ON THE POLITICS OF FAILURE

Perspectives on the "Mathematics Machine" in Sweden, 1945-1948 [1]

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Abstract: This paper departs from the notion that most accounts of the early period of digital computer design and construction in Sweden have had as starting points a business and producer-centered perceptive which has hidden many of those activities that surround all complex technologies. It reinvestigates the ideological foundations underpinning the forming of a State agency in 1947/48, Matematikmaskinnämnden (The Board of Computing Machinery), with the responsibility to monitor all options and, eventually, to construct and manage two digital computers. In doing so, it attempts to understand what kinds of goals that the machines were to accomplish. The argument is that it is perfectly possible to perceive the Swedish computer project as a part of a larger process of change. The paper shows how professionals gathered information in the U.S. and interpreted it locally, and also how the initiative on the whole was a part of a new and progressive post-war agenda favoring basic research and, in particular, the advancement of mathematics for the purpose of modernizing both scientific and technological research and the society at large.

Key words: Computer history, Sweden, BESK, Matematikmaskinnämnden, historiography

1. INTRODUCTION: AIMS AND SCOPES

This paper is about computer technology ideology and policies in Sweden in the 1940s. It tells a prehistory of two digital computers, designed and

[1] Based on research which is still ongoing, this paper should be read as work in progress. The contents form a part of my forthcoming PhD thesis, *Elektronvalsen: Studier i svensk datorteknik under 1950-talet* (The Electron Waltz: Studies in Swedish Computer Technology in the 1950s).

constructed in Sweden 1948–1953: one relay machine called BARK, operational from mid-1950s and one full-scale electronic machine in the so-called IAS-class, named BESK, operational from early 1954.[2] The basic question is simple, yet broad: Why did politicians in a small country like Sweden, with just over 6,500,000 inhabitants at the time, fund such a complicated and comparatively costly project with such a tremendously uncertain outcome?[3]

In order to provide an answer I will make a close reading of a public investigation presented in 1947, the first proposal made in order to raise funds for the introduction of digital computer technology into Sweden, and try to sort out issues that they have previously neglected. The investigation text is rich in claims and references and has the advantage of being an intermediary inscription, linking the aims and scopes of different actors.[4] My argument is that computers became useful assets not the least since they could relate to other proposed changes regarding scientists' and, in particular, engineers' skills. This paper will not describe the BARK and the BESK.[5] It will rather be about expectations, hopes, and attempts to relate the very first experiences, however elusive, to a larger ambition concerning technical and social renewal in Sweden in the years immediately after World War II.

Furthermore, I wish to contribute to the historiography of Swedish computing by revisiting the discussion about the outcome of the BARK and BESK computer project. The two machines were highly successful by

[2] BARK: *Binär Aritmetisk/Automatisk Relä-Kalylator*. BESK: *Binär Elektronisk Sekvens-Kalkylator*. Concerning the IAS-class of computers, see William Aspray, *John von Neumann and the Origins of Modern Computing* (Cambridge/MA, 1990), pp. 86-94.

[3] The Swedish project was early in comparison with, for instance, the corresponding ones in Denmark and Finland. Cf. Petri Paju, *Ensimmäinen suomalainen tietokone ESKO ja 1950-luvun suunnitelma kansallisesta laskentakeskuksesta*, lic. thesis in Cultural History, University of Turku (2002), and P. V. Klüver, "From Research Institute to Computer Company: Regnecentralen 1946-1964", *IEEE Annals of the History of Computing*, vol. 21 (1999). However, one other point of reference would be the Netherlands, where, "in the second half of the 1940s, scientists and engineers took several initiatives to develop digital computers", according to Jan van den Ende, *The Turn of the Tide: Computerization in Dutch Society* (Delft, 1994), p. 92.

[4] [Josef Weijne], *Kungl. Maj:ts proposition till riksdagen angående närmast erforderliga åtgärder för tillgodoseende av Sveriges behov av matematikmaskiner; given Stockholms slott den 9 maj 1947*, below referred to as "Prop. 1947:275".

[5] For close descriptions, see Göran Kjellberg and Gösta Neovius, "The BARK: A Swedish General Purpose Relay Computer", *Mathematical Tables and other Aids to Computation*, January 1951, and Erik Stemme, "Den svenska automatiska räknemaskinen BESK", *Teknisk Tidskrift*, vol. 85 (1955). The BESK lay the foundation to other computer projects in Sweden, among these the SARA at Saab's aircraft industries (1956–57), the SMIL at the University of Lund (1956–57) and the Facit EDB, a commercial version from Åtvidaberg Industries (1957–63), and also the DASK in Denmark.

contemporary standards since they were useful in solving problems identified as relevant ones. By attracting visitors and observers such as journalists and foreign researchers, they also helped sharpening the image of Sweden as a scientifically and technologically advanced and "modern" nation. Influential historical accounts, however, have maintained that the project, at least on the grand scale, was a failure. Due to decision-makers' hesitancy no persistent State computer industry or no large-scale cooperation between industry and the State, as had been the case in the electrical power and telecommunications sectors, was established. Instead, the country became a victim of market forces as IBM in the mid-1950s started to sell and rent digital computing machinery, dominating the market from 1960 onward by means of its hegemonic practices – so the story goes.[6] Although such accounts certainly recognize the importance of understanding technological change as a social process, they do focus on *construction* and *production* of computers in restricted senses of the concepts and they imply that a successful State-funded research or development initiative almost by definition should result in an industrial program that is beneficial for the nation. The furthest-reaching aim of this paper is thus to discuss "failure" and "success" against the backdrop of the first attempts to define what the BARK and BESK machines were in fact meant to accomplish.

