: "Evaluering av tilbud 02.02.83" (A preliminary evaluation), INDIG's final evaluation of the tender is dated 06.06.83.

¹⁶⁶ Meurling and Jeans 2000. p. 314.

¹⁶⁷ Meurling and Jeans 2000. p. 314.

the System 12 was inferior to the AXE. It might reflect the problem of allowing employees to write a company's business history, but even more important is the fact that it may also confirm that LME had not done its homework in 1982. Consequently, the EB/LME high price and poor tender can be explained by complacency, but how could STK operate with a price that was so much lower than EB's? A major factor in explaining this was the desire of ITT and BTM to win the Norwegian contract.

Norway, ITT's lead market

ITT and Rand V. Araskog were almost desperate to win contracts for the System 12. "Araskog's success or failure", said a former ITT employee, "depended on System 12".¹⁶⁸ The development costs had been very high so far, and if ITT was to stay in the telecom business, it needed several orders. It had won a contract in Mexico, with an earlier version of the System 12, known as the "Alec version", with only 60 lines per line board, which had not worked out well.¹⁶⁹ The version STK offered to Televerket was an ILS version, with 128 lines per line board, known as the 4.2.¹⁷⁰ It was important for ITT to show the telecom community that the System 12 was more than a "paper tiger", and thus it needed successful installations, and quickly. But it was difficult to find any PTOs that would host the inauguration of a new version of the System 12 switch.

Moreover, ITT, or BTM, wanted a PTO that had a good chance of having a successful handover. The PTO had to be competent, the network had to be suitable, i.e. not too big or complex, and it was no drawback if BTM were well acquainted with the PTO and the network. Norway and Televerket fulfilled these requirements. BTM had cooperated closely with Televerket on installing the Metaconta 10C switches since the early 1970s, and the two had developed a mutual respect. BTM had learned to know Televerket as a pioneer in the field of specifications, which was crucial in avoiding software problems, which had troubled the installation in Mexico. In relation to the digital contract, INDIG produced 50 files of manuals of specifications. This was unheard of in the telecom world. "The Norwegians were the first and only PTO with such demanding specifications", recalled Rudy Scholliers from BTM.¹⁷¹ Hence, Televerket's competence in this field was exactly what "System 12"

¹⁶⁸ "ITT may be putting its future on the line" in *Business Week* 13.05.85.

¹⁶⁹ "ITT may be putting its future on the line" in *Business Week* 13.05.85.; Kathleen A Griffith: "Telecommunications in Mexico" in <http://www.vii.org/papers/mexi.htm>.

¹⁷⁰ Interview with Hugo Wuyts, and Toon Govers.

¹⁷¹ Interview with Rudy Scholliers.

needed at this stage. Another factor, which is worth repeating, is the positive personal experiences BTM's people had had with Televerket.

One thing was BTM's relation with Televerket, another was Televerket's international standing. BTM had to find a PTO that was respected among other countries, if it was to function as a showcase.¹⁷² A slogan developed at BTM: "If you can sell to Norway, you can sell to anyone."¹⁷³ Televerket had earned a very good reputation and international standing throughout the 1970s, not least by its active participation in international telecom bodies. Along with the Danish private operators, it had become known as a very proficient and demanding customer.¹⁷⁴ "All the other PTOs looked to Norway", recalled BTM's Toon Govers.¹⁷⁵ Thus, Norway was perfectly suited for ITT/BTM's System 12 strategy. It was BTM's test market for the 8B in the 1950s, and in the 1980s it was ITT/BTM's lead market for the System 12. It should be superfluous to distinguish between a "test market" and a "lead market" in this context, but for the record, when Norway was a test market for the 8B in the 1950s, it was because Televerket was weak in relation to its equipment supplier, so it could be turned into a guinea pig. When it was a lead market in the 1980s, it was because it was competent and demanding towards its suppliers, and thus, a model for other PTOs.

BTM convinced Araskog that Norway could play a key role for the System 12, and it was decided to gear the whole organisation, i.e. ITT-Europe, towards winning the Norwegian contract.¹⁷⁶ It was recognised that the pricing was crucial, and that STK would run a large risk if the installation process was not successful. The tender invitation from Televerket had completely new rules regarding fines for delays etc. If the supplier did not meet the contractual demands, for instance, Televerket could call off the order and be entitled to compensation for losses. So, STK needed backing from ITT to be able to set a low price. STK signed back-to-back-agreements with BTM, and these were to play an important part in the Norwegian delivery. Such inter-company agreements were standard procedure in ITT-Europe, and STK and BTM had signed similar agreements for the Metaconta installations in the Oslo network.¹⁷⁷ In general, it regulated the parties' duties and responsibilities towards Televerket and each other, but the main point, however, was that financial losses

¹⁷² There was no marketing value in installing the System 12 in a country that nobody respected.

¹⁷³ Interview with Ludo Pignet.

¹⁷⁴ Interview with Hugo Wuyts, Ludo Pignet, Toon Govers, and Rudy Scholliers.

¹⁷⁵ Interview with Toon Govers.

¹⁷⁶ Interview with Ivar Ørbeck.

¹⁷⁷ STK-TC: File: "TEL 23 - BTM/STK back-to-back-avtale 10CN".

resulting from delays or faults that were due to BTM were not to be covered by STK. The logic behind the back-to-back-agreements was that the Norwegian contract was not only STK's issue, but also one for the whole of ITT-Europe and ITT. Thus, these agreements were to give STK insurance, in case of financial losses.

Araskog and ITT asked Thoresen to set the price as low as possible.¹⁷⁸ A notable aspect is that Norway, being a small market, was perfectly suited for “dumping”. After all, the STK/EB price difference of NOK 170 million was peanuts compared to the total development costs of the System 12, which by 1985 had risen to \$1.1 billion.¹⁷⁹ Araskog played a key role in this, as he ran the Norwegian System 12 project, Ivar Ørbeck recalls, and he saw “Norway as a test case, as ITT's laboratory”.¹⁸⁰ He visited Norway in 1981, and met with Prime Minister Kåre Willoch, and Televerket's Director General Kjell Holler in 1982.¹⁸¹ At this last visit, he was joined by the head of ITT's global telecom operations, Jack Guilfoyle, and the head of BTM, Eugene A. Van Dyck. In a meeting with Thoresen, the four decided to set the price as low as necessary to win the contract.¹⁸² STK was given the assurance that “BTM would follow this price in their supplies under the contract.”¹⁸³ As STK was secured with the assurances and agreements, Thoresen did not hesitate to comply with this, because, as he said to ITT-Europe just after handing in the bid, an order “will be extremely important both to STK, BTM and ITT as a whole”.¹⁸⁴ After the final calculations had yielded a very low price, Thoresen, after consulting BTM on the telephone, reduced it by yet another 15 per cent - or about NOK 90 mill.¹⁸⁵

One reason why Thoresen made this final deduction, even though the price was much lower than EB's, was that he knew Televerket was apprehensive about inaugurating yet another BTM switch. If Televerket had learnt one lesson from its decades of procuring switches, it was to avoid another 8B situation. This is repeated time-and-again in the documents from the LPC meetings and the TA. Moreover, several of Televerket's staff were fed up with STK's equipment. The 8B and 11B experiences almost ruined STK's relations with Televerket. So, the general attitude within

¹⁷⁸ CHA1: F. Thoresen to Eugene A. Van Dyck 10.01.83.

¹⁷⁹ *Wall Street Journal* 19.12.85, here from Chapuis and Joel 1990, p. 419.

¹⁸⁰ Interview with Ivar Ørbeck.

¹⁸¹ Ivar Ørbeck's private archive: Fredrik Thoresen to Kåre Willoch, 20.11.82; Araskog 1989, p. 168.

¹⁸² Interview with Fredrik Thoresen.

¹⁸³ CHA1: Thoresen to Eugene A. Van Dyck 10.01.83.

¹⁸⁴ CHA1: Thoresen to Eugene A. Van Dyck 10.01.83.

¹⁸⁵ CHA1: Thoresen to Eugene A. Van Dyck 10.01.83.

Televerket was that EB would and should win the contract.¹⁸⁶ INDIG had had another experience, however, which the rest of Televerket did not have, namely a fruitful relationship with BTM over the previous decade. Sure, they were anxious to be the first to install the new version of the System 12. But the price was much lower than that of EB, which was to be the most important aspect. Moreover, “ITT 1240 is technologically”, concluded INDIG, “the most modern of all the offered systems”.¹⁸⁷ The distributed architecture seemed to be in line with the recent development in microprocessor technology, and it would ease Televerket's operations. The AXE, on the other hand, was seen as a bit outdated, and INDIG thought it appropriate to ask whether the AXE's best days were over.¹⁸⁸

So, most aspects were in favour of the System 12, except that Televerket had to be a pioneer again. Thus, the 8B ghost burdened the INDIG group.¹⁸⁹ Gladsø has been characterised as the driving force behind Televerket's digitalisation process. Televerket's success, claims Rudy Scholliers, was due to “Bjørn Gladsø's ability to protect Alf (Nilsen) and Kjell (Christensen) from the rest of Televerket”.¹⁹⁰ Among other things, Scholliers referred to the Metaconta projects in Oslo, where Christensen and Nilsen were allowed to experiment with modern features and services in computerised switches, while telephone queues were growing and subscribers lacked a dialling tone. Scholliers might exaggerate this aspect, but the descriptions fit with how the INDIG group worked, and how the final decision was taken. Gladsø said that he trusted Christensen and Nilsen, and would stand by and support their conclusions before the board.¹⁹¹ The technical director, Ole Petter Håkonsen, did the same, and he told them to follow their «gut feeling». Christensen and Nilsen wanted to go for the System 12, but were anxious, not least of the accusation that they were in BTM's pocket, after having spent so much time there.¹⁹²

On one of the final days, their mentor, Johs Skinnes came to see them. He was also fond of the System 12, and knew about the dilemma Christensen and Nilsen faced. The System 12 was the best, on paper; it was by far the most economical, and a

¹⁸⁶ Interview with Magnhild Slettbak. She was not a member of the INDIG group, and was thus able to pick up the general sentiment in Televerket regarding the digital contract. All the INDIG members confirm this impression.

¹⁸⁷ NTM3: “Innstilling om Digitalt telefonsentralsystem for det offentlige nett” 06.06.83. (ITT 1240 er teknologisk sett det mest moderne av samtlige tilbudte systemer).

¹⁸⁸ NTM3: “Innstilling om Digitalt telefonsentralsystem for det offentlige nett” 06.06.83.

¹⁸⁹ Interview with Bjørn Gladsø.

¹⁹⁰ Interview with Rudy Scholliers.

¹⁹¹ Interview with Kjell Christensen, and Alf Ivar Nilsen.

¹⁹² Interview with Magnhild Slettbak.

successful installation could turn Televerket into a world-class PTO. But it would be an unexpected choice, and would meet much resistance within and outside Televerket. Skinnes boosted the confidence of Christensen and Nilsen, and convinced them that they would be able to program the complex software of the System 12.¹⁹³ The members of the INDIG group stress that the System 12 was chosen because of the price and economy, not because it was more modern than the AXE.¹⁹⁴ Still, there were differences, for instance that the System 12 provided the signalling system, Signal 7, which was important for network control and the provision of digital services. Nilsen and Christensen confirm that the good relationship with BTM counted, and they do not think they would have dared to go for the System 12 without this experience.¹⁹⁵

Consequently, INDIG chose the System 12, and the final evaluation report was sent over to the Board of Directors in June 1983. Holler and the Board of Directors endorsed the decision, as did the government after some rounds of protest from and on behalf of EB's workers. EB's management was in shock, and the company started to drift during the following years. STK, with its fine-tuned intelligence, had anticipated the result for some months.¹⁹⁶ EB, on the other hand, was caught totally off guard. A few days before Televerket announced STK as the winner, EB placed two large advertisements in a newspaper, depicting itself as the future supplier of digital switches.¹⁹⁷ This amused Thoresen, and perhaps it was a sufficient reward for him? But STK faced one of its biggest industrial challenges ever; it was a moment of simultaneous apprehension and delight. ITT and BTM were more than pleased, knowing that they would not get a better opportunity to test and market their main product. Televerket was divided; several thought it foolhardy to go for the “paper tiger”. The INDIG group knew that there was hard work to come over the following years, in installing the System 12. But they probably did not know just how hard it would be.

¹⁹³ Interview with Kjell Christensen.

¹⁹⁴ Interview with the members of the INDIG group.

¹⁹⁵ Thus, the irony is that Televerket's relationship with BTM came about as a result of the 8B problems in Oslo. The network in “LME's” largest city, Trondheim, functioned perfectly with a transit switch, surrounded by many local KV switches. Thus, there was no need to go to Stockholm to sort out problems. Thus, BTM's endeavour with the electro-mechanical switch from the 1950s finally paid off.

¹⁹⁶ Interview with Fredrik Thoresen, and Tidemann.

¹⁹⁷ “Det er to hovedgrunner til at Norge bør velge telefonsentraler fra EB” in *Aftenposten* 16.06.83. and 17.06.83; 16th of June, *Aftenposten* wrote that Televerket had chosen STK and the System 12.

Conclusion

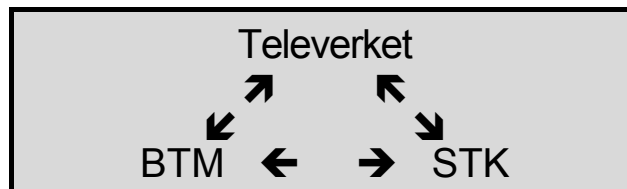
The international tender for *one* system of digital switches came about as STK and EB had lost their oligopolic grip over Televerket. It is apposite to repeat and summarise this development, that is, how each finger had lost its strength. The *first finger*, technological interfaces, started to lose strength with computer-controlled switches, and this process was completed with digital switches. Switches from different companies could interact, simply by programming the computer to accommodate different signals and so forth. Thus, digitalisation was a major pre-condition for liberalisation. The *second finger*, the maintenance of old equipment, was not solved, and it is striking how firmly STK and EB held on to this when they argued that Televerket should order two systems, to secure the maintenance of the 8B and KV. Televerket did not believe, however, that the firm that lost the tender would close down its telecom department. Moreover, these costs were only transitional, as the old electro-mechanical and analogue switches were to be replaced in the foreseeable future anyway.

The third finger was related to Televerket's lack of network and switching competence. Jonsson pointed to this problem in the electro-mechanical procurement regime. This was not the case with the new SPC/digital procurement regime. Televerket, or the INDIG-group, proved to be world-class in arranging tenders; several PTOs came to study the Norwegian tender process, and not least Televerket's meticulous specifications. EB failed to recognise this, and made a fool of itself when not complying with Televerket's requirements in the tender documents. *The fourth finger* was Televerket's responsibility for the industry's employees. STK and EB stressed Televerket's stakeholder responsibilities, in opposing a tender for one system. Nevertheless, the companies' own scenarios showed that several hundred jobs would be lost in the near future anyway. Hence, Televerket disregarded these short-term interests while choosing to go for one system, as did the Conservative government when it pushed through an international tender.

The final finger was Televerket's stakeholder responsibilities as an industry provider. In several other countries, the PTO supported projects for developing digital switches, thus leading to higher prices. Televerket did not want a Norwegian digital switch, among other things, because its experience with "Norwegian" switches - STK's 8B and 11B - was poor. Unlike many other PTOs, however, Televerket did not demand that STK or EB should have any role in further developing the System 12 or AXE. The main reason was that Televerket wanted to cooperate with the mother companies on such high-end issues, and not with STK and EB. Still, Televerket could have taken industrial aspects into account, arguing that a contract

for digital switches would be significant for the other industrial concerns of STK and EB, in both technological and financial terms. Moreover, it could have used the tender to induce a merger between the subsidiaries, more or less regardless of the contract. Televerket recognised this, and invited STK and EB to consider a merger, so as to restructure and preserve the industrial and technical environment of the Norwegian telecom industry. STK and EB had every chance to influence this, but chose to follow their own short-term interests. It illuminated their double identity; they were invited as large Norwegian high-tech companies, but responded as small foreign subsidiaries. Hence, it was no surprise that Televerket disregarded such issues, when the companies also did so.

Consequently, this story supports the general view, that the telecom industry lost its oligopolic grip as a result of digitalisation and liberalisation.¹⁹⁸ In addition, however, specific features made this process go more quickly in Norway, so Televerket became one of the first PTOs with a true competitive tender on local switches. Such tenders were not normal in Europe before the 1990s.¹⁹⁹ The most important element was Televerket's competence building on specifications and programming in the 1970s, which it did in close cooperation with BTM. As shown in chapter 4, this changed STK's relational setting in the switching business. From its initial position, as a controlling mediator between Televerket and BTM in a linear relationship, STK was, in certain issues, sidelined within a new triangular relationship, in which Televerket and BTM developed an independent relationship.



This relationship was decisive for the outcome of the Norwegian tender. First, in that BTM chose Norway and Televerket as its lead market for the System 12, and second, in that Televerket dared to be the first customer of the switch. When STK mediated between BTM/ITT and Televerket in the linear relationship, a frequent topic was whether it could develop into a lead house, either with the 8B or 11B. As the triangular relationship replaced the linear relationship, the lead-house issue vanished, and Norway/Televerket became BTM/ITT's lead market. Still, STK was not out of the equation, as it played a key role in winning the digital contract for ITT

¹⁹⁸ Doz 1987, p. 102; Eliassen et al. 1999, p. 24.

¹⁹⁹ Eliassen et al. 1999, p. 24 f.

and BTM. It was by no means obvious that a subsidiary, which demanded to be perceived as a national high-tech company, and which was about to invite Norwegian private investors as shareholders, was willing to accommodate the interests of its main shareholder and mother company by setting such a low price. To explain this, we need to return to Thoresen's understanding of telecom and his corporate governance principles. By contrasting the latter with Kveim's view of corporate governance, we also shed light on how EB priced itself out of the competition, which, after all, is necessary to explain STK's victory.

Kveim did not look upon the supply of telecom equipment to Televerket as his main concern; it was above all a means for developing EB as an independent high-tech company, as the supply of LME's telecom equipment financed the "Norwegian" products. Thus, the price-oriented tender caught Kveim in a "Catch 22" situation. EB risked losing money on the contract if the price was too low, and it risked losing the contract if the price was too high, and both would be damaging to the Norwegian products and Kveim's strategy. Kveim did not, however, see this as a dilemma, as he was sure that EB would win the contract with LME's AXE. He was caught up in an outdated perception of EB as a national champion in telecom. EB failed to take sufficient notice of the changes that followed from digitalisation and liberalisation and Televerket's increased competence and proficiency. Thus, he did not appreciate what Robert A.G. Monks and Nell Minow see as the "ultimate aim of corporate governance structure", that it must be "continually re-evaluated so that the governance structure itself can adapt to changing times and needs."²⁰⁰

Thoresen was not caught in a Catch-22 situation by the price-focused tender; it was probably the only way STK could win with such a futuristic switch. Moreover, as everybody expected STK to lose, he probably felt freer to set a very low price. What is more, he thought it was a good opportunity to teach his telecom department to hold to the budgets, to show them that the times with high margins from Televerket were over. Taking his perception of corporate governance into account, one would assume that Thoresen was willing to set such a low price, and risk losing money on the project, to accommodate the interests of ITT. It seems evident that BTM saw STK's offer as dumping. Thoresen rejects this strongly in hindsight, insisting that the pricing was fair, which may be indicative of Thoresen's understanding of tele-

²⁰⁰ Robert A.G. Monks & Nell Minow: *A View From the Top: Corporate Governance for the 21st Century*, 1996.

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com. Notwithstanding, if STK lost money due to delays from BTM, it had an inter-company agreement to fall back on.

Chapter 7 The fall of the Norwegian telecom industry

Introduction

STK was flying high in 1983; it was appointed the Norwegian company of the year for 1982, and won the «contract of the century» for delivering digital switches to Televerket; and floated 20 per cent of its shares in STK on the Norwegian stock market.¹ STK's management was always keen to enhance the company's Norwegian profile, and relished in the publicity the stock issue gave them. ITT sold shares worth NOK 311 million, in an issue that was oversubscribed by 100 per cent.² The share price was set at NOK 185, but it soon rose to NOK 270.³ This was at a time when the Norwegian economy was booming, due to large oil revenues and political liberalisation and deregulation. With the Conservative government, Norway went through a period of reform and modernisation, and STK was riding the tide, being Norway's largest and most successful company in one of the industries of the future. In May 1986, however, STK's share price was NOK 90.⁴ Hence, STK's market capitalisation plummeted from NOK 3 billion to 1 billion in less than three years.⁵ This reflected the volatile stock market, which crashed in October 1986, but mostly, it reflected STK's problems. STK incurred heavy financial losses, as it had serious difficulties in meeting the terms of the digital contract with Televerket. Still, it hoped it would regain some of the losses in winning the second contract for installing digital switches in 1990.

STK went through dramatic changes during this decade: it laid off hundreds of workers, Thoresen stepped down as managing director, and it had new French owners from 1987. EB also experienced hard times after losing the digital contract. It was attacked by corporate raiders in 1984, resulting in a new management from the financial group Investa. ITT suffered the same on Wall Street, but was able to hold off the raiders, not least due to the successful installation of the System 12 in Norway. Another important development trait during this decade was the fact that European champions replaced the old national champions, as the European community was further integrated. Alcatel was depicted as a European champion, which pur-

¹ That was 15 per cent of STK's share capital.

² STK's public issue prospect 12.10.83.

