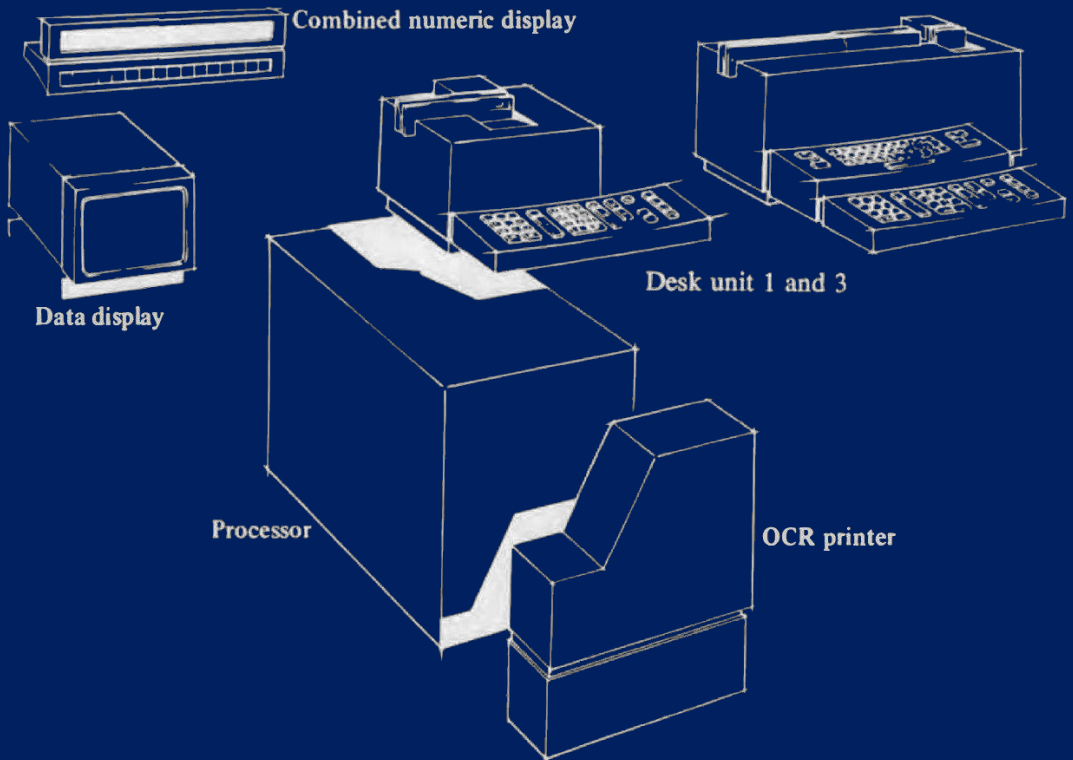


The Rise and Fall of Philips Data Systems

A Major European Computer Industry



Mats Danielson
Arne Läppinen

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Sine Metu

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Front cover image: Arenco Electronics 6110 bank teller terminal from 1969

Back cover image: Philips PTS 6811/UK01/6863 bank computer from 1976



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Third corrected printing, March 2024

Ticking away the moments that make up a dull day
You fritter and waste the hours in an offhand way
Kicking around on a piece of ground in your hometown
Waiting for someone or something to show you the way

Tired of lying in the sunshine, staying home to watch the rain
You are young and life is long and there is time to kill today
And then one day you find ten years have got behind you
No one told you when to run, you missed the starting gun

So you run and you run to catch up with the sun but it's sinking
Racing around to come up behind you again
The sun is the same in a relative way but you're older
Shorter of breath and one day closer to death

– *Time*, Roger Waters, 1973

“There is no reason anyone would want a computer in their home.”

– Ken Olsen, founder, chairman and president of Digital Equipment Corp., 1977

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Preface

This book is about Philips Data Systems (PDS) in general and Philips Terminal Systems (PTS) in particular. PTS, a division of PDS, was one of the very few European computer system manufacturers, perhaps the only one, that managed to occupy the top spot worldwide, with a margin, in a large computer systems market segment over a considerable amount of time. In this case, it was the segment of front-office banking systems from circa 1975 to 1985. Or possibly over a longer period; we try to be conservative here. The book commemorates the great efforts of the many people involved, not only at PTS but also at the rest of PDS, the great pleasure of working with those colleagues, products, systems, and projects, and the fantastic results that came out of the endeavour as a whole.

This book can be read in two ways. Either you read it from the first page to the last. That will give you the complete story. *Readers who are mostly interested in general Philips Data Systems history rather than particular PTS matters can skip ahead to Chapter 4 on early Philips computers without much loss of continuity.* But as authors, we of course recommend reading the entire book.

After a long development period together with the pilot customer Svenska Handelsbanken, regular production shipments of its front-end banking computer systems commenced in early 1973 – more on this foundational project in the book itself. At the same time, requests for similar equipment were made to Philips from many other banks, nationally as well as internationally. In May 1973, Philips Sweden decided to make PTS banking equipment a large-scale international offering with its focal point in Stockholm. At the same time, also in May, it was decided to expand the Philips Veddesta (Järfälla) “Electronics Centre” premises to also house the PTS banking development and manufacturing division as well, thereby doubling its area. To commemorate these two 50-year anniversaries during the same month, which is in reality the month when this worldwide industry in practice was born, this book is finally completed and sent to the publisher in May 2023.

The purposes of this book fall within the categories of education, entertainment and preserving cultural heritage rather than trying to be overly analytical. It is not a research book in an academic sense, even though thousands of hours have been spent researching facts included (or not included) in the book. While factual truth is of course paramount, an ambition to be fully comprehensive would have been time-wise overwhelming and probably

killed the project.¹ But if the book can bring back some good memories combined with some new insights and realisations for those working with Philips computer equipment in one capacity or another during the 1970s to 1990s, its purposes have been fulfilled, perhaps even exceeded.

The book was written over a rather long period of time, with frequent intermissions. From the outset, it was conceived as a textbook but it was subsequently decided that it would be made more of a picture book. Images are quite often more enjoyable and more effective in arising old memories for us that were a part of the endeavour at that time.

And if the book was written over quite some period of time, it was conceived over a much longer period. The authors collected stories as long ago as back in the 1980s when we started working with Philips equipment and collected images from the early 2000s and on – just for fun. After a while, the idea of compiling the material into a more coherent form emerged, but the end result has certainly been a long time in the making. Now we are finally here.

Happy reading!

The authors, Stockholm, May 2023

¹ This book is a compilation of information gathered and stories told to us over many years. It has been fact-checked as far as possible. However, since this is self-funded work, it would, for resource reasons, have been untenable to keep an academic reference note system.

1. Early Swedish Computers

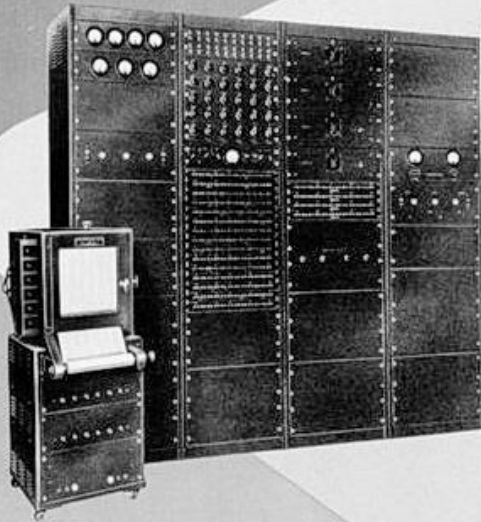
Like many countries at the beginning of the post-war era, Sweden felt the need to secure its own supply of computing power in order to use it for everything from meteorology to weapon ballistics, plus (much more unusual) for its in 1945 secretly launched nuclear weapons programme. To that end, Matematikmaskinnämnden (MMN, the Mathematical Machinery Board), a governmental institution, was established in 1948 to do research on and develop computer technology in Sweden. The Swedish government had secretly, immediately after the end of the Second World War in 1945, decided on the development of a nuclear weapons programme while keeping the nation and its people in the dark. The programme had three cornerstone guises: i) defence research at FOA (the Swedish National Defence Research Institute), officially aimed only at defending the country from nuclear weapons attacks; ii) civilian nuclear power research, officially aimed only at producing cheap electric power from controlled nuclear reactions; and iii) an ambition to be computationally self-sufficient in times of crisis. To begin fulfilling the third requirement, MMN in mid-1948 started scanning the market (which was an all-US market) containing both differential analyses and real computers with stored programs in memory. After an investigation into needs and availability, they placed an order for a REAC differential analyser from Reeves Instrument Corporation in the US. In those days, no tender process was required, and they placed the order directly with Reeves.

In the 1940s, Reeves Instrument Corporation had begun developing plans for a digital computation machine. They hired a mathematician from the original team who designed the UNIVAC computer to lead the project. His initial proposal was to build a machine called the REEVAC, which was based on the design of the EDVAC. For unknown reasons, Reeves decided to scrap his approach and move forward with an analogue computer instead, REAC. It did with electric circuits what a mechanical differential analyser did with gears, shafts, and discs, but operated roughly at ten times the speed but one-tenth the accuracy. Not very impressive. Why did the MMN board settle for this rather outdated computing device? The main reason was that they thought it would be easier to obtain an export licence for it, and the second reason was that the Swedish Navy was one of the project's more prominent promoters, and they preferred to have an almost immediate solution. Besides, the REAC differential analyser suited their needs reasonably well. When the MMN board convened in December 1948, the news had just arrived. Sweden was denied an export licence for the REAC differential analyser, and now all that remained in terms of possibilities was for MMN to build a computer on its own.



ELECTRONIC ANALOG COMPUTER AND ASSOCIATED EQUIPMENT

*An office-size all-Electronic
Differential Analyzer
for Speedy Dynamic
Solution of Simultaneous
Differential Equations*



REAC

COMPUTER • SIMULATOR • TESTER

The REAC differential analyzer

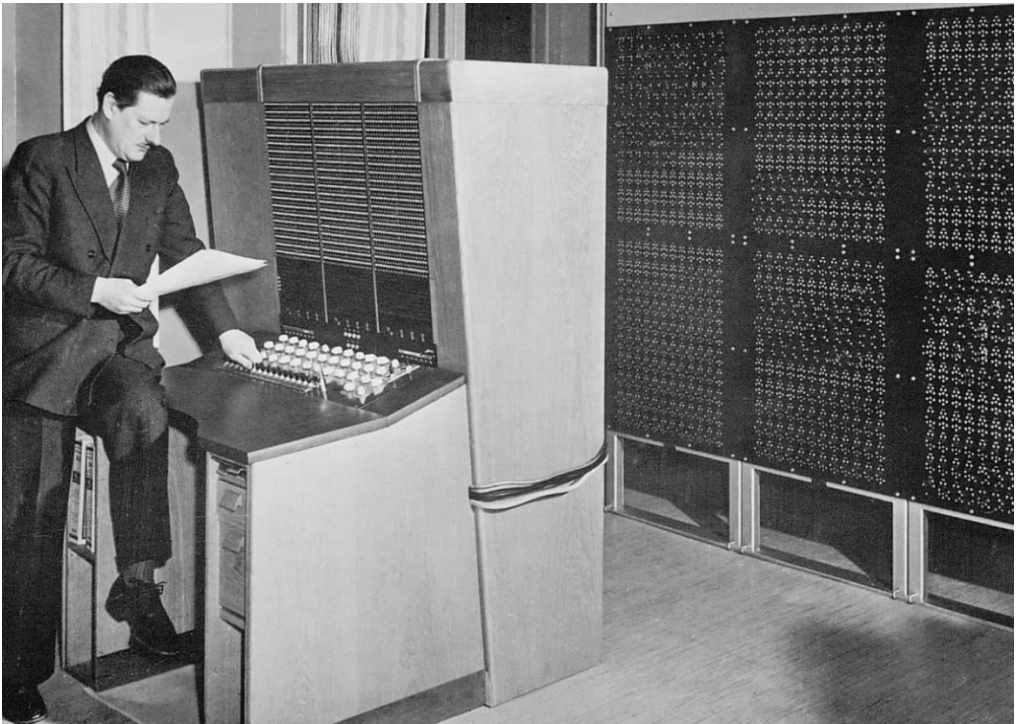
1.1 BARK

When the US, who likely knew about the nuclear weapons programme and doubted Sweden's abilities to defend itself against the Eastern Bloc, thus in 1948 denied Sweden an export licence for a REAC, the reasons were not understood by Swedish researchers. The REAC was an analogue computer of relatively low capacity. It would only have been a stopgap machine until Sweden either acquired or designed and built its own fully digital general-purpose computer. Now, however, Sweden had to find another intermediate solution. MMN quickly chose a practical solution to meet the urgent needs of the military. More specifically, the Navy needed to calculate firing tables for projectiles. In the background was the FRA (Försvarets radioanstalt, Sweden's NSA), which also required a computing machine to decrypt and interpret intercepted communication. The solution came in the form of a relay computer design without stored program memory called BARK (binary arithmetic relay calculator). BARK was inspired by the American ENIAC computer and was also a way for Swedish scientists to learn about computers hands-on. Through invisible channels, the nuclear weapons programme was also pushing for an expedited completion of BARK, which was being built partly from off-the-shelf telephone switch relays. MMN decided that BARK would be designed and built at the old premises of KTH Royal Institute of Technology at Drottninggatan 95 in central Stockholm.



The former Drottninggatan site of KTH Royal Institute of Technology

The project, which started in 1948 and was completed in 1950, was a high-pressure undertaking for the participants. The associate professor (Swedish: *docent*) in charge of the BARK design and construction was Conrad Palm. The pressure from the military (primarily the Navy and the intelligence forces, FRA) presumably took a significant toll on the promising scientist Palm's health, and he died within a year of the project's completion at the remarkably young age of 44.



Conrad Palm in front of the completed BARK computer

1.2 BESK

While BARK was better than nothing, it was both slow and unreliable compared to “real” computers, which were built with vacuum tubes instead of relays by this time. For example, BARK turned out to have a capacity too low for the calculations required for the nuclear weapons programme. Thus, the limited success of BARK rushed the plans for an electronic, vacuum tube-based computer, and the same MMN project group was tasked with building the successor to BARK that they called BESK (binary electronic sequence calculator).

Consequently, BESK was based on vacuum tubes rather than relays and thus much more powerful. It was so advanced at the time that it, at its debut, was one of the fastest computers in the world. Depending on which program was being run, it was rivalled by the Standards Western Automatic Computer (SWAC) at the US National Bureau of Standards (NBS) in Los Angeles or the IAS machine at the Institute for Advanced Study in Princeton, New Jersey. Folklore in Sweden had it that the BESK computer at some point in time (“for several weeks”) held the world record for computing capacity.² The primary point of observation was not the world record as such but that Sweden managed to build a world-leading computer despite being snubbed of a contract for a simple differential analyser only five years prior. BESK was completed in late 1953 but not inaugurated until April 1, 1954, by H.M. King Gustaf VI Adolf of Sweden. At the BESK inauguration ceremony, the King asked, “How can you know its results are correct”? The host lost his thread for a short while and mumbled, “That’s an interesting question”, upon which the King replied, “And what is the answer? I would like to know”. The King was promised an answer at a later point in time, and the host was let off the hook.