2. SCIENCE AND TECHNOLOGY IN THE "STRONG" SOCIETY

Two contexts are important to this paper. The first one is a self-image about Sweden being an outsider, a unique nation, yet open to influences. Historians and political scientists have derived its mixed identity from its mix of capitalism and socialism. Decisive components in the construction of such a "middle way" came from ideological negotiations – although never explicit – between the isolationist conservatism of the early 20th century and the emerging Social Democrat movement. Nationalistic ideals and labor

[6] I am particularily referring to Jan Annerstedt, *Staten och datorerna: En studie av den officiella datorutvecklings- och datorforskningspolitiken*, FEK-meddelande nr 41, Kommittén för forskningsorganisation och forskningsekonomi (Stockholm, 1969). The one major opponent of the views expressed there is Hans De Geer, *På väg till datasamhället: Datatekniken i politiken 1946–63* (Stockholm, 1992), an account focusing on the computers as potential aids toward a rationalization of the governmental administration. Cf. Sten Henriksson, "Den svenska utvecklingen", in Peter Naur, *Datamaskinerna och samhället* (Lund, 1969). There is no history of IBM Sweden although the company has had a Swedish office since the late 1920s. For "national" cooperation between industry and the State, see Mats Fridlund, *Den gemensamma utvecklingen: Staten, storföretaget och samarbetet kring den svenska elkrafttekniken* (Stockholm, 1999).

solidarity merged into one, and seen from the opposite shore of the Atlantic, the Swedish nation increasingly appeared like an interventionist, corporate State and a highly successful techno-economic regime. However, the image of America had been central to this small grand-scale national project and a local interpretation of the combination of American production ideals and work ethics became part of what we sometimes refer to as "the social democrat synthesis".[7] Engineers and leading industrialists highlighted themes like corporate research and scientific management in their proposed programs for domestic industry. This in part explains why scientists and engineers already during the decades before World War II steered their interests towards the U.S., extending and strengthening their already wide-ranging international networks. Notably two of those mentioned below, Stig Ekelöf and Edy Velander, established durable contacts with American colleagues, and as the war ended in 1945, these were to be exploited again.

The second context more explicitly addresses political power in relation to science and technology. Terms like *change* and *progress* have been truisms in the political debate ever since the early 1900s and have often been loaded with scientific-technological connotations. This is a result of both the labor movement's interest in finding means to growth and social security and professional claims. Early on, technological research was described as a strategic resource for communication, control, administration and policy – functions defined by representatives of the increasingly strong engineering profession, most of whom to be members of the new *Ingenjörsvetenskapsakademien* (The Royal Swedish Academy of Engineering Sciences, IVA) in 1919.[8] This Academy became a key actor in spreading the message of rationalization during the interwar years, bringing a new set of engineering norms into the pedagogy of industrial planning practices, based on professional ideals.[9] In addition, its members had a great influence in shaping the national research policy agenda. Edy Velander of the Academy was an important individual in the preparations preceding the establishment of *Tekniska Forskningsrådet* (Technical Research Council,

[7] Aant Elzinga, Andrew Jamison and Conny Mithander, "Swedish Grandeur: Contending Reformulations of the Great-Power Project", in Mikael Hård and Andrew Jamison (eds.), *The Intellectual Appropriation of Technology: Discourses on Modernity, 1900-1939* (Cambridge/MA, 1998), p. 130.

[8] Bo Sundin, *Ingenjörsvetenskapens tidevarv: Ingenjörsvetenskapsakademin, Pappersmassekontoret, Metallografiska institutet och den teknologiska forskningen i början av 1900-talet* (Umeå, 1981), pp. 195-206.

[9] See Hans De Geer, *Rationaliseringsrörelsen i Sverige: Effektivitetsidéer och samhällsansvar under mellankrigstiden* (Stockholm, 1978), passim, ch. 6-8.