³ "Standard Telefon og Kabel: Prisgitt Televerket". in *Kapital* nr. 20 1985.

⁴ "Kraftig kursfall på Oslo Børs", in *Aftenposten* 05.05.86.

⁵ There were 11.4 million shares in STK.

portedly would provide STK with better chances of attaining a position as a lead house in certain areas. Then again, a consequence of the digitalisation and liberalisation was that R&D was centralised in the multinational telecom companies' headquarters, and that PTOs, such as Televerket, cut down on their R&D and development contracts. The main objective of this last chapter is to explain the fall of the Norwegian telecom industry in the light of digitalisation and liberalisation.

The negotiated environment changed, in the sense that Televerket no longer felt a strong obligation to act as an industry provider. Thus, the Norwegian *system of innovation* in telecom, as it was known from the establishment of the TF in 1967, was about to disappear. The second tender for digital switches, in 1990, shows that Televerket was totally freed from the *oligopolic grip*. As Televerket lost its monopoly as a service provider, and thus its monopsony in its upstream activities, STK's *relational setting* was about to be cemented: it became sidelined in Televerket's relationship with the multinational industry, irrespective of the Norwegian subsidiaries.

STK's Pyrrhic victory

Having won the contract, STK met with Televerket to negotiate a final agreement for the supply of the System 12. This was in accordance with the tender invitation: the winner was to negotiate with Televerket, based on its offer. Thoresen claims that Televerket exploited its position, with tougher demands than had been indicated in the tender, and that they used lawyers on a «no cure no pay»-basis.⁶ Gladsø rejects this, saying that the terms in the final agreement followed naturally from the tender invitation and STK's offer.⁷ This is not the place to assess if there is something in Thoresen's allegations, but it is not surprising that the two parties experienced these negotiations differently. Moreover, it is tempting to suggest that Thoresen felt uncomfortable during these negotiations, because he realised how "expensive" STK's offer really was, not least since ITT and BTM did not stand by their promises of sharing eventual losses.

In January 1983, only a fortnight after handing in the tender to Televerket, STK clashed with BTM over contractual issues. Thoresen wanted to be assured that the back-to-back agreements would be changed in accordance with the 15-per cent price cut. Moreover, the back-to-back agreements had not been adjusted to the real price, since STK and BTM "worked with a fictitious material price" to conceal the actual

⁶ Interview with Fredrik Thoresen.

⁷ Interview with Bjørn Gladsø.

price.⁸ As Thoresen stressed to BTM's Van Dyck, in the meeting with Araskog in December 1982, it “was agreed that STK would fix the final price level and that BTM would follow this price”, since the order was “very important to BTM and ITT as reference for other competitive bids”.⁹ Van Dyck responded that BTM had “been carrying a very heavy burden in the development of System 12”, allegedly amounting to 20 per cent of BTM's total turnover.¹⁰ Van Dyck also said that STK “seems to me to be a very profitable company capable also of taking its share of the load”,¹¹ thus indicating that STK's profitable cable business could take its share.

After having won the bid, Thoresen wrote to Van Dyck again, stressing that he felt “very strongly that BTM should fulfil its obligations and share their part of the price we had to pay in order to get the Norwegian contract”.¹² Thoresen was still referring to the December meeting with Araskog, Guilfoyle and Van Dyck: “I believe your exact words were; «STK must set the price and BTM will follow»”.¹³ The tension between STK and BTM was escalating, and although Thoresen acknowledged BTM's System 12 costs, he thought it pertinent to put it in an historical context, pointing to the “fact that BTM over the years has obtained excellent results in its main line of activity - switching”, and that STK had been a main contributor.¹⁴ Van Dyck replied that he was delighted with STK's victory, and was sure that STK and BTM would “come to an agreement which is satisfactory to both parties”, but gave no response to Thoresen's attempt to include the 15-per cent discount in the back-to-back agreements.¹⁵ Thoresen and STK were disappointed, as this was also problematic: STK was about to invite Norwegian investors as minority owners, and thus the company could no longer be tossed around as a mere department within ITT. As a listed company in Norway, it was an independent judicial entity, separate from ITT.

STK could just hope that the tight schedule would hold; if not, it would have to pay Televerket penalty fines. As STK's price was lower than Televerket had anticipated, it decided to increase the orders from 520,000 to over 700,000 lines. When a repre-

⁸ CHA1: File: Thoresen to Eugene A. Van Dyck, “ITT 1240 bid for Norway” 10.01.83.

⁹ CHA1: Thoresen to Eugene A. Van Dyck, 10.01.83.

¹⁰ “I believe therefore that, from a corporate standpoint, BTM takes more than its share and that this fact should be taken into consideration when judging that overall situation.” CHA1: Van Dyck to Thoresen, 19.01.83.

¹¹ CHA1: Van Dyck to Thoresen, 19.01.83.

¹² CHA1: Thoresen to Van Dyck, 03.08.83.

¹³ CHA1: Thoresen to Van Dyck, 03.08.83.

¹⁴ CHA1: Thoresen to Van Dyck, 03.08.83.

¹⁵ CHA1: Van Dyck to Thoresen, 10.08.83.

representative from the Swedish PTO met STK's Gunnar Tidemann at a conference, he advised Norway not to install more than 50,000 lines a year, due to the complex software handling. When he heard they were going to install 300,000 lines in 1986, and another 400,000 in 1987, he thought Televerket and STK were idiots.¹⁶ Trondheim was to be the pilot switch, a local switch with only 7,000 lines, but this switch was crucial, as the firms would have to debug the complicated software, and find viable solutions to how the software-based switches were to interact with the old electro-mechanical switches in the rest of the country. The Økern transit-switch and the Lillestrøm group-switch were to be the next switches. These switches were to introduce the main novel features of the System 12 network in Norway; namely *Signalling System no. 7*, facilitating communication between the switches in the network, a *Network Service Centre*, supervising and controlling all the traffic, and finally a rural local switch, called the *Remote Subscriber Unit (RSU)*.¹⁷ These features solved problems that Televerket had struggled with since the 1960s, and became important trademarks of the System 12.

The Trondheim switch was to be handed over in July 1985. A *handover* meant that the supplier delivered the switch to the PTO, which could start on the acceptance test, whereas the *cutover* was when the switch was put in service. BTM's preparation of the System 12 for Televerket's specifications took longer than it had promised, so in May 1984, STK announced the first of several delays.¹⁸ BTM had known all along, claims STK's Knut Berg, that the promises it had given STK and Televerket would not hold.¹⁹ We do not know if Berg understood this when the offer was handed in, still it calls for some reflections on Thoresen's competence in telecom. As he lacked understanding of telecom, Thoresen was not in a position to evaluate the realism in the prognoses or promises BTM gave STK on the System 12, before the offer was submitted in 1982. As *Business Week* wrote in 1985 "Araskog pushed some of ITT's subsidiaries in Europe to line up orders for the system before it was ready for sale".²⁰ It is not obvious that Araskog would have been able to push such a project onto any other subsidiaries, especially if the manager in charge had a better knowledge of telecom than Thoresen had.

Matters became even worse for STK, as BTM was stretched with the System 12. SEL, the German ITT subsidiary, was given a bigger role; it was to be in charge of the

¹⁶ Interview with Gunnar Tidemann, Bjørn Gladsø has told a similar story.

¹⁷ STK-TC: "Kontrakt om levering av DIGITALT TELEFONSENTRALUTSTYR ITT 1240 mellom STK og Televerket."

¹⁸ STK's Board-meeting 05.12.84.

¹⁹ Interview with Knut Berg.

²⁰ "ITT may be putting its future on the line" in *Business Week* 13.05.85.

Network Service Centres. Moreover, the Bundespost ordered the System 12, and it demanded from ITT that SEL was allowed to export some of its System 12 production. The German contract was crucial to ITT, as it was the first time Siemens had lost; and ITT was very eager to maintain its newly gained foothold in Germany.²¹ Thus, it complied with Bundespost's demand, at STK's expense; SEL was to deliver 100,000 lines in Norway, taken from STK's initial share.²² STK was furious with the decision: the economy in the project was very volume-dependent, so a reduction of lines would incur bigger losses.²³ As compensation, STK was to develop the Remote Subscribers Units, but this generally entailed larger costs. ITT Europe (ITTE) promised STK "preferential consideration in forthcoming export projects", but little came out of it.²⁴ Moreover, STK had to fight SEL throughout the 1980s, to get compensation for the penalty fines it paid, which were caused by SEL's delays.²⁵

ITT(E) decided to drop the old Alec version of the System 12, and go for the "Norwegian" 4.2 version for all future deliveries, and thus the Norwegian contract was even more important. As a result of the Norwegian delays, ITT(E) rearranged its System 12 programme in 1984. Ralph Welken, who was one of ITT's troubleshooters, was put in charge of the Norwegian project. He set up a new timetable for Televerket. The PTO was disappointed, but accepted ITT's new plan in August 1984.²⁶ Still, the trouble with the System 12 persisted, so Welken took over all of ITTE's System 12 operations in December, with STK's Joys as one of his assistants. BTM's difficulties had escalated, as it had lost control over its System 12 responsibilities. Jozef Cornu replaced Eugene A. Van Dyck as Managing Director of BTM in late 1984, and ITTE took over BTM's System 12 operations.²⁷ BTM was over-committed with the System 12, so an order for Switzerland was transferred to SEL. BTM had signed a very promising System 12 contract in China, with plans of setting up a unit in Shanghai.²⁸ ITT was eager to enter the enormous Chinese market,

²¹ Siemens lost because of its "natural catastrophe" with its SPC-switch, see footnote 3, in chapter 4.

²² Interview with Carl-Edward Joys.

²³ Interview with Carl-Edward Joys.

²⁴ CHA1: Daniel P. Weadock (President ITTE) to F. Thoresen 25.06.84.

²⁵ STKA: File: TEL 23: STK - SEL - BTM avtale: Correspondence between STK and SEL, the issue was settled when Alcatel's Joseph Cornu stepped and settled it in 1988. Minute from meeting in Brussels 11.05.88, from Harper and Tidemann to Thoresen, dated 02.06.88.

²⁶ CHA1: Fredrik Thoresen to Kjell Holler 08.08.84.

²⁷ Interview with Carl-Edward Joys, "Mr Jo Cornu has been appointed managing director of the Belgian division of Bell Telephone in Antwerp." in *Textline Multiple Source Collection* 30.09.84.

²⁸ Interview with Carl-Edward Joys; "ITT Belgian unit receives \$240 million China contract" in *Dow Jones News Service* 20.07.83.

but it needed the Norwegian project as a showcase for future customers. Thus, Welken ordered BTM to give Norway and Trondheim top priority.

Welken set up a new timetable, with an additional 3-4 months' delay, taking the total delay up to seven months, so Trondheim would not be delivered before February 1986. ITTE's Weadock came to Oslo in December 1984, to assure Televerket and Holler that the whole project would be completed according to the new plan. Promising that "the contract between Televerket and STK will be given highest priority within ITT" and that he would "personally use all means at my disposal".²⁹ ITT was in distress during these months, fighting criticism from Wall Street as Araskog had cut dividends for the first time since the Second World War.³⁰ Moreover, it proved very expensive to adapt the System 12 to US standards, so there were strong doubts about ITT's chances in the US equipment market. Thus, the importance of the Norwegian contract increased. As the pressure mounted on Araskog and ITT, so it did on Thoresen and STK, because STK had to pay penalty fines due to the delays.

When the seven months' delay was announced in December 1984, STK had to pay heavy fines to Televerket. In addition, it had to finance the development of the Remote Subscriber Units, and finally STK had to pay \$1.7 million (ca. NOK 15 million) for BTM's increased development costs.³¹ Therefore, before the end of 1984, before the installation of the System 12 had commenced, STK had lost money on the contract, and there was worse to come.³² Thoresen appealed to ITTE, but Weadock said that "the generic S12 development has been led by the bigger ITT Units", indicating that the smaller houses now had to contribute their share.³³ Weadock wanted Welken and Cornu to meet with Thoresen to "iron out any particular problems"³⁴ Such a meeting would probably not help at all, as the relationship between STK and BTM's management was strained. A BTM aide allegedly opened

²⁹ STKJA Box 89: File Tel 23 - System 12": Daniel P. Weadock (President ITTE) to Kjell Holler 11.01.85: "Delivery of System 12 to Norway".

³⁰ Araskog 1989, p. 65; "ITT Profit Fell 41% in Quarter Before a Gain ..." in *The Wall Street Journal* 14.11.84.

³¹ CHA1: P.R. Geurickx/ITTE to S. Falck-Pedersen STK 11.12.84. "According to the back to back agreement between you and BTM all overrun should be shared between STK/BTM in proportion to sales. BTM has estimated the overrun at \$1931 of which STK should carry 7/8 or \$1690."

³² STK's Board-meeting 05.12.84.

³³ CHA: File "Tele 23 STK-SEL-BTM avtale": Telefax from Weadock to F. Thoresen 18.02.85.

³⁴ Telefax from Weadock to F. Thoresen 18.02.85.

a meeting by saying: “Well, sue me, it’s your problem anyway”.³⁵ Televerket, for its part, indicated a willingness to cancel the whole contract, which would have cost STK dearly.³⁶ Hence, Thoresen and STK were caught between a rock and a hard place. The annual accounts for 1985 showed a drop in profit from NOK 180 million in 1984, to NOK 30 million in 1985, the main reason being the penalty fines and increased costs of the digital contract.³⁷

It is interesting to see the similarities in STK's problems with the System 12 and with the 11B. First, STK was persuaded to budget too optimistically. Second, the company lacked the capability of running projects of such a magnitude. Third, the system specifications were far from completed when the project arrived at STK. Fourth, the initial prognoses were also far too modest in terms of costs and required material, such as circuits and development tools. Moreover, the 11B's wired logic and the System 12's software needed much more debugging than expected. Finally, delays and time shortages increased the costs.³⁸ The exact same reasons are highlighted in explaining the problems STK's encountered with the System 12. It is tempting to ask whether Thoresen would have acted the same way with the System 12 had he known this.

The Trondheim switch

The first System 12 switch was delivered in Trondheim in March 1986, seven months late.³⁹ This was the handover, which was far from the cutover, i.e. the actual putting into service. It was now that the real work started; the software had to be debugged, and programmed to accommodate the features of the old equipment in the network. It was now that Televerket and BTM would have to come up with viable solutions for the rest of the network. If the Trondheim switch passed Televerket's acceptance test, one could be fairly confident that the rest of the project would go well. This was what ITT had waited for; a successful acceptance test in Trondheim would mean that the System 12 was endorsed by one of the most demanding PTOs in Europe. The cutover was scheduled for June 13, and Araskog arranged for an ITT board meeting in Oslo at the same time. “This decision is based on my (...) high confidence level that we will successfully cut over the Trondheim Exchange just prior to the Board's arrival”, announced Araskog, suggesting a “visit

³⁵ Interview with Knut Berg.

³⁶ STK's Board-meeting 05.12.84.

³⁷ STK's Board-meeting 19.03.85.

³⁸ Ivar Mo: “Historien om Metaconta 11 B”, p. 13.

³⁹ “«En milepæl for Televerket» Den første digitale telefonsentral leveret” in *Aftenposten* 07.03.86.

to the Trondheim Exchange might also be appropriate.”⁴⁰ The main reason was that in February 1986, ITT decided to drop the US market, because the adaptation of the System 12 was too expensive, and because Araskog had negotiated a merger of ITT's telecom business with the French Compagnie Générale d'Électricité (CGE), i.e. CIT-Alcatel's owners.⁴¹

The handover in Trondheim did not mean that project was back on track: nothing could be further from the truth. The switches that were to be installed in 1986-87, were, on average, delayed by five months.⁴² Araskog and several others from ITT's management met with Televerket in April 1986, to present a new timetable. At this meeting, Araskog told Holler that ITT had dropped the US market, to put all its resources into the Norwegian project.⁴³ 40 engineers, who had worked on adapting the System 12 to the US market, were sent to BTM, SEL and STK to help complete the Norwegian contract.⁴⁴ Despite Araskog's assurance, Gladsø replied that he was uncomfortable with the delays.⁴⁵ Now the strict demands in the digital contract proved their worth for Televerket, while they became a heavy burden for STK. It had to cover all Televerket's extra costs stemming from the delay, as well as the penalty fines. This should in no way, Holler told Thoresen, affect Televerket's right to cancel the whole contract.⁴⁶ Due to the delays, Televerket had to install analogue equipment as a replacement. STK wanted to install its own equipment, but Televerket preferred to lease AXE and KV switches from EB. STK had to pay for this, and it goes without saying that EB was in a favourable position while negotiating the price with Televerket.

Thoresen wrote to Weadock that Televerket's last claim “amounts to 90 mill NOK”, and that STK's Board expected a “fair distribution of Norway's System 12 costs between ITT houses”.⁴⁷ It wanted ITT to cover half of the sum, but felt it was most important that ITT, as STK's majority shareholder, acted on an “arm's length basis” in this issue, because it “was very concerned that the interests of minority share-

⁴⁰ CHA1: R. v. Araskog til D. Weadock, copy Fredrik Thoresen 03.04.86.

⁴¹ Araskog 1989, p. 177.

⁴² STKA: Papers for Board-meeting: Letter from Thoresen to Holler 16.04.86, Holler to Thoresen 17.04.86.

⁴³ Interview with Bjørn Gladsø.

⁴⁴ STKJA: Box 42: File: “LOV 13 - Ledergruppen”: “System 12 - Aktuell informasjon pr. 20. mai 1986” 20.05.86.

Minutes from STK's management meetings.

⁴⁵ Interview with Bjørn Gladsø.

⁴⁶ STKA, papers for Board-meeting: Letter from Holler to Thoresen 17.04.86.

⁴⁷ CHA: Fredrik Thoresen to Mr. D. P. Weadock, 21.04.86.

holders be protected”. What Thoresen did not tell Weadock was that the board had decided, in secret, to calculate the costs of cancelling the whole contract.⁴⁸ The situation was somewhat desperate at STK; it was not much better in Televerket. The members of INDIG felt that several of those who were sceptical about the System 12 in 1983, were showing a degree of «schadenfreude» in the midst of their problems. Some, including Knudtzon from the TF, wanted to cancel the contract.⁴⁹

Televerket's management, however, never lost faith and was destined to complete the contract. They probably envisaged STK's financial problems, while declaring that the penalties and compensations STK paid to Televerket, should be seen in relation to each other, i.e. that supplementary purchases should be deducted from penalties “as it was not Televerket's intention to profit from STK's delays”.⁵⁰ The pressure was mounting on INDIG and Televerket's management, not least because of all the critical attention from the media.⁵¹ Still, to cancel the contract would be dramatic, and probably very costly for Televerket. Moreover, INDIG was confident that the System 12 would function, and would equip Televerket with the most modern network it could dream of. The first obstacle was to have a successful cutover in Trondheim.

When the pilot switch was delivered to Trondheim, there were several shortcomings in the software package, but the main task was to debug the software. At one point, more errors appeared in the program than INDIG or BTM were able to correct.⁵² Kjell Christensen described in an article what it was like to be thrown into the inferno of 415 processors at Trondheim, which “tries to break you down psychologically with its error reports”. One digs into the relational database that is distributed in all the processors, and desperately seeks a connection between data elements hanging together in kilometres. One makes a move towards the database, but is often rejected by ‘Data Base Access Failure’.⁵³ A joke, which evolved out of ITT's work with the System 12, became popular in Trondheim: the System 12 was to be

⁴⁸ STK's board meeting 21.04.86.

⁴⁹ BGA: Notat av 08.07. 1986 fra Nic Knudtzon til generaldirektøren og teknisk direktør. Interview with Nic. Knudtzon.

⁵⁰ CHA: File “Erstatningsoppgjør System 12”: Avtale mellom Televerket og STK 29.04.86, (idet det ikke er Televerkets hensikt å profitere på STK's forsinkelse).

⁵¹ “Telefonsentraler blir ytterligere forsinket” in *Aftenposten* 22.03.85.

⁵² Interview with Bjørn Gladsø.

⁵³ Kjell Christensen: “Konsept for sentralisert drift av System 12” i *Telelektronikk* nr. 4 1986 side 354, here after Sjuve 2002, p. 93.

operated by a man and a dog; the dog was to make sure the man did not enter the switch to do any harm. The man's task was to feed the dog.⁵⁴

Televerket and BTM worked long days and nights in Trondheim. Once again, the social relations between BTM and Televerket proved fruitful. Christensen and Nilsen said it would have been difficult to overcome the problems in Trondheim without the trust that had developed among the parties, and the BTM aides hold the same view.⁵⁵ STK contributed little in comparison. According to the BTM people, STK's representatives refused to work overtime at the first switches, where BTM had the contractual responsibility. "Norwegian working moral is very different than the Belgian", says one BTM aide. This may be true, but the most important reason why the STK people refused to work overtime was that the most competent STK aides were not in Trondheim: they were busy preparing the handover of Lillestrøm and Økern. Besides, STK's did not want to pay their engineers overtime for work on switches that were BTM's responsibility. STK thought it had covered, or lost, enough on the System 12. Televerket shared BTM's impression of STK's efforts at Trondheim, with the notable exception of Dag Wilhelmsen. He was STK's project leader, together with Knut Berg, and was allegedly criticised within STK for being more concerned about completing the contract with Televerket than about STK's financial problems.⁵⁶

It is easy to understand STK's attitudes towards BTM, and the company's apprehension about working and paying overtime. Still, the fact that STK refused to put in overtime may say something about its industrial ambitions. If it wanted to benefit from being one of the first installers of the System 12, associated with such a demanding PTO as Televerket, and to attain a position within ITT on the System 12, then its stance was not very wise. STK did play a substantial role in developing the RSU, but did not try to build on that. "Asians and Swedes would have exploited such a competence", claimed Scholliers from BTM, indicating that STK lacked the necessary willpower. Perhaps STK did not have such ambitions, or perhaps they thought it impossible, or not worthwhile, to attain such a position. If BTM and Televerket really did feel that STK lacked ambition, then it is no surprise that STK was sidelined in the fruitful relationship that developed between Televerket and BTM. Nevertheless, it is important to stress that after BTM delivered the first six switches; STK did - according to BTM and Televerket - an excellent job in "rolling

⁵⁴ Ole Petter Håkonsen in interview with Christopher Sjuve (2002, p. 93.)