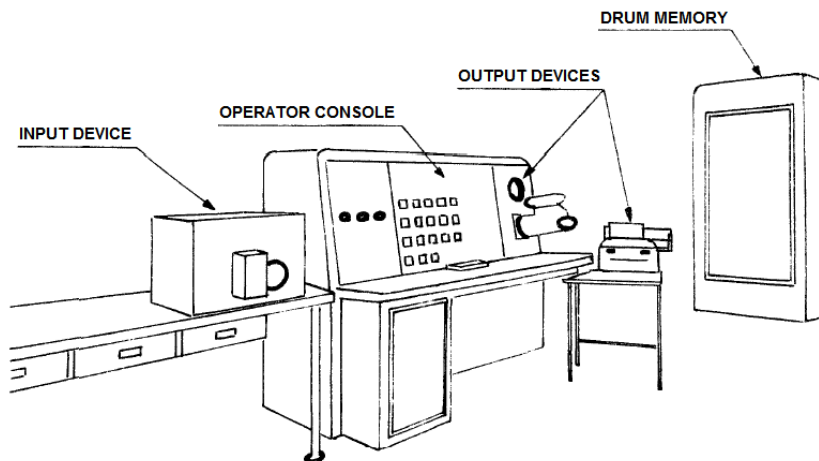
At its completion, the machine was offered to and recommended for an installation at the site of the underground reactor hall in the middle of Stockholm (Drottning Kristinas väg) near KTH, where Sweden’s first experimental nuclear reactor R1 was being built.³ Much to the chagrin of the military, who could not disclose the primary reason for the suggested placement, BESK was instead kept at the former KTH premises on Drottninggatan, also in Stockholm city but some kilometres away, where the machine had been built. One of the world’s fastest computers and an experimental nuclear reactor in the same building would have been a formidable installation. Now, the military personnel and researchers instead had to carry their programs (on punched paper tape) downtown to run their calculations. Apart from losing time, it also gave them much less control over security. To this day, some software programs and calculations from the nuclear project are still classified information.

² Regardless, BESK and the others were surpassed by quite a margin by the IBM NORC (Naval Ordnance Research Computer) built at Columbia University in New York and completed in late 1954. It kept the world record as the fastest number cruncher for a number of years. Already at its inauguration, NORC beat the world record for most decimals of π , delivering a result of 3,089 digits. BESK countered with the largest known prime number having 969 digits, a world record held until 1961.

³ The risk-taking by placing an experimental nuclear reactor, intended both for weapons and power-generating research, in the middle of the city is, by today’s standards, totally incomprehensible. The risk of it running rampant could by no means be excluded or even quantified since too little was known in Sweden about critical nuclear processes at the time.



BESK installed and running at Drottninggatan 95

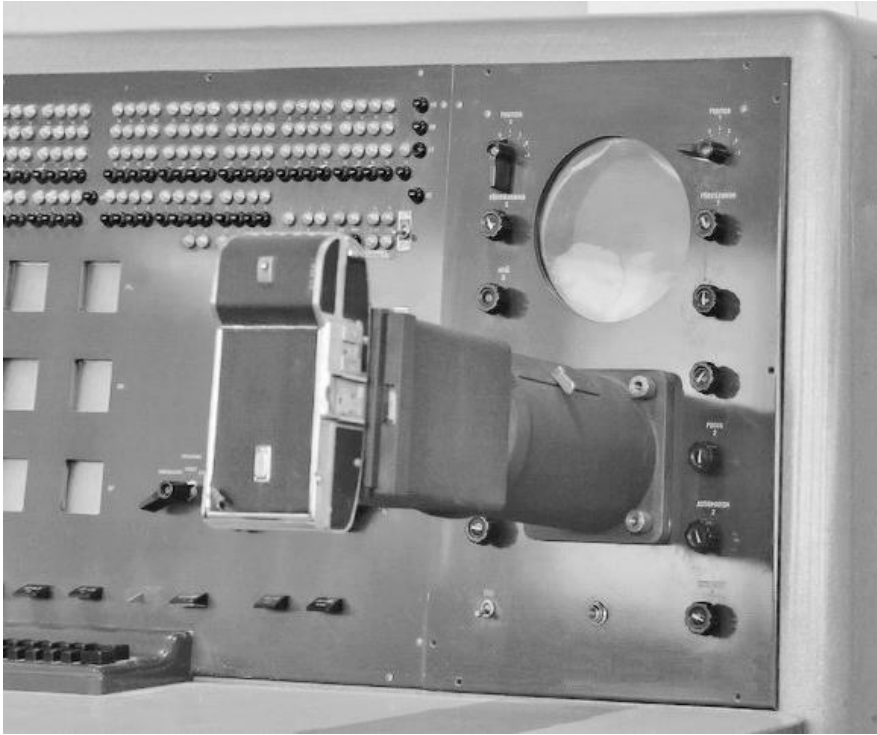


Outline of BESK's main components (except for the Williams memories)

BESK calculated very advanced (at the time) numerical problems, including telephone traffic statistics for Televerket (the state-controlled Swedish phone operator monopoly), weather forecasts for SMHI, wing profiles for Saab's military aircraft and road profiles for the Swedish Road Administration. At night, FRA decrypted intercepted radio traffic but it was secret, so secret that some of the logbooks are still classified. Equally secret were the calculations for the Swedish atomic bomb programme that were run on BESK. For some such processing, the smaller BESK-copy SMIL in Lund was preferred since it was a more low-profile installation, and secrecy and security were key. However, SMIL was not operational until June 1956, which meant that all calculations before that date had to be made using BESK during the night shift. The suggested placement of BESK's "cousin" Facit EDB 3 (see below) in the R1 reactor hall that was argued for in 1959 and onwards also had to do with the nuclear weapons programme. But that installation was instead made in the same building as BESK, just one floor down (on the ground floor). The two computers served in parallel until January 1966. When the extent of the weapons part of the nuclear programme was revealed to the public in 1966, requests for computer placements or computing capacity at the R1 site ceased immediately. Four years later, in 1970, the R1 reactor was closed. The weapons programme did, though, continue until 1972, when it was finally abandoned.

In 1960, a 49-second vector graphics animation of a car travelling down the planned motorway from Stockholm City to Nacka (Värmdöleden, Road 222) was created using the BESK computer. Programmers at the Swedish Royal Board for Public Road and Water Structures (later the Swedish Road Administration, Vägverket, presently Trafikverket) realised that they had all the information available to be able to visualise a perspective from the driver's seat for the planned road. In front of a specially designed digital oscilloscope connected to BESK with a resolution of about one megapixel, a 35 mm camera with an extended film magazine was mounted on a specially made stand. The camera was automatically controlled by the computer, which sent a signal to the camera to advance the film when a new image was fed into the oscilloscope. It took a picture every twenty meters of the virtual path. Not much post-processing was possible, so the making of the film was quick once the equipment had been built and tested. The result of this was a fictional journey on the virtual highway at a speed of 110 km/h (70 mph). The animation was broadcast in November 1961 during primetime on the national television newscast *Aktuellt*. This was the world's first computer animation, and the general public was duly amazed.⁴

⁴ The film can still be found on YouTube in 2023.



The 35 mm filming device attached to BESK



The Road 222 animation on the BESK computer

The image above shows one frame of the animation. It can clearly be seen how the road stretches out ahead of the viewer. Some claims were made that the animation shows a road in another country. For example, Germany was suggested but it is apparent from viewing it that it shows left-hand traffic, which was rather unusual among non-British/Commonwealth countries but was observed until 1967 in Sweden.



The IBM NORC definitely took over as the world's fastest computer in late 1954

Already at the completion of BESK in late 1953, plans for its successor were made. Super-BESK was the MMN employees' project name for the larger and faster machine they wanted to build as the successor to BESK. The MMN board had to belong to some governmental agency and reside in some organisational chart to fit the Swedish state's bureaucratic system. It had been decided that they should be placed under SCB (the Swedish Central Statistical Agency, now Statistics Sweden), whose General Director Karin Kock, as a consequence of the MMN placement under her control, almost single-handedly killed off the Swedish government's computing initiative. Surprisingly, even though BESK was fully booked day and night, she turned out to be of the opinion that the computing capacity of BESK would be enough for the coming 10–20 years and consequently did not want to support another machine, not even a feasibility study. BESK was never a financial burden to SCB – its hourly rate easily covered the running costs. Even though Kock was a former member of the Swedish government, she was probably not aware of simultaneously killing a cornerstone of the Swedish nuclear weapons programme. There was another development option suggested to her by the MMN team as well; to build a transistorised version of BESK that would use the same architecture and thus software but would run much faster and more reliably due to the use of newer technologies. That option was likewise turned down.

1.3 Facit EDB

Disgruntled, the key personnel at MMN (18 out of 40) collectively looked for new positions and opportunities in another organisation where they could continue developing and building new computers. The Swedish company Facit, one of the world's largest suppliers of typewriters and mechanical pinwheel calculators, wanted a share of the emerging computer industry business. In 1956, they acquired the blueprint rights for BESK and hired many MMN group members to make their own version of BESK. The group was internally at Facit referred to as the "BESK boys". The computer was named Facit EDB (meaning elektronisk databehandling, electronic data processing), and it was manufactured and sold in a total of nine copies, four of which became the basis for an internal service business. All except the first copy were partly transistorised and called model EDB 3. The new Facit division's offices were initially housed in the predominantly residential area Östermalm in Stockholm city at Karlavägen 62. It is a classic address in Swedish computing history. They soon outgrew the premises, and additional offices were rented in neighbouring buildings. When this was not enough either, other solutions had to be found. The land was acquired in Vreten industrial park in Solna, just north of Stockholm, and a five-storey "computer centre" was established there (instead of at Facit's primary location in Åtvidaberg, 220 kilometres south of Stockholm) to produce the EDB computers. The centre was inaugurated in 1960. This was a significant undertaking by Facit. Around 300 people were employed in its heyday, but only a few years later, in 1962, the entire computer division was closed. The last (and most spectacular) computer was delivered in November 1962 to the insurance company Framtiden ("the Future"). They displayed their computer and its ten magnetic tape carousel memories in their corporate storefront windows located at Birger Jarlsgatan 50 in the middle of Stockholm City. Those were the days when an insurance company could keep its information core behind ordinary glass windows and display it to the public in the capital's city centre without risking interruption, sabotage or data theft. And speaking of storefront windows, the Facit computing service centre at Karlavägen 62 remained operational until November 1966, displaying a giant model of the EDB 3 computer in its storefront, enticing the kids in the neighbourhood. Computers were known as "electronic brains" to the public at that time, spurring all kinds of fantasies in the kids in the vicinity. One of the authors started school only one block away a few years later, and the stories still lingered. An "electronic brain" residing just a block away was something out of the ordinary for grade school kids, especially at that time when both information and, in particular, sensations were scarce. Could it think? How? Could it know what we were thinking? What more could it do? An

electronic brain was both scary and intriguing to us young school kids. And although we never got to see it in real life, its impression lasted with us for many years.

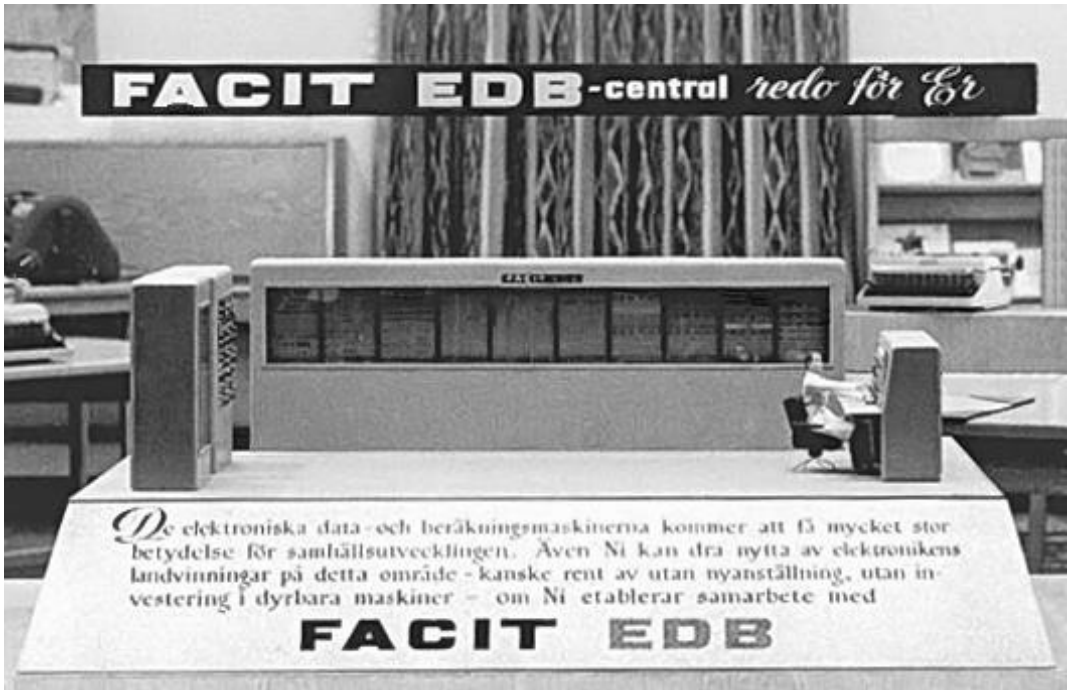


Karlavägen 62, containing Facit Electronics head office and computing service centre

In fact, some stories of the Facit EDB electronic brain, albeit quite a bit more real, were one of the reasons that led one of the authors to study computer science more than a decade later.



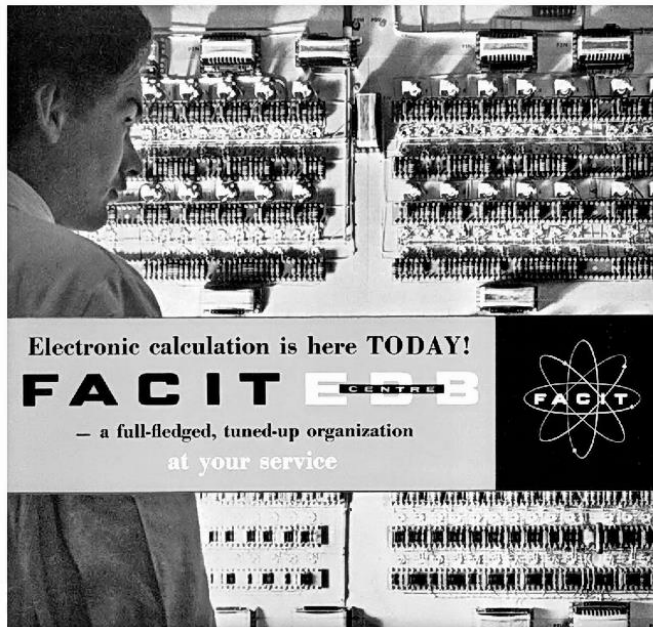
Karlavägen 64, containing Facit Electronics offices, demolished in 1964



Display model of a Facit EDB 3, the same as in the storefront at Karlavägen 62



The surprising actual size of the Facit EDB 3 model



Electronic calculation is here **TODAY!**

FACIT EDB CENTRE

— a full-fledged, tuned-up organization
at your service

FACIT

Advertisement for Facit EDB 3 computer

FACIT EDB

Användare	Plats	Invigd
Åtvidabergs servicecentral	Karlavägen, Stockholm	oktober 1957
Asea	Västerås	december 1958
Matematikmaskinnämnden	Drottninggatan, Stockholm	oktober 1959
Åtvidabergs servicecentral	Karlavägen, Stockholm	1960 (flyttad till Düsseldorf 1962)
Åtvidabergs servicecentral	Göteborg	november 1960
Facit AB	Solna	september 1961
Norske Meteorologiske Institutt	Oslo, Norge	mars 1962
Försvarets radioanstalt	Stockholm	juli 1962
Försäkringsbolaget Framtiden	Stockholm	november 1962

The nine installations of the Facit EDB (in Swedish; all but the first were EDB 3 models)

When Facit realised that there was no money to be made from hand-built, over-engineered mainframes, they tried to halt the business but nine systems had already been sold and thus had to be manufactured. When the management of Facit realised that the Facit EDB model had become obsolete, they decided to move on to transistorised military computers and peripherals. The transistorised military DS 9000 computer, manufactured in ten copies, became Facit's last computer.