TFR) in 1942, referring to the then widespread idea about technology's essential function in reaching national economic goals.[10]

All this is crucial in the understanding of the mid and late 1940s. We should also note that, in spite of political instability and expectations of a post-war recession, an unexpected and unprecedented economic growth period was emerging. Consequently, after World War II, scientific and technological research received portions of the national budget so large that they have been considered extreme in international comparison.[11] Because the country had been rather neutral during World War II the institutional landscape was relatively untouched. They could be revisited and exploited further to implement a strongly felt need for social renewal and draw level with recent changes in scientific and technological research. In the years prior to the emergence of the digital computer research project TFR was complemented with several other research councils, notably one for medicine in 1945 and one for science in 1946. Prime Minister Tage Erlander, who took office in 1946, regarded these councils, along with other political "tools", as instrumental innovations in the creation of the "strong" society.[12]

3. DEFINING COMPUTERS

The first indications about large calculating machines reached Sweden in fall 1943, the receiver being the recently established *Försvarets radioanstalt* (the Defence "radio institute", FRA). According to FRA's own accounts of the knowledge about computers in the years 1943-45, the lack of details had not prevented its engineers and mathematicians to theorize about what kinds of problems the machines were used for and thereby, by rudimentary reverse-engineering, assume the basics of their potentials and functions.[13] In any case the very scale of this technology, both in terms of labor division

[10] TFR and its successors are scrutinized in Hans Weinberger, *Nätverksentreprenören: En historia om teknisk forskning och industriellt utvecklingsarbete från den Malmska utredningen till Styrelsen för teknisk utveckling* (Stockholm, 1997).

[11] Sven Widmalm, "Inledning", in idem (ed.), *Vetenskapsbärarna: Naturvetenskapen i det svenska samhället 1880–1950* (Hedemora, 1999), p. 9.

[12] Tage Erlander, *Tage Erlander: 1955–60* (Stockholm, 1976), pp. 15, 26-32. For a useful survey of all research councils, see Gösta Funcke, *[Introduktion till] Naturvetenskaplig forskning i Sverige* (Stockholm, 1963).

[13] Anonymous, "PM i matematikmaskinfrågan", Försvarets radioanstalt, archive, Databehandlingsfrågor, F IV:4. This document was most likely put together in March, April or possibly May 1946 in response to a proposal about the organization of a "mathematical laboratory" in Stockholm. See also Carl-Gösta Borelius, "Databearbetningens historia vid FRA", unpublished manuscript, Försvarets Radioanstalt, p. 1, and De Geer, *På väg till datasamhället*, p. 30, n. 13.

and hardware complexities, could be estimated by following the Harvard MARK I machine, which was inaugurated openly in 1944.[14] Further information about these machines, the centerpiece probably being the ENIAC, was analyzed at various Swedish defense organizations in January 1946 as U.S. authorities a few months earlier had declassified some relevant accounts and descriptions. The response was immediate in the sense that FRA presented the issue to the Government and pushed for a thorough evaluation in addition to its own disappearance from all necessary future investigations.

More useful knowledge about and reports from concrete experiences of big-scale computing reached the country as Swedish researchers reestablished their exchange with American colleagues, beginning in 1946. One of them was Stig Ekelöf, a professor in electrical engineering at Chalmers Institute of Technology in Gothenburg, who traveled in the U.S. that year. One of his purposes was to buy instruments. However, by agreement with IVA, *Kungl. Vetenskapsakademien* (The Royal Swedish Academy of Sciences), *Marinförvaltningen* (the Navy authorities), *Försvarets forskningsanstalt* (the Defense's research institute, FOA) and also indirectly with FRA and various academic departments, he also observed installations that he called "super calculators".[15] Ekelöf was an important actor, in particular with regard to how they described these calculators. He had already communicated the prospect of calculations carried out with the help of various analyzers to the engineering society in the latter part of the 1930s.[16] Among his new reports – apart from those given at lectures and other presentations – was an extensive non-printed survey of American machines and computer research institutions and, in more digestible form, the paper "Matematikmaskiner" in *Teknisk Tidskrift* (Journal of Technology) in 1949, including a rich bibliography.[17] Equally importantly, he was appointed as a member of the 1947 group funded by the

[14] See I. Bernard Cohen, *Howard Aiken: A Portrait of a Computer Pioneer* (Cambridge/MA, 1999), p. 121.

[15] Cf. De Geer, *På väg till datasamhället*, pp. 19 f.

[16] Stig Ekelöf, "Matematiska maskiner i U.S.A.", *Teknisk tidskrift*, vol. 69 (1939). See also Enar Eskilsson, "Maskinell lösning av differentialekvationer", *Teknisk tidskrift*, vol. 65 (1935).

[17] Stig Ekelöf, "Matematikmaskiner" in *Teknisk Tidskrift*, vol. 79 (1949). At Chalmers, partly under Ekelöf's supervision, analog computers were constructed and used successfully in the 1950s. For an account of analog machines, see Magnus Johansson, "Early Analog Computers in Sweden: With Examples from Chalmers University of Technology and the Swedish Aerospace Industry", *IEEE Annals of the History of Computing*, vol. 18 (1996). The question about "digital" vs. "analog" problems is treated briefly in "Från Flinta till Ada", *Minnesbubblor och datavisioner: Svenska samfundet för informationsbehandling 25 år* (Malmö, 1984), by Elsa-Karin Boestad-Nilsson, who was a prime programmer in the early 1950s.

Government that investigated how to introduce this new technology into the country. This group, apparently following Douglas Hartree who was a consultant on organizational issues to the group, coined the Swedish term for *computer* that was used throughout the late 1940s and 1950s, namely *matematikmaskin*, or "mathematics machine".