⁵⁵ Interview with Kjell Christensen, Alf Ivar Nilsen, Hugo Wuyts, Ludo Pignet, Rudy Scholliers, Toon Govers.

⁵⁶ Interview with Bjørn Gladso.

out” the rest of the switches. The BTM aides add that STK were good repeaters and mass producers of the System 12.

The cutover of the Trondheim switch took place on June 13 1986, in accordance with the plan laid out when Araskog met Holler in April 1986. A delegation from ITT, headed by Araskog, came to inspect the switch, and was very satisfied with the completion. Along with the ITT delegation, were representatives from the French state-owned company CGE, who wanted to make sure that the System 12 was more than a paper tiger. At its board meeting in Oslo in June 1986, ITT decided to merge, and eventually sell, its telecom business to CGE. The next section looks into ITT's troubles from the mid-1970s.

ITT - a giant with feet of clay

ITT's turnover rose from \$765 million in 1960 to \$14.6 billions in 1976, and at its peak, it was number nine on the Fortune 500 list.⁵⁷ In 1974, however, its “consistent record of increased quarterly earnings over fifty-eight quarters during the 1960s and 1970s was broken.”⁵⁸ Geneen left behind “a debt-laden corporation”, claimed Araskog, “one that was struggling to pay its bills for many mergers and acquisitions”.⁵⁹ ITT was dubbed “a museum of the investment and management ideas of the sixties”.⁶⁰ The conglomerates fell out of fashion, one talked of “profitless growth”, and big was not that beautiful anymore.⁶¹ The emphasis was now on such entrepreneurial development as was occurring in Silicon Valley, and on the importance of flexible specialisation, with “small was beautiful” becoming a new mantra.⁶² One thing was that the conglomerates delivered smaller returns, another thing was that the stock market rated such giants much less favourably, and thus the Price/Earnings (P/E) ratio fell, as did the market capitalisation compared to the underlying value of the firms.

This is not the time or place to assess the reason for the fall of the conglomerates; however, some major reasons are worth mentioning. First, a macro-economic condition for the profitability of the conglomerates was general economic growth. The 1973 recession hit ITT hard, and its “stock plummeted from 60 in early 1973 to 12

⁵⁷ “ITT begins slimming down following heavy diet of mergers” in *Financial Times* 08.03.85.

⁵⁸ Goold and Luchs 1993.

⁵⁹ Araskog 1989, p. 3.

⁶⁰ Here from Araskog 1989, p. 6.

⁶¹ Goold and Luchs 1993.

⁶² An influential book, in praising small business and its flexibility, was Michael J. Piore and Charles F. Sabel: *The Second Industrial Divide, Possibilities for Prosperity*, 1984.

in late 1974”.⁶³ An accompanying factor was the increasing competition from Japanese firms. The recession and the «Japanese challenge», called for more corporate flexibility, which the conglomerates lacked. Moreover, “Geneen’s methods were widely copied in other conglomerates and were taught in business schools,” adds Araskog, “He was imitated, admired, and envied.”⁶⁴ Thus, to some extent, the business environment’s imitation of ITT and Geneen’s financial control and report system eroded ITT’s relative ownership advantage in the management field.⁶⁵ There was also an important change in management fads: away from the Druckerian assertion, that a manager could manage anything, to the trend of “Stick-to-your-knitting”, and core-competence. Some saw this a managerial response to the coming of the post-industrial society, with concerns shifting from productivity to efficiency.⁶⁶

Another line of defense was that conglomerates were like corporate mutual funds, and that the CEO with his managerial apparatus would be able to beat the market. The shareholder revolution from the early 1980s drove such assumptions away. In an article entitled “ITT - The death of the Geneen machine”, *The Economist* wrote: “The growing efficiency of capital markets means that investors no longer need conglomerates to spread investment risk.”⁶⁷ Another factor was that ITT’s allies in the “financial world turned to divestments”, according to Araskog, and “Investment bankers found that they could make just as much money - no, even more money - by tearing down and destroying what had already been built”.⁶⁸ A key reason for this transition was that when conglomerates enjoyed favourable P/E ratios, the whole was worth more than the parts. Conversely, when the P/E ratio dropped in the 1970s, the reverse synergy became true - the sum of the parts was more worth than the whole. Thus, the financial community was no longer ITT’s ally: on the contrary, in the 1980s it assisted the raiders of ITT.

After ITT’s share price fell in the 1970s, several considered the break-up value to be worth more than its market capitalisation.⁶⁹ Araskog recalls that when ITT’s stock

⁶³ Book review of Araskog’s book ‘The ITT Wars’ in “The InterNet Bankruptcy Library” February 1, 2002, Vol. 6, No. 23, (http://bankrupt.com/TCR_Public/020201.mbx).

⁶⁴ Araskog, 1989, p. 3.

⁶⁵ Both in a sense that other companies had acquired the same ownership advantage, and in the sense that there were fewer acquisition targets in market, which could be “renovated” by ITT.

⁶⁶ Bente Løwendahl and Øyvind Revang: “Challenges to Existing Strategy Theory in a Post Industrial Society.” 1998.

⁶⁷ “ITT - The death of the Geneen machine” in *Economist* 17.06.95.

⁶⁸ Araskog 1989, p. 5.

⁶⁹ For instance “Drop in ITT Payout May Have Made Company An Acquisition Candidate, Some Analysts Say” in *The Wall Street Journal* 12.07.84.

was worth \$40 in 1983, he was approached by some raiders, who thought they could make a \$20-per-share profit if they succeeded in breaking up ITT. According to this, the market value was two-thirds of the break-up value.⁷⁰ Araskog thought it immoral that the raiders should reap this margin, as it belonged to the shareholders, and the margin was only a result of an inefficient market. The proponents of hostile take-overs would argue that the shareholders could simply refuse to sell to the raiders if they agreed with Araskog, or that it was Araskog, and his like, who fought shareholders' activism, that were the biggest obstacles to achieving an efficient market. There were some democratic notions attached to this, that shareholders should take control over the companies, and that the CEO was to be the servant of the shareholder. Michael Jensen laid the intellectual foundations for the shareholder-based corporate governance philosophy in 1976, with his normative agency theory, which claimed that the shareholder was the principal and the CEO was the agent.⁷¹ The reasons for this development were manifold and complex; one important aspect was the reaction against corporate empires. Several asserted that these were built to accommodate the ego of CEOs like Geneen.

Araskog agree with the raiders in that ITT needed to move from diversification to divestment, and between 1979 and 1984 he divested sixty-nine companies worth \$2 billion. He thought, however, that ITT and himself should be in charge of the process of restructuring ITT. In portraying his fight against the raiders as heroic, Araskog says that he turned down what he "perceived to be a gargantuan bribe" of \$30 million,⁷² Others maintain that Araskog's resilience is best explained by a tremendous stock option programme in ITT, allegedly dwarfing any bribe offers.⁷³ There is a strong irony in how Araskog condemns the financial world in his book on ITT, claiming that there are more interests to be taken into account than just those of the shareholders. He argued in line with a *stakeholder* capitalism, but he did not learn this reasoning from Geneen.

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⁷⁰ Araskog 1989, p. 12.

⁷¹ Christensen 2003, p. 136.

⁷² Quotation on the front of Araskog's book from 1989.

⁷³ "Araskog, Confronted by ITT Holders, Defends \$11.4 Million '90 Compensation" in *The Wall Street Journal* 08.05.91; "Can you believe what you see at ITT" in *Fortune* 17.04.95.

Other companies in the telecom industry were following ITT's struggle on Wall Street like vultures, ready to pick up its telecom business in case of an attack.⁷⁴ This was natural, as it was a common understanding that the rocketing R&D costs, estimated at \$1 billion for developing a digital switch, entailed a restructuring of the industry. Moreover, the liberalisation of the markets for telecom equipment led to strategic alliances, most notably between AT&T and the Dutch Philips, intended to give the two companies market access on both sides of the Atlantic. ITT's problems led to many rumours about its future; a successful sale of the telecom business would improve the balance sheet, and not least, prove how "wrong" the market evaluation of ITT was. In 1984, ITT's total market capitalisation was \$4 billion, while the telecom business alone was perceived to be in the range of \$2.5 to \$4 billion, very dependent, obviously, on the System 12's destiny.

ITT had always struggled with its foreign exposure. Both Behn and Geneen had been eager to balance its overseas operations; because ITT's foreign assets were "subjected to the particular economic conditions and political vicissitudes in these countries".⁷⁵ Araskog reasoned along the same lines, as he felt the "writing was on the wall in the 1970s and early 1980s".⁷⁶ He added that the "swelling nationalist sentiment around the world led to pressure on almost all of our subsidiaries, to buy them out, force them to sell at absurdly low prices".⁷⁷ A major proponent of this sentiment was France, which, as a part its Colbertism High-Tech, nationalised both ITT subsidiaries. In 1982, ITT sold off its shares in its British subsidiary, STC, keeping only 25 per cent. In addition to political pressures on its subsidiaries, it was difficult to enter foreign markets with digital switches, which were perceived as a key technology and infrastructure in the digital revolution, an area in which it was important to have a national capacity. Moreover, because of the nature of public procurement, it was easy and even expected to use protectionist measures in the digital switching industry.

ITT's US strategy for the System 12 was followed closely by Wall Street; not least the internal conflicts in the US System 12 team.⁷⁸ The writing for the System 12 in

⁷⁴ CGE's chairman George Pebereau, who introduced a trustful liaison between the two, warned Araskog of an alliance between the raiders and some multinational telecom companies, Araskog 1989, p. 126.

⁷⁵ Geneen and Moscow 1984, p. 201.

⁷⁶ Araskog 1989, p. 158.

⁷⁷ Araskog 1989, p. 158.

⁷⁸ "Crucial Call -- ITT Faces a Big Test: Selling Its New Switch To Phone Firms in U.S." in *The Wall Street Journal* 19.12.85. "ITT Shuffles Executives, Including System 12 Aides" in *The Wall Street Journal* 31.01.86.

the US was on the wall, so Araskog was given the green light by his board to approach potential future partners. He held talks with Nixdorf Computer Company, Digital Equipment Corporation, Northern Telecom, and, last but not least, the French CGE. Araskog met with CGE's Georges Pebereau in late 1985, and proposed a joint venture, in which CGE would hold the majority; this was ITT's first step to get out of the telecom business. In February 1986, ITT announced that it had given up the US market.⁷⁹ After renouncing the US market, and writing off an enormous loss, ITT concentrated most of its System 12 resources on the Norwegian project. The successful cutover in Trondheim was decisive to obtain a good price from CGE, which resulted in ITT's decision to merge, or sell, its European telecom activities in June 1986. ITT was to keep 37 per cent of the newly formed Alcatel N.V., a European holding company, dominated by CGE. Even if this was depicted as a merger, there was never any doubt that it was a take over. In its note to the press, STK wrote: "STK becomes European".⁸⁰

Araskog's support for the System 12 was a bet-the-company decision.⁸¹ In a way he succeeded: thanks to the System 12, he was able to get a fair price for the telecom business. On the other hand he failed, because when the US market slipped away, the telecom business was doomed. This was a big loss for Araskog; his strategy was to turn ITT into a world-leading telecom company, based on the System 12. Most "observers", wrote the *Wall Street Journal*, were "shocked that the 54-year-old Mr. Araskog would contemplate a major shedding of the overseas telecommunications operations".⁸² Robert Sobel, the author of ITT's history, was taken by surprise, as he was sure Araskog would hold on to telecom.⁸³ The reason was the failure in the United States. The break up of AT&T came earlier than anticipated, says Araskog, and ITT was delayed in the USA, because it had to protect its European markets.⁸⁴ It was probably, as one observer noted, a case of "I guess the smart thing to do is to get the hell out, save some money and save some face."⁸⁵ While the divestiture of ITT may be explained by a contingent factor, i.e. that the System 12 was not adapted in

⁷⁹ "ITT's Chief Technical Officer Resigns As Firm Assesses U.S. System 12 Strategy" in *The Wall Street Journal* 03.02.86.; "ITT's Closing of Phone-Switch Project Cited in \$15 Million 4th-Quarter Loss" in *The Wall Street Journal* 14.02.86.

⁸⁰ STK's Board meeting 12.06.86

⁸¹ "ITT Chairman Rand Araskog «has bet the company on this thing,» says Ivan Cermak, who in October resigned as the president of ITT's System 12 division." in "Crucial Call -- ITT Faces a Big Test: Selling Its New Switch To Phone Firms in U.S." *The Wall Street Journal* 19.12.85.

⁸² "Araskog's Dream for ITT Appears to Be Slipping Away" in *Wall Street Journal* 27.06.86.

⁸³ "Araskog's Dream for ITT Appears to Be Slipping Away" in *Wall Street Journal* 27.06.86.

⁸⁴ Araskog 1989, p. 176.

⁸⁵ "Araskog's Dream for ITT Appears to Be Slipping Away" in *Wall Street Journal* 27.06.86.

time for the US market, it was no accident that it was a French company that took over ITT's telecom business.

Alcatel N.V. - a European champion

France had always played an important role in ITT's telecom business: it was its main market. Behn's ability to win this market with the Rotary switch in the 1920s was, in reality, the foundation of ITT's future. The French also played a decisive role with the crossbar switches. Furthermore, when the French government increased the price on telecom equipment in the 1970s, "to protect the growth of CIT-Alcatel", France became ITT's "golden cage".⁸⁶ Still, the French had never been content with ITT's domination of its telecom business, and as early as the 1930s, CGE had begun its "long march against ITT".⁸⁷ From the 1970s, France took advantage of its confederate - some would say weak - structure, when it nationalised LMT in 1976. After Francois Mitterrand's election victory in 1981, six leading industrial companies were nationalised, including CGE, Thomson, and not least, ITT's last French subsidiary, Compagnie Générale de Constructions Téléphoniques (CGCT).

Thomson's telecom business was strengthened in the 1970 through the acquisition of Le Matériel Téléphone (LMT) from ITT, and LME's French subsidiary. This was initiated by the PTO, so as to provide competition for CIT-Alcatel. Thomson did not fare well in the civilian telecom business, however, and constantly lost money. So, in 1983, despite the fierce protests of the PTO, CGE and Thomson did a major swap, as CGE took over Thomson's civilian telecom activities, in exchange for consumer and military electronics. This deal, called the "Yalta de l'électronique", signified that CGE had freed itself from the PTO, and was calling the shots in the French telecom business. CGCT was retained as an independent company to give CIT-Alcatel competition, but the other ITT subsidiary, LMT, became a major part of CGE's telecom business. Thus, in a sense, ITT was swallowed by its French subsidiary. A more precise, but still cunning, interpretation, is that the French authorities exploited ITT's weaknesses by stripping it of its French subsidiaries, and thus taking over the damaged remains. An ingenuous version is that Alcatel filled the vacuum that was created when ITT faded out of the global telecom industry.

CIT-Alcatel became a major equipment supplier, with 87 per cent of the French market, and was the fourth largest in the world, with over 7 per cent of the global

⁸⁶ Doz 1979, p. 69.

⁸⁷ Noam 1992, p. 139-140.

market.⁸⁸ Still, it had problems in getting access to foreign markets with its E10 switch, and the French market base was not big enough to fund the increasing R&D costs that digitalisation, convergence, satellite communications and fibre optics demanded. As observers noted, a “company needs at least 10% of the world market.”⁸⁹ CGE held talks with AT&T, but this would have left CGE as a junior partner, and would have opened the French market to AT&T’s products. In this sense, ITT was better, as it did not have a home country or market. After having lost LMT and CGCT, the French market was closed to ITT. Without market access in the United States, ITT needed a European identity to get market access for the System 12. Therefore, selling the “European telecommunications manufacturing facilities to a strong European telecommunication company”, recalled Araskog, was an “elegant solution to a complex problem”.⁹⁰

Thus, there was a Euro-dimension to the ITT deal. The political and economic integration in the European Community in general, and EC’s deregulation and liberalisation of the telecom sector in particular, aimed at creating a single European market for telecom equipment.⁹¹ A major impetus was that the European «national champions» had problems in competing with the larger American and Japanese firms.⁹² Thus, the EU wanted to stimulate “European champions”, and the national markets were considered too small to finance the increasing R&D costs that followed from the convergence of information and communication technologies. Thus, the EU put forward several legislative measures in the second half of the 1980s, including the 1987 Green paper from 1987, “on the Development of Common Market Telecommunication Services and Equipment”.

“Alcatel was one of the earliest to formulate an internationalisation strategy”, according to Razeen Sally, “to take advantage of these markets trends in good time, as opposed to being caught off guard by them.”⁹³ The French, and not least Jacques

⁸⁸ Sally 1993, p. 76.

⁸⁹ “Telephone Switch: ITT-CGE Deal Shows The Change Buffeting Telecommunications” in *The Wall Street Journal* 30.04.87.

⁹⁰ Araskog 1989, p. 157.

⁹¹ Eliassen et al. 1999.

⁹² “The systems of 'national champions' was increasingly seen as restricting the European CPE (custom premises equipment) manufacturers’ ability to compete in design and innovation with the American and Japanese, and that some kind of co-ordination in research and development was necessary to avoid a European slump in the sector.” Eliassen et al. 1999, p. 25.

⁹³ Sally 1993, p. 77.

Delors, were instrumental in this.⁹⁴ Therefore, CGE's acquisition of ITT's telecom business was depicted as the creation of a European champion. It was an “historic chance for France and Europe”, according to CGE's Georges Pebereau, to acquire “a leading position in the telecommunications business until the end of this century”.⁹⁵ The other owners of Alcatel N.V. strengthened the Euro-dimension. Apart from ITT and CGE, there was the Spanish PTO, Compañia Telefonica, and the Société Generale de Belgique, which was Belgium's biggest and most powerful industrial holding group, and Alcatel NV was to be registered in Holland.

Alcatel would attain “a European market share of 42.5% for telephone switches”.⁹⁶ CGE representatives stressed that this was not going to be a French company, but a pan-European one. It was crucial that the national home markets were replaced by one European home market, in order to achieve economy of scale, and critical mass to finance R&D. One thing was that trade barriers had to be removed; another was that national sentiments had to be modified. This was in line with the overarching reasoning for the European integration, i.e. each nation had to give up sovereignty, in order to achieve a greater goal on a higher, European, level. Still, the creation of Alcatel was not a result of European cooperation, but rather an industrial and political power struggle, in which the European countries manoeuvred to get in a position for the internal market. Alcatel and the French government succeeded in this game, in transforming a national champion into a European champion. Norway, through the System 12 contract, played a role in the formation of Alcatel N.V., as did EB in creating another European champion.

The Norwegian financial revolution

After losing the digital contract, Kjell Kveim of EB was in a state of shock. EB's management did not conceive of such a possibility.⁹⁷ In STK's contract for 520,000 lines, there was an option for another 200,000 lines, and then Televerket was to arrange a new large tender in 1990. In 1983, most actors assumed that STK would get this contract as well. Televerket had, after all, argued strongly for one supplier. Consequently, the prospects for EB's telecom business were dim. It was to continue to supply its KV as an extension of the analogue networks for several years, but there was no future in this line of business. Besides, this diluted EB's other product segments, since the sale of telecom equipment to Televerket had subsidised the bulk

⁹⁴ Delors was Mitterrand's Minister of Finance from 1981, before he became President of the European Commission in 1985.

⁹⁵ “Benefits still questioned in CGE-ITT deal” in *New York Times* 26.08.86.

⁹⁶ “France Allows ITT-CGE Pact To Go Ahead” in *The Wall Street Journal* 31.07.86.

⁹⁷ Interview with Jon Stenberg, and Peter Pay.

of EB's «Norwegian» products, not least maritime satellite communication.⁹⁸ The backbone of EB's economy in the 1970s was the supply of KV switches and telephone apparatuses to Televerket.⁹⁹

With EB in such a dismal condition, it was only natural that a merger with STK was considered. Thoresen informed his Board, before it was public that STK had won, that he wanted negotiations with EB about a future merger.¹⁰⁰ After STK's victory was made public the Minister of Industry, Jens Halvard Bratz, asked the two companies to discuss their future.¹⁰¹ Abortive talks were held in August 1983, and Thoresen approached Kveim again in November, suggesting a new structure in the Norwegian telecom industry.¹⁰² Kveim declined Thoresen's invitation, arguing that STK and EB followed very different strategies. Kveim stressed that EB had built up a considerable foreign business, consisting of subsidiaries and foreign offices. He claimed that this strategy had been possible because EB had no dominant foreign owner. If STK acquired EB, Kveim feared that ITT's 80 per cent ownership would limit EB's freedom to follow this strategy. He saw the freedom to operate internationally as much more valuable than the benefits that could come out of a merger. STK regretted that EB wanted to negotiate cooperation only in limited areas.¹⁰³

When rejecting STK's invitation, EB may have thought it could continue its business as normal, forgetting that once it had been stripped of its switching business, its main cash cow was gone. Its market value plummeted after the stock market learned of its poor cash flow in 1984, and earnings per share dropped 70 per cent between 1982 and 1984.¹⁰⁴ In 1984, a financial analyst was asked to give his investment advice in *Kapital*, a business magazine.