The insurance company Framtiden's windows facing Birger Jarlsgatan

1.4 TRASK

Those who stayed at the Mathematical Machine Board when the BESK boys left were mainly kept busy running BESK and planning for and receiving a Facit EDB 3 that would more than double MMN's computing capacity despite the opposition from SCB. It was installed on the ground floor in October 1959 (BESK was one floor up), and MMN could, after that installation, start planning for the next generation, the replacement for BESK in the form of a machine that could take over BESK's programs and tasks but which was faster

and more reliable and which could be gradually expanded with new capabilities. Since SCB ruled out new designs, one idea was that the next machine should be software compatible with BESK and thus programs could continue to run even after BESK was scheduled to be closed down in 1966. One part of the plan was constructing ferrite core memories to replace the drum memories in BESK. While the new memories were being built, MMN was busy designing the first version of TRASK (transistorised sequence calculator), which was a transistorised version of the BESK architecture. But too much time had been lost, and the next disaster soon struck. MMN was disbanded by SCB in 1963, and the responsibility for and ownership of the half-finished TRASK was handed over to the Nobel Institute for Physics at Stockholm University in Frescati (from 1964, the Atomic Research Institute, AFI). They had no space for the development, and therefore, TRASK was mainly built elsewhere, in a former dairy shop at the corner of Dalagatan and Vanadisvägen in northern central Stockholm. TRASK was completed in 1965 and handed over to AFI in Frescati, where it remained in operation until 1980. It was mainly used by AFI themselves (nowadays, the Manne Siegbahn Laboratory for Physics) but also for some KTH engineering student assignments.



The TRASK computer at the Atomic Research Institute

1.5 Alwac

In 1952, the Electrolux (Swedish whiteware giant) founder and billionaire Axel Wenner-Gren founded Logistics Research in California (later renamed Alwac Corporation), and began manufacturing Alwac – Axel Leonard Wenner-Gren’s Automatic Computer. It was initially intended for control purposes for another Wenner-Gren invention, the Alweg monorail⁵ (an acronym also created directly from his name) but it was soon realised that the computers could also be marketed and sold more widely. In 1956, Wenner-Gren decided to start manufacturing in Sweden. Parts were produced in Norrköping and Mjölby while the assembly was being done in the newly-built Wegetronic Center in Bollmora, a suburb of Stockholm. The Bollmora computer was a copy of Alwac called Wegematic 1000. Sales were slow, though, on both sides of the Atlantic, but Wenner-Gren had a habit of donating equipment to educational institutions. For example, Uppsala University received an Alwac III computer, and in 1960, Åbo Akademi received Finland’s first computer, a Wegematic. The mandatory oscilloscope on every operator console underscored the scientific touch on all Alwac and Wegematic installations. Ten Wegematic computers were delivered in 1960–61, and there was a sales agreement with the office equipment manufacturer Addo in Malmö before production ceased in connection with Wenner-Gren’s death in November 1961.

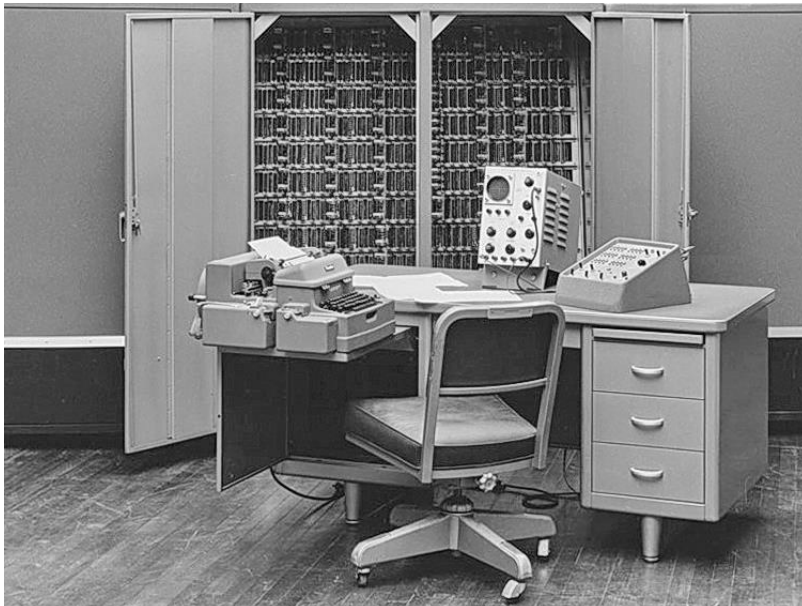


The Tokyo Monorail in 1970, based on Alweg technology

⁵ When Wenner-Gren’s health declined in 1960, Alweg’s technology was licensed to Hitachi who continues to this day to build monorail systems worldwide based on that technology. For example, the world’s busiest monorail line, the Tokyo Monorail, was completed in 1964 and was delivered by Hitachi.



Alvac III computer, complete with an oscilloscope



Wegematic 1000 computer, also with an oscilloscope

New Car? Ask ALWAC If You Can Afford It

By **KARL FLEMING**

They'll be installing quite a gimmick in the National Weather Records Center here soon which does the work of 50 brainy people and can tell you whether or not you can afford a new automobile.

The machine, a giant computer of the famous "Univac" breed, thinks mechanically. It has a personality. It possesses memory incapable of forgetting anything. If something goes awry in its innards, the machine can message out what the trouble is.

This electronic monster is named "Alwac III."

The thing which makes the machine well-nigh revolutionary is its ability to remember. Ordinary computing machines can't do this.

But if you were to "tell" this gizmo that the capitol of North Carolina is Raleigh and then came back 10 years later and "told" the machine the Tar Heel capital is Asheville, the machine would light up like a pinball machine and give you, in effect, a firm, "No, bud, that's not correct."

Or say you wanted to buy a new automobile. Insert the price of the car, the monthly payments, your income, the rest of your budget into the machine, then it would be able to let you know whether or not you could afford the purchase.

Leslie Smith, administrator of

the Records Center, says the gimmick will do the work of 50 people, each salaried at \$3,000 a year and equipped with an \$800 desk computer.

It can solve in four minutes a mathematical problem it would take a human three hours to work out.

The machine has a sort of split personality, one side of the machine checking the other side against errors.

The computer, which is going to cost \$80,000, works in much the same manner as does the human brain. It works on the basis of previously-learned information. After it has the basic information required to solve a problem, impulses sent into the right channels will produce a correct answer.

You can drive the machine batty. Stick in a problem something like this: One divided into zero. This has infinitesimal possibilities. So the machine would keep dividing away—forever—if you don't message it to cease fire.

Soon, when additional basic equations are solved, this mental monster actually will be able to make weather forecasts on a daily basis.

The machine has a modest appetite, too. It'll burn about the same electricity as does the common family electric stove.

It will be set up for display at the Battery Park Hotel May 26-28 from 9 a.m. to 5 p.m.

Should be interesting to watch.

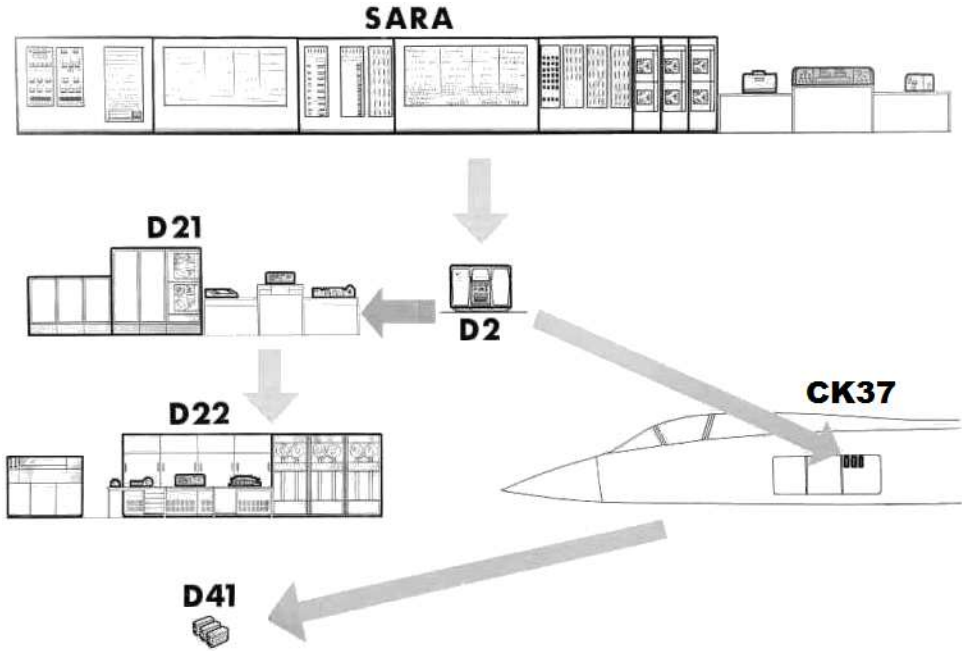
Wenner-Gren was good at finding publicity for his projects

1.6 Saab

Facit realised already in the early 1960s that low-volume hand-built computers were not profitable and closed their production in 1962. Saab, on the other hand, held on to the idea and developed a line of computers that unfortunately never became profitable but rather accrued significant losses over the years.

To begin with, Datasaab was a department within Saab that, at the turn of the 1950–1960s, began to design computers as a by-product of aircraft manufacturing. The first step in this direction was the signing of an agreement in December 1954 with Matematikmaskinnämnden (MMN) in Stockholm for the permission to build its own copy of BESK in Linköping, which, when completed in 1957, was called SARA, Saabs RäkneAutomat (Saab’s Calculator Automaton). This vacuum tube-based digital computer performed strength calculations (especially for the wings) for the already almost developed fighter jet Saab 35 Draken and later for its successor Saab 37 Viggen. For some reason, though, compatibility was not high on the SARA designers’ list of priorities, even though they were building a BESK copy. SARA’s instruction set was subtly different from BESK’s (“improved”), even though they were the same machine in principle, prohibiting compatibility and software reuse. Instead, Saab had in 1958 to develop an emulator for BESK to run SARA’s programs there. A lesson learned many times since, almost every time a “superior” instruction set was implemented instead of the industry standard. One of Saab’s first computer-oriented experiments was carried out in the late 1950s on board the Robot 330, a two-stage missile that could strike the ports of the Baltic countries and be equipped with a nuclear bomb.

The completely transistorised Datasaab military computer SANK (Saabs Automatiska NavigeringsKalkylator, Saab’s Automatic Navigation Calculator, later called D2 in its civilian version), completed in 1960, was the prototype for Datasaab’s further computer development. SANK was specified to be so small that later versions could fit on board an aircraft, and possibly later also on a nuclear missile. Thus, SANK was a cornerstone of the Swedish nuclear weapons programme. Saab’s continued efforts followed two branches: on one hand control computers that were mounted in Saab’s military aircraft and robots, on the other hand production of civil computers for the commercial market. The mainframe computers were called the “heavy” product line (D21, D22, D23 and derivatives), based on the military SANK, and the minicomputers the “light” product line (D5, D15, D16), with both the latter products based on computers from Computer Automation (CAI) in the US rather than emanating from Saab. The nuclear missile computer development was dealt a blow when the weapons programme was exposed to the public in 1966.



Saab's early computer development



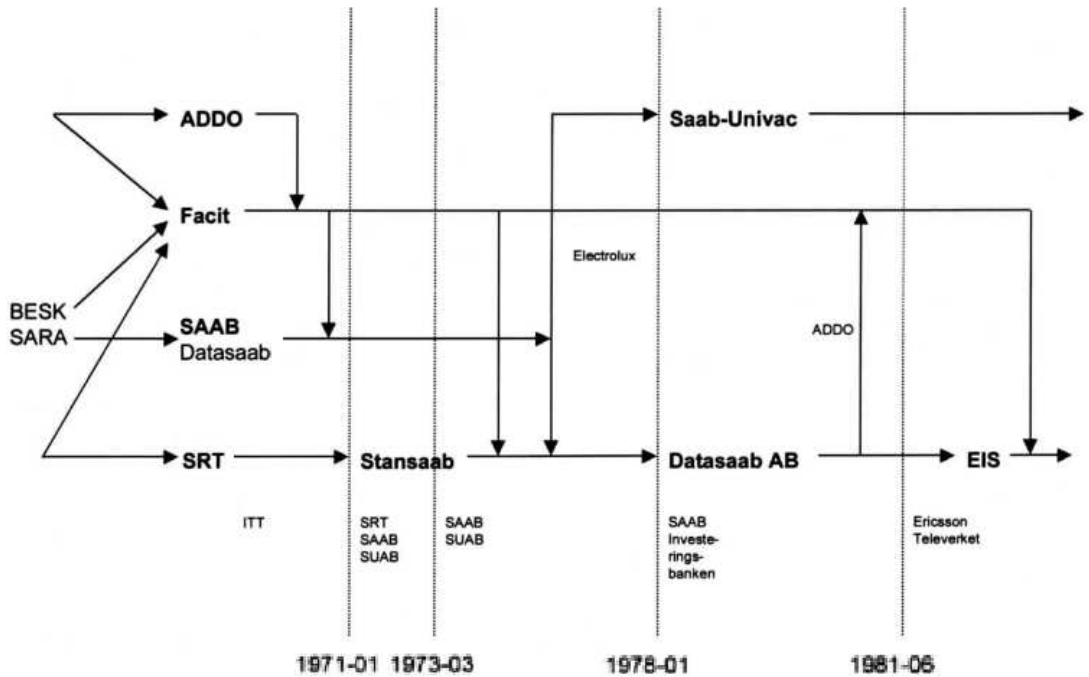
The first D21 installation, at Skandinaviska Elverk in Stockholm

The volume of general military orders in Sweden decreased sharply at the second half of the 1960s, and the company SRT then wanted to eliminate its thereby unprofitable computer-oriented military activities. Thus, the company's computer division was spun off and established as the new company Stansaab, initially owned in equal parts by the government, Saab and ITT. After about two years, ITT left its co-ownership. The formation of Stansaab was one event in the structural changes of the Swedish computer industry.

The global development of the computer industry was in the early 1970s dominated by several American companies led by IBM. The European computer industry had a tough time with the competition from these companies, which inspired the European governments to invest considerable tax funds to keep their domestic computer industries under their wings. In Sweden, it was decided to merge the operations within Datasaab and Stansaab by Stansaab buying the Datasaab division from Saab-Scania. The new company Datasaab, i.e. the combination of Stansaab company and the Datasaab division, initially received substantial government grants and subsidies (in the spirit of the trend of that age).

Thus, in 1978, the Datasaab *division* was separated from Saab and merged with Stansaab to form the new *company* Datasaab. In 1981, the telecom company Ericsson took over Datasaab, and Ericsson Information Systems AB (EIS) was created. Thus, Datasaab as a company existed for only three years. Ericsson would later sell its business to Nokia in 1988. In 1990, Nokia sold this business to ICL, which in turn was acquired by Fujitsu in 1998 (name changed in 2002). By that time, all the banking and other knowledge collected within the original organisation was lost. Unfortunately, as we will later see, Philips Data Systems suffered a similar fate which connects to the theme of this book.