The motives were numerous, apparent at the so-called computer conferences held in 1947 and in the constitution of the investigating group, reflecting the assumed functions and uses of the machines by calling one representative each from key academic disciplines: electrical engineering (Ekelöf), physics and mathematics apart from one from IVA (Velander) and the Ministry of Defense respectively.[18] The military needs were expressed openly. In the text that later that year became the Government's proposal to the parliament, we can read about the urgent demand of producing a new ballistic "lexicon" but also about signal intelligence and about the fact that all potential research on rocketry seemed to imply a mathematics machine.[19] Input like this came typically from FRA, *Marinförvaltningen* and FOA.

However, in my view, we must not exaggerate the military influence. True, the speedy process that advanced the emerging computer project from merely being a suggestion to becoming a State-sanctioned investigation must be explained by the urgent needs of the military.[20] (The formal proposal came on 13 January 1947 and was followed only ten days later by a complimentary recommendation by *Naturvetenskapliga Forskningsrådet*, the Scientific Research Council. This resulted in the appointment of the investigating group on January 31.) Nevertheless, applications such as ballistics and code breaking were regarded as provisionary and not enough for the financial venture that they seemed to need and it was stated quite clearly in the proposal that the ballistic calculations could be negotiated with a smaller custom-made machine. Others should also use computers; therefore, the passages about the need for a *general-purpose* machine, meaning they would not design a computer for a particular user or algorithm but rather for a general customer group of scientists and engineers from private and public sectors. Stellar statistics, nuclear physics, aero- and hydrodynamics, electrodynamics, mechanics, mathematical statistics (here incorporating meteorology, economics, forestry, sugar and textile research) and hydropower construction – all these were regarded as fields of inquiry that would prosper from a fast calculating machine. In fact, the first formal

[18] The members were: Nils Rosén (chairman, Ministry of Defence), Stig Ekelöf (electrical engineering, Chalmers Institute of Technology, Göteborg), Edy Velander (The Royal Swedish Academy of Engineering Sciences), Ivar Waller (physics, Uppsala University), Nils Zeilon (mathematics, University of Lund).

[19] Prop. 1947:275, pp. 7 f.

[20] Prop. 1947:275, pp. 2, 7.

proposal to investigate this new calculating technology, the one on January 13, had come not from military quarters but from representatives of the engineering profession.

4. PROFESSIONAL MOVES

Edy Velander, then executive director of IVA, was a strong proponent of cooperation and exchange with other nations and the Academy did support a number of trips to other countries in order to collect information about recent advances.[21] In this regard, computer technology was only one in the row studied by professionals traveling overseas. Yet computers drew special attention and the Academy, as a complimentary contribution to the Parliament's appropriation of a very large sum (SEK 2,000,000) for *carte blanche* use, functioned as a promoter and coordinator of a one-year scholarship program. This allowed six young mathematicians, physicists, and engineers to work and conduct extensive investigations at the Observatory in Oslo, IBM in New York, Harvard, MIT, the Radio Corporation of America, and the Institute of Advanced Study in Princeton. The Academy also engaged its technical attaché – a post established and once held by Velander – at the Swedish consulate in New York as an observer.[22]

The scholarship holders in the U.S. traveled widely and received access to many, if not most, of the ongoing computer projects. They did so not the least by following in the footsteps of an older generation of Swedish engineers who had gone overseas for short study periods to places like Harvard and MIT. The commitment of the IVA thus expressed a wish to sustain existing professional networks by giving them new contents; it is a striking fact that Ekelöf and, in particular, Velander knew several of – or, by pointing at earlier acquaintances, had very little trouble getting to know – the visitors' supervisors. However, it also exemplifies the Academy's preparedness to support a State initiative in a mutual agreement about the necessary procedures. The Government and the Academy were actors on equal foot, although with different resources at hand, and they defined a common goal. The following actions were therefore seen not as part of a

[21] Edy Velander, "Intensifiering av våra utlandsförbindelser inom teknisk och vetenskaplig forskning", *Teknisk tidskrift*, vol. 76 (1946).

[22] See correspondence in IVA's archive, vol. 439, at Riksarkivet, Stockholm. Four of the stipendiater are mentioned in Herman Goldstine, *The Computer: From Pascal to von Neumann* (Cambridge/MA, 1972), p. 350: Gösta Neovius, Göran Kjellberg, Erik Stemme, Carl-Erik Fröberg. However, a fifth one, Arne Lindberger, shared his time between IBM and Harvard and a sixth one, Bengt Holmberg, made the shorter study trip to the differential analyzer in Oslo.

simple fact-finding mission to bring the technology over the Atlantic but, typically, as a mixture of research and finance, demanding the involvement of the ministries of defense, trade and education and recognizing the continuous surveillance by the Academy.