⁹⁸ Interview with Peter Pay.

⁹⁹ This was in line with other telecom companies, for which switching amounted to 56 per cent of the equipment manufacturing sales between 1976 and 1980.

¹⁰⁰ STK's Board meeting 17.06.83.

¹⁰¹ IØPA: Kveim to Thoresen, 08.12.83, Copy to Minister of Industry Jan P. Syse, The Høyre government was expanded into a coalition government in 1983, including two non-socialist parties, the Kristelig Folkeparti and Senterpartiet.

¹⁰² CHA1: F. Thoresen to Kjell Kveim 28/11-83

¹⁰³ IØPA: Kveim to Thoresen, 08.12.83.; STK's archive: Box 57 Jur. avd, Mappe: "LOV 13 - STK-EB, samarbeid tilbud digitale sentraler".

¹⁰⁴ *Kapital* nr. 7 1985: "Elektrisk Bureau: Tapernes slagmark".

He considered EB a “sleeping beauty”, asserting “The present stock price gives the company a market capitalisation of NOK 700 millions, which amounts to the value of its real estate on 100.000 m². Accompanying the bargain is an exciting future in telecommunication.”¹⁰⁵

The article helped bring EB into play.¹⁰⁶ An ironic aspect is that the book, celebrating EB's centennial anniversary in 1982, boasted about EB's real-estate values.¹⁰⁷ We do not know if the financial analyst learned about EB's real estate through this book, but the mere possibility is food for thought for any business historian.

EB's market capitalisation dropped to NOK 630 millions in September 1984. The same month, a well-known, and controversial, financial actor, Nils A. Bugge, or the Bugge group, started a raid on EB, buying 2.5 per cent of its shares.¹⁰⁸ Bugge had been in and out of several companies, and was accused of «greenmailing».¹⁰⁹ It was not only EB that was “in play” in the mid-1980s: a large part of Norwegian business was restructured, some through peaceful negotiations, others through power struggles in the stock market, boardrooms, and general assemblies. Bugge and his likes contributed to a fierce debate about “transactions economists”, “raiders”, “sharks” and “traders”.¹¹⁰ Critiques claimed that Bugge's affairs were not productive, just speculative, and played with companies that had been built over decades. Other asserted that this was just what Norwegian business needed - demanding and financially oriented owners, who could revamp and open up the old and closed arenas for decision-making in Norwegian business.¹¹¹

Bugge's raid put Kveim in “a state of shock”.¹¹² When Bugge showed up at Billingstad, i.e. EB's headquarters just outside Oslo, to present himself, Kveim remained in his office, in disarray, and others from the management group met Bugge. He could not conceive of the situation EB had ended up in. Jon Erik Stenberg and others from EB's management group had urged Kveim to take steps to accommodate the new

¹⁰⁵ “Carl Kierulf: Kjøp Bjølvfossen, bank og EB” in *Kapital*, nr. 18 1984, p. 25.

¹⁰⁶ Interview with Oskar A. Munch.

¹⁰⁷ Skogaas 1982, side 113.

¹⁰⁸ 08.09.84: number of shares 6.353.600 * share value NOK 100,0 = market value NOK 635.360.000 EB's Annual Report 1984, and “Buggegruppen inn i EB” *Aftenposten* 26.09.84.

¹⁰⁹ “Niels A. Bugge forteller: «Vi tenker ikke, vi har aksjer»”, in *Kapital* nr. 15 1984 p. 33.

¹¹⁰ Even the personal advisor of the Minister of Industry, from Høyre, Gottfred Greve wanted increased measures against “sharks in the stock-market.” “Industriministerens rådgiver: Skjerp motstand mot haier i aksjemarkedet” in *Aftenposten*: 18.12.84.

¹¹¹ Confer for instance Fusjoner og oppkjøp over børs: Nødvendig i konkurransen” in *Aftenposten* 02.10.85.

¹¹² This paragraph is based on the interview with Jon Erik Stenberg, and Peter Pay; The impressions of Kveim are verified by most other interviews.

shareholder sentiment, not least things that could improve EB's figures and stock price, such as the sale of real estate and the cutting of R&D. Kveim refused to engage in such symbolic endeavours, which had no industrial justification. It went against everything he stood for as a human being and as a business leader. No one doubted that Kveim was very intelligent, and with high moral standards, according to Peter Pay and Stenberg, but he was too rational and fact-oriented to cope with the new era. Kveim rejected the need to give EB a more market-friendly profile, and though such things could be decisive in the new shareholder-era, Kveim disliked such symbolism. Moreover, in accordance with his ethical principles, he lacked the taste for tactics and cunning, which was required for the game EB was thrown into.

The Bugge group bought more EB shares, and held 25 per cent, the same as LME, in January 1985.¹¹³ EB was vulnerable, as the financial results for 1983 were catastrophic.¹¹⁴ *Kapital* pondered the company in several issues, calling it the “losers’ battlefield”.¹¹⁵ Others said it was too focused on engineering, rather than marketing.¹¹⁶ EB had to spend valuable time and resources on combating an unfavourable impression of the company. Kveim renounced his principles, and engaged in a symbolic battle. He tried to adjust EB's engineering image, by giving shareholder-friendly interviews, highlighting market-orientation, the need for divisionalisation and other fashionable phrases of the time.¹¹⁷ The old and honourable name Elektrisk Bureau was to be replaced by “The EB Group” (EB-gruppen). He also emphasised EB's export-orientation, claiming that EB did not want to be so reliant on the Norwegian market, in which Televerket was so dominating, and away from the constant struggle with STK. Most of these strategies were old news for Kveim, as he had been pursuing them for industrial reasons from 1972; the new thing for him was that he had to go public with it, to participate in the public «beauty contest».

In addition to the media campaign, EB made arrangements with a «white knight», an investment company called Nimbus, which bought shares in EB to outweigh Bugge's influence.¹¹⁸ *Kapital* was furious about Nimbus and other «white knights»,

¹¹³ “EB-oppkjøp for over 200 mill” *Aftenposten* 23.01.85. og “Bugge viste EB-flagget” *Norges Handels og Sjøfartstidene* 23.01.85.

¹¹⁴ “Øket aksjeomsetning” in *Aftenposten* 27.02.84.

¹¹⁵ “Elektrisk Bureau: Tapernes slagmark” in *Kapital* nr. 7 1985.

¹¹⁶ and “Klarer EB omstillingen” *Aftenposten* 09.03.85.

¹¹⁷ “Klarer EB omstillingen” in *Aftenposten* 09.03.85.

¹¹⁸ EB rejected the notion that Nimbus acted on their behalf, but Nimbus' leader admitted this in “AKTUELL IDAG: EB-konsernets «hvite ridder»” in *Aftenposten* 19.09.85. Nimbus forced the Bugge group to sell them 180,000 shares in EB, and this was allegedly possible because the Bugge group was financially vulnerable.

and credited Bugge for trying to shake life into EB and the assets everybody knew were there. They thought it typical that it was the raider who became the scapegoat, and not Kjell Kveim, “who has had every opportunity, but failed in the most gruesome manner”.¹¹⁹ *Kapital* could not understand why EB's other shareholders accepted Kveim and EB's deal with Nimbus: was it just another sign of the camaraderie in Norwegian business, or were EB's shareholders masochists? EB's financial results for 1984, which were presented in March 1985, bolstered *Kapital*'s assertion, and undermined Kveim's strategy: the figures were even worse than those of 1983.¹²⁰

EB had agreed with Bugge to let McKinsey analyse the company, and Bugge was probably confident that the recommendations would be in accordance with his interests. McKinsey suggested splitting EB into different stock-listed companies: cable, telecom, real estate, Nera and EB's business communication.¹²¹ The report also verified that the underlying value of EB was much higher than the market capitalisation, which was NOK 700 million in August 1985: even the cable subsidiary, Norsk Kabelfabrikk, was expected to get a market price of between NOK 400-600 millions, and the real estate value was still higher than EB's total market value. Even if the stock price rose as a result of the report, the conflict with Bugge remained a problem, which needed to be solved if EB was to start on its complicated reorganisation. At this point, in August 1985, STK made another approach to EB, being interested in taking part in the discussion regarding EB's possible reorganisation. The main argument was that Norway was too small for two telecom companies, and that STK and EB could be a unit to be reckoned with internationally.¹²²

This time it was STK's chairman, Johan B. Holte, who contacted EB's chairman, Halvdan Bjørum, perhaps to prevent the Thoresen - Kveim relationship from getting in the way. STK was most keen on Norsk Kabelfabrikk, which was profitable. The telecom was different, as Thoresen reported to ITTE: “it is here EB has its problems (...). Heavy R&D and overstaffing are having negative impact on results”.¹²³ The head of ITTE, Daniel P. Weadock, was sceptical and told Thoresen to “go very slowly” because STK's “balance sheet is not in the best shape” and was “projected to deteriorate”. Weadock allowed for discussions with EB, but “under no circum-

¹¹⁹ “Elektrisk Bureau: Tapernes slagmark” in *Kapital* nr. 7 1985.

¹²⁰ “Utbytte på 12 prosent: Svakere for EB” *Aftenposten* 21.03.85.

¹²¹ “EB splittes i flere nye ’børsbedrifter” in *Aftenposten* 13.08.85; “EB-deling skal avklares raskt” in *Aftenposten* 14.08.85.

¹²² STK's Board's archive: From Johan B. Holte, STK's chairman, to Halvdan Bjørum, EB's Chairman 16.08.85.

¹²³ IØPA: Thoresen to Weadock, Cchlusski and Carpenter 20.08.85, Cc. R.V. Araskog.

stance, I repeat under no circumstances, are you to get yourself or ITT in a position where it could be inferred that we have made a commitment.”¹²⁴ Weadock reasoned that STK would have their hands full in meeting the terms of the digital contract, and this was much more important for ITT(E) than the Norwegian market. Workers at STK and EB were anxious when they heard the merger rumours, and Thoresen promised that STK would not make a hostile move, claiming they were “not interested in buying ourselves a war”.¹²⁵ After EB ignored STK's initiative, STK decided not to contact the “Bugge group or others with EB shares”.¹²⁶ Thus, STK and EB did never engaged in serious talks on merging the companies.¹²⁷

Bugge and Nimbus, the «white knight», owned half of the shares in EB by August 1985, and had agreed to sell out. Elektro-Union, which was owned by Investa, the former owner of Nera, was interested. In 1982, the Conservative government sold the government's stake in Elektro-Union, and thus it was freer to engage in mergers and acquisitions, and it used this freedom.¹²⁸ EB's cable business was interesting for Elektro-Union, since it was in the electro-technical area, but Investa's main interest was financial. Bugge-Nimbus met Elektro-Union's Chairman Oskar A. Munch and CEO Kjell Almskog in London, and negotiated a deal in secrecy. A precondition for Elektro-Union was that EB's cooperation with LME continued, and that EB accepted Elektro-Union as a dominant owner.¹²⁹ Kveim and Bjørum went to Stockholm with Munch and Almskog. It was the same quartet that had met when EB bought Nera in 1976, and much had changed in Norwegian business during those nine years.

On the plane to Stockholm, the four went over EB's accounts, which, according to Munch, were a real mess, and he claims that Kveim was not able to understand his own accounts.¹³⁰ Probably, this said more about the circumstances than Kveim's

¹²⁴ IØPA: Telefax Weadock to Thoresen, 22.08.85.

¹²⁵ STK's internal paper Minutt-nytt 26.08.85; “STK interessert i samarbeide, men: EBs ansatte må høres” and “STK vil ikke «krige» for å kjøpe opp EB” in *Aftenposten* 27.08.85.

¹²⁶ STK's archive: Board-papers: Thoresen to STK Board of Directors 26.08.85.

¹²⁷ STK and EB did cooperate in defence communication, and established some sort of a joint venture in this line of industry. (“EB og STK skal forene markedsføringskrefter” i *Aftenposten* 18.05.84.) Still, it is an open question whether this had been forced upon the companies by the Ministry of Industry and Defence. There were also negotiations with Televerket to establish a joint venture with all three parties for business communication (Norsk Bedrifts Kommunikasjon.), but this did not materialise because Televerket's status was unsettled. STK's board meeting, letter from Thoresen to STK's Board members 26.01.83.

¹²⁸ Interview with Oskar Munch.

¹²⁹ Interview with Oskar Munch.

¹³⁰ Interview with Oskar Munch.

financial understanding. He understood probably better than anyone else why the accounts were so cryptic, that even such financial experts as Munch and Almskog were not able to penetrate them. EB's accounts were a riddle in order to conceal the fact that the supplies to Televerket subsidised the other product lines.¹³¹ In fact, Kveim was probably one of the few who really understood these accounts. Nevertheless, LME welcomed Elektro-Union as a majority owner.¹³² The only one to protest heavily against Investa's intrusion was EB's telecom director Tor Egil Holte. Kveim had already announced that he would step down as CEO, and Holte had positioned himself to replace Kveim.¹³³ Elektro-Union bought the Bugge group's shares, accounting for 25 per cent of EB. As the share price had almost doubled after the Bugge group's entry, it made a huge profit: Bugge himself, allegedly, made NOK 35 millions.¹³⁴

Later, Elektro-Union took over Nimbus's shares, and some from LME as well, acquiring a majority share.¹³⁵ Kjell Almskog, who became the new CEO, was renowned for his rough management style, purportedly stating that he would throw colleagues out of the window, if they were not able to hold their budget. He stressed that financial results are the only thing that counts, and "everything else is bullshit".¹³⁶ Not too dissimilar from one of Geneen's doctrines, that "the only line, is the bottom line". One might say that Almskog and Munch instigated «Geneenism» in EB. Both had studied in the United States in the 1960s, at the time of the financial revolution on Wall Street, and were some of the main proponents of this development in Norway. It is important to mention that Almskog and his methods came as a relief to many EB aides, who longed for financial control and closer following up of results. They thought one of EB's main problems was that Kveim lacked toughness towards R&D-happy engineers.¹³⁷ If one did not meet one's terms during Kveim's regime, recalls Peter Pay, one was never confronted with it, and the problem dragged on for years. This way, he added, one "slowly roasted", whereas with Almskog, the matter was taken care of right away.

¹³¹ Interview with Jon Erik Stenberg, and Peter Pay.

¹³² Interview with Oskar Munch; "EB-ansatte stanset Investas aksjekjøp" in *Aftenposten* 24.08.85; "Oskar A. Munch Lyttet til de ansattes 'Nei'" in *Aftenposten* 28.08.85.

¹³³ Interview with Oskar Munch; "Nye eiere i EB snart, Kveim vil ha avløsning" in *Aftenposten* 22.08.85.

¹³⁴ "Solgte EB-aksjer til Investa: Bugge tjente 35 millioner" in *Aftenposten* 14.09.85.

¹³⁵ "L. M. Ericsson: Riktig å redusere andelen i EB" in *Aftenposten* 17.12.85.

¹³⁶ "AKTUELL PROFIL Ville bli noe stort" in *Aftenposten* 31.03.01.

¹³⁷ Interview with Peter Pay.

EB's profitability increased substantially after Almskog's arrival, and so did the stock price. One irony in relation to EB's good results from 1985 was that the company made huge profits on delivering KV switches to Televerket. The installation of the System 12 was delayed by several months, and a large switching station in Oslo burned down in 1984, and as a consequence EB supplied switches to meet the increasing demand for telephones. So, STK won the digital contract, but EB made money on it.¹³⁸ Critics will have it that Almskog disregarded R&D and EB's hard-earned competence in electronics.¹³⁹ It is beyond the limits of this thesis to evaluate such claims. It is true that several hundred workers lost their jobs in EB during the Almskog regime, but this had little to do with Almskog: it was a result of the technological and political development. While Peter Pay was head of EB Telecom in 1986-87, he had to dismiss 1350 of 2500 employees.¹⁴⁰

EB bought Elektro-Union in 1986, and the companies were merged, turning into one of Norway's largest industrial companies.¹⁴¹ Now, it was as much an electro-technical company as a telecom company. Some say that this was the problem with Almskog, that with his background in Elektro-Union, he never got deeply engaged in telecom.¹⁴² About the same time, Investa sold 20 per cent of EB's share to the Swedish electro-technical giant, ASEA, which, like LME, was a part of the Wallenberg sphere. After buying some more cable companies in 1987, EB acquired Norsk Elektrisk Brown Boveri (NEBB) in August 1987, which was the Swiss Brown Boveri's Norwegian subsidiary.¹⁴³ EB was now acclaimed the largest privately held industrial company in Norway, but that did not last for long. The acquisition of NEBB came about the same time as ASEA and Brown Boveri announced a

¹³⁸ In June 1986, Televerket ordered KV switches worth NOK 85 million; STK had to pay 64 million of this sum, and in addition, EB delivered KV equipment worth NOK 24 million to replace the switch destroyed in the fire. STK's archive: Thoresen to STK's Board: "Notat om System 12 kontrakten 02.06.86"

¹³⁹ Most of those interviewed say that Almskog was better at downsizing than building. Interview with Kjell Kveim, Harald Erichsen, Former CEO of Nera, Asbjørn Birkeland. Others, such as Jon Erik Stenberg and Peter Pay, reject this. Moreover, the creation of ABB Norway goes against this.

¹⁴⁰ Interview with Peter Pay.

¹⁴¹ STK's chairman, Holte, who resiliently fought hostile takeovers, called this transaction a robbery. Holte was chairman of the Kværner company as well, and tried to fend off its raiders; the article was written in relation to this. "Elkems aksjon mot Kværner en byrde for næringslivet" in *Aftenposten* 15.12.86.

¹⁴² Interview with Peter Pay; Knut Sogner: *En liten brikke i et stort spill. Den norsk IT-industrien fra krise til vekst 1975-2000*, 2002, p. 96.

¹⁴³ An important asset here was NEBB's lucrative real estate. Its former location at Skøyen, in the western part of Oslo, has become a fashionable shopping and corporate centre.

merger, creating ABB.¹⁴⁴ In the same month, ABB bought 60 per cent of EB from Investa, in of the largest-ever acquisitions on the Norwegian stock market.¹⁴⁵

Some say this was the final nail in the coffin for EB's decade-old ambitions of being an independent telecom company.¹⁴⁶ One thing that goes against this assertion is that in 1988, EB joined Simonsen Elektro and ELAB in a government-sponsored effort to capitalise on the Norwegian competence in mobile telephony. Simonsen was to manufacture the handset and EB the base stations for the future GSM system. Notwithstanding, in hindsight, there is little doubt that the most striking thing with EB in the 1980s was that Investa made a fortune on the company, according to Munch, of about NOK 1 billion in current values.¹⁴⁷ Thus, Investa's acquisition and transactions with EB were the most successful in Norwegian history, in financial terms. EB's financial reserves, earned from supplying Televerket, and intended for strengthening its and Norway's position in telecom, were swallowed by Investa. In the mid-1980s, Investa was regarded as a potential Wallenberg-like sphere in Norway, with assets, allegedly, amounting to NOK 30 billion, and ownership in several Norwegian industrial companies. But Investa faltered, after hazardous expansion into the insurance business.¹⁴⁸

ABB - a European champion

Still, it is fair to assert that the Munch and Almskog engagement in EB was successful in industrial terms as well, only not in telecom. Almskog succeeded in developing the Norwegian ABB unit into a lead house in oil-related business, and it also had substantial business in power generators, and was a major contributor to ABB's global success in the 1990s.¹⁴⁹ So, Almskog was right when he said that EB was not going to be swallowed by the giant Swedish whale, but "sit on its back around the world".¹⁵⁰ ABB Norge was frequently used as an example of how foreign owners did not need to be a drawback for Norwegian industry.¹⁵¹ Eventually, Almskog became Percy Barnevik's second in command in ABB, and one of the few Norwe-

¹⁴⁴ "EB - NEBB - Asea mulig ny gigant" in *Aftenposten* 13.08.87.

¹⁴⁵ "Nynfusjon ga ny, norsk industrijempe" in *Aftenposten* 18.08.87.

¹⁴⁶ Interview with Peter Pay.

¹⁴⁷ Interview with Oskar Munch.

¹⁴⁸ "Bergenskapitalen ut av Fyllingsdalen - Pulverisert imperium" in *Aftenposten* 02.09.89; "Milliardgjeld stopper Investa" in *Aftenposten* 31.08.92.

¹⁴⁹ "ABB Appoints New Head of Oil, Gas and Petrochemicals Segment" in *abb.com*; "Fra småkonge til marionett" in *Økonomisk Rapport nr. 6 2001*.

¹⁵⁰ "Asea skal bidra til å styrke EB-gruppen" in *Aftenposten* 30.09.86.

¹⁵¹ Almskog did this himself in an interview; "Almskogs milliardvekst i olje og gass" in *Dagens Næringsliv* 28.06.95.

gian industrial leaders who has succeeded internationally. It was ABB's strategy and structure that made such a position possible, even for a subsidiary from a small country like Norway. We should look briefly into ABB's multinational strategy to get an understanding of how European integration and liberalisation had changed the perception of MNCs and subsidiaries in the 1990s.