Fujitsu has since been involved in a surprising number of software scandals, especially in the UK, ranging from the Libra (legal management system) and NHS (the National Health Service's digitalisation of medical records) cases in the early 2000s to the Horizon Post Office reconciliation scandal in the 2010s and counting, the latter almost certainly being the most significant societal computer scandal in the world, unfortunately taking place in a similar niche segment (banking/postal office equipment) where PTS was active and did most of its terminal systems business. A definite trust is put in those who develop banking and retail systems that deal with large amounts of money. The sense of responsibility for keeping such systems reasonably bug-free should be strong. Many workers using these systems handle much larger amounts daily than they have as savings in total. It must not be the systems that let them down by malfunctioning in case of, for example, reconciliation problems. Every reasonable measure should be taken to prevent the computer systems from being the culprit. Philips personnel were constantly reminded of this moral and ethical responsibility.



The complicated genealogy of Saab's computer endeavours⁶

But could anyone in Sweden build *office* computer systems? Let us go back in time to the mid-1960s. The two mechanical office equipment manufacturers Addo and Facit were fierce competitors. Addo developed calculators based on so-called ledger cards, and those were eventually transistorised. However, the competition between the two companies ended when Facit bought Addo in 1966, and within the combined company, Sweden's first mini-computer saw the light of day. In 1974, Saab (Datasaab) bought the office computer business from Facit/Addo consisting of an American minicomputer (CAI, which Facit called 6501 and Saab subsequently called D15, later D16) and some calculators. Datasaab's D1x mini-computers were thus not initially incorporated in the business by Saab but via Facit/Addo.

⁶ The authors would like to mention that we are not experts on the Saab camp/lineage, coming from the other one, the Philips/PEAB camp. There are much better and more detailed sources on the Saab camp's activities (that are also much more documented than the Philips camp's). But for completeness, we include some facts about the Saab camp as well since they became world-leading competitors in the front-office banking computing market segment, which this book is about to a large extent. This section is partly based on a Wikipedia article and material from the organisation Datasaaabs vänner (Friends of Datasaab).

Ordern från Handelsbanken var på i runt tal 50 miljoner kronor. Då Philips köpte Arencos var produktutvecklingen inte helt klar, ej heller fanns erforderlig programvara framtagen. Efter ändringar i avtalet togs en ny terminalutrustning fram. Den nya versionen testlevererades 1972 och serielevererades 1973. Philips och Handelsbanken låg alltså ungefär jämsides med Datasaab och sparbankerna, men Swedish Computer var nog före Datasaab med bankelektronik. Deras första dator påminde f. ö. om Datasaab's första bankdator, internt kallad Halvan.

Tord Jöran Hallberg

However, there was also the earlier D5. Inspired by the development of the “heavy product line” and the development of flight computers, Datasaab produced in 1969 the D5 minicomputer partly in collaboration with Facit. It was a weak minicomputer. It had a 16-bit instruction length and was made by TTL logic mounted on printed circuit boards. It had only 28 different instructions and 16 kwords of memory (32 kB). An addition of two 16-bit numbers took 9.4 μ s on a D5/20 from 1972. This can be compared to Philips P855 from 1971, which we will discuss in coming chapters. The P855 had 97 instructions and took less than 4 μ s for a double add, i.e. a 32-bit add on a 16-bit

machine, which is a considerably more complicated operation. Even the Saab history document Tema Bank⁷ admits that Swedish Computer was ahead of Saab regarding front-office banking computers. This despite the newly acquired Swedish Computer’s CPU being considered severely behind at Philips, but who decided to still use that CPU for the first generation for compatibility reasons and time constraints within the project.

But despite its weaknesses, the D5 formed the core of one of the world’s first online front-office banking systems. The Nordic Savings Banks (SPADAB) wanted to set up a chain of bank terminal systems at the end of the 1960s. It became the world’s second distributed computing contract for online banking, signed in September 1969 and only preceded by the Svenska Handelsbanken’s contract with Arencos Electronics in April 1968. Datasaab had minicomputers under development but no suitable workplace modules. The solution for Datasaab was to join forces with Facit. Together, they won the SPADAB contract and the first pilot installations in a real banking environment took place in April 1972. During 1973, online banking terminals were connected to the central computers of the savings banks. In

⁷ Datasaab's historia – Tema Bank, page 6, by Datasaab's vänner. The particular text cited is by Tord Jöran Hallberg whose book on Sweden’s IT history is recommended in the References, and who was deeply involved in Saab’s computer activities at the time.

total, more than 6,000 terminals were installed in the four Nordic countries. Ultimately, more than 1,000 Nordic savings (non-commercial) banks participated in this project. The project was the first of several bank terminal system projects sold by Datasaab, and the company successfully made it to number 5 in the world market of front-office computers, albeit unfortunately without making much profit since the systems had to be heavily customised for each customer. More on the banking office systems market in Chapter 3.



A Datasaab D16 computer with peripherals

The “heavy” product line was in 1975 passed on to a jointly formed company, Saab Univac, in which American Sperry Univac (earlier Sperry Remington Rand, later Unisys) was the majority owner. Saab had large problems with the quality of its D23 mainframe computers, which after repeated delays were finally produced in only six copies, of which four were ever sold. The joint company existed only for five years. From records the authors have studied, it seems that only 32 D21, 42 D22, 18 D220, 12 D223 and 4 D23 computers were ever sold. This sums up to 108 units, below the Philips P1000 series discussed in Chapter

4. Even if the numbers are not completely accurate, they were orders of magnitude behind many American manufacturers. See also Section 4.5 for a “heavy” world market overview and Section 8.10 for a “light” one. Thus, in conclusion, and in a parallel to Philips’ trajectory, Saab’s “heavy” computers were much less of a market success than the “light” ones. It was simply not tenable for European actors during that time and age to compete within the civilian mainframe market sectors. Of course, the financial situation was different for projects involved in and financed by military resources such as the Swedish nuclear weapons programme. The “heavy” offspring CK37 was the navigation computer for the Viggen military aircraft, and from what we understand a version of it was destined to become the on-board navigation computer for future nuclear missiles. However, since not all is yet known about the Swedish atomic bomb programme, it is not fruitful to discuss the Saab “heavy” computers’ profitability. It might be that the “heavy” product line was ultimately able to break even due to indirect financing from the nuclear weapons programme; we cannot know. But it is one possibility, since it was not otherwise profitable and why would it then continue? The weapons programme might also have been one reason for the large subsidies and preferential treatment the civilian “heavy” Saab computers received in Sweden at that time; again, we cannot know and therefore will refrain from speculating. The fact that the Swedish government had a nuclear weapons programme running for 27 years up until 1972 makes it hard to exclude such external factors when trying to understand the domestic computer markets in Sweden at that time. Perhaps we will never fully understand.

In 1981, Ericsson took over Datasaab, now only selling the “light” product line, with Televerket (the Swedish telecom monopoly) as a minority shareholder and called it Ericsson Information Systems (EIS). As a forecast, it was planned for 1990 that EIS’ sales volume would constitute as large a share within Ericsson as the telephony division. It was perceived within EIS as a realistic objective to be as big as telecommunications at the end of the 1980s. That would be realised with the help of existing products supplemented by acquiring additional companies. When EIS was formed in 1981, the question of the future of the bank terminal systems was a stumbling block. They constituted a large problem, losing a lot of money every year. One plan was to hold discussions with Philips about a joint venture or other alternative solutions. However, Philips showed no interest, having a more modern and profitable business in exactly the same sector. Further, Philips felt it could win over Datasaab’s customers through future tender competitions. Thus, EIS was forced to keep the bank terminal business. These systems formed the Business Systems division together with the minicomputer systems business. The strategy was to reduce costs by cooperating with the minicomputer part of the new division. The plan ultimately failed, and the banking business

could never be turned around. See the PhD thesis recommended in the References for a much fuller account of the events that unfolded before and after the takeover and merger.

1.7 Comparison

Although this chapter precedes the description of the Philips minicomputers in Chapter 5, we will briefly compare the two systems' processors before we leave Datasaab. Both manufacturers' systems in the early 1970s were built around homemade minicomputers with self-designed processors. In the Saab case, around ten different architectures were suggested and designed in 1969 in a design process that seemed rather academic and non-industrial. At least three professors from KTH were involved in the design (Dahlquist, Langefors and Thorelli), which might partly explain the way of working in the project. Even though they were all three very good professors, their industrial experience was limited. This is a clear parallel to professors Dijkstra and Parnas, who worked on the Philips P1000 mainframe that we will meet in Chapter 4. They did not contribute much to Philips' industrial success either.

Of the ten Saab suggestions, some were 16-bit solutions; others were 8 or 24. In the end, four CPU suggestions were selected to become a family of minicomputers called D5/10, D5/20, D5/30 and D5/40 (of which the latter one was never realised). There was some compatibility between the four members of the family but not completely. The family members all had limited instruction sets, ranging from 25 to 30 instructions. This can be compared with the Philips minicomputer CPU P855 discussed in Chapter 5. It was conceived at the same time as the D5 family, but the architecture was inspired by studies of the, at that time, leading processor PDP-8 from Digital Equipment, and several study trips to the US were made to meet with leading manufacturers. P855 had 97 instructions in its instruction list; see page 118. The exact number depends on what counts as an independent instruction, but it was evident that the P855 had a full and rich instruction set while the D5 did not. Further, only one Philips architecture was ever suggested, and once approved, it was realised as only one processor model. This set the stage for larger sales volumes and thus profitability.

Another difference was that the Philips CPU was, from the outset, designed for real-time applications. Thus, it had a complete interrupt-handling system with 63 interrupt levels, including software interrupts. This enabled the construction of a real-time operating system with very short response times, and the CPU was easy to use in everything from banking systems and office computers to process control systems. The Saab D5 family, on the other hand, lacked interrupt handling, and thus it was hard to implement a real operating system. Instead, the language interpreter had to check the peripherals' hardware status by a busy

loop to see if data should be transferred. An architecture that mandated code like the following would never have been accepted at Philips. It contains an instruction that jumps to itself, seemingly creating an eternal loop, i.e. a lock-up. However, in the absence of an operating system, the interpreter in the background had to do a lot of manipulation and somehow released the code once the keyboard was activated. Such behind-the-scene semantics was rarely advisable, especially when it was done in lieu of a real operating system.

```

NYSIFFRA:
    RCH   TK           Läs ett tecken från tangentbordet till T0
    CASE  K3   SIFFRA
    HIF   SLUT        Hoppa till läget SIFFRA om T0 innehåller
                       en siffra (ett tecken i kolumn 3).
                       Hoppa till SLUT om T0 innehåller
                       den hexadecimala koden 1F (= ENTER)
    WCH   TK   S70    Lås tangentbordet (ej siffra eller ENTER)
L1: JUMP L1          Vänta på upplåsning
SIFFRA:
    NED           Flytta siffran till nästa position i A0
    JUMP  NYSIFFRA Hoppa till läget NYSIFFRA

```

Code for reading a digit key press in Saab's interpreted D5 DIL language (in Swedish)

While the Philips P855 was further developed in two more generations and also cast onto chipsets (a five-chip set in 1976 and a single chip in 1979), the D5 series seems not to have been developed any further. Instead, in 1974, a computer from Computer Automation (CAI) in the US was imported by Facit and relabelled Facit 6501.⁸ This computer was then taken over by Saab and re-relabelled Saab D15. Philips was no stranger to relabelling either. Before it built its own P855 CPU, it imported Honeywell minicomputers and gave them Philips names. The difference was that Philips did this before they had designed their first mini-computer CPU, not after. The subsequent Saab D16 was also a CAI Alpha LSI machine with a chipset from CAI called LSI-2, consisting of four ALU chips and three control logic

⁸ Computer Automation in California developed the Alpha LSI computer containing an LSI technology processor (standard at the time) and sold it either as a circuit board or as a complete computer in a rack-mountable unit. It can be seen as part of a D16 computer on page 31 (the upper half of the cabinet). The Alpha LSI computers were actually imported to Sweden by the electronics instrument maker and trading house Scandia Metric, which then resold them to Swedish customers including Facit and (later) Datasaab. However, the largest customer group in Sweden were engineering high schools that bought Alpha LSI computers for educational purposes. More than a thousand units were imported in total.

chips (comparable to the Philips P851 chipset from 1976 with four ALU chips and one PLA control logic chip). Alpha LSI could handle 18 address bits, equal to Philips P857 and two more than P851 at 16 bits. Thus, Saab now had access to a machine with a modern processor. When Saab via Datasaab became Ericsson Information Systems in 1981, the Datasaab D16 was re-labelled EIS E2100 in banking applications and E2500 in office applications.

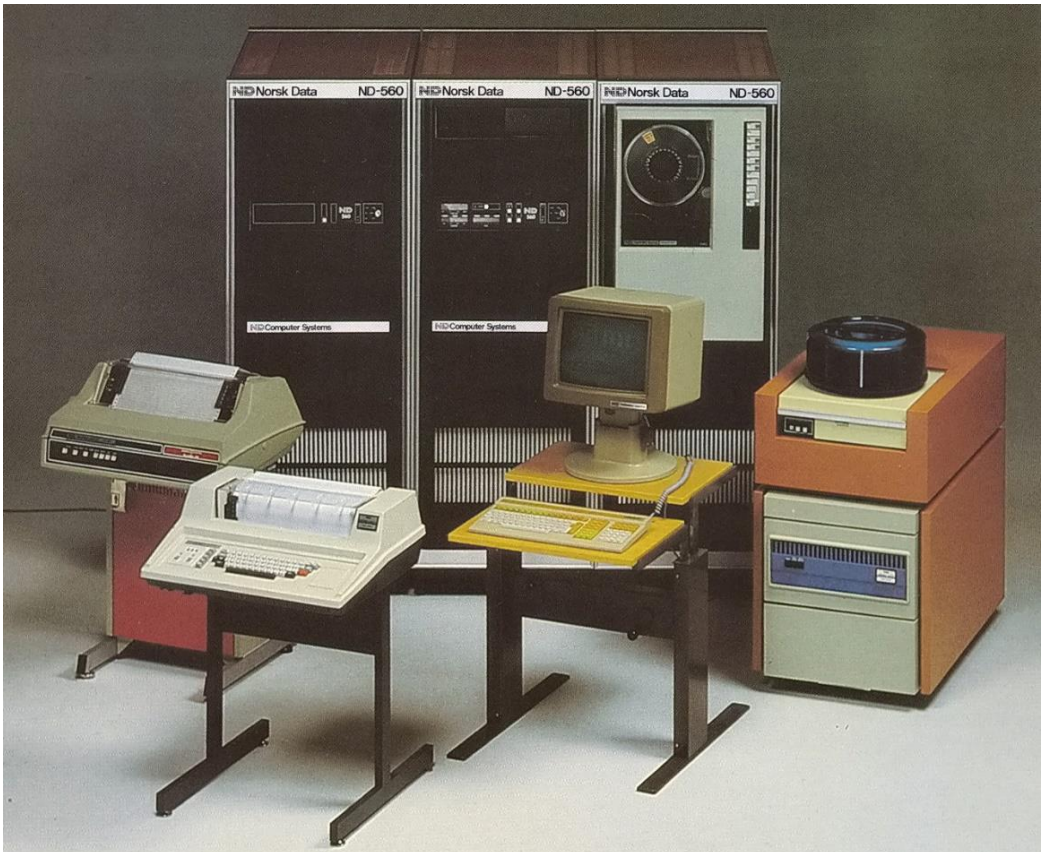


**What this country needs
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The Computer Automation Alpha LSI computer

1.8 Nordic Countries

In all Nordic countries, as well as in the rest of Europe, domestic computer manufacturers were subsidised and received preferential treatment. Be it Saab in Sweden, Norsk Data in Norway, Regnecentralen in Denmark or Nokia in Finland, it was rarely a good idea in the long run compared to participating in open procurement processes. We end this chapter with a story from Norway. Norsk Data was a minicomputer manufacturer located in Oslo, Norway. Existing from 1967 to 1998, it had its most active period from the early 1970s to the late 1980s. At the company's peak in 1987, it was the 30th largest in Norway by turnover but hyped to be second by market capitalisation. According to themselves, the next page tells the story of how they conquered the university college market in their home country.