One argument in the investigators' work had clearly stressed the importance of a wider perception of the contents of computer technology in the late 1940s than being merely useful hardware and it provided a common rationale for the Academy and the Government. In discussing the needs and motives for a launch of the project, a term that was by no means commonplace now proved meaningful: *industrimatematiker*, or "industrial mathematician".[23] On a general policy level, they related this term to the question about national independence in the sense that Swedish engineers were regarded as falling short in mathematics compared to colleagues in other countries. Consequently, the industry was considered to be too dependent on foreign skills and results and thus mathematics should have an emphasis at the universities and institutes of technology, preferably by appointing professors in applied mathematics.[24]

This argument was, in a way, a translation of the present political situation: these were tense times in international politics and Sweden had no plans to abandon its neutral profile, at least not in writing.[25] Indeed, although statistics already formed an integral part of the vision of *social ingenjörskonst* (social engineering), mathematics in a more general meaning had recently become a strategic resource of a significantly high order. Having been mostly unaffected by industrial ambitions in the interwar years, the mathematical field in the U.S. was altered substantially by the industrial power of the war, forming new ideals and practices. "The 'purest' mathematicians, or those most attached to basic research [...] changed their fields, or reoriented their goals, their work habits, and their criteria of rigor", according to Amy Dahan Dalmedico.[26] Previously non-applied

[23] Prop. 1947:275, pp. 8 f.

[24] Cf. Arne Kaijser and Joar Tiberg, "From Operations Research to Future Studies: The Establishment, Diffusion, and Transformation of the Systems Approach in Sweden, 1945-1980", in Agatha C. Hughes and Thomas P. Hughes (eds.), *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After* (Cambridge/MA, 2000), p. 396.

[25] The question about Sweden's "neutrality" during the Cold War is far from settled. "Technological cooperation was far-reaching", according to Hans Weinberger, "'På sidan av de stora kraftlinjerna'? Teknik, vetenskap och det kalla kriget", in Widmalm (ed.), *Vetenskapsbärarna*, p. 363 (my translation). See also Karl Grandin, "Naturlig neutralitet? Tage Erlander, Torsten Gustafson och den svenska atompolitiken, 1945-53", in the same volume.

[26] Amy Dahan Dalmedico, "Mathematics in the Twentieth Century", in John Krige and Dominique Pestre (eds.), *Science in the Twentieth Century* (Amsterdam, 1997), p. 657. Cf.

mathematicians had been involved in goal-oriented missions like the atomic bomb, missile guidance, and computers, bringing them closer to professionals of other disciplines. New mathematical sub-disciplines and activities emerged, operations research being one and the new set of analytical tools (such as Monte Carlo) within probability and statistics another. Calculations became increasingly legitimate in areas where little or no attention was given to advanced mathematical practices. Referring to this situation, the investigators presented mathematics as a key element, not to say an emblematic quality, for the needs to renew the engineering profession and the overall industrial performance in Sweden in the years immediately following World War II.

The question had been touched upon in *Teknisk Tidskrift*, an important debate ground and source of information for the engineering society, most likely with some reminiscences of the debate about the "terror of mathematics" in schools in the early 1930s.[27] The opinions about the use of mathematics were not uniform. In some quarters, mathematics, construed as synonymous to "theory", were discharged towards the background of a claimed need for more *practical* engineers. Here, the crossover between mathematics and the already established engineering disciplines seemed confusing if necessary at all.[28] However, others welcomed a potential overthrow regarding the role of mathematics: "If the habit of calculation has not been accomplished through academic studies it will hardly be accomplished [at all] later on [...]. [Calculations] might often give unexpected results which corrects irrational misapprehensions and, thereby, offers a new view of things".[29]

In the Government's proposition to the Parliament, the investigators expressed similar ideas in a more coherent manner and they related them to the new material resource. The military motive was clear since there was a "need for a mathematical machine for Swedish use, which is supposed to facilitate and hasten scientific and technical research [...] and make new areas available for research of this kind, all this besides the fact that the need is particularly well documented within the defense organization". Simultaneously the former part of this quotation is interesting also because it demonstrates a kind of activism. By "facilitating" and "hastening" through

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Peter Galison, *Image and Logic: A Material Culture of Microphysics* (Chicago, 1997), ch. 4.

[27] See Daniel Lövheim, "Kampen om läroplanen: Synen på naturvetenskap och matematik i läroplansdiskussion och läroplansformering 1922-1937", unpublished manuscript, Dept. of History of Science and Ideas, Uppsala University, September 2002.

[28] P Eg. Gummeson, "Den svenska ingenjören och vårt lands framtid", *Teknisk tidskrift*, vol. 76 (1946).

[29] Jarl Salin, "De tekniska högskolornas pedagogiska problem", *Teknisk tidskrift*, vol. 76 (1946) (my translation).

the means of a computer project, the State should not only support research but also actively step in and expedite the emergence of new methods.