ABB was, like Alcatel, perceived as a European champion, but in the electro-technical area, and the merger was a positioning for the advent of the EC's inner market, and to meet the competition from American and Japanese firms. An important feature of ABB was that it stressed that it was not a traditional hierarchical MNC. Its CEO, Percy Barnevik, stressed that ABB was to combine global reach and economy of scale with local presence and adaptation.¹⁵² He ripped off the environmental slogan: "Think global, act local."¹⁵³ The idea was to decentralise R&D and innovation, and tap into and exploit each country's competence bases, or systems of innovations. Such ideas were very much in vogue in the late 1980s, and several articles were published on how MNCs' strategy and structure should be decentralised and competence-driven, and not centralised and dictated by headquarters. Christopher Bartlett and Sumantra Ghoshal advocated that an MNC should "Tap (its) subsidiaries for Global Reach".¹⁵⁴ Similarly, Gunnar Hedlund wrote a much-acclaimed article about how the modern MNC was a 'heterarchy', as opposed to a 'hierarchy', allegedly inspired by studies of ASEA and ABB.¹⁵⁵

ABB and Barnevik certainly believed in this strategy, but there were some factors that made such an image and strategy more likely for ABB. First, many of ABB's customers were public utilities, and living off public procurement entailed a strong degree of national responsiveness. Another important element inducing this strategy was that most of ABB's products needed local adaptation, and this required a decentralised structure. Thus, the economy of scale and standardisation was smaller in ABB's line of business. ABB's business was R&D-intensive, but first and foremost *development*-intensive, and much of this was conducted while installing products such as a gas turbine or an oil installation. There was a similar situation with STK's success in the field of submarine cables, which may be a main structural explanation for its development into a lead house. In telecom, by way of contrast, there was a

¹⁵² William Taylor: "The Logic of Global Business: An Interview with ABB's Percy Barnevik" 1991.

¹⁵³ Taylor 1991.

¹⁵⁴ Christopher Bartlett and Sumantra Ghoshal "Tap Your Subsidiaries for Global Reach," in *Harvard Business Review*, 1986 64 (6), 87-94.

¹⁵⁵ Hedlund, Gunnar "The hypermodern MNC: a heterarchy?" in *Human Resource Management*, 1986 Vol. 25, pp. 9-25.

transition from local to global products. As more national telecom networks became “seamless”, with standardised interfaces, less competence was required for adapting and installing equipment. Thus, more of R&D could be centralised. Moreover, it is normal that MNCs from small countries undertake more R&D in their subsidiaries, as they are not large enough to have the competence and R&D facilities needed for a large MNC.¹⁵⁶ Finally, Sweden and Switzerland were not EC members, so ABB needed to be more responsive to the EU, than, for instance, Alcatel.

For Alcatel to follow this new fashion would entail a breach of the traditional policy of French MNCs, since they were known to centralise their R&D in France.¹⁵⁷ Notwithstanding, Alcatel proclaimed an integrated strategy when taking over ITT's telecom business. To accomplish standardisation and avoid duplication, Alcatel stressed that it wanted to induce cooperation, and promote specialised subsidiaries, across the national boundaries. By exploiting national advantages, each subsidiary should be able to attain a lead-house position, based on competence.¹⁵⁸ Alcatel's representatives stressed that it was not going to be a French company, but a pan-European one. It was crucial that the national home markets were replaced by one European home market, in order to achieve economy of scale, and critical mass to finance R&D. Alcatel used the prevailing euroism for what it was worth, to combat the impression of a French take-over. So, it seemed as if STK had a new - European - room for strategic manoeuvre under its new French owners.

STK - a French subsidiary

If STK's telecom business were to attain a position within Alcatel's integrated strategy, it would have to be in an area in which it had a comparative advantage. This is the main idea of the integrated strategy, that multinationals should exploit subsidiaries' and host-nations' advantages. STK had such advantages within military communications, based on its development of the Nodal point switch. Such advantages are often derived from natural resources and/or geographical features of a country. The first was the case for ABB Norway's strong position within the oil business. The second, i.e. geographical structures, lies behind Nera's strength in radio link,

¹⁵⁶ Cantwell and Kosmopoulou 2002.

¹⁵⁷ This pattern, i.e. French centralism, is verified by studies John Cantwell and others have conducted of US patents, in which they measured how many patents can be ascribed to subsidiaries' R&D. Through this, one finds a proxy for the degree of internationalisation of R&D on different levels, i.e. country, industry, technological field and/or company. Cantwell and Kotecha 1997 and Cantwell and Kosmopoulou 2002.

¹⁵⁸ David Charles “Alcatel: a European champion for a globalizing market” 1996.

and STK's in submarine cables.¹⁵⁹ Norway's relatively strong position within radio communication and wireless communication is based on a combination of the two, resources and geography, i.e. fish (later oil) and the long coastline. This in turn formed the basis for Televerket's contribution to mobile telephony. STK's new managing director from 1988, Bjarne Aamodt, tried to exploit all these advantages in his pursuit of positioning STK within Alcatel. He stressed that STK had to move from being a miniature replica, to a lead house in certain areas, as each subsidiary had to develop in the areas in which they were strongest; adding that "if everybody shall produce everything for every market, it goes without saying that the competition will be lost."¹⁶⁰

Besides reaching the mature age of 61, Fredrik Thoresen thought it natural to resign once Alcatel had become the majority owner. He replaced Johan B. Holte as STK's chairman, a position he held until 1999.¹⁶¹ Aamodt had an unfortunate admittance to STK, as the employees favoured the Director of Personnel, Lars Harlem, as Thoresen's successor. They claimed Aamodt lacked industrial experience and knew little about telecom, and that Harlem was the right man for creating the vibrant management team STK needed.¹⁶² The discord hit the newspapers, and due to the employees' insistence on Harlem, the Board discussed the issue for twelve hours, before settling on Aamodt.¹⁶³ The Board never seriously considered Harlem, and some maintain that he had launched himself as a candidate. Despite the Board's lack of confidence in Harlem, he chose to remain in STK. In the management reshuffle following Aamodt's replacement of Thoresen, Harlem took over Tidemann's place as head of the telecom division. Thus, it was Harlem who was to handle STK's telecom business within Alcatel. Harlem and Aamodt pursued a growth policy, based on the assertion that STK was the only vital telecom company in Norway. This belief was strengthened by ABB's take over of EB in 1987, which turned EB into an electro-technical company.

The first expansion took place when STK bought Scanvest Ring and its manufacturing subsidiary Kitron in 1989. Scanvest had a strong position in business communication, while Kitron was one of few specialised and effective manufacturers of elec-

¹⁵⁹ Norway's mountainous topography was perfectly suited for radiolink transmission; the mountains served as communication "towers" for the transmitters and receivers of micro-waves.

¹⁶⁰ Aamodt's message in Annual report 1989, (Hvis alle skal produsere alt for alle markeder, sier det seg selv at konkurransen tapes.)

¹⁶¹ STK's Board-meeting 16.12.87.

¹⁶² STK's Board meeting 26.08.87; Letter from STK's employees to STK's Board, 20.08.87.

¹⁶³ "Aamodt STK-sjef efter hard dragkamp" in *Aftenposten* 28.08.87.

tronic components in Norway. When ABB announced that it was to sell EB's telecom business back to Ericsson, STK presented a Norwegian alternative, wanting to take over EB's telecom business.¹⁶⁴ Alcatel STK was the only company in Norway, Aamodt told the press, which had the capacity to unite the Norwegian telecom industry.¹⁶⁵ He told Paris that he wanted an "integration" of the "Norwegian Telecom Industry" with a "majority holding" for Alcatel.¹⁶⁶ He thought stronger units in defence, business communication, and Nera's radio link business would be interesting to Alcatel. The long-term objective was "to restructure and consolidate the Norwegian telecom industry in order to establish a strong subsidiary within the Alcatel-group instead of (having) several smaller subsidiaries with different international owners."¹⁶⁷ Aamodt's ambition was never realistic, as Ericsson wanted EB's telecom business to position itself before Televerket's new tender for digital switches. In reality, it was a reshuffle within the Wallenberg sphere.

A consequence of Ericsson's acquisition of EB was that EB withdrew from its GSM project with Simonsen Elektro and ELAB. Some feared that Ericsson obtained a free ticket to the Norwegian development of mobile telephony systems.¹⁶⁸ There are few indications, however, that Ericsson was attracted by this project.¹⁶⁹ Still, Simonsen was in trouble after EB's departure from the project. In June, the Ministry of Industry asked "Alcatel STK to take over the GSM activity in Norway and look into Simonsen as a possible take over candidate".¹⁷⁰ Public bodies urged STK to take over Simonsen, as it feared that the national investments in mobile telephony would be wasted. It seemed a bitter fact that Norway had the highest penetration of mobile telephones, but that Nokia, selling most phones in Norway in 1988, reaped the benefits.¹⁷¹ Negotiations between STK and Simonsen stalled because STK thought the price was too high, but then, as Aamodt informed Alcatel, Televerket's "very strong chairman", Egil Abrahamsen, stepped in and forced Simonsen to re-enter negotiations with "STK, based on half the price demand".¹⁷²

¹⁶⁴ STK's Board meeting 06.02.89.

¹⁶⁵ "Kjøper gjerne EB Telecom" i *Dagens Næringsliv* 08.02.89; "STK reagerer på EBs handel med Ericsson" in *Aftenposten* 09.02.89.

¹⁶⁶ STK's Board meeting 01.06.89: Aamodt to Alcatel NV 25.05.89.

¹⁶⁷ STK's Board meeting 01.06.89: Aamodt to Alcatel NV 25.05.89.

¹⁶⁸ "Norsk mobiltelefon til Ericsson?" in *Dagens Næringsliv* 11.02.89.

¹⁶⁹ Sogner 2000, p. 115.

¹⁷⁰ STKJA-25: File: JAA - Simonsen Elektro mP. 2: "Simonsen case - day by day".

¹⁷¹ "Norge størst i mobiltelefoner" in *Dagens Næringsliv* 13.08.88.

¹⁷² STKJA-25: File: JAA - Simonsen Elektro mP. 1: "Proposal for acquisition of all activities, technologies and markets shares from Simonsen Elektro A/S, Norway." Another person who was eager to see STK take over Simonsen was Jens P. Heyerdahl, CEO of Orkla. In addition to being generally concerned about Norwegian industry, he wanted to make sure that Simon-

Simonsen Elektro had had success with manufacturing handsets for the NMT system (Nordic Mobile Telephone) since 1978. Its competence in the field was based on contracts with the armed forces. It had big challenges in 1989, when it had to manage the transition from stationary to portable phones, and the transition from the NMT to the GSM system. This required increased R&D and scale manufacturing, which in turn necessitated larger markets. The government and Simonsen hoped STK could provide it with competence in R&D and scale production, and that Alcatel would secure market access. Aamodt thought that Kitron's manufacturing capabilities would fit Simonsen's technology, and endorsed the project, if Alcatel granted STK a position as a "«lead-house» for the NMT-area."¹⁷³ Alcatel, however, was apprehensive from the outset. Perhaps they did not believe in Simonsen as a good case. It might also be that they did not want to locate a lead house of such a potential important product line in Oslo, far away from French influence. Or it might be that Alcatel did not believe in mobile telephony, they allegedly regarded it as a Scandinavian toy.¹⁷⁴ On the other hand, Alcatel had already formed a mobile telephone consortium with AEG and Nokia in 1987.¹⁷⁵ An interesting correlation is that Siemens's first mobile handset was developed by its Norwegian subsidiary. Siemens Norge, which hoped that it could be Siemens's lead house in the field, but the business was moved to Germany as soon as it reached a certain volume.¹⁷⁶

Despite French reluctance, STK pushed the case through, without Alcatel's approval, and signed an intentional agreement with Simonsen's main owners in October 1989. More seriously, however, was that the parties notified the press that Alcatel STK would pay NOK 22 million to take over Simonsen.¹⁷⁷ Harlem was instrumental in pushing this through. Maybe he hoped that this would secure the deal, that Alcatel would feel obliged by the intentional agreement and the press coverage. There are strong indications that he did not give accurate reports to his STK colleagues about Alcatel's reluctance towards the project.¹⁷⁸ This is why Aamodt, as

sen's activity at Løkken continued. This was Orkla's old industrial site, Heyerdahl had arranged for Simonsen to locate its plant there, and he had very strong feelings for this local community. Interview with Hans Jørgen Blomseth.

¹⁷³ STK's Board meeting 26.10.89: Aamodt to STK's Board 17.10.89.

¹⁷⁴ Interview with Ivar Ørbeck.

¹⁷⁵ Häikiö 2002, p. 131; Palmberg 2002.

¹⁷⁶ Ole N Hoemsnes: *Siemens i Norge (1898-1998) 100 år*, 1997; p. 380.

¹⁷⁷ STKJA-25: File: JAA - Simonsen Elektro mP. 1: Avtale mellom Alcatel STK (ASTK) og I.M. Skaugen A/S Bertel O. Steen A/S/Erik O. Steen" 20.10.89. "Alcatel STK overtar Simonsen Elektro" in *Aftenposten* 24.10.89; "Ut i verden med Alcatel" i *Dagens Næringsliv* 24.10.89.

¹⁷⁸ STKJA-25: File: JAA - Simonsen Elektro mP. 2: Aamodt to Mr. J. Curvale Alcatel N.V. 01.11.89; and several interviews.

late as late 1 November 1989, asked Alcatel for an “approval to acquire 100% of Simonsen Elektro A/S”.¹⁷⁹ Soon after, STK learned, apparently through a due diligence, that Simonsen’s financial state was worse than thought.¹⁸⁰ It is hard to believe that STK did not have better oversight of Simonsen’s financial state when signing the intentional agreement; moreover, the government had given promises regarding financial support to STK if it took over Simonsen.

The main reason STK backed down was that Alcatel did not support the project. It was Alcatel’s Business Systems Group that dealt with mobile telephony, and its leader, Christian-Georges Chazot, was furious with STK in general, and Harlem in particular.¹⁸¹ Chazot told Aamodt that each time Harlem had contacted his group he had received a negative reaction to the Simonsen deal. “We learnt of the STK Simonsen agreement via press articles (...) in spite of renewed warnings (...) against such operations. (...) No wonder that this negative stand was reaffirmed on November 8.” He concluded by “strongly requesting that, in the future, corporate rules be strictly adhered”.¹⁸²

Perhaps Simonsen’s financial state was too poor, or perhaps it and STK, or even Kitron for that matter, lacked the capability to engage in scale production. Nevertheless, it was a major blow for STK. It was bad for its public image; and not least for its relationship with Televerket and the government, which was important as the second tender for digital switches was due soon. It created internal tensions at STK, and the relationship with Alcatel was very strained. Still, the major problem was that it was difficult to envisage how STK could attain a position as a lead house within Alcatel after this. If Alcatel was not interested in trying to exploit the Scandinavian and Norwegian competence in mobile telephony, what other field could it be interested in? It is true that the acquisition of Simonsen was risky, but the NOK 22 million it cost combined with the potential losses were nothing compared to STK’s loss on the digital contract. These losses could be reduced if they won the next contract for digital switches.

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¹⁷⁹ STKJA-25: File: JAA - Simonsen Elektro mP. 2: Aamodt to Mr. J. Curvale Alcatel N.V. 01.11.89

¹⁸⁰ STKJA-25: File: JAA - Simonsen Elektro mP. 2: “Redegjørelse for Styret” 10.11.89.

¹⁸¹ STKJA: Box 88, Tel 23: File: “AAA 30 Simonsen Elektro”: Letter from G. C. Chazot, Alcatel N.V. to Aamodt 11.11.89.

¹⁸² Letter from G. C. Chazot, Alcatel N.V. to Aamodt 11.11.89.

The System 12 contract from 1983 was a financial blow for STK. According to the press it lost NOK 500 millions, but according to Thoresen and Hans Jørgen Blomseth, STK's Economic director from 1986-92, the company lost over NOK 700 millions.¹⁸³ Still, STK received much acclaim for its swift installation of the rest of the switches, after BTM and SEL had delivered their share. Moreover, the System 12 installation was regarded as major accomplishment, and Gunnar Tidemann claims it is one of the most outstanding technological achievements in Norwegian history.¹⁸⁴ STK installed 250 switches, serving 700,000 lines, before the end of 1987.¹⁸⁵ After having perfected its System 12 routines, STK hoped to recoup some of the losses by winning Televerket's next tender.¹⁸⁶ Televerket's was very satisfied with the System 12 network, which was confirmed when it used the option in the 1983 agreement to extend the contract by a further 200,000 lines.¹⁸⁷ The upgraded software, the Remote Subscribers Switches, the Network Service Centres and the Signalling No. 7, all functioned according to the plan. Televerket postponed the next tender in 1989, due to capacity problems, and instead it prolonged the agreement with STK. Thus, by 1991, STK had delivered 1.4 million lines, covering 40 per cent of the Norwegian network.¹⁸⁸

In addition to the low prices Televerket paid, the network was regarded as very modern and cost-effective. Thus, the System 12 project was a success for ITT and for Alcatel as well, as Norway functioned as a good showcase for the System 12. *Business Week* wrote an article about this in 1988, entitled: "How Alcatel turned a sinkhole into a success - The System 12 switch, a loser for ITT, is a winner for the French".¹⁸⁹ The article misses an important point, namely that ITT succeeded in its strategy, in using Norway and Televerket as a showcase for the switch, but this did not pay off before after the establishment of Alcatel N.V. Many PTOs sent representatives to Televerket to examine the network, which, according to BTM, improved

¹⁸³ "Kamp om milliardkontrakt" in *Aftenposten* 15.06.90.; Interview with Fredrik Thoresen, and Hans Jørgen Blomseth.

¹⁸⁴ Interview with Gunnar Tidemann.

¹⁸⁵ "Pionerarbeid i perspektiv" in *Åpen Linje*, nr. 14 1997 (Telenor's magazine).

¹⁸⁶ STK's Annual report 1987.

¹⁸⁷ STK's archive: File: "Televerket/Opsjon 88-89: Press release from STK and Televerket 16.12.86.

¹⁸⁸ This figure included 1.2 million subscriber lines and 200,000 transit lines. STK's annual report 1988; "STK brikke i ITTs spill" i *Dagens Næringsliv* 07.11.90. Totally, Televerket paid about NOK 3 billion to STK, in current prices, for the System 12 switches. It is difficult to make any assessment based on these figures, but there is a general opinion that Televerket paid a very low price per line, which contributed to its low subscriber charges in the 1990s. Interview with Bjørn Gladsø.

¹⁸⁹ *Business Week* 09.05.88.

Alcatel's sales of the system into the 1990s. It was particularly the Remote Subscriber Units and the Network Service Centres that caught the attention of the other PTOs. Thus, the System 12 became a key factor in Alcatel's growth during the following years. In 1990, a new contract was up for grabs in Norway.

Televerket arranged a new tender for digital switches in 1990, ordering 800,000 lines, with an option for an additional 500,000 lines. Televerket decided to have a closed tender, inviting Alcatel STK, Ericsson Norway and Siemens to hand in offers. There was little debate about this decision, probably because most people considered that the first tender had been sufficient in removing the «negotiated environment», and reducing the prices. An important difference in the 1990 tender was that Televerket did not demand Norwegian manufacturing. This was another sign of how digitalisation and liberalisation had changed the relationship between Televerket and the telecom industry. Digitalisation had erased any ambitions of a Norwegian switching industry, and liberalisation demanded that Televerket put price and quality before employment in its procurement policy. Still, STK stressed that the manufacturing of the circuit boards would take place in Norway, and that this would benefit the Norwegian telecom industry in general, and STK in particular. Moreover, STK insisted that Televerket would be better off with one digital system in the network. Thus, it tried to revitalise the logic of the oligopolistic grip.

Moreover, STK stressed that it was the only real Norwegian telecom company, that Ericsson Norway was more foreign than Alcatel STK.¹⁹⁰ Thus, the tactics had similarities to those used by EB in 1982, but the Simonsen issue had made Alcatel STK look very French. STK claimed there was a big difference from the tender in 1982; that time, the winner would have had to build up its capacity to supply digital switches, but this time, if Ericsson won, STK would have to reduce its capacity, while Ericsson Norway would have to increase its capacity.¹⁹¹ Televerket, for its part, was reluctant to give Alcatel and STK a monopoly in Norway. In fact, Ingar Hansen, who was responsible for the price evaluations, put an extra monopoly tariff on STK's prices, as he was certain that Alcatel would exploit an eventual monopoly in the future.¹⁹² LME dumped the price in much the same manner as ITT did in 1983, and was much lower than STK in the first round. Hansen says LME's price

¹⁹⁰ Some of STK's old-timers said to the newspaper that the Swedish PTO would never buy equipment from a Norwegian company, as Televerket did from a Swedish. "STK en kjempe i motvind" in *Aftenposten* 13.07.90.

¹⁹¹ Thor Viksveen, Alcatel STK's Director of public Relations: "Telekontrakten og industripolitikken" in *Aftenposten* 18.07.90.