A Norsk Data ND-560 computer system

The following is an illustrating story from the early days. It happened when Agder Regional College was to buy its first computer system. My friend, Tor Brattvåg, was the head of the department of data processing and I was marketing director at Norsk Data (ND), then a small and newly started company. ND had submitted a bid, based on Nord-1 and the timesharing system Nord TSS. We knew that Hewlett-Packard (HP) was our main opponent. For ND it was critical to keep HP out of the Norwegian market and it was important to win the regional college market for ND computers.

In the critical days before Agder should decide, I called Brattvåg. He informed me that the President of HP Europe should arrive in Kristiansand the next day. I responded directly "Just a moment; you can talk to the World President of Norsk Data, Mr. Lars Monrad-Krohn". Brattvåg laughed and told me that they would get a very favorable bid from HP. HP wanted to enter the Norwegian market with their computers. I then asked if HP would give the same offer to the other regional colleges. Brattvåg answered that this was a special offer to Agder and they were in favour of this offer. After this conversation, it was obvious that HP was trying to enter the market with a dumping offer, and we started a political action. Øivind Fjell, working in the marketing department at ND, was a schoolmate of the Minister of Industry. Øivind called him and asked for a meeting. One hour later Øivind and I met him in the Parliament and explained the situation. The minister took swift action and when we returned to ND, the message came from Agder informing us that HP was out and ND was in.

This was the first, but not the last, time that ND used political manoeuvring to get a contract. After a short period, ND dominated the market for computers in the regional colleges. Only Møre & Romsdal Regional College in Molde was lost to DEC. Since the Nord Time Sharing System included the Basic compiler, it was so decisive in winning the education market for ND in the early 1970s.

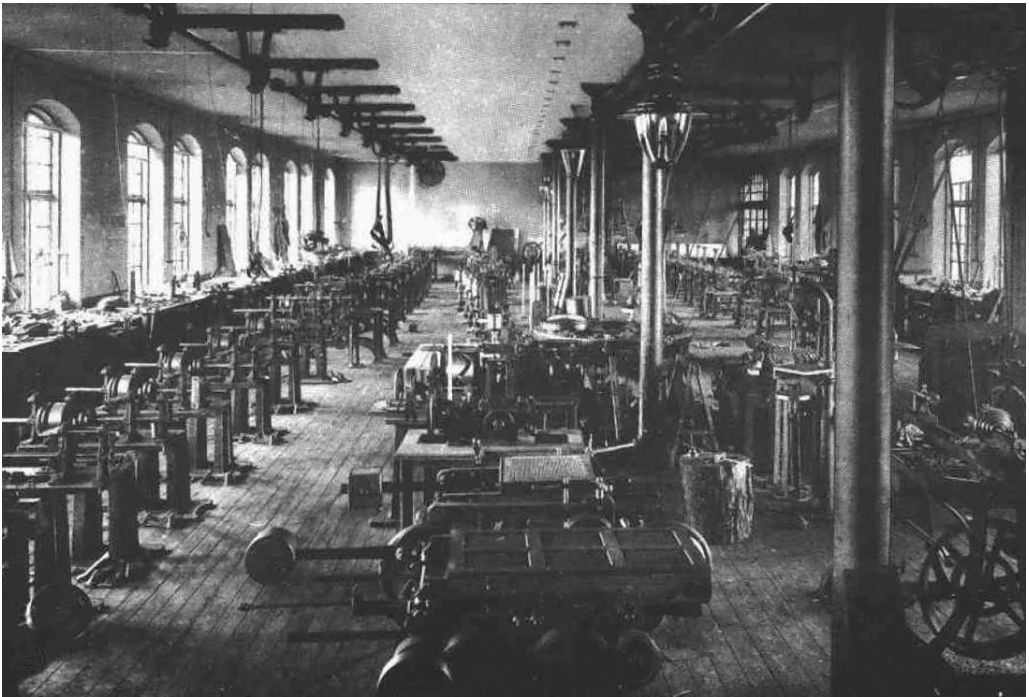
Part of a paper from the conference History of Nordic Computing, IFIP WG 9.7, June 16-18, 2003, in Trondheim, Norway. Proceeding editors Bubenko, Impagliazzo and Sølvberg.

Unfortunately, this way of winning tenders in home countries was not uncommon, and the text seems to conclude that Norsk Data found this to be a viable and suitable method for defeating competitors. Further, the company claims to have been using it repeatedly.

2. Arenco

2.1 Arehns Mekaniska Verkstad

The precursors to Arehns Mekaniska Verkstad, a set of smaller match-making companies, were established in the mid-1800s in the western part of Kungsholmen island, then a remote industrial area in Stockholm, now a part of the inner city. Some were located close to Igel-dammarna, the pharmacies' leech farms.⁹ During the 1880s, more efficient machines were developed for manufacturing both matches and matchboxes and the businesses started to become more industrialised. Oscar Arehn and his son Gerhard were active in the industry and bought patents for several machine inventions. Gerhard Arehns Mekaniska Verkstad was founded in 1885 and became a subsidiary of Förenade Tändsticksfabriker in 1915. Its business was to develop automatic machines for, e.g., the match and packaging industries.



Interior at the Arehns Mekaniska Verkstad factory in 1908

⁹ Leeches were considered an essential and efficient medical treatment at that time.

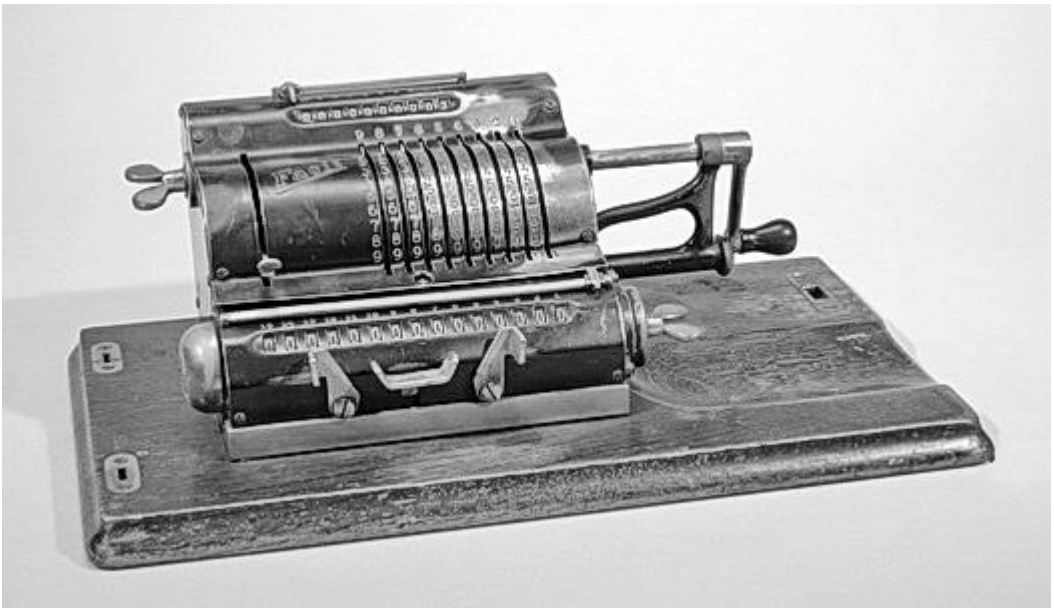
In 1927, it was renamed Arencø AB. The company's factory was located at Alströmergatan on Kungsholmen island in central Stockholm. Arencø manufactured mechanical parts with great accuracy that were resistant to harsh environments. New customers were sought where this property was required, whereby defence equipment customers became a prospective group to target.

The Arencø premises consisted of a four-storey factory and a single-storey foundry for casting the larger machine parts. The foundry can be seen as a gap in the front of the building to the right in the picture. Later, the gap was filled when three more storeys were built on top of the foundry. This became profitable when real estate prices went up on Kungsholmen as an effect of the former industrial area being gentrified and turned into a fashionable inner-city residential area.



Arencø's Kungsholmen factory building

On the same island where Arehns resided, the company Formator AB was formed in September 1907 to explore advances in die casting in nearby Hornsberg on Kungsholmen. When the casting business did not turn out well, the company turned to manufacturing military weapons instead, with greater success. After a while, they supplemented their product portfolio with machine parts for the match and tobacco industries. During the autumn of 1923, Formator was sold to the German company Brunsviga, a manufacturer of mechanical calculators among other things. As a consequence, Formator started to develop more modern calculators, having ten separate keys for the ten digits instead of traditional levers. When Arehns acquired Formator some years later, the calculator division was, however, disbanded and the patents by Karl Rudin of Formator were sold to Åtvidabergs Industrier in 1929, laying the foundation for the Facit calculators from 1932 onwards and thus for the entire Facit office machine business discussed in Chapter 1 which was initially built on those patents. Thereby, Arenco, by its own actions, missed out on a very large world-class business.



Early Facit calculator

From the beginning, Facit was a calculator business with manufacturing facilities on Alströmergatan in Stockholm, i.e. on the same street as Arenco. When the company went bankrupt in 1922, Åtvidabergs Industrier was given the opportunity to take over the business

of manufacturing the Facit Standard calculating machine. The Standard had been developed by Karl Rudin, who laid the foundation for Åtvidabergs Industrier's later successes through his inventions. The machine was initially not a financial success for the company. Facit made substantial cost savings by moving the production to Åtvidaberg and the company did better financially, but for a long time, Åtvidabergs Industrier was sceptical of Facit and it was close to being sold to Brunsviga.

Arenco and Formator shared offices and production facilities but had separate product lines. Most parts were hand-made at this time, and there were fewer synergies in production than what was possible some years later. They shared a construction office, though, so that the mechanical engineers would work on products from both companies.



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Maskiner för **Tändsticks- och Tobaksindustrierna.**

ARENCO FORMATOR

Arenco and Formator shared offices and production facilities on Kungsholmen island

2.2 Siefvert & Fornander

Siefvert & Fornander (colloquially called Sivco) was founded in 1877 by the mechanical engineers Sten Siefvert and Daniel Fornander. It was a mechanical workshop with a foundry in Kalmar in southern Sweden. The castings were used as components for machines, not least for the match factories Jönköping Tändsticksfabrik and Kalmar Tändsticksfabrik within the Kreuger Group. In 1914, the company was transformed into a limited company and purchased by the businessman Torsten Kreuger's Förenade Tändsticksfabriker, known as Svenska Tändsticks AB from 1917, and had until the 1970s a very diversified product range covering, apart from match making machinery, also packing and tube filling machines, fish cleaning and processing machines, cigar rolling machines, and many other products.¹⁰ Being under the wings of Svenska Tändsticks AB meant a fair level of protection from unruly market forces but, on the other hand, also having to confine the business to the sectors appointed to them by the mother company. In Sivco's case, that meant being able to design and manufacture special machines for printing, corrugating and rolling wallpaper, as well as wrapping razor blades. In short, it was a much diversified mechanical business whose assortment made more sense when seen more globally from the viewpoint of the Svenska Tändsticks AB mother company.



Siefvert & Fornander around 1930 in Kalmar

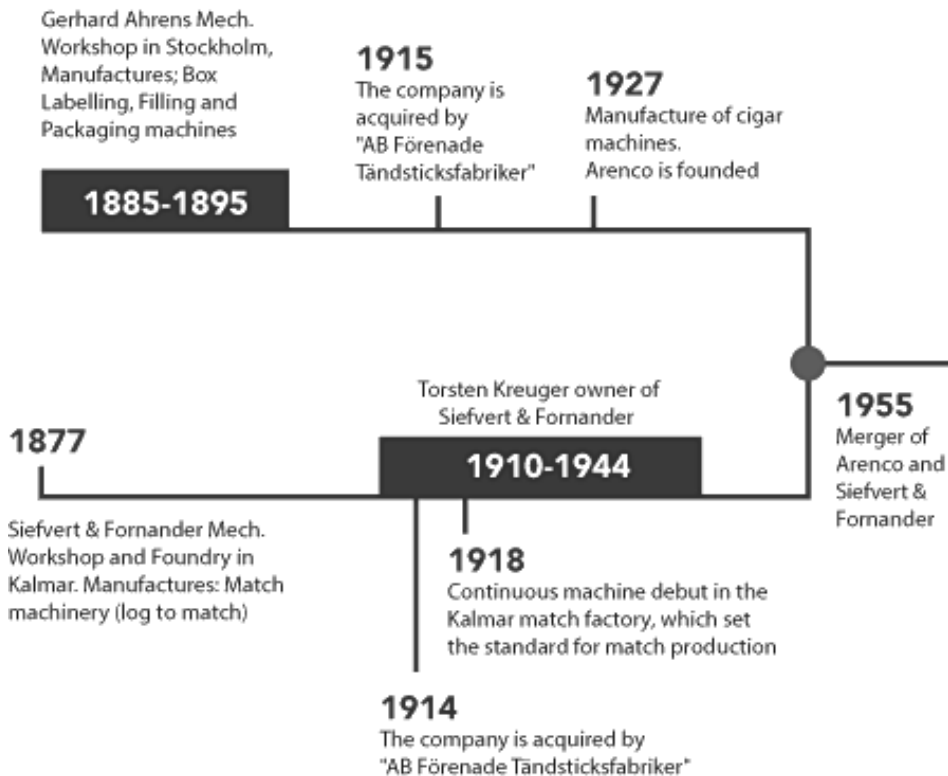
¹⁰ The merged company's Kalmar division went through a number of strategy cycles. In the beginning, it was focused only on match-making, then during the 1900s it divested into a broad product range. In 1979, again having a focus only on match-making, while from 1996 the product range once more expanded into other machines, more similar to the Arencos offerings in 1962; see page 50.



Siefvert & Fornander in 1940 and 1974, respectively, both years in Kalmar

2.3 Arencos and Sivco Merger

Since Arencos and Sivco both had the same parent company (Svenska Tändsticksaktiebolaget, later Swedish Match) and were active in the same broad business areas, the parent wanted to merge the two companies, and in 1955 a new company was formed by a merger under the name Arencos. The former companies' activities remained in Stockholm and Kalmar, respectively, with synergies mostly found in trimming and streamlining the product lines and in marketing. Since it was a merger by the parent company rather than a takeover, neither Arencos nor Sivco got control of the product line planning. On the contrary, the parent ensured both parties that it was a merger of two equals. While good for the work climate and ethics, it prohibited some pruning of product line overlaps. It would not be until the early 1970s that the merged company's divisions were physically co-located in Kalmar when Arencos left Stockholm altogether, and some product rationalisations could occur.



Arencos and Sivco merged in 1955 but were physically separated until 1970

2.4 Arenco Electronics

Arehns' military engineering business began already in the 1930s with license manufacturing of electromechanical anti-aircraft instruments, developed in Hungary for their army. This product series was then further developed by Arenco's own design team during the 1950s and 1960s and became successful in a broader export market.

When the Second World War broke out in September 1939, most mechanical industries in Sweden were, as a consequence, (at least partly) converted into military equipment suppliers. This was also true for the merged Arehns Mekaniska Verkstad/Formator. Partly to reflect its new direction, the merged companies decided in 1943 to use the former machine brand Arenco as the name of the merged company instead. Following the WW2 peace in May 1945, Arenco wanted to explore its newfound skills in manufacturing military equipment and continued to be a substantial supplier to the Swedish military also in peacetime. This success led Arenco to outgrow its premises, and they started looking for a new location. This was accelerated by the Swedish government which, having witnessed increased precision bombings of cities during WW2, did not want military suppliers to have their manufacturing plants in what had at that time become the city centre.