The investigators reinforced this view by repeating expressions about "pushing", "pressing", and "forcing" research. It is imperative to note that they made the argument by drawing boundaries between apparent hardware options. Indeed, punched card machines seemed to belong to the rather disparate group of calculating devices presented in a general background in the investigators' plan. Likewise, we should note that, according to a survey made by the investigators, those who favored the acquisition of new machinery *the most* had in fact been users of punched cards. The general view was nevertheless that of a disturbing lack of experience from any automatic calculating machinery among industrial actors; that is, among those who believed to have the most critical need for mathematics in terms of obtaining the tools that, in the end, should generate general societal change. Punched card machines were not construed to be "modern" whereas the new machines should – and this is decisive – "in a near future create completely new possibilities for utilization of mathematics within science and technology".[30]

The "need for a mathematical machine for Swedish use" was ultimately responded to by *Matematikmaskinnämnden* (The Board of Computing Machinery, MMN), a State agency created in 1948 to plan, design, and eventually manage the Swedish-built BARK and BESK machines. In an earlier attempt to formulate a solution, in fact as early as 1946, the idea had been to establish a national "laboratory" of mathematics. Although such an institution never opened MMN in many ways functioned as a more independent institute for numerical analysis. Retrospectively, one commentator has even regarded it as a research council meaning that it did not confine itself to support research but actually contributed to shaping new research areas.[31] By differentiating the costs for computer time, the Board disposed a tool for profiling its own enterprise and supporting such assignments or orders considered as relevant.[32]

[30] Prop. 1947:275, pp. 3-8, 12; quotations on p. 3 and 4 respectively (my translations).

[31] Funcke, *Naturvetenskaplig forskning i Sverige*, pp. 61 f. The English translation of Matematikmaskinnämnden (MMN), "The Board for Computing Machinery", is somewhat misleading since MMN was not a board in the strict sence of the word but rather a calculating service unit with its own administration and workshops. A distinction should be made between MMN's actual board and its working group, the latter being its mathematicians, engineers, technicians and administrators. The English name is used here since it was the official translation in the 1950s.

[32] The pricing for computational services is touched upon, although not analyzed, in De Geer, *På väg till datasamhället*, ch. 2. The choices made are subject to further investigations.

5. CONCLUDING REMARKS: BETWEEN FAILURE AND SUCCESS

The narrative of failure enrolls a few dramatic developments in the history of the BARK and BESK computer project. During 1956, it became clear that MMN would not be able to counter-bid for a number of those engineers, mathematicians, and technicians who had been the most involved in the design and construction of the BESK computer. The result: a "flee" of MMN employees to AB Åtvidabergs Industrier – two mathematicians already having taken up posts at LM Ericsson – where they would be instrumental in establishing the company as the first industrial producer of computers in Sweden, prospering as such by the privilege of using the BESK design commercially.[33] Furthermore, in spite of an attempt to renew the BESK design into a "Super-BESK" machine in the early 1960s, they transferred MMN's duties and resources to *Statskontoret*, an agency for public management, in 1963, thereby mostly serving the mission of rationalizing the State administration. At that time the BESK, altered in several ways, was still running whereas BARK had been dismantled already in 1955 as the military calculations had been completed. Due to these transitions, there was no way for the State to fulfill any possible industrial ambitions.

However, as for instance historian of technology Thomas Kaiserfeld has pointed out concerning a much more recent "failed" Swedish computer project, the notion of failure is not self-evident but rather subject to perspectives and perceptions about technological change.[34] The narrative of failure often depends on a linear logic regarding the relation between technological "qualities" and market potential – a logic that cannot be taken for granted due to the multiple meanings that most technologies have. In this paper, I have revisited the social landscape in which politicians met other powerful groups to examine how they *represented* computers as the very first measures were taken to investigate this new technology. As a result, I wish to stress the importance of seeing the computers as tools for the renewal of the engineering profession and of scientific research and the society as a whole in the years immediately after World War II, rather than techno-scientific ends in themselves or, for that matter, as purely military tools. Several motives, two of which were military requirements and the

[33] Cf. Henriksson, "Den svenska utvecklingen", 88. It should be noted that the "flee" arose a much more vibrant media discussion than the one Henriksson refers to.

[34] Thomas Kaiserfeld, "Computerizing the Swedish Welfare State: The Middle Way of Technological Success and Failure", *Technology and Culture*, vol. 37 (1996), pp. 277 ff. Kaiserfeld focuses on the school computer Compis (Computer in School), launched in 1984.

prospect of advancing scientific research and technology and engineering skills, formed the same agenda. The Swedish Government was indeed willing to support learning about computers by funding a major research program, regarding science and technology as essential to building a modern, post-war, "strong" and independent welfare society. At the same time, representatives for the engineering elite supported the formulation (or construction) of a renewed engineering identity in which mathematics would encourage experimenting as well as guarantee a higher degree of confidence and also independence from "external" influences. The computers were supposed to materialize and intensify such a transition.

This is not to say that the State *could not* have established a successful computer industry. Nevertheless, I do claim that the financial support to MMN from the Government and the Parliament was never assigned for the creation of a computer industry. Historian Hans De Geer has rightly emphasized that the creation of a national industry is not an obvious task for a government.[35] This is especially the case, one may add, in a technological field surrounded by political uncertainties, as was the case in the mid 1950s when computers, apart from being scientific instruments, were construed as industrial tools with a possible potential to drive workers within industrial production and administration out of competition.[36] Given the mixed complex of professional and political motives framing the practices of translating available information and knowledge from a U.S. to a Swedish context and shaping the organization of MMN, it seems imbalanced to judge the Swedish computer project in the 1950s solely from an industry or production-focused point of view.