¹⁹² Interview with Kjell Christensen; Televerket's board meeting 03.07.90: Televerket added NOK 350 millions to STK's offers.

was about half of Alcatel STK's. His impression was that LME wanted to win the contract, because it had seen how valuable Norway had been as a showcase for the System 12. And, as with ITT's dumping in 1983, it did not amount to much in LME's total economy, as Norway was such a small market.¹⁹³

When Televerket called for a price reduction, Aamodt gave a new offer without including the manufacturing of circuit boards at STK.¹⁹⁴ This decision caused many misgivings at Økern, and Knut Berg resigned in protest, as did Vidar Østreng, the director of switching.¹⁹⁵ Ericsson's offer was still much lower than STK's, so Televerket chose Ericsson in July 1990. STK, its unions and politicians in Oslo protested, not least because Oslo had lost many jobs during the previous years. Nevertheless, the Stortinget endorsed Televerket's choice, so Ericsson Norway won the contract. LME's price was decisive for Televerket's choice, as Televerket paid half of what the Swedish PTO had paid for the AXE during the same years.¹⁹⁶ The evaluation group said that Ericsson had defined a new price level with this offer.¹⁹⁷ Moreover, the AXE system had been upgraded considerably since 1982, and had advantages compared to the System 12, not least as it consumed only half as much electricity. The AXE was also able to accommodate Televerket's demand for centralised control through the Network Service Centres. A final reason for choosing the AXE was that this laid the ground for competition in the future between Ericsson and Alcatel.¹⁹⁸

Televerket's choice in 1990 sent STK's share price further down, and it fell to NOK 33 at the end of 1990.¹⁹⁹ It also prompted STK to shut down its telecom manufacturing at Økern and Kongsvinger. Several hundred people were laid off, and STK moved the rest of its minor manufacturing of telecom equipment to its newly acquired manufacturing subsidiary, Kitron, at Kilsund in southern Norway. STK's unions and the Norwegian Confederation of Trade Unions protested fiercely. It accused STK and Aamodt of merely executing orders from Alcatel's headquarters. These reactions said more about the feelings at Økern, than about Aamodt's rela-

¹⁹³ LME's sales in 1990 totalled 30 billion Swedish kroners, and the Norwegian digital contract of 1990 was worth around NOK 2 billion, for supply over four years. Thus, given that 100 Norwegian kroners equalled 100 Swedish kroners at the time, the Norwegian market accounted for 1.5 per cent of LME's turnover during the four years the installation lasted.

¹⁹⁴ Interview with Tidemann; "Arbeidere ofres i priskamp" in *Aftenposten* 09.07.90.

¹⁹⁵ Interview with Knut Berg; and annual reports from 1988 and 1990.

¹⁹⁶ Interview with Bjørn Gladsø.

¹⁹⁷ BGA: "Innstilling om valg av leverandør for utstyr til 90-årenes telenet, no date.

¹⁹⁸ BGA: "Innstilling om valg av leverandør for utstyr til 90-årenes telenett, no date.

¹⁹⁹ "Alcatel STK ble årets aksje i 1991" in *Aftenposten* 20.12.91.

tions with Alcatel. STK did get some new contracts from Televerket, first for the upgrading and extending of the already existing System 12 network, and later to install System 12 switches for the Winter Olympics at Lillehammer in 1994. Nevertheless, the writing was on the wall, and STK's days as a switching manufacturer was over. The 1990s, for STK's telecom business, are a story of downscaling.

The fall of the Norwegian telecom industry

Ivar Ørbeck elaborated on STK's situation while giving his contribution to the Norwegian Porter study, which was completed in 1992.²⁰⁰ As Ørbeck's contribution is illuminating, we need to take a look at it. Michael Porter's "cluster theories" resemble Bengt-Åke Lundvall's "system of innovation" perspective, in that interaction between economic actors spurs innovation. Porter argues that in a cluster, upgrading mechanisms develop due to demanding customers.²⁰¹ Hence, both Lundvall and Porter stress that innovations take place in the interface between firms. Ørbeck drew a dismal picture in his contribution to the Porter study, it sounded like the swansong of the Norwegian system of innovation in telecom, as he knew it.²⁰² He did not acknowledge that Televerket had been among the first to pursue a cost-efficient procurement policy in Europe, thus quite contrary to Porter's call for demanding customers. He claimed that this had happened at the expense of the Norwegian telecom industry. His main complaint was that Televerket and the TF offered fewer development contracts to STK than before.

Ørbeck recapped his perception of multinational companies, which had not changed since 1978.²⁰³ MNCs were technology and growth diffusers, and Norway, as a small country, needed multinationals more than other.²⁰⁴ At the same time, however, he conveyed that the R&D in multinationals were much more centralised than before, due to liberalisation and the transition from local to global products. Nevertheless, Ørbeck advocated the same policies towards STK as before, even though he recognised that the negotiated environment or relational setting had changed completely. Ørbeck's point was that Televerket's neglect of the national telecom industry was short-sighted. The PTO might obtain low-cost equipment in the first years, as the development costs of the equipment were covered in the protected home-market of

²⁰⁰ Torger Reve and Terje Lensberg and Kjell Grønhaug: *Et konkurransedyktig Norge*, 1992.

²⁰¹ Michael Porter: *The Competitive Advantage of Nations*, 1990, p. 19.

²⁰² IØAii: Ivar Ørbeck 15.01.92: "Et konkurransedyktig Norge - Telekommunikasjon".

²⁰³ IØPAi: "STK - norsk deltager i det verdensomfattende multinasjonale selskapet ITT", 27.09.78.

²⁰⁴ IØPAi: "STK - norsk deltager i det verdensomfattende multinasjonale selskapet ITT", 27.09.78.; IØAii: Ivar Ørbeck 15.01.92: "Et konkurransedyktig Norge - Telekommunikasjon".

the multinationals, but in the long-term these prices would even out in an open market. In the next phase, when Televerket, in its own competitive setting, needed national partners, Ørbeck claimed, they might be gone. Hence, Televerket would also be the victim of such a policy.

Ørbeck told the Porter group that STK's future ought to be bright, given “the considerable competence Alcatel STK A/S has gained in modern digital net-systems” and the “international connection the company has through Alcatel N.V”.²⁰⁵ He said that even if Alcatel would have the main responsibility in supplying Televerket, STK would direct its effort towards developing system components for the System 12 network. STK was given a chance to do just this, when it signed a development contract with Televerket in 1993: to develop and supply a software-based solution for business communication within the public System 12 network. It was called Alma Centrex, and in a sense it was the successor of the old PABX.²⁰⁶ Anne Kristine Børresen has documented how STK and Televerket “network cooperation” was far from a success.²⁰⁷ It is interesting to see that the problem STK encountered with the Alma Centrex was very similar to the ones it had faced with the 11B and System 12. The main problem was that the technical specifications for the product were not good enough; thus, due to a poor start with many delays, unexpected expenditures arose. Once again, STK underestimated the complexity of a project, and proved it lacked the capability for complicated programming and software handling.

The project almost broke down several times, due to disagreements among the parties, the main reason being that Alcatel STK thought Televerket should cover some of the extra costs. Moreover, it proved to be very difficult to use the software in the AXE switches, which also hampered the possibilities for exports. Alcatel STK's engineers complained that Televerket was too narrowly oriented on earning money, and too little engaged in industrial development. In Alcatel STK the prevailing attitude was that Telenor had abandoned the cooperation with them because the PTO was too business-minded, according to Børresen, and Alcatel STK felt “unfairly treated by one of its old partners”.²⁰⁸ Her explanation of Televerket's “new” toughness towards STK was that the competition from new service providers demanded a

²⁰⁵ IØPAii: Ivar Ørbeck 15.01.92: ”Et konkurransedyktig Norge - Telekommunikasjon”.

²⁰⁶ It was called Alma Centrex, and was an external support system for the System 12. The technological product was a software program that constructed a virtual network for business communication, which was closed to other parties. Anne Kristine Børresen: “Alma Centrex; Et nettverkssamarbeid mellom Alcatel STK og Telenor” in Britt Dale, Ragnheidur Karlsdotir, Ola Strandhagen (red.): *Bedrifter i nettverk*, Trondheim : Tapir akademisk forlag, 2004.

²⁰⁷ The following is based on Børresen 2004.

²⁰⁸ Børresen 2004, p. 255.

greater price-consciousness. This thesis shows that Televerket's toughness was far from new, as it had been a demanding procurer since before the digital contract in 1983. Still, Børresen points to a key issue, namely that Televerket no longer had a monopoly as a provider of telecom services. An important consequence in this analysis is that Televerket was no longer a monopsonist.

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Ørbeck was right when he said that Televerket/TF offered fewer development contracts: one reason was that the TF lost its independent role within Televerket around this period, and was reduced to a support unit. The TF's director, i.e. Knudtzon's successor, was no longer a member of the management group.²⁰⁹ Another reason was that Televerket became more cautious with spending on R&D, as the politicians and the public demanded a more cost-efficient PTO. This was a general phenomenon among other PTOs.²¹⁰ Thus, the large public expenditure on R&D, through the PTOs, which functioned as subsidies for the telecom industry, diminished in this period. Televerket/TF had also lost in faith in Knudtzon's old policy of helping STK and EB to obtain a mandate within their multinationals. One thing was the poor experience in the past, as with Alma Centrex, another was that the negotiated environment had disappeared, and Televerket was no longer expected to be an industry provider. It was expected to be a service provider, and to follow a corporate governance system similar to that of private enterprise, i.e. to generate sufficient return on invested capital.

Another important development trait during these years was that the multinational telecom industry centralised its R&D. There were several reasons for this. First, the increased R&D costs made it compulsory to avoid duplication; second, less R&D was needed for adapting global products in a "seamless" network; third, liberalisation led to reduced need for national responsiveness; and finally, the subsidiaries obtained less public R&D funding. Moreover, the PTOs' R&D spending in general decreased during these years, whereas the R&D spending of the telecom industry increased.²¹¹ Whereas the "'innovative engine' was located largely in the central research laboratories of the monopoly network operators" before, according to Mar-

²⁰⁹ Collett and Lossius 1993, p. 192.

²¹⁰ "There was relatively little pressure on the R&D function to prove that it was paying its way". Fransman 2002, p. 220.

²¹¹ "R&D-intensive activities, mainly relating to the elements that go into networks, have moved decisively into the specialist technology suppliers, (Cisco, Ericsson, Nortel, Lucent and Nokia). These specialist technology suppliers are some six times as R&D-intensive as the incumbents AT&T, BT and NTT." Fransman 2002, p. 48.

tin Fransman, the new “‘R&D engine' has moved decisively into the specialist technology suppliers.”²¹² As STK received fewer development contracts from the TF and other public bodies, Alcatel ordered Aamodt to close down the FA in 1995. The rest of STK's management was allegedly shocked, even if the writing had been on the wall for a long time.²¹³

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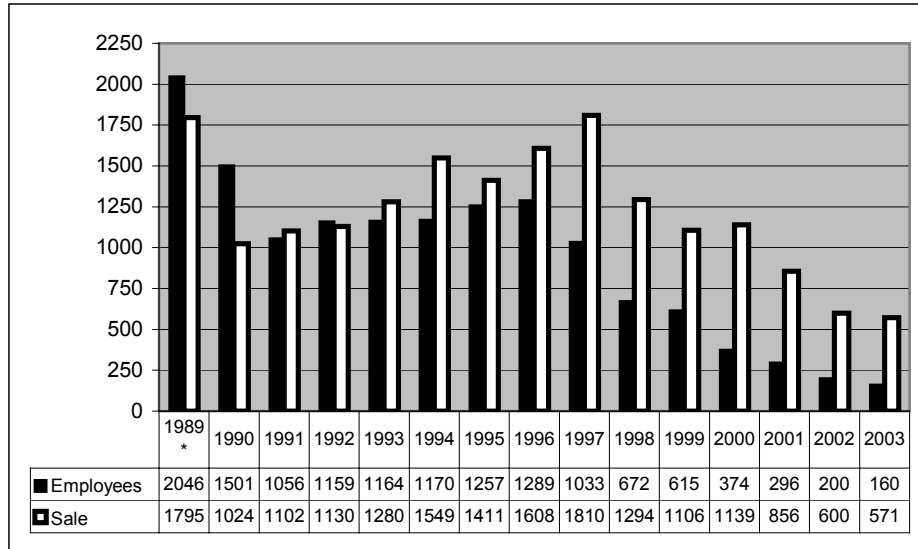
The downscaling of STK's telecom business started before it lost the contract in 1990. The workforce needed for supplying Televerket with System 12, was much less than had been needed for the electro-mechanical switches. Thus, this was part of the international *deindustrialisation* process, which for the telecom industry commenced with the development of the computer-controlled switch - the SPC switch - in the mid-1960s. STK's Ivar Mo gives an illuminating numerical account of the process. One 8B line cost Televerket NOK 5000 in 1974, and half of the value creation was done by STK, i.e. NOK 2500 per line. One System 12 line in 1990 cost NOK 1500, but STK's share of the value creation was only 5 per cent, or NOK 75.²¹⁴ The main technological reason being that all the manual (re)wiring the electro-mechanical 8B switch had required had now disappeared into the microchip, and with it, thousands workers lost their jobs. Alcatel STK's telecom business was reduced from over 2000 employees in 1989 to 1500 in 1990. The development from 1990 to 2003 is as follows:

²¹² Fransman 2002, p. 48.

²¹³ Interview with Ivar Ørbeck.

²¹⁴ Interview with Ivar Mo.

Table 7.1: Alcatel Telecom Norway's employees and sales (NOK millions), 1989-2003.



Source: Annual reports and alcatel.no. (*The figures for 1989 are not comparable with the others, but give an indication of the pattern.)

The increase in Alcatel Telecom Norway's (ATN) sales in 1997 was because it was merged with another division, Alcatel Telettra. This was an access company that Alcatel STK bought in 1993, and it provided broadband solutions for business. Combined with STK's own competence in access-technology, which had roots in the PCM contract in the early 1970s, it had great success on the export market. It became the main supplier of fibre optics for British Telecom in the mid-1990s, and won a contract worth NOK 600 million in 1997.²¹⁵

Telettra's success was noted in Paris, but it was not able to attain a leading position within Alcatel; a Spanish company with similar competence became Alcatel's lead house in the field. This supports the notion that subsidiaries from neighbouring countries to the multinationals' home country have a bigger chance of attaining leading roles. Or, subsidiaries from bigger countries, like Spain, have better chance than subsidiaries from smaller countries, like Norway. ATN's director at the time, Ingvild Myhre, thought that the geographical and cultural distance between Oslo and Paris was a disadvantage not least that Norway was not a member of the EU.²¹⁶

²¹⁵ Alcatel Telecom Norge's Annual report 1997; "Stor kontrakt til Alcatel" in *Aftenposten* 10.04.97.

²¹⁶ Interview with Ingvild Myhre.

Telettra's fate, as well as other incidents, made it clear to several managers, that it was futile to try to attain a lead-house position within the French multinational.²¹⁷ ATN was strong on Internet, smart-house and software development in the 1990s, claims Myhre, but it was impossible to get any positive backing from Paris on these things.²¹⁸ ATN divested Telettra in 2000, through a management buy-out, to give the company a new start outside Alcatel.²¹⁹ Telettra, or Axxessit as it is called today, might be the most promising company at present, with roots in STK's telecom business.²²⁰

STK's former defence division has a leading role in the French multinational Thales, selling equipment for defence communication. The Norwegian subsidiary had almost 300 employees, and exports worth about NOK 40 million annually, in 2004.²²¹ In a restructuring of the French electronics industry, Alcatel sold its defence activities to Thomson-CSF in 1997, in return for shares in Thomson-CSF. The minority shareholders in STK protested, asserting that the French owners sat on both sides of the table, and that STK did not get enough money for its defence business, particularly the technological remains of the nodal switch. STK carried out an investigation of the deal, and a due diligence of the defence division, which concluded that the price was fair.²²² Nevertheless, it reflected a conflict between the Norwegian shareholders and the French majority owner. Aamodt and Thoresen were depicted as "errand boys" for Alcatel, and Thoresen chose to resign in 1999.²²³ The last Norwegian shareholders were forced out of Alcatel STK in 2000, and the papers wrote that the starved Norwegians gave up.²²⁴ Just after this, Alcatel STK performed a sale and leaseback arrangement on its real estate at Økern, which allegedly was worth more than the company's total market capitalisation when the last Norwegian shareholders were forced out.²²⁵

²¹⁷ Interview with Ingvild Myhre, Henry Kleive, and Dag Haug. Kleive and Haug were managers in Alcatel Telecom Norway.

²¹⁸ Interview with Ingvild Myhre.

²¹⁹ "Dobbelt sikring" in *Teknisk Ukeblad* 28.09.00., Interview with Bjarne Aamodt, Managing Director in Alcatel STK 1988-1999.

²²⁰ In the summer 2005, Ericsson tried to buy Axxessit, "Ericsson vil ha Axxessit" in *Elektronikknett* 20.06.05.

²²¹ Interview with Jens Gjerdsjø.

²²² STKA: "Granskingsrapport til Bedriftsforsamlingen i Alcatel STK ASA."

²²³ "Franske løpegutter i Alcatel STK" in *Dagens Næringsliv* 05.06.98.; Interview with Fredrik Thoresen.

²²⁴ "Alcatel-krigen: Utsultede nordmenn gir opp" in *Aftenposten* 24.06.00.

²²⁵ Interview with Christopher Harper, legal director of (Alcatel) STK.

In 2000, Alcatel floated its cable business, calling the company Nexans. The only corporate remains of STK's telecom business are ATN's 160 employees. "STK" as a name disappeared in 2003, when the holding company Alcatel STK dissolved itself. In April 2004, Alcatel Norway moved from Økern to Fornebu, to be located closer to its main customer Telenor. For EB the circle was ended when Ericsson took it over in 1990. After having been more and more nationalised through Kveim's tenure in the 1970s, and depicted as a Norwegian company, it became a wholly owned subsidiary of LME. The downsizing of Ericsson Norway has taken longer, and it has had a more prominent role within LME, than STK had within Alcatel in the 1990s, and it considered itself as a lead house in data communication.²²⁶ This role is definitely over. The Billingstad headquarters has been nicknamed the *Departure Hall*, as the number of employees was reduced from 1222 in 1998 to 350 in 2004.²²⁷

So, the remains of STK and EB have virtually disappeared. Little came out of the ambitions to create a vibrant telecom industry in the Norway.²²⁸ Millions of kroners were invested in industrial development at STK and EB, on the 11B, the nodal point switch, maritime satellite communication and other projects. True, some offspring do exist: Nera, Thales and Axxessit, but given the magnitude of the investment, this is rather modest. We remember that TF's Knudtzon wanted to help STK and EB "win the internal MNC competition among the subsidiaries, so resources and mandates could be allocated to Norway with possibilities for export". Instead, Televerket developed into a lead customer for ITT and LME. Telenor has replaced the industry as the potent vibrant company, with potential for future business. We remember how Televerket had difficulties recruiting competent personnel, as the engineers preferred STK and EB. Over the last twenty years, Telenor has recruited several of its top managers from STK and EB.²²⁹ The old bureaucratic whipping boy has become the national ICT locomotive.

Televerket - a world leader

In a few decades, the Norwegian telecom network was transformed from backwardness to one of the most modern in the world.²³⁰ It was fifth in the world in terms of

²²⁶ Sogner 2002, p. 120 f.

²²⁷ http://www.ericsson.com/no/presse/pressemeldinger/2003_09_22.shtml; "Det er i motgang at du skal synes" in *Computerworld.no* 24.12.04.

²²⁸ Few would call Nera vibrant today, as it has been fighting aggressive shareholders during recent months, and its satellite technology never took off.

²²⁹ A few of many examples are Bjarne Aamodt and Ingvild Myhre from Alcatel STK, and Peter Pay from EB.

²³⁰ Thue 2006: "Already at the beginning of the 1990s, we had one of the most modern and digitised (networks) in Europe"

telephone density in 1989, up from 14th in 1983; it was world-class in usage, density and overall growth in mobile telephony, telefax, and data communication; Televerket's productivity growth between 1984-1989 was, according to itself, the highest in the world; and its willingness to invest in modern advanced technology went beyond that of other PTOs.²³¹ Norwegian subscribers paid the highest call rates in Europe in 1970, but business subscribers had among the lowest rates in Europe in 1991, while the same was true for private subscribers in the mid-1990s.²³² "We were so satisfied with ourselves in the late 1980s", recalled former employee Kåre Aarvik, "that the only thing we lacked was the Lord's blessing".²³³

There are several reasons for Televerket's development into a world-class PTO in the 1990s. A very important factor is the joint efforts by Televerket and TF within the field of data communication and mobile telephony. Coming from a small country, Televerket's contributions to international specifications for both data communication and mobile telephony are outstanding. Halvor Bothner-By's central role in developing CCITT's X.25 standard, a protocol for packet switched data communication, was a sign of Norway's standing in the field.²³⁴ The same goes for the contributions of Jan Audestad, Torleiv Maseng and others in developing the GSM system for mobile telephony.²³⁵ Nevertheless, this thesis is not about data communication or mobile telephony: its technological focus is on switching, which, at any rate, is an essential area in comprehending Televerket's development into a world-class PTO in the 1990s. First, when Televerket had among the lowest call rates in Europe in the 1990s, it was due to the low prices it paid for the System 12 and AXE.²³⁶ Moreover, the System 12 and AXE, along with Televerket's demands, laid the foundation for efficient network operations.

An important asset from the System 12 was the *Remote Subscriber Units*, i.e. small local switches, operating between 100-1000 lines. This became the final solution to the problem of rural switches in sparsely populated Norway. We remember from chapter 4 that rural and small switches created an economic dilemma, as the processor was too expensive for such small switches. The Remote Subscriber Units solved this by having limited "intelligence", thus a less costly processor. They obtained the

²³¹ Internal memo from Televerket/TF date 15.05.90, signed by Helge Godø, here after Thue 2006.