In 1952, Arenco was convinced by Stockholm city planners that the new ABC suburb of Vällingby was the ideal place to move to.¹¹ Vällingby was created from mostly farmland during the early 1950s and the area of Johannelund was designated as an industrial area (the A in ABC). After WW2, all advanced military equipment started to contain more and more electronics to enhance its functionality. Consequently, Arenco built up considerable skills within electronics, and they decided to create a subsidiary called Arenco Electronics to specialise in electronics and move that subsidiary to Johannelund ahead of the mother company. In 1954, it moved to new and functional premises, although quite far from the city centre, and in 1955 the subsidiary was incorporated. But already in 1956, the new Johannelund metro station opened within a two-minute walking distance from Arenco. From Johannelund station, it was a 22-minute train ride to Fridhemsplan station, close to their old premises on Alströmergatan. For employees living in the city or to the south, this meant a 45-minute prolongation of their daily commuting time. Nevertheless, most employees decided to remain with Arenco due to it being a reasonable and stable employer offering job security.

¹¹ An ABC suburb was designed by urban planners to contain A (arbete = workplaces), B (bostäder = residential areas) and C (centrum = shopping malls) within a small geographical area. This was an attractive idea within urban planning research and practice in the 1950s when jobs were simpler and much less diversified.

ARENCO
finns
med i
bilden...

Där kraven på snabba, precisa besked är störst – inom flyget, kustförsvaret och luftförsvaret – där finns Arengo med i bilden.

ARENCO ELECTRONICS
SIKTGATAN 11, VÄLLINGBY

ARENCO ELECTRONICS
SIKTGATAN 11 • VÄLLINGBY

Typical Arengo Electronics advertisements for defence equipment (in Swedish)

Vällingby, being an ABC suburb, had very few workplaces to offer when it was established, despite its efforts to focus on all of A, B and C. Arengo’s only neighbour in Johannelund in the late 1950s was IBM, which can be seen in the aerial photo over Johannelund. In line with its more high-profile image, IBM had its logo painted on the roof. Since no drones or satellite photos were available at the time, why did they do this? Because Johannelund was located in the approaching zone of Bromma Airport, which was Stockholm’s only international airport at that time. Thus, IBM customers and employees could be greeted on approaching the airport. Initially mainly a factory, the IBM building would also partially house the newly founded IBM Nordic Laboratories from 1960 to 1965 (the lab was split between Johannelund and Ankdammsgatan in Solna – “Duck Pond Street”) before they moved to brand-new offices on Karins Allé in Näset, Lidingö, on the other side of Stockholm City.



Aerial photo of Johannelund from 1958; Arenco Electronics at the bottom

2.5 Reunion

In 1960, the mechanical industry Arenco followed Arenco Electronics out to Johannelund in Vällingby. Their office and factory were built adjacent to the Electronics building, on the south side toward the metro station. The authors do not have any pictures of the combined buildings from that time, but the buildings look almost the same today and now house a discount department store. From the height of the brick-covered staircase between the two buildings, it can be seen that the second building (mechanics) was being planned at the same time as the first one (electronics). Both also had equally designed factories in the rear.



Arenco Electronics building to the left (brick building), mechanics to the right



An Arenco manager's office in the mechanics building

The offices, especially in the newer mechanics building, were much more modern and spacious than the old ones at Kungsholmen, which were more than 60 years old. A manager had a four-window room, while engineers and other office workers had two- or three-window rooms. In any case, it was a considerable upgrade from Alströmergatan.¹² The products designed and manufactured at the Johannelund location of the merged Arencos continued to be similar throughout the 1960s, with increasing quality due to the much more modern newly-built premises that also allowed for more extensive quality control measures. But it came at the expense of much higher costs for the premises compared to Sivco in Kalmar.



ARENCO tillverkar bland annat tändsticksmaskiner, packningsmaskiner, fiskrensningmaskiner och tobaksmaskiner – automatiska maskiner som arbetar snabbare, säkrare och billigare än mänsklig arbetskraft förmår. De bidrar till ökad produktion, högre och jämnare kvalitet, lägre kostnader och större vinst.

ARENCO-maskiner finns idag över hela världen.

ARENCO AB Siktgatan 11, Vällingby

Advertisement from 1962 showcasing the range of Arencos offerings (in Swedish)¹³

¹² In the image of a manager's room, the high-rise buildings of the Hässelby Gård residential area can be seen in the foggy distance in the third window, behind the car park.

¹³ See also the note on page 43 which discusses the cyclic strategic planning of, initially, Sivco. Later, after the merger, also including Arencos.

2.6 Scienta

In 1951, a couple of newly graduated electrical engineers from Chalmers University of Technology (CTH) in Gothenburg started a business, Scienta (actually Scienta Scandia AB), importing industrial electronic instruments and equipment to resell to manufacturing companies of different kinds intended for their internal production needs.

ELEKTRONIK- och SERVOKOMPONENTER

KNICK IMHOF ELCONTROL SCIENTA

Egna tillverkningar av standardapparatur samt specialkonstruktioner.

Begär ER egen specialbroschyr!

ELFAXTRON Elektriskt hastighetsreglerad motor. Kontrollsvärligt varvstakt varvtal, förhållande 1:600. Konstant vridmoment. Ogränslig styr. Induktions- och reversering. I järnkonstruktion och programstyrt. Vridmomentnummer 0,25, 0,5, 1,0 och 1,5 kN vid 8000 v/min.

ELEKTRONISK VARVRÄKNARE typ CRM11 för olika gear. Värstakt indikeras direkt på visningsinstrument. Fotodokumentation, typ PPH, för användning tillsammans med elektroniska räkare.

IMHOFS Instrumentkåpor och rack. Stort utval t standardiserande. Korta leveranstider.

VARVREGLERINGSÖGREGAT för stegvis varvtaktreglering mellan 2.800 och 140 v/min. Värstakt inställbar. Utvaliga användningsseparat.

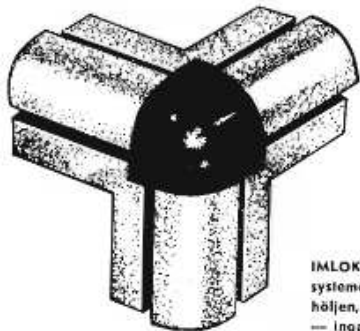
CONTRAVEN elektronikkomponenter. Omkopplare, reläer, reläer, hölphäns, motstånd m.

ELEKTRONIKERIA typ ER2. Manöverinstrument reducerad till stora mikroampere. Användbar vid gränshänsytare, termometer, avläsningsutlösning inom k.a., papercass och textilmaskiner.

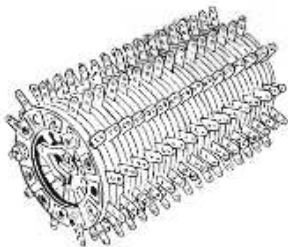
AKTIEBOLAGET **Scienta** GÖTEBORG 1
 KVILLEGATAN 98 Tel. vx 23 29 11, 23 73 22 BOX 366

Typical Scienta advertisement from the mid-1950s (in Swedish)

During the 1950s, electronics manufacturers and many other businesses began incorporating electronics into their products to improve both functionality and quality. Scienta also sold electronic instruments to the Swedish Army and the Swedish Air Force.



IMLOK — byggsats-systemet för instrument-höljen, rackar och skåp — inga skruvar, nitlar eller svetsar. Ekonomiskt — flexibelt.

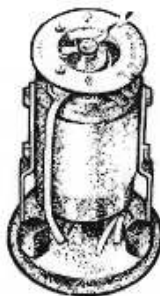


BYGGBARA OMKOPPLARE för upp till 8 A brytström — isolation $> 0,5 \cdot 10^{11}$ ohm — övergångsmotstånd ca 2 mohm — spänningsprovad för 2000 V.



LÖDPLINTAR med förtillrade kontakter ingjutna i araldit — tropiksäkra — isolation $> 5 \cdot 10^7$ Mohm — temperaturområde -40° — $+100^\circ$ C — numererade kontakter.

KOMPONENTER FÖR ELEKTRONIKERN



SENSITACT RELX — högkänsligt mätrelä med inställbara kontakter 2 — 10000 μ A — upp till 200 mW brytförmåga — indikering på skala — skaksäkert upp till 40 g — tropiksäkert.



UNIVERSALINSTRUMENT

typ UNIVEKA
10000 ohm/V — 31
mätområden: för ström
och spänning AC/DC
50 μ A — 10A, 50 mV — 5kV
— resistans 0 — 10 Mohm —
dämpning — 2 — 0,5M
— noggrannhet DC 1,5 %

Vi erbjuder ett mångsidigt sortiment för elektronikern —
kontakta våra försäljningsingenjörer redan idag.

Kvilegatan 9 B, Box 366
GÖTEBORG 1
Tel. 23 29 11, 23 55 29

Scienta

Gulddragargränd 9
VÄLLINGBY
Tel. 38 62 84

Elektronik • Mätteknik • Automatisering

Another advertisement, this time with their Grimsta (Vällingby) address as well

In 1958, they set up a subsidiary office in Grimsta in the northwest of the capital of Sweden, Stockholm, less than a kilometre away from Arenco Electronics (who had moved to nearby Johannelund in 1954) – a short distance that will play a role later in this book. Scienta began to get to know Arenco Electronics by selling instruments and other equipment to them.

During the late 1950s and early 1960s, Scienta started to build their own electronics systems rather than only being a reseller. One of the markets that Scienta successfully entered was NC machines (numerically controlled tooling machines).

Numerisk styrning av verktygsmaskiner

Civilingenjör Ingvar Nilsson och ingenjör Börje Nyquist, Göteborg



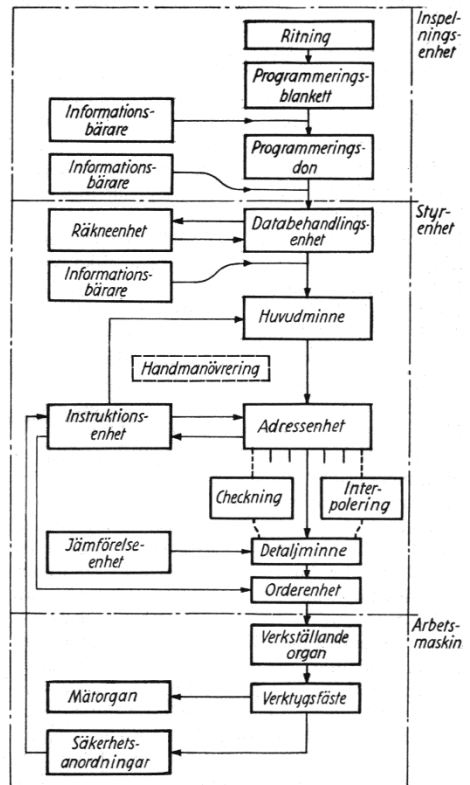
Ingvar Nilsson

Elektroniken är ej ett nytt element för styrning av verktygsmaskiner. Redan tidigare har elektroniskt styrda maskiner konstruerats för t.ex. kopiertillverkning, och elektroniska element har använts i bearbetningsautomater. Elektroniken i dessa har innehållit servosystem av analogtyp och olika typer av programgivare.



Börje Nyquist

Elektroniken till en sifferstyrd verktygsmaskin innehåller också servosystem, men dessa är företrädesvis baserade på överföring av mät- och jämförelsedata i sifferform. Liksom vid tillverkningen av databehandlande maskiner för kontorsautomatisering kräver även tillämpningen av siffersystem på tillverkningsprocesser och för styrning av bearbetningsmaskiner en noggrann analys av hela tillverkningsproceduren. Man tvingas att logiskt klarlägga alla de olika moment, som sammantagna utgör tillverkningscykeln alltifrån uppgörande av ritningen till avsyningen av den färdiga detaljen. Redan denna analys kan i många fall utgöra en grundval för en rationalisering och effektivisering av tillverkningen, men kombinerad med elektronikens möjligheter ges ofta uppslag till helt nya tillverkningsmetoder. Ett exempel härpå är tillverkningen av komplicerade verktyg med hjälp av automatiskt styrda fräsmaskiner. Genom den elektroniska styrningen kan maskinen kontinuerligt utföra en tredimensionell bearbetning, vilket ännu endast med stor svårighet kan göras manuellt.



Article in a Swedish trade magazine describing Scienta's NC solutions (in Swedish)

In 1962, Gothenburg-based Turitz & Co, owners of the nationwide EPA (EnhetsPrisAktiebolaget, the Unit Price Company) department store chain, asked Scienta to carry out a feasibility study for a system for the automation of department stores, including electronic cash registers, bar code readers, etc. This was a co-creation project that was, in reality, primarily a design study for a new product line at Scienta. At the same time, it constituted administrative development and rationalisation for Turitz. The study led to a fully operational demonstrator with an electromechanical cash register connected to the horse racecourse odds computer in the next section.



EPA department store in Uppsala, north of Stockholm

Because of rather mature plans to sell the EPA chain, which grew stronger in 1963–1964, Turitz turned out to be somewhat reluctant to invest heavily in an automation project that

would almost certainly be incompatible with the acquirer's systems (if any) and thus not represent that much of an added value for a new owner, so the study was not taken beyond the demonstration stage. Nevertheless, this feasibility study later became pivotal for Scienta's new owner.



EPA department store in Handen, south of Stockholm

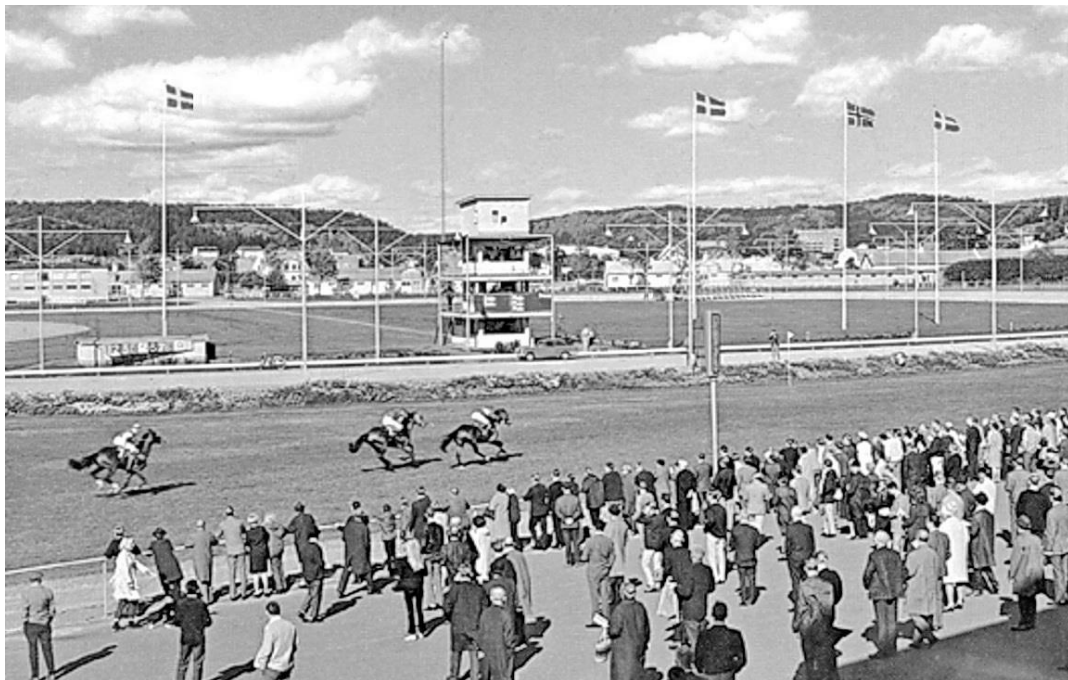
A couple of years later, in 1969, the EPA chain was finally sold to NK, another Swedish department store chain, thus finally sealing the fate of the Turitz project.