Such an argument has historiographical implications. In his book *The Computer: From Pascal to von Neumann* (1973), Herman Goldstine, who supervised one visiting Swedish mathematician at IAS in Princeton 1947-48, noted that "the computing people in Sweden have turned their attention [...] to numerical analysis and the computer sciences away from machine construction."[37] Indeed, a look at the BARK and BESK computers as "mathematics machines" points at other possible outcomes of the computer project than merely to establish a State-owned computer industry. In the later part of the 1950s, *coding* was the one major skill that the modern engineer – the "electron-engineer" – should master.[38] However, already in

[35] De Geer, *På väg till datasamhället*, p. 15.

[36] Cf. Anders Carlsson, "Tekniken – politikens frälsare? Om matematikmaskiner, automation och ingenjörer vid mitten av 50-talet", *Arbetarhistoria: Meddelande från Arbetarrörelsens Arkiv och Bibliotek*, 4/1999. For a substantially longer version, see "Elektroniska hjärnor: Debatten om datorer, automation och ingenjörer 1955-58", in Sven Widmalm (ed.), *Artefakter*, to be published in 2004.

[37] Goldstine, *The Computer*, p. 350.

[38] Carlsson, "Tekniken – politikens frälsare?", p. 29.

the late 1940s and early 50s, in the process of translating the need for mathematics into an educational effort, coding turned out to be what needed to be supplied for. Here, it is interesting to note that the spread of coding practices took place through courses arranged in collaboration between MMN and the Department of Meteorology at the then University College of Stockholm, where Carl-Gustaf Rossby launched a research project to develop numerical methods for weather forecasting in the late 1940s.[39] Early on, the use of the BESK was a key element in this project, and by taking the courses, meteorologists as well as other potential users learned how to use the BESK computer some two years prior to its dedication. Through the interaction between the mathematicians at MMN and the course participants – and parallel to the mounting of vacuum tubes, cathode-ray tubes and memory drums – essential experiences were made regarding how to program and, in general terms, how to arrange an operative center of calculation.[40]

This is where the notions of "producers" and "users", being separate categories, become unacceptably simplified. Computers in the 1940s and 50s, seen not as machines but as *practices*, were collective undertakings involving various forms of skills and knowledge. Mathematics in the form of coding or programming was the common ground where negotiations about design and needs led to practical functioning.

REFERENCES

Annerstedt, Jan, *Staten och datorerna: En studie av den officiella datorutvecklings- och datorforskningspolitiken*, FEK-meddelande nr 41, Kommittén för forskningsorganisation och forskningsekonomi (Stockholm, 1969).

Aspray, William, *John von Neumann and the Origins of Modern Computing* (Cambridge/MA, 1990).

Boestad-Nilsson, Elsa-Karin, "Från Flinta till Ada", *Minnesbubblor och datavisioner: Svenska samfundet för informationsbehandling 25 år* (Malmö, 1984).

Carlsson, Anders, "Tekniken – politikens frälsare? Om matematikmaskiner, automation och ingenjörer vid mitten av 50-talet", *Arbetarhistoria: Meddelande från Arbetarrörelsens Arkiv och Bibliotek*, 4/1999.

- - -, "Elektroniska hjärnor: Debatten om datorer, automation och ingenjörer 1955-58", in Sven Widmalm (ed.), *Artefakter*, to be published in 2004.

[39] This theme will be developed in a forthcoming thesis chapter on the collaboration between MMN and the Department of Meteorology. The forecasting program was in turn a collaborative effort involving IAS in Princeton and, to some extent, the University of Chicago. Cf. Frederik Nebeker, Calculating the Weather: Meteorology in the 20th Century (San Diego, 1995), pp. 158-162.

[40] The issue was discussed in some detail in the correspondence between the heads of the two institutions. See for instance Stig Comét to Carl-Gustaf Rossby, 1953-08-27, Department/Institute of Meteorology at Stockholm University, archives, E1A:2.

- - -, "Elektroniska hjärnor: Debatten om datorer, automation och ingenjörer 1955-58", in Sven Widmalm (ed.), *Artefakter*, to be published in 2004.

Cohen, I. Bernard, *Howard Aiken: A Portrait of a Computer Pioneer* (Cambridge/MA, 1999).

Dalmedico, Amy Dahan, "Mathematics in the Twentieth Century", in John Krige and Dominique Pestre (eds.), *Science in the Twentieth Century* (Amsterdam, 1997).

De Geer, Hans, *Rationaliseringsrörelsen i Sverige: Effektivitetsidéer och samhällsansvar under mellankrigstiden* (Stockholm, 1978).

- - -, *På väg till datasamhället: Datatekniken i politiken 1946–63* (Stockholm, 1992).

Ekelöf, Stig, "Matematiska maskiner i U.S.A.", *Teknisk tidskrift*, vol. 69 (1939).

- - -, "Matematikmaskiner", *Teknisk Tidskrift*, vol. 79 (1949).