²³² Interview with Bjørn Gladsø, Thue 2006; "Ikke prisras på tele-tjenester" in *Aftenposten* 31.08.95.; "Restmonopolet i telesektoren avvikles" in NTB 24.05.96.

²³³ Aarvik, p. 130, here after Thue 2006.

²³⁴ Paulsen 2004, p. 59.

²³⁵ Kathrine Skretting: "Da GSM ble til", 2002; Thue 2006.

²³⁶ Interview with Bjørn Gladsø.

required intelligence from their mother switch.²³⁷ Another important feature of the System 12 network was that it could be operated in a centralised manner, through the *Network Service Centres*. There were two national service centres, one in Trondheim and one in Oslo. The centralised, and thus simplified, operation through the service centres was a major reason for Televerket's low call rates.²³⁸ Moreover, they signified that a long process had come to an end, that finally, the network had become one technological system. We recall that the national automation transformed the national network from several local networks, bundled together by long-distance lines, into one integrated technological system; however, this process was completed by the introduction of the National Network Service Centres.

Both the RSU and the NSC were developed through the Norwegian System 12 contract, in cooperation between ITT and Televerket. Other PTOs admired and copied these features, and they became important assets in marketing the System 12 during the following years. A pre-condition for the “dumb” RSU switch, as well as NSC, was communication between the switches, which entailed a good signalling system. This would, in time, mean an end to the problems with inter-faces between different switches. The old weed-flora was finally replaced by an almost seamless network. Televerket was the first PTO in the world to demand the use of Signal System No. 7 in the 1983 tender. It was chosen as the international standard by CCITT. In addition to making the operation of the telephony network better, No. 7 was essential for the ISDN.²³⁹ “System 7 must be regarded”, claim Chapuis and Joel, “as one of the pillars of any ISDN”.²⁴⁰ Thus, INDIG's demanding specifications did not merely contribute to a very good telephony system, but also led to increased use of other digital services in Norway. Norway, along with Germany, became world leaders in installing ISDN.²⁴¹ Thus, by focusing on telephony as the backbone of the telecom network, the TA and INDIG were able to accommodate the TF's vision of digital services.

Besides increasing efficiency in operating the telecom network, Televerket/Telenor has also gained from providing Value Added Services (VAS). An important reason for its success in this field was the technological foundation that was laid in the network; the control and oversight Televerket had over the network; and its willing-

²³⁷ The RSUs were also economical because they were so small they did not need their own housing. Interview with Rudy Scholliers.

²³⁸ Interview with Magnhild Slettbak.

²³⁹ Thor A. Halvorsen:” Signaleringsystem nr. 7” in *Elektronikk nr. 2 1982*, p. 138.

²⁴⁰ Chapuis and Joel 1990, p. 486.

²⁴¹ Interview with Thor A. Halvorsen; Some will claim that ISDN was a blind alley in data communication, but few said that in the early 1990s.

ness and proficiency in choosing the best technology. Televerket's choice of the AXE, instead of the System 12 in 1990 is important in this relation. One thing is that it would avoid a monopoly from Alcatel in the future, but another is that Televerket gained experience from two digital systems, and broadened its access to the technological development that took place among the multinational equipment suppliers. Perhaps most important of all is the fact that Televerket would not be caught up in one system, as the Swedish PTO was with Ericsson. At a seminar in Norway in the early 1990s, Mats Fridlund presented his work on the relationship between the Swedish PTO and LME, for which he coined the term *development pair*. Televerket's Ole Petter Håkonsen stressed that he was relieved that Televerket never had been caught up in such a pair.²⁴²

Televerket/Telenor's network competence has also been a valuable for its large mobile operations. Its ability to "roll out networks" in other countries has roots in the INDIG group. The international mobile business was regarded as very promising and as the future of Telenor's business, but Lars Thue has shown that the financial results of Telenor's international business and VAS have been modest, and that its main source of revenues has been the network in Norway, both the GSM network and the fixed network, which includes mobile telephony, ISDN and ADSL. The figures for 2000 are illuminating. Telenor's total net operating profit was NOK 3,629 billion, the fixed network's share was NOK 3,047 billion, and for mobile telephony in Norway, NOK 2,216 billion. Thus, these two network-based business areas accounted for 145 per cent of Telenor's net operating profit.²⁴³ This may very well be due to monopolist pricing, as Telenor had a market share of about 96 per cent of the fixed network in Norway, but it also reflects the efficient network Norway has, i.e. Telenor's low costs in running the network. Even though the fixed network has been the financial backbone of Telenor during recent years, it is still the only Norwegian telecom company with a global potential.

Conclusion

Televerket's decision to install the System 12 proved to be ruinous for both STK and EB. It was a Pyrrhic victory for STK, as it lost NOK 700 million on the contract, which was twice the company's market value at the end of 1990. How was such a disaster possible? How could Fredrik Thoresen, with his dedication to financial control, misjudge the situation in such a manner? One reason, as Chapter 6 concluded, was Thoresen's commitment to ITT as the main stakeholder. Still, the main

²⁴² Seminar at the Norwegian School of Management 08.03.96.

²⁴³ Thue forthcoming, chapter 6.

cause was that ITT did not stand by its inter-company agreements. Even if Thoresen could be quite cunning in business, he probably never imagined being double-crossed in such a way as he was by BTM/ITT. Another vital factor was his lack of understanding of telecom. If he, or the others responsible for the System 12 at STK, had investigated the real problems with the 11B, they would have been more able to assess the information BTM gave them regarding the System 12. Better integration or more cooperation between STK's many switching projects in the 1970s would also have been beneficial. There is an irony in that Thoresen's financially grounded disbelief towards telecom-related R&D contributed to STK's greatest-ever financial loss.

STK's problem was that it was naive in its unreserved loyalty to ITT, while EB was equally naive in its confidence as a national champion and as an important stakeholder of Televerket. It was fair enough that EB based its corporate governance on this presumption in the 1970s, but Kveim failed to take sufficient notice of the changes that were bound to follow from digitalisation and liberalisation. First, it cost them the digital contract, and then it afflicted the company through the corporate raids. Kveim was a brutal victim of his failure to adjust to the shareholder revolution. The contrast between Kveim and Bjørum's meetings with Munch and Almskog in 1976 and 1984 is illuminating. EB bought Nera to accommodate political stakeholders in 1976, whereas Investa bought EB to accommodate financial shareholders in 1984. The climate in politics and business had shifted, so the capital market had become a central arena for conducting and structuring business. Kveim had mastered the old politicised era, where technological engineering had primacy, while Investa's people had mastered the liberal era, in which financial engineering prevailed.

Investa's shrewdness earned the company NOK 1 billion on the EB adventure. Hence, both STK and EB were deprived of their financial reserves during this decade, by ITT and Investa respectively. To a large degree, these reserves were built up by the high prices Televerket had paid for its equipment. Some considered these high prices as a means of bringing about a stronger Norwegian telecom industry, but it turned out very differently. That is not to say, however, that STK and EB would have found good telecom projects to invest money in. In retrospect, however, it seems that Harlem's attempt to buy Simonsen was sensible. There was no guarantee that Alcatel STK would have succeeded in turning it into a success. Still, it would have been a cheap lottery ticket to take part in the Scandinavian mobile-phone wonder, and with guaranteed backing from Televerket. Lack of capital was not the main obstacle for STK to develop into a lead house, as the new institutional setting in the

Norwegian telecom sector and the strategy and structure of Alcatel were more important.

The French policy makers in telecom contributed strongly to the fall of ITT's telecom business, before taking it over. ITT was perhaps one of the most globalised companies in the world before 1980, but fell apart as globalisation took off. Alcatel's self-portrayal as a European champion held promises of improved chances for STK to develop into a lead house. Alcatel stressed it would pursue an integrated strategy, to avoid duplication of manufacture and R&D, and to take advantage of the competence of each subsidiary and home country. In hindsight, however, it seems that this was mainly lip service to gain political support for the new European telecom giant. It was not only French nationalism that had led to Alcatel's centralised and hierarchical structure, but also digitalisation and liberalisation. The main reason was that the rapidly increasing R&D costs called for more centralisation in order to avoid duplication of R&D. The other reason was that it was harder for local R&D units to attain public funding. The liberalisation led PTOs to abandon their role as industry providers; focused on its financial results, they cut back on industrially motivated development contracts. Televerket did give STK a chance in the Alma Centrex project, but STK failed. Alcatel did not have to worry about national responsiveness, and when it was impossible for STK to attain sufficient funding for the FA, it was closed in 1995.

Thus, the Norwegian system for innovation in telecom, meaning the system that was institutionalised in the late 1960s, and based on development contracts from the TF, started to evaporate in the early 1990s. This is what Ørbeck complained about in his account to the Norwegian Porter study in 1992, that when the development contracts dried up, the innovative relationship with Televerket disappeared. Still, a system of innovation should not be equated with a system of development contracts. It is also points to the user-producer relations in any given industry. In describing such interactive relations, there is a difference between the system of innovation and the Porterian approach. For Porter, these relations are in concordance with market behaviour, thus, he uses the phrase buyer-supplier. In contrast, Bengt-Åke Lundvall stress that "pure market interactions" are "incapable of transmitting the qualitative information between users and producers".²⁴⁴ The relation between Televerket and STK, regarding the digital contract, resembled a buyer-supplier relation in accordance with Porter. This was confirmed with the Alma Centrex project, when Televerket preferred a contractual relationship. Televerket's relation with BTM is also best described as Porterian buyer-supplier relation. It was Televerket's role as a

²⁴⁴ Lundvall et. al. 2001, p. 218.

demanding and competent buyer that spurred the innovation in the relation, not a cooperative user-producer relation.

Hence, it was not only the vanishing development contracts that signified the death of the traditional Norwegian system of innovation in telecom, but also the fact that Televerket opted for multinational buyer-supplier relations to meet its future needs, and not national user-producer relations. Ørbeck warned against this development, claiming it would harm Telenor's development in the long run. In doing this, Ørbeck was in line with Lundvall's emphasis on national relations for innovation. Looking to the future, this might suggest that Telenor is faced with a problem. Looking back at the history of Norwegian telecom sector, however, one can conclude that a "multilateral system of trust relationships" does not necessarily develop within a national system of innovation - especially if the industry is dominated by small foreign subsidiaries.

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It is pretty straightforward to point to the forces that led to the downsizing of STK's telecom business, from around 2000 employees in 1989 to below 200 in 2005. Digitalisation and liberalisation freed Televerket from the industry's oligopolic grip, and eradicated the negotiated environment in the Norwegian telecom sector, which to a large extent had underpinned STK's telecom businesses. Still, this is not sufficient to explain the fall of the Norwegian telecom industry. Digitalisation and liberalisation also opened a window of opportunity for entering the telecom industry. It is impossible to explain the emergence of Nortel, Alcatel and Nokia as global companies, by pointing to the "general" consequences of digitalisation and liberalisation. One must include internal factors, i.e. how these companies were positioned when the electronic revolution started in the 1960s, and *how* these companies went through the digitalisation and liberalisation the following decades. Therefore, a central reason for asking *how* STK and the Norwegian telecom sector went through the digitalisation and liberalisation process, has been to detect key reasons for why Norway - with its strong capabilities in telecom - did not succeed in using the window of opportunity to create an Ericsson or a Nokia.

By analysing how STK and Televerket went through this transformative process, we have learned that an important reason why Televerket never wanted to support a project to develop a digital switch in Norway was the trouble it had with STK's 8B and 11B switches. Furthermore, we have learned that it was difficult for the government to pursue an industrial policy with STK and EB as partners, as they were more inclined to being loyal subsidiaries, than Norwegian high-tech companies. For STK, the heritage of ITT's Harold S. Geneen proved decisive, as it shaped Fredrik Thoresen's corporate governance philosophy, in a way that was not beneficial to STK as an innovative enterprise in telecom. Finally, by asking how digitalisation and liberalisation affected STK's initial relational setting, between Televerket - STK - ITT, we have learned that as STK deteriorated, Televerket excelled. Televerket succeeded in exploiting the window of opportunity to become a world leader, which was not an obvious outcome of digitalisation and liberalisation in Norway. In fact, very few would have presumed that the old scapegoat would have achieved the global rank it did. In the following we will look a bit closer into these issues.

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The background and foundation for STK's telecom business was Telegrafverket's procurement of Rotary switches. In the first chapter, we saw that this took place after a competitive tender in the 1910s, where Telegrafverket used its procurement

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power, as it was not confined by the oligopolic grip. It was not expected to take stakeholder considerations into account, by, for example, caring for EB's workers or national industrial development. Moreover, as it was the first automatic switch, Telegrafverket was not constrained by path dependencies, i.e. technological interfaces and the need for competence to upgrade incumbent switches. Furthermore, it had relatively good knowledge of switching when arranging the tender, stemming from cooperation with other PTOs and international conferences. After having installed the first automatic switches from STK and EB, however, Telegrafverket was trapped in the oligopolic grip, which underpinned the Lillehammer agreement. In the following years, the automatisisation and oligopolisation strengthened the industry's grip on the PTO. Path dependencies made their mark, as did Telegrafverket's stakeholder duties. Finally, Telegrafverket's knowledge of switching decreased compared to that of the national and international equipment suppliers. Consequently, the oligopolic grip became ITT's main ownership advantage as a foreign investor in Norway.

Telegrafverket's dependence on the industry increased when it became a victim of ITT's internal crossbar competition, and thus a lonely rider with the 8B switch. A main source of revenue for STK, and thus a main cost for Telegrafverket, was to fix ad-hoc problems with the 8B, often with a home-made solution. It appears paradoxical, however, that while Telegrafverket took a chance in procuring the 8B switch from STK/BTM, it also declined to procure, and thus support, Nera's radio link equipment. The oligopolic grip offers a sound explanation for this. In relation to the 8B, all five fingers made their mark, but especially Telegrafverket's lack of competence: turning it into BTM's guinea pig. In terms of Nera's radio link, it had sufficient competence and confidence in transmission to fend off the critics, who insisted on Telegrafverket's role as an industry provider. Both of these issues, the 8B and Nera's radio link, had a strong bearing on later developments. The 8B from around 1970, when it caused problems in the Oslo network, while the radio link issue had an immediate impact, in creating and shaping the institutionalisation of a new R&D system.

The radio link conflict, led to the establishment of the Committee of Electronics. The main message of the committee's report was that Telegrafverket had to start doing research. Its arguments were in line with the normative assumptions of the SI approach that were developed in the mid-1980s. Still, the SI literature stresses that innovations are often incremental, a result of learning by doing, or trial and error in a constant process of generating higher quality and lower cost products. The TF, or the FA for that matter, was always somewhat detached from the operational activities of Televerket and STK. Thus, there was a system *for* innovation. Being a re-

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search institute, it was not surprising that the TF contributed to this. Moreover, its theoretical approach was valuable in putting the accent on long-term planning and strategising within Televerket, and in bringing forth the new perspectives the electronic revolution and digitalisation offered. The TF's origin in the radiolink conflict, however, probably made it even more distant from everyday operational business, thus, explaining, among other things, its inclination to engage mathematicians to get to the bottom of switching. The arm's-length approach to everyday business was a good strategy for Bell Labs, where the number of Nobel Prizes was a parameter for its success.¹ It did not, however, make the TF the successful industry provider it was meant to be. One example is how the TF's theoretical approach hampered EB's project on maritime satellite communication for years.²

TF was important for turning STK into a high-tech company in the 1970s, but did not outweigh Thoresen's influence. His heart and soul was in cables, where he had experienced lucrative innovations through learning by doing. For him, R&D ought to be justified by credible possibilities for making profits in the foreseeable future, something he had witnessed in the cable business. As such, he was caught in a linear perception of technological development, failing to recognise that R&D is only one of several factors in innovating. Research is important in codifying knowledge, and by that increasing the absorptive capacity and the potential for incremental innovations. Thoresen's financial focus was hardly beneficial for STK as an innovative enterprise. O'Sullivan and Lazonick have shown that an innovative enterprise requires different, in some cases opposite, conditions and perceptions than a financial perspective provides. First, Thoresen failed to facilitate *organisational integration*, thus impeding collective and cumulative learning in STK's telecom business. The company's was engaged in five different switching projects in the 1970s, and the cooperation was negligible, while the antagonism was noticeable.

Moreover, neither Thoresen, nor Gunnar Tidemann, the head of STK's telecom department from 1974 to 1987, was in a position to perform adequate *strategic control* over STK's telecom business. The main reason was that they lacked the proper technological understanding of the field, which was all the more important as the industry went through radical technological changes during their tenures. It hampered STK as an innovative enterprise, because the managers were not able to induce organisational integration, and because it failed to equip STK's telecom business with a technological strategy behind its substantial R&D efforts. The lack of

¹ The researchers at Bell Labs have been awarded seven Nobel prizes.

² Lossius 1991; Christensen 1999; Interview with Håkon Otterlei, director of Elektrisk Bureau's activities in maritime satellite communication.

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strategic control is important in explaining how STK could spend millions of kroners on finalising the semi-electronic 11B switch, while the rest of the telecom world, like Alcatel and Nokia, allocated R&D resources to computer and digital technology. It was very different from Televerket's strategy.

Televerket's decision to install SPC switches in 1971 was early in a global context. At some point, during the 1970s, Per Øvregaard sanctioned Bjørn Gladsø's strategy of leaving the old electro-mechanical world behind. Televerket could have spent millions of kroners trying to fix the 8B and straightening out the old weed flora, but it would have been a waste of time. Here lies the answer to what STK's Nils Kåre Myklebust thought was a paradox in the second half of the 1970s: that Televerket wanted all the features of the SPC switches up and running, like automatic re-direction, wake-up calls, and speed dialling, while it had problems providing the dialling tone for other customers. Thus, in contrast to STK, Televerket decided to concentrate its resources on the future technology, with the aim of being one of the best PTOs in the world on the electronic and later digital switching. Televerket's use of tenders in its procurement policy was not merely to reduce the price, but to make the equipment suppliers meet Televerket's specifications and demands. There is little doubt that the TA, and later INDIG, thrilled in being a demanding customer, finally getting the upper hand in the relation, holding STK and EB in its own grip.

Digitalisation and liberalisation were processes that telecom companies had to confront, one way or another, and there was no way of escaping the transformative forces of these interconnected processes. Hence, the organisations' freedom, i.e. their room for strategic manoeuvre, lay in how they confronted these interrelated developments. STK's handling of digitalisation and liberalisation was hardly proactive. It did not allocate the resources to upgrade its competence in computerised switches, and it did everything it could to halt the liberalisation of Televerket's procurement policy. It held on to its oligopolic grip from Televerket's first use of competitive tenders in the early 1970s right into the 1980s. As stated in the introductory chapter, STK's strategy in these matters was limited to responding to ITT and Televerket's shifting policies and strategies. As such, it proved very loyal to ITT, not least in relation to the digital contract. Hence, in its telecom business - in sharp contrast to its cable business - STK was more like a small subsidiary than a large high-tech company. A main reason was the strength in the oligopolic grip, with which it held Televerket. It is likely that the complacency and lenience, which Thoresen claims it had, was a result of the strong oligopolic grip.

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Moreover, the relative strength of this grip made Televerket proactive in confronting digitalisation and liberalisation. “Televerket was completely dependent on the suppliers”, says Gladsø, and operated with no demand specifications towards the suppliers.³ Most European PTOs went through such a development, i.e. increasing their competence in switching and specifications, and international cooperation and the nature of electronics paved the way for this. Still, the problems with the Oslo network and the 8B around 1970 made Televerket a frontrunner in freeing itself from the oligopolic grip. In some cases the loosening of the oligopolic grip led to tighter relations between the PTOs and the national industry. In some countries, like France, Britain and to a certain degree Finland, this was a matter of freeing itself from the multinational telecom companies. So, when the French broke the oligopolic grip, it freed itself from the multinationals, i.e. ITT and LME, to promote its national industry. When Televerket freed itself, however, it did so from the national industry, to cooperate with a BTM. An important background for Televerket's choice was that the relationship with EB was harmed by moral hazard, and STK had proved that it lacked the competence to support Televerket.

Perhaps the Norwegian telecom industry was doomed, as long as it was foreign-owned. Thus, perhaps the main reason Finland has a Nokia was that its telecom industry was not dominated by foreign subsidiaries. Still, Alcatel's rise to prominence goes against this. Then again, the method that the French government used to eradicate ITT and LME's subsidiaries could hardly have been applied by a small country like Norway. Nevertheless, STK and EB had room for strategic manoeuvre in what Doz called the negotiated environment. This was evident when Televerket's chairman and vice president, Egil Abrahamsen and Finn Lied, invited them to discuss a new structure in the Norwegian telecom industry in 1981, in relation to the tender for digital switches. If Thoresen and Kveim had sided with the Norwegian authorities in this instance, there is a good chance that ITT and LME would have yielded in order to maintain their business. This was a last opportunity for the two companies to take structural steps before digitalisation and liberalisation were launched upon them. One could only contemplate how a merged STK and EB would have fared.

Let us call the imaginative company «Norwegian telecom», and let us assume the company would have been nationally owned, with a license agreement with ITT and/or LME. It would have had at least two strong market segments, namely maritime and military communication, through EB's maritime satellite communication and STK's nodal switch. Furthermore, one way or the other, the company could

³ Interview with Bjørn Gladsø; Memo from Bjørn Gladsø to Lars Thue, 30.12.03.