2.7 Swedish Computer

In 1959, Scienta received an order from the Åby horse racecourse outside Gothenburg for an automated totalisator (odds calculator) and betting system. This system was designed and constructed by a project team at Scienta, consisting partly of newly hired engineers, and was successfully installed at the track in 1961. This was the world's first electronic totalisator (albeit not computerised), and the installation caught the eye of many other racecourses as well as competing totalisator manufacturers.

Since several requests for installations of totalisators started coming in, Scienta started in 1962 a subsidiary that they futuristically called Swedish Computer for the development and

sales of totalisators. A pre-computerised system was installed in 1964 at the Vincennes racecourse in Paris, home of the world's most prestigious trotting horserace, Prix d'Amérique. The turnover was almost immediately increased by 30% due to the more efficient handling of betting odds.



Åby horse racecourse outside Gothenburg

Swedish Computer was soon contacted by AmTote, The American Totalisator Company, the world's largest manufacturer of totalisator equipment, who wanted to co-develop a computerised totalisator based on Swedish know-how. A cooperation started, in which a very adaptable computer was acquired (Monrobot IX from Monroe Calculating Machines Co. in San Francisco), and work began on its integration with the electronics from Swedish Computer. After a year, equipment and personnel were transferred to AmTote in Maryland, US, and in 1965, the world's first computerised totalisator was finished and installed at Roosevelt Raceway in New York. Later the same year, the US subsidiary of the Australian company Automatic Totalisators also installed computerised totalisators at three other racecourses in New York State.

JORNAL DO BRASIL

Rio de Janeiro — Quinta-feira, 8 de junho de 1967

Ano LXXVII — N.º 53

Eletrônica faz cálculo no hipódromo

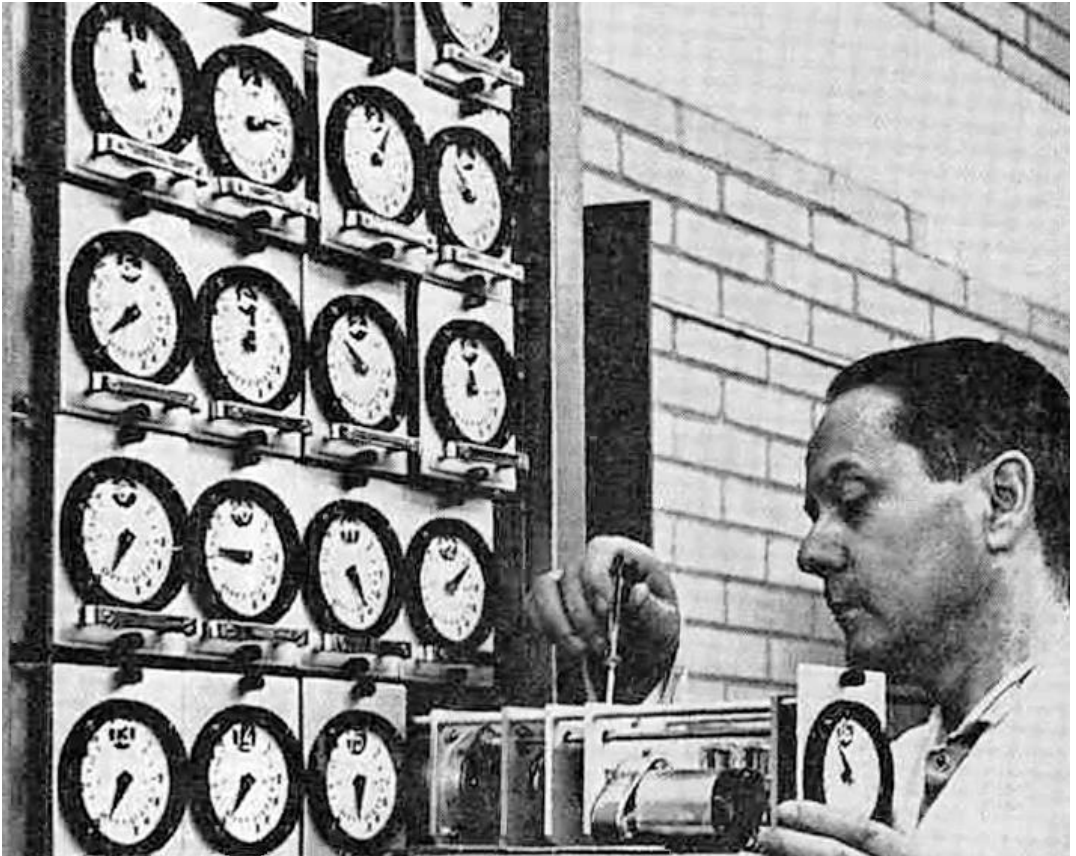
Estocolmo (SIP-JB) — Vincennes em Paris, a maior pista de corridas da Europa, instalou recentemente um totalizador eletrônico desenhado na Suécia, o qual tornou possível acelerar todas as operações de cálculo e pagamento. Aos quatro ou cinco minutos da corrida, Vincennes pode anunciar agora o ganhador, lugar, show e dupla, um cálculo que antes requeria meia hora de trabalho.

O novo totalizador foi desenvolvido por Swedish Computer de Göteborg, filial da Aranco Electronics, e inclui um sistema de elaboração de dados e uma máquina emissora de bilhetes.

A maior vantagem do sistema eletrônico, segundo disse Swedish Computer, está em que o equipamento pode ser adaptado a toda classe de competições desportivas tais como corridas de cavalos, de galgos, bicicletas etc. e para diferentes tipos de apostas. O equipamento ultrapassa as exigências práticas de velocidade, enquanto que ao mesmo tempo calcula as apostas e os pagamentos.

The high-profile installation at Vincennes in Paris was news worldwide

In 1967, the French Vincennes system was updated to full computerisation, news of which spread around the world. Many more installations followed at prestigious racecourses, such as Täby Galopp outside Stockholm in Sweden and Gelsenkirchen in Germany. The totalisator installations were rather complicated, with (in the beginning) a lot of mechanics and electromechanics, later supplemented by a computer that added even further to the complication level. Handling these kinds of projects prepared Swedish Computer for upcoming projects in which computers were to be integrated with both electronics and mechanics in time-critical installations where the downtime was measured in minutes, preferably in single-digit numbers. In events that followed, the focus of Swedish Computer would change from horseracing to other sectors of societal automation, which will constitute the subject of most of the rest of this book.

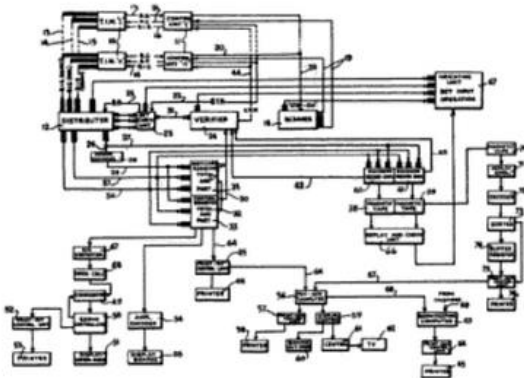


Field service of a totalisator from Swedish Computer

Swedish Computer formally described their totalisator design and applied for a patent already in 1962. The patent was subsequently granted in 1965 when Arenco had already acquired the company. Since the company remained located in Gothenburg, there was not much interference from the new owners, either in product lines or design and production methods, as long as the company continued to show profits. Thus, Swedish Computer could develop their 4-bit processor to suit their needs within the totalisator business. This was a large and complicated undertaking for such a small company, but their skills were considerable – to the extent that Saab later admitted that Swedish Computer’s horseracing CPU was clearly ahead of their own D5 series of computers; see page 30.

**3,327,292
RACE TRACK BETTING DATA HANDLING
SYSTEM**

Sven Eriksson and Börje Nyquist, Goteborg, Sweden, as-
signors to Swedish Computer AB, Goteborg, Sweden
Filed Sept. 11, 1962, Ser. No. 222,921
Claims priority, application Sweden, Sept. 12, 1961,
9,064/61; Mar. 3, 1962, 2,354/62
10 Claims. (Cl. 340—172.5)



1. In a data handling system for automatically classifying and processing information items of preselected amounts and including,
an input check unit,
an integrated system of sequentially operative gates and pulse generating means for routing the items of information as coded pulses to appropriate storing devices,
a plurality of count registering and storing circuits each arranged to register and store a count of more than one of said items and responsive to said pulses for registering and storing each count of said items;

a number of positions from which a plurality of said items are registered in said circuits and,
an electronic scanner,
means operatively associated with each of said positions and responsive to said scanner to emit a signal identifying one of said amounts,
means responsive to said signal and said pulses to select at least one of said count circuits to receive said pulses and,
verifier means responsive to said signal, said verifier means including,
control count circuits arranged to register and store for verification the counts received at each digital position of the count registering and storing circuits representing one of said amounts and responsive to said pulses for registering and storing said count, said control count circuit being arranged to provide an output voltage on one of a number of terminals, each corresponding to one amount that can be selected,
a set of amount terminals, each representing an amount which may be selected, said set of terminals having a voltage signal on only one terminal corresponding to the selected amount,
first logic circuit means responsive to the voltage from the control counter circuit output terminals and the voltage at one of said amount terminals for delivering a signal to an "and" circuit when a voltage is present on corresponding amount terminals in both sets of terminals,
second logic circuits means including an "and" circuit responsive to the said signal and the signals from at least one other source to deliver an output signal from the verifier if all prescribed signals are present,
third logic circuit means to provide a warning signal, if the control counter output voltage is present on a terminal other than the one corresponding to the selected amount, or if all prescribed voltages are not present at said "and" circuit of said second logic circuit means.

Swedish Computer's horserace totalisator patent application

2.8 Acquisitions

Arenco got to know Scienta through its sales office in Grimsta, which as we have seen was less than one kilometre away from Johannelund where Arenco was located. Scienta sold electronic instruments to Arenco and also tried to sell their electronic design capabilities at Scienta and its subsidiary Swedish Computer, both located in Gothenburg. After some successful projects together, Arenco decided to acquire its project partner. In 1964, Swedish

Computer was sold to Arencos and the Turitz project fell by the wayside. The following year, 1965, the mother company Scientia met with a similar fate, being sold to Arencos, but in Scientia's case, it was also partly moved to Stockholm and integrated into Arencos Electronics. This was made possible by the oversized buildings that Arencos resided in, a consequence of planning for an expansion but also a result of a sharp decrease in military defence orders in the mid-1960s.

3. Swedish Banking Automation

Swedish banks were at the forefront globally regarding automation and other optimisation efforts – having a long history of banking dating back to the world’s first central bank (Riksbanken), established in 1668. When, in Sweden in the early 1960s, the development of data processing in the banking and insurance sectors began in earnest, data capture was a major problem. A way to find cost efficiency in electronic data processing was to centralise it. The transactions had to be captured by the central data facility effectively. Collecting and recording bank transactions was often time-consuming and fraught with inaccuracies. It could take days before a transaction at a bank branch was registered in the central computer system. Methods and techniques were developed to deal with these problems. Equipment for recording transactions on punch cards or punched paper tape was developed. Simple check digits carried out the error control. The key objective was to reduce transaction processing time and meet the banks’ and customers’ demands for fast and reliable information about their accounts. In addition to purely financial benefits, the banks saw competitive advantages in such developments.

As the technology matured, banks began considering the possibility of transferring transactions via a telecommunications network. Some banks had slowly begun to realise how an online bank front-office terminal should be specified and constructed to be appropriate. Besides the obvious requirements of cost efficiency, there were a number of things to keep in mind in those days. Since data communication was not very reliable, the backup solution must be reasonably efficient and secure. The backup solution also had to fit in with the manual routines that were prevalent at the time. In other words, as few new procedures as possible should be invented for the offline case, both for reasons of efficiency but also familiarity. It could reasonably be assumed that all bank tellers and other front-office personnel were familiar with the manual procedures. Piggybacking on those for a backup solution was a necessity.

The first two banks in Sweden (and among the very first in the world, possibly the first two) to consider implementing these online ideas were Svenska Handelsbanken (SHB) and the regional Savings Banks (Sparbankerna). In the mid-1960s, they started separate feasibility studies. Their only point of contact was that they made sure the studies were made with separate automation partners. There were two very large producers of office machines in Sweden at the time: Facit and Addo. So it was no surprise that SHB’s study was conducted in collaboration with Addo and Sparbankerna’s in collaboration with Facit.

3.1 Handelsbanken System 70

strong
and
reliable



MANUFACTURERS of office machines
MALMÖ SWEDEN



ADD0 PUTS YOUR FIGURES IN ORDER

Addo

MADE IN SWEDEN

Addo

SYSTEM 70



In 1966, before Facit's takeover, SHB asked Addo to specify and demonstrate a solution for a new generation of front-office banking machines. They came up with an electromechanical solution that was about to be accepted by the SHB board. The solution was called System 70 since it would lead the bank into the next decade. It was based on Addo's mechanical cash registers and was demonstrated to SHB in a set of relatively successful events.

Later in 1966, Facit acquired all of Addo, its fiercest competitor in Sweden as well as one of the best in the world market of mechanical calculators, where Facit was number one worldwide. This coincided with the beginning of the downfall of both Facit and Addo since electronics was taking over the markets, which was not understood by those companies' boards at the time. Nor, obviously, by the banks that selected them for demonstration studies and proofs of concept regarding future automation projects.

Recreated project logo for the Addo front-office project¹⁴

¹⁴ All images in the book are authentic except this one. The authors have reconstructed it from hearsay. It should contain the Addo logo with "Made in Sweden" either replaced or supplemented by "System 70", plus the SHB logo.