Elzinga, Aant, Andrew Jamison and Conny Mithander, "Swedish Grandeur: Contending Reformulations of the Great-Power Project", in Mikael Hård and Andrew Jamison (eds.), *The Intellectual Appropriation of Technology: Discourses on Modernity, 1900-1939* (Cambridge/MA, 1998).

Erlander, Tage, *Tage Erlander: 1955–60* (Stockholm, 1976).

Eskilsson, Enar, "Maskinell lösning av differentialekvationer", *Teknisk tidskrift*, vol. 65 (1935).

Fridlund, Mats, *Den gemensamma utvecklingen: Staten, storföretaget och samarbetet kring den svenska elkrafttekniken* (Stockholm, 1999).

Funcke, Gösta, *[Introduktion till] Naturvetenskaplig forskning i Sverige* (Stockholm, 1963).

Galison, Peter, *Image and Logic: A Material Culture of Microphysics* (Chicago, 1997).

Goldstine, Herman, *The Computer: From Pascal to von Neumann* (Cambridge/MA, 1972).

Grandin, Karl, "Naturlig neutralitet? Tage Erlander, Torsten Gustafson och den svenska atompolitiken, 1945-53" , in Widmalm (ed.), *Vetenskapsbärarna*.

Gummeson, P Eg., "Den svenska ingenjören och vårt lands framtid", *Teknisk tidskrift*, vol. 76 (1946).

Henriksson, Sten, "Den svenska utvecklingen", in Peter Naur, *Datamaskinerna och samhället* (Lund, 1969).

Johansson, Magnus, "Early Analog Computers in Sweden: With Examples from Chalmers University of Technology and the Swedish Aerospace Industry", *IEEE Annals of the History of Computing*, vol. 18 (1996).

Kaijser, Arne and Joar Tiberg, "From Operations Research to Future Studies: The Establishment, Diffusion, and Transformation of the Systems Approach in Sweden, 1945-1980", in Agatha C. Hughes and Thomas P. Hughes (eds.), *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After* (Cambridge/MA, 2000).

Kaiserfeld, Thomas, "Computerizing the Swedish Welfare State: The Middle Way of Technological Success and Failure", *Technology and Culture*, vol. 37 (1996).

Kjellberg, Göran and Gösta Neovius, "The BARK: A Swedish General Purpose Relay Computer", *Mathematical Tables and other Aids to Computation*, January 1951.

Klüver, P. V., "From Research Institute to Computer Company: Regnecentralen 1946-1964", *IEEE Annals of the History of Computing*, vol. 21 (1999).

Lövheim, Daniel, "Kampen om läroplanen: Synen på naturvetenskap och matematik i läroplansdiskussion och läroplansformering 1922-1937", unpublished manuscript, Dept. of History of Science and Ideas, Uppsala University, September 2002.

Nebeker, Frederik, *Calculating the Weather: Meteorology in the 20th Century* (San Diego, 1995).

Paju, Petri, *Ensimmäinen suomalainen tietokone ESKO ja 1950-luvun suunnitelma kansallisesta laskentakeskuksesta*, lic. thesis in Cultural History, University of Turku (2002).

Salin, Jarl, "De tekniska högskolornas pedagogiska problem", *Teknisk tidskrift*, vol. 76 (1946).

Stemme, Erik, "Den svenska automatiska räknemaskinen BESK", *Teknisk Tidskrift*, vol. 85 (1955).

Sundin, Bo, *Ingenjörsvetenskapens tidevarv: Ingenjörsvetenskapsakademin, Pappersmassekontoret, Metallografiska institutet och den teknologiska forskningen i början av 1900-talet* (Umeå, 1981).

van den Ende, Jan, *The Turn of the Tide: Computerization in Dutch Society* (Delft, 1994).

Velander, Edy, "Intensifiering av våra utlandsförbindelser inom teknisk och vetenskaplig forskning", *Teknisk tidskrift*, vol. 76 (1946).

[Weijne, Josef], *Kungl. Maj:ts proposition till riksdagen angående närmast erforderliga åtgärder för tillgodoseende av Sveriges behov av matematikmaskiner; given Stockholms slott den 9 maj 1947.*

Weinberger, Hans, *Nätverksentreprenören: En historia om teknisk forskning och industriellt utvecklingsarbete från den Malmska utredningen till Styrelsen för teknisk utveckling* (Stockholm, 1997).

- - -, "'På sidan av de stora kraftlinjerna'? Teknik, vetenskap och det kalla kriget", in Widmalm (ed.), *Vetenskapsbärarna.*

Widmalm, Sven, "Inledning", in idem (ed.), *Vetenskapsbärarna.*

- - - (ed.), *Vetenskapsbärarna: Naturvetenskapen i det svenska samhället 1880–1950* (Hedemora, 1999).

ARCHIVAL MATERIAL

Försvarets radioanstalt; Matematikmaskinnämnden (Riksarkivet, Stockholm); Ingenjörsvetenskapsakademien (Riksarkivet, Stockholm); Meteorologiska institutionen, Stockholm University.