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have capitalised on the national competence in data communication, maybe by hiring Halvor Bothner-By. Similarly, with mobile telephony and the GSM technology, they could have hired Jan Audestad and Torleiv Maseng. Moreover, assuming that ITT and LME would not have stripped STK and EB financially before a sale, the merged company would have had financial freedom to invest in telecom.⁴ In such a counterfactual speculation, one must recall that STK and EB were each “deprived” of around 1 billion NOK during the 1980s. Moreover, let us assume that the new CEO would be Kjell Almskog, with his taste for rigorous financial control and industrial ambitions. It is reasonable to assume that «Norwegian telecom», unlike STK, would have taken over Simonsen Radio, to compete with Ericsson and Nokia.

Still, could «Norwegian telecom» have succeeded in mobile telephony without a digital switch? It would probably have needed an international partner with a digital switch. Ericsson would have been ruled out, so a solution with ITT/Alcatel could have been feasible. Televerket could have used its procurement power, in the 1990 tender for digital switches, to bring about such an agreement. Maybe Televerket's expertise in digital switching and specifications could have been a competitive edge for «Norwegian telecom»? Taking the considerable competence into account, it is not obvious that such a company would have failed. These are just speculations, and it is impossible to consider the possibilities of such a company. Such speculations are difficult as they have a number of possible outcomes, but are a good way to illustrate the point that deterministic assumptions rarely pay off in explaining the turn of events. It is noteworthy, however, that the above-mentioned invitation did not come from Televerket's management, but from external board members. Televerket and the TA were not interested in exploiting the regained procurement power to re/structure or stimulate the Norwegian telecom industry. On the contrary, the TA excelled in using this to make the suppliers meet their demands.

The French used their public procurement power to eliminate foreign telecom companies; this was based on the traditional French perception of multinationals as obstructers of national industrial development. For the TA, on the other hand, the British perception prevailed and underpinned its actions. More or less - probably less - consciously, the TA embraced Ørbeck's notion of a multinational, as a diffuser of technology, competence and prosperity. In forming its relationship with BTM, it undertook to “surfride the technological tides”.⁵ And, as Ørbeck claimed, it

⁴ When ITT's French subsidiary, CGCT, was nationalised in 1981, ITT stripped it of resources. At an ITT summit in Brussels, CGCT's managing director complained to Araskog, saying that if he went through with what Araskog asked, “they will send me to prison”. Araskog replied: “I'll come and visit you”. Interview with Hans Jørgen Blomseth.

⁵ Ørbeck 27.09.78.

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was easier to form such a relationship with ITT, or BTM, as it did not have a home market. The French took advantage of ITT's trait as a freestanding company, when Alcatel swallowed it, whereas Televerket took advantage by becoming ITT's lead market for electronic and digital switches. Thus, given the lack of national partners to form innovative relationships with, Televerket formed such a relationship with BTM. The relationship was characterised by many of the features of the SI approach: it was a relationship with interactive learning, and the innovations were, to a large degree incremental, a result of learning by doing, or trial and error. Still, it differed in a major way, as it was an international relationship, thus not part of a national system of innovation.

An element in the SI approach is that institutions and systemic features promote or constrain innovation. In the TA-BTM relationship, there were no common institutions or systemic features, promoting innovation, but, on the other hand, there were no such features constraining it either. Moreover, it did not benefit from a shared culture and language, and thus there would be, following Lundvall, constraints to "the transfer of tacit knowledge" and the organising of a "multilateral system of trust".⁶ This is probably why the parties, from both Televerket and BTM, put so much emphasis on the social relations that developed, and benefited the business relation. Still, despite these social relations, there was never any doubt that the market relation was underpinning the activities. It is fascinating to witness the joy of the informants, when recalling the TA-BTM relationship, and telling how much fun it was. Still, the climate was rather tough, the negotiations and interactions were always surrounded by contractual realities, rather than trust. So, the relationship is better characterised by Michael Porter's concept of a demanding buyer-supplier relationship that led to upgrading mechanisms, than by a trustful user-producer relationship. The proponents of the SI approach would probably object to this point, claiming that the SI literature also describes demanding, contractual and international relations. Well, this is the main problem with the SI approach, that it is too open. As it purports to cover every innovation, or every system, its analytical power is weakened.

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Now, returning to the subject from the introduction, this thesis has showed that similar dichotomies have reoccurred throughout history. Taking the four theoretical approaches as a point of departure, firstly there were contrasting perceptions of multinationals: some deprecated multinationals as obstructers of national industrial

⁶ Lundvall et. al. 2002, p. 219-220.

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development, while others appreciated them as diffusers of technology and growth. Secondly, with public procurement, there were disagreements whether the government should support national industry, or concentrate on price and quality. Thirdly, regarding innovation, one can envisage disagreements as to whether a trustful user-producer relation, was more innovative than a demanding buyer-supplier relation. Finally, there was the dichotomy of taking all stakeholders into consideration when considering a business strategy, or just focusing on the financial interest of the shareholder. Although the dichotomies are different, they are also so similar that we can label one set of positions continental or market-sceptic, and the other set Anglo-Saxon or market-friendly.

A striking finding is that the governmental bodies operated with conflicting perceptions in most of these dichotomies, which halted a coherent industrial policy towards the industry. The most surprising conclusion, however, is that by the first half of the 1980s, the TA was coherently placed in a market-friendly position, and the rest of Televerket followed soon after. It cooperated closely with multinationals, it pursued a competitive public procurement policy, it favoured the role of being a demanding customer, and it more or less disregarded former stakeholders in its strategy.⁷ Some would find it surprising that the old governmental organisation, associated with the Labour Party, took such a stance. The TA and INDIG seemed apolitical, however. Yet, in as much as there were sympathisers of the Labour Party within the TA, and not least for someone like Finn Lied, they most certainly liked surfriding and exploiting the market ideology of the 'Right wave' to whip the two fat, capitalist, cats'. Some might credit TA and Televerket with foresightedness, in that they anticipated globalisation and the convergence towards Anglo-Saxon business principles. This thesis does not suggest that, rather that Televerket's preference was a result of the historical development: that its lengthy experience of being held in an oligopolic grip by small subsidiaries made it a competitive, demanding and internationally oriented PTO.

STK also held contradicting perceptions within the company, but the noteworthy trait with STK was that the company's public stance shifted between an Anglo-Saxon/market-friendly position and a continental/market-sceptic positioned in a rather *opportunistic* manner. In the 1950s, it wanted Telegrafverket to procure the 8B and 11B, to promote the Norwegian telecom industry, but advised Telegrafverket not to procure the radiolink from Nera. Another example is when Thore-

⁷ It is pertinent to remember that it was Inger Kopperræs who insisted on an international tender in 1983. TA's opposition to this, however, was not ideological or based on principles, but was simply pragmatism.

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sen appealed to the government's stakeholder responsibilities to avoid the digital contract in 1983. This bore a strong resemblance to Araskog's criticism of Wall Street's financial capitalism. Be that as it may, Thoresen was placed rather coherently in an Anglo-Saxon/market friendly position on most issues, except for his focus on industrial relations. This philosophy had earned him great respect, not least in the cable business. Kjell Almskog's success with ABB Norway is another illustration of how such an approach to industrial issues and politics can be successful. And the same goes for Televerket's policy.

These three successful cases have an interesting thing in common, namely that they faced limited uncertainties, compared to, for example, the manufacturers of digital switches or mobile telephones. An innovative enterprise normally faces three classic uncertainties. Firstly, productive or technological uncertainty, i.e. what needs to be learned or innovated, will in fact need to be learned or innovated. Secondly, market uncertainty: does the market want the product? And thirdly, competitive uncertainty: i.e. will competitors outperform you with lower cost/higher quality products.⁸ When STK laid submarine cables in Norway, or ABB Norway built oil installations in the North sea, or when Televerket invested in upgrading its competence on electronic and digital switches, they all faced technological uncertainty, but the uncertainty regarding market preferences and or competitors was small in comparison with other kinds of business. The same goes for Statoil's oil business in the North Sea, which involves huge technological uncertainties, but minor market and competitive uncertainties. Technological uncertainty has not been the main obstacle in Norway's industry, as the technological achievements related to the oil installations in the North Sea, STK's submarine cable under the Skagerrak, and last but not least, the swift installation of the System 12 in the 1980s, are nothing short of impressive. Perhaps the main reason why Norway does not have a Nokia is that Norwegians are seldom able to show financial commitment, when facing market and competitive uncertainties.

A key point in facing such uncertainties is the ability to perform strategic control. STK and EB had limited authority to perform strategic control, as they were small subsidiaries in the telecom business. Nevertheless, the decision Thoresen had to make when offering the System 12 to Televerket called for strategic control, as there were 'no objective guidelines for making such a decision'.⁹ It entailed insight and oversight concerning a wide range of areas, not least digital switches, and how large

⁸ Lazonick 2003, p. 24.

⁹ A pertinent point in this matter is that most investments and decisions are also uncertain, not only those related to innovation.

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technology projects usually turn out. If Thoresen had examined STK's 11B project more thoroughly, i.e. the reasons for the pecuniary losses, he would have been warned against trusting ITT and its prognoses for the System 12. The history of the 11B could have 'instructed his use of reason'. The irony is strong, in that Thoresen's financially grounded disbelief towards telecom-related R&D was a main factor in explaining his endorsement of the System 12, and thus STK's greatest-ever financial loss.¹⁰

After STK's Pyrrhic victory with the System 12, it is harder to engage in counterfactual speculations about a promising Norwegian telecom industry. Thus, the System 12 contract is significant in explaining why and how STK's telecom business disappeared. The financial losses, and the loss of the digital contract in 1990, shattered STK's confidence. Moreover, when squeezed between ITT and Televerket throughout the 1980s, STK lost its illusions, and most of its industrial ambitions. The same reasoning applies, by and large, to EB as well, after being stripped by Investa in the 1980s. Thoresen was naïve in his unreserved loyalty to his shareholder, while Kveim was naïve in sticking to his stakeholder version of corporate governance. Another way of putting it is that Kjell Kveim did not pay sufficient attention to the liberalisation process, whereas Fredrik Thoresen did not pay sufficient attention to the digitalisation, whereas Televerket mastered both digitalisation and liberalisation.

¹⁰ Moreover, his lack of understanding and standing in telecom, as opposed to cables, affected his ability to tackle the mounting problems with the System 12 and ITT in the 1980s. Thoresen and STK were in a position to bargain with ITT, i.e. threatening to cancel the contract. Thoresen had the personal qualifications to play hardball with ITT, but he lacked the technical insight to do so.

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Berg, Knut	26.02.02.	STK Research Department 1968-1980, Director of System 12 1980-1990.
Blomseth, Hans J.	14.10.04	Worked at ITT-Europe in Brussels 1976-83; Director of finance at (Alcatel) STK 1986-1992.
Brataas, Torbjørn	18.01.00/03.06.02.	Director of STK's Research Department 1968-1990, Later worked in Thomson CSF/Thales.
Braathen, Jest	23.08.02.	Leading positions in STK's Research Department, head of the "Nodal Switch project", Later worked in Thomson CSF/Thales. Son of Amund Braaten, STK's Managing Director in 1953-1972.
Christensen, Kjell	04.06.03	Leading positions in Televerket's Technical Department, most notably the Station (switching) office. 1971-20??. Member of the INDIG-group.
Erichsen, Harald	29.06.99.	Leading positions in Nera.
Gjerdsjø, Jens	10.03.04	Director in Televerket's Procurement office 1973-82.
Gladsø, Bjørn	14.11.02.	Leading positions in Televerket's Technical Department, most notably Station (switching) office. 1958-1993. Head of the INDIG-group.
Govers, Toon	04.06.03.	Leading positions in BTM's switching business, worked with Metaconta and System 12.
Halvorsen, Thor A.	13.05.03.	Leading positions in Televerket's Technical Department, most notably Station (switching) office. 1973-, Member of the INDIG-group.
Hansen, Ingar	29.04.03.	Leading positions in Televerket's Technical Department, most notably Station (switching) office. 1973-75, 1980-20??. Member of the INDIG-group.

Harper, Christopher	10.09.01	Legal director of Alcatel STK.
Haug, Dag	16.11.99.	Responsible for Alcatel Telecom Norway's attempts to create business networks.
Himle, Erik	05.12.03.	Minister of Communication 1964-65.
Joys, Carl-Edward	15.03.04./30.09.04.	Different leading positions in STK related to Metaconta 1970-82 and System 12 1982-1995.
Kleive, Henry	16.12.99.	Manager in Alcatel Telecom Norway.
Knudtzon, Nic.	14.11.01	Director of Televerkets Forskningsinstitutt.
Kveim, Kjell	23/24.08.99	Managing Director in Elektrisk Bureau 1972-1983.
Mo, Ivar	15/20/28.05.03	Director of switching in STK's telecom division, head of the 11B-project.
Munch, Oskar A.	10.11.99.	Leading positions in Bergen Industriinvestering/Elektro Union/Investa, Chairman of the Board in Nera and Elektrisk Bureau 1986-1989.
Myhre, Ingvild	05.12.01	Head of Alcatel STK's cable division, head of Alcatel Telecom Norway 1997-2000, head of Telenor Mobile from 2000.
Myklebust, Nils Kåre		24.06.04. STK's Research Department 1971-76, worked on Metaconta 1976-80.
Nilsen, Alf Ivar	08.05.03	Leading positions in Televerket's Technical Department, most notably Station (switching) office. 1971-. Member of the INDIG-team.
Otterlei, Håkon	27.08.99	Director of Elektrisk Bureau's activities in maritime satellite communication.
Pay, Peter	28.09.04.	Leading positions in EB telecom business from 1970-1989, leading positions in Telenor from 1993-2000.
Pignet, Ludo	04.06.03.	Several positions in BTM's switching business, was in Norway with System 12 from 1985-94.
Riisnæs, Jon B.	03.12.01.	STK telecom division from 1958, marketing director in the 1970s.

Scholliers, Rudy	04.06.03.	Several positions in BTM's switching business, was in Norway with Metaconta from 1978-82, and with System 12 in 1986-87.
Slettbak, Magnhild	16.05.03.	Employed in different sections in Televerket's Technical Department.
Stenberg, Jon Erik	20.10.99.	Director of Personal relations in Elektrisk Bureau.
Thoresen, Fredrik	03.05.00/05.04.05.	Leading positions in STK's Cable Division from 1953-1968, Head of STK's Cable division 1968-1969, Vice Managing Director 1969-1972, Managing Director 1972-1988, Chairman of the Board 1988-1999.
Tidemann, Gunnar	07.06.00/13.11.01	Head of STK's telecom division 1974-1988.
Wuyts, Hugo	04.06.03	Several positions in BTM's switching business, was in Norway with Metaconta in 1977, and with System 12 from 1983-87.
Ørbeck, Ivar	16/20.02.02.	Technical Director in STK.
Aamodt, Bjarne	20.09.00.	Managing Director in Alcatel STK 1988-1999.

Parliamentary documents

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White papers to the Stortinget	= St. meld.
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St. prp. nr. 82 1964-65	“Telegrafverkets og Postverkets organisasjon m.v”.
St. prp. nr. 30 1971-72	“Om ny administrativ oppbygging av Televerkets sentraladministrasjon - Teledirektoratet”.
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St.f. 1964	“Interp. fra repr. Kyllingmark om Regjeringen vil ta telefonpolitikken opp til ny vurdering.”
St.f. 1964	“Telegrafverkets budsjett for 1965”.
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NOU 1980:10A	“Televerkets langtidsplan”.
NOU 1982:2	“Teleutvalgets utredning I: ‘Om Televerkets situasjon og oppgaver i 80-årene’”.

Archives

I have used abbreviations on all archives in the footnotes. I have also used abbreviations on boxes and files that are used extensively.

Alcatel STK's archive

STK's historic archive	= STKA
File: Telephone Agreement STK - EB - Correspondence	= STKHA
	= STKHAT
STK's telecom department archive/TEL 23	= STK-TC
STK's Judicial archive:	= STKJA
STK's Board meetings are referred to by the date of the meeting	
Book with minutes from Board meetings.	
STKJA: File: Lov 13 - STK Styremøter 1.12.69 - 15.12.75.	
STKJA: Box: Lov 13 - STK Styremøter fra 1.1. 1976.	
STKJA: Box: Lov 13 - STK Styremøter 1983-1987.	
STKJA: File: "Teledirektoratet - Langtidsavtale 1974 - 1977"	= STK-LTA
STKJA: Box 25: Norsk Informatikk Simonsen Elektro	= STKJA-25
Personal archives from STK employees	
Christopher Harper's archive	= CHA
File: System 12 delays:	= CHA1
Ivar Ørbeck's archive	= IØA
Ivar Ørbeck's private archive	= IØPA
Box: "Div. Notater 1975-82 I. Ørbeck":	= IØPAi
Box: "Div. Art. foredrag 1991-94 I. Ørbeck"	= IØPAii
Torbjørn Brataas's private archive	= TBA

The Norwegian Telecom Museum

EB's archive	= NTM
File: "273190 - Korrespondanse med LME ? styret 1958-73"	= NTM-EB
File: EBs sysselsettingsproblemer i 1963/64"	= NTM-EBi
File: "Langtidsavtale 1966-69"	= NTM-EBii
	= NTM-EBiii
Ingar Hansen's delivery, 003.4 Telegrafstyret 1958-72	= NTMS

Ingar Hansen's delivery, Nils Jonsson og Amundsen's arkiv

NTM Box 3	= NTM3
NTM Box 5	= NTM5
NTM, Box 7:	= NTM7
File - "11B priser og nedtrapping"	= NTM7-11Ba

File - "11B 1969-79 Fremdrift Forsinkelser" = NTM7-11Bb
 File: "Ny FS i Ålesund 1968" = NTM-Å
 NTM, Box 8: = NTM8
 NTM, Box 9: = NTM9
 File: "STK's tilbud for fjernsentral i Oslo (1971-72)" = NTM9a
 File: "Ny datamaskinsstyrt FS til Oslo Innstilling styredokument" = NTM9b

Riksarkivet = RA

Industrifondet (Katalog: 1289.1/16)

Industrifondet 1936-1980; Dab - Saksarkiv Utviklingsfondet
 0022 Søknadsnummer 221-232; 03
 Standard Telefon og Kabelfabrikk, Oslo = RAUi
 01.01.1965 - 31.12.1979; 0022 Søknadsnummer 224;
 03 Standard Telefon og Kabelfabrikk, Oslo = RAUii

Ministry of Industry

Statsselskapsavdelingens juridiske kontor (Katalog 1289/15) = RA-S
 Box: 15 (About Elektrisk Bureau) = RA-EBi
 RA-S: Box: 56 "V Konesjoner iht til konsesjonsloven (...) frem til 1975",
 File: 08 STK. Forhøyelse av aksjekapitalen m.v. 1972-1975 = RA-S56
 RA-S: Box: 57: "Konesjoner gitt t.o.m. 1975" (Akrivnr. S-412.1)
 File: Mappe: STK, avslag på søknad om endring av kons.vilkår 1967 = RA-S57
 RA-S: "De enkelte bedrifter" = RA-D
 Box: "Industridepartementet - St 273"
 File: "STK A/S, Produksjon av mikroelektronikk, tidsrom 1972-1973" = RA-STKi
 File: "Standard Telefon og Kabelfabrik tidsrom 1969-77" = RA-STKii
 Box: "Indu.dep - El 64 - De enkelte bedrifter"
 File: A/S Elektrisk Bureau, 1975-80 = RA-EBii
 Box: "Indu.dep - El 65 - De enkelte bedrifter"
 File: A/S Elektrisk Bureau - Partialobligasjonslån (Nera), 1977 = RA-EBiii

RA, Teledirektoratet (Televerket)

Meetings in Telegrafverket/Televerket's Board of (internal) Directors.

Fa - Konsernledelse og teknisk direktør;
 Box: FA 0003: Styremøteprotokoller 1963 - 1988 = TBD
 Fa - Konsernledelse og teknisk direktør;
 Box: FA 0018: Direktørmøter 1969 - 1974 = TBD
 A - Direktørmøter; Box: A - 0002 Referater, 1976 - 1980 = TBD

Serie: Eb - Langtidsplanleggingskomitéen (LP), 1968-1989 = LPC-A
The sources are referred to by the date of the meetings in the "long-term-planning-committee, which are easily traceable in the archive = LPC-M

D. Saksarkiv
Box D -0028, File: Samarbeid med industrien 1976 - 1977 = RA-28
Box D- 014, File: "Korrespondanse Administrerende Direktør 1968-1980" =
RA-14

Other archives

Nærings- og Handelsdepartementets arkiv, Box 464 Elektrisk Bureau

Bjørn Ole Helsing Lossius' EB-arkiv = LEBA
Nera's archive = Nera-A
Bjørn Gladsø's archive = BGA

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Annual reports

Standard Telefon og Kabelfabrik's annual reports
Elektrisk Bureau's annual reports
International Telephone and Telegraph's annual report
Televerket Forskningsinstitutt annual report

Newspapers

Aftenposten
Arbeiderbladet
Dow Jones News Service
Dagbladet
Dagens Næringsliv
Financial Times
Morgenbladet
New York Times
Textline Multiple Source Collection
Wall Street Journal
The Washington Post

Magazines

Business Observer
Business Week
Computerworld.no
Economist
Forskning.no
Fortune
Ingeniør-Nytt
Kapital
International Management Europe
Minutt-nytt (STK's internal paper)
Norges Industri
Næringsrevyen
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Telecom.no
Elektronikk (Telegrafverket/Televerket internal magazine)
Økonomisk Rapport