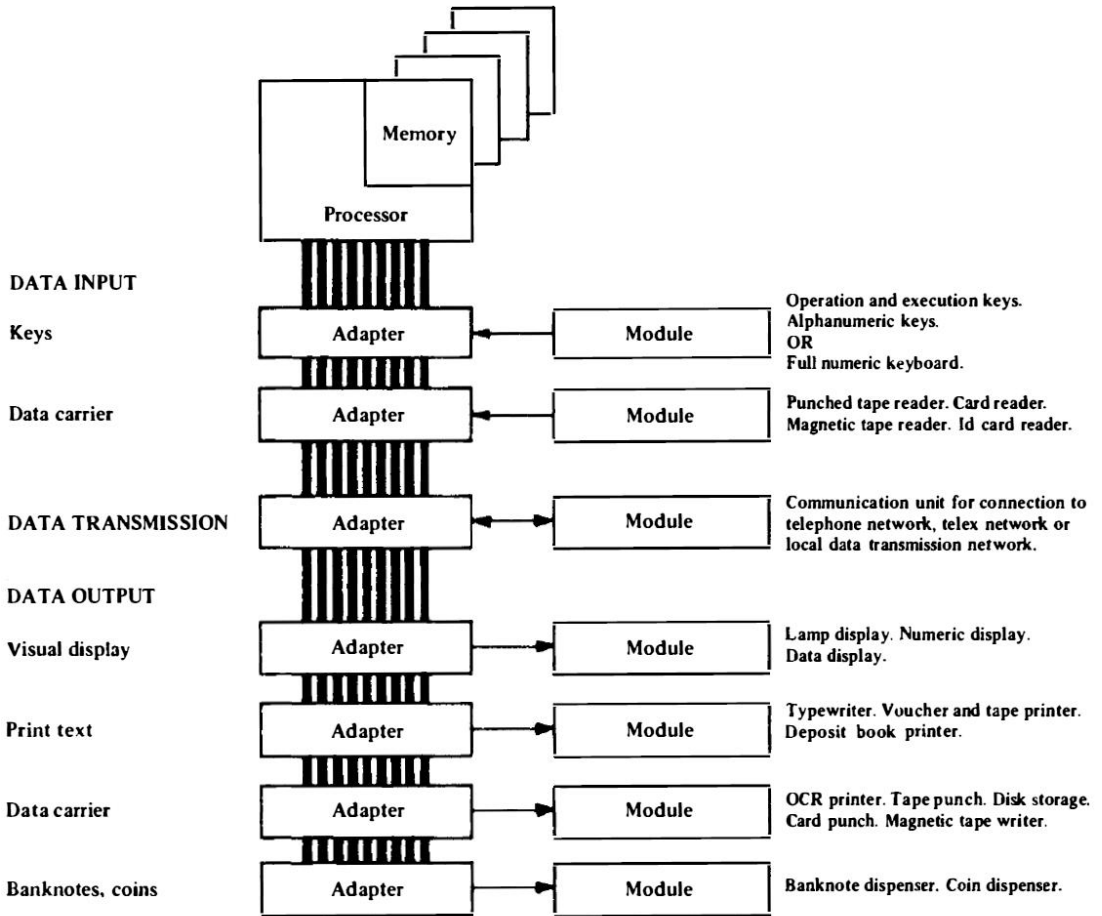
3.2 Handelsbanken System 71

However, not all Addo demonstration viewers at SHB's management level were overly impressed. Thus, the project team needed a second opinion and SHB was recommended to contact the Swedish Match subsidiary Arenco since they had (as Scienta) been working with Turitz on cash register automation a few years prior. Arenco, together with its subsidiary Swedish Computer, quickly assembled a specification and a mock-up demonstrator of a teller workplace consisting of a modified Turitz cash register connected to the horserace totalisator computer developed by Swedish Computer. This impressed SHB to the extent that they soon abandoned the Addo proposal and began working with Arenco to specify an

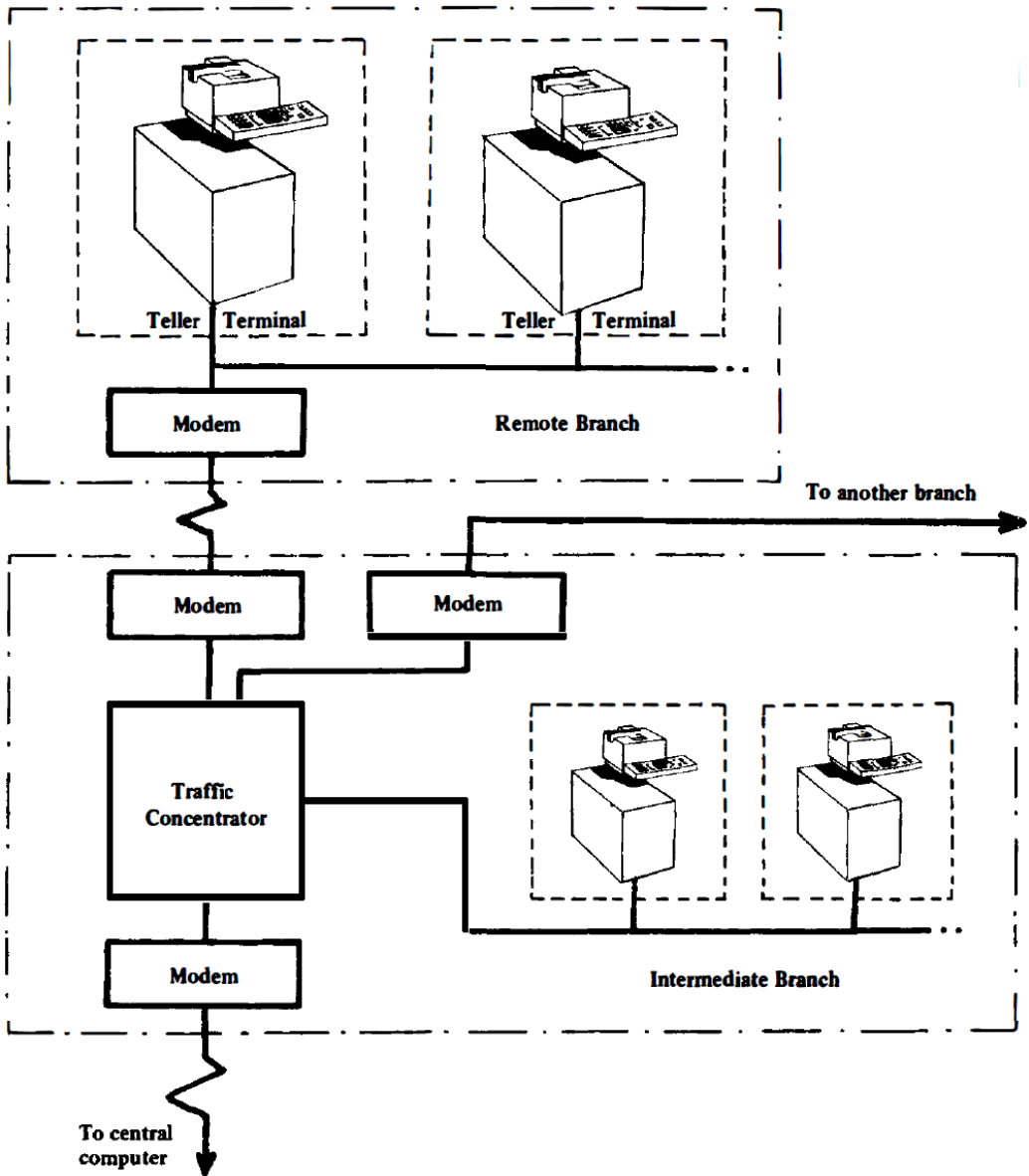


Demo of a cashier-made-teller terminal and digital display in a mock-up branch office

all-electronic front-office teller workplace instead. From that followed more demonstrations and trials, resulting in a draft contract that was subsequently signed in April 1968, making it the first contract for online front-office banking equipment worldwide. SHB ordered bank terminals for SEK 50 million, plus an additional SEK 10 million order to IBM for data communication devices. The project was called System 71, reflecting both the year when the first test installation was planned and signalling a step up from the Addo proposal.



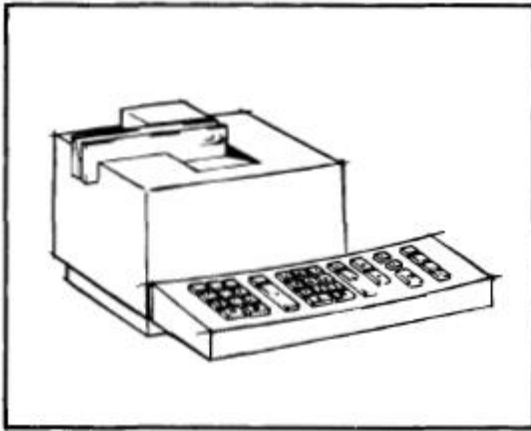
Arengo envisioned a design with a processor controlling each teller unit. This was due to the limited capacity of Swedish Computer's 4-bit processor. The idea was later abandoned when the project changed hands, with the new solution being a redesign of the processor, which originated from horse betting odds calculations, to suit banking transactions better.



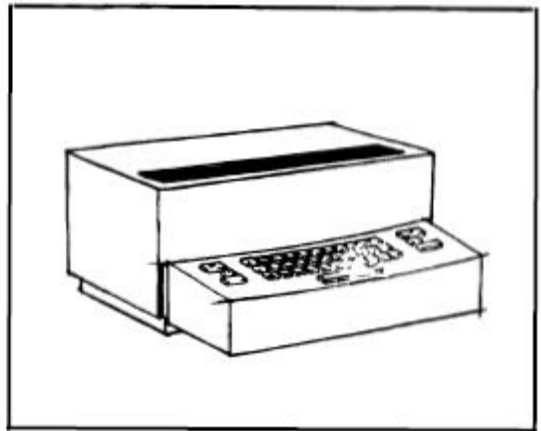
The local area communication solution within a group of branch offices was developed internally at SHB (which incidentally had its data processing centre across the street from Philips Sweden's head office on Tegeluddsvägen) by a former Philips employee. It was

based on an idea of a kind of token being passed around between computers, with several offices connected via a telephone network in a ring. The current holder of the token was allowed to transmit data over the network, the others only to listen. The idea was later refined by the inventor and patented in 1981. It was subsequently licensed to IBM and others and became known as Token Ring, a protocol for extensive networks, and as a direct consequence, the inventor nowadays propels around the world in a private jet.

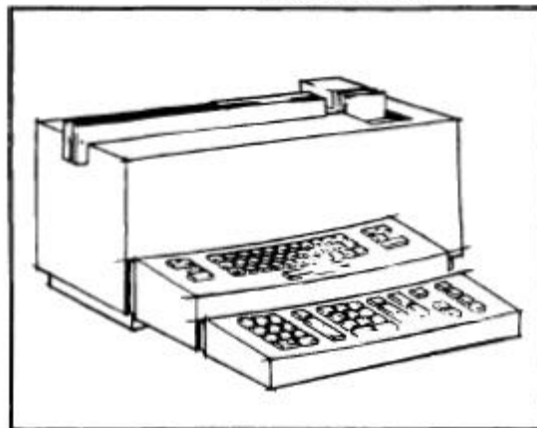
Immediately after the contract was signed, Arenco started developing keyboards and printers for front-office use. There were plans for three different desk unit configurations.



Teller's desk unit type 1, with numeric 11-digit keyboard, voucher and tape printer.



Inquiry station unit consisting of an electric typewriter with control panel.



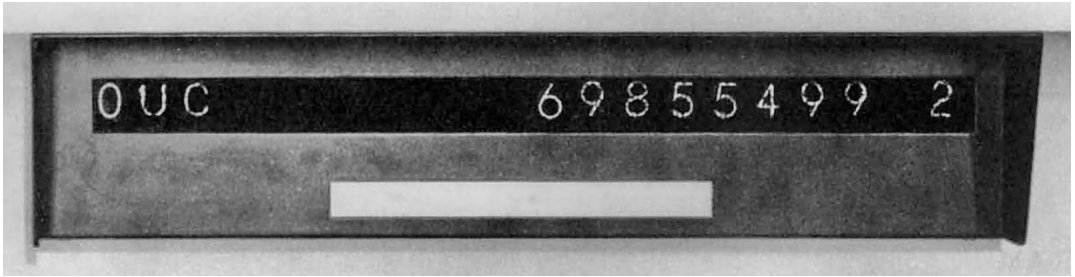
Teller's desk unit type 3, with alphanumeric keyboard including 11-digit keygroup, alphanumeric printer for voucher, deposit book and tape.

The designs were prototyped, built in small pre-series, and tested in live settings with role plays involving real bank tellers and customers. This way, the project was able to develop well-functioning equipment in a market segment that hardly existed. Continuous and strong engagement from the bank was necessary for the project to reach its goals regarding efficient workplaces and ergonomics, as well as bank customer satisfaction.



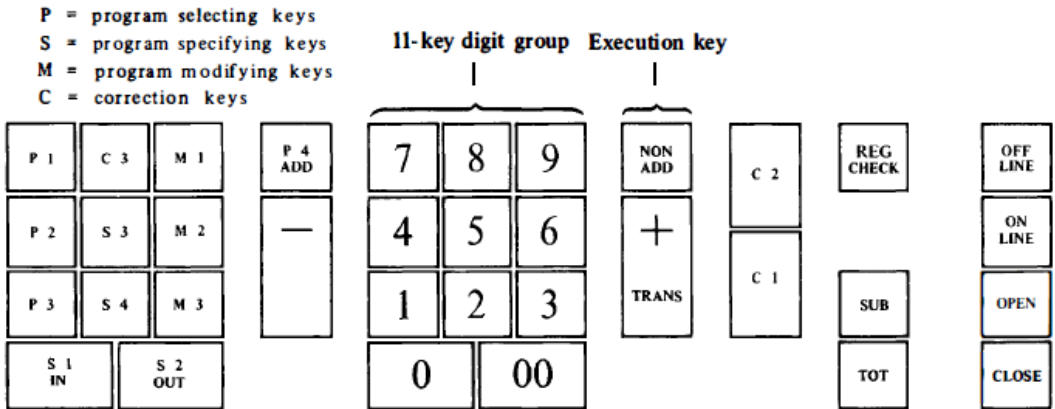
Desk unit type 1 being demonstrated

Note that the keyboards and printers were produced, tested and demonstrated separately by one project team (under the codename Lisa) while the numerical Nixie display and the connection to the office computer were handled by another team (under the codename Karin).



Numerical display using Nixie tubes

Further observation studies of tellers and more tests led to a redesign of the keyboard layout.



3.3 Philips Terminal Systems

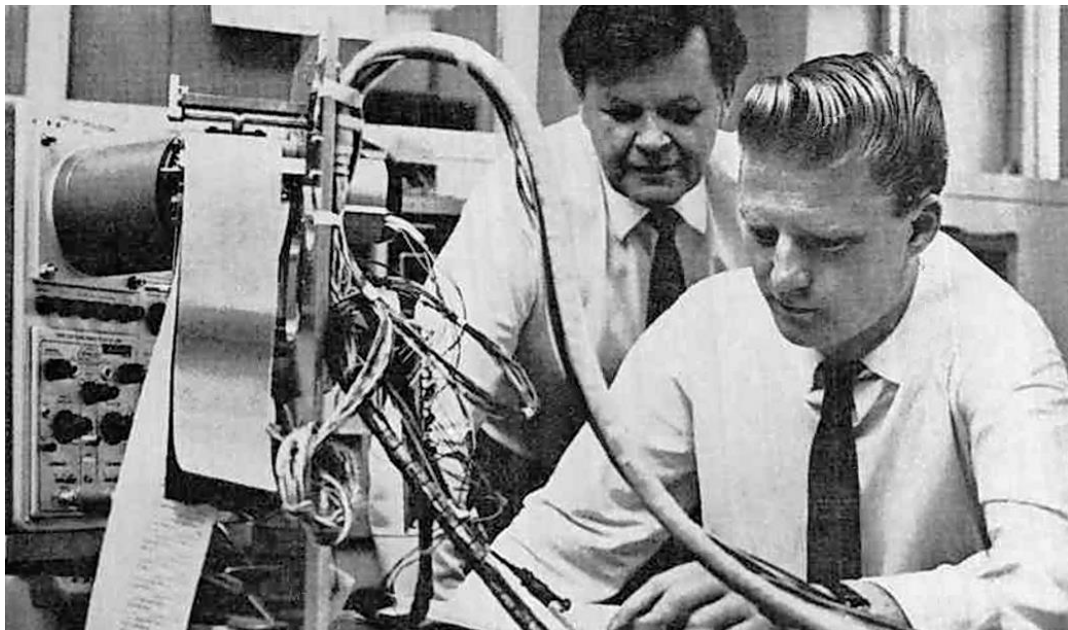
As we saw in Chapter 2, Arengo Electronics' work had initially mainly been focused on products for military use. But eventually, they also began to develop products for the civil electronics market, which, for example, resulted in advanced systems for collecting and transmitting data. Due to drastically reduced incoming military orders – from SEK 60 million in 1966 to SEK 20 million in 1968 – Arengo was destined to reduce the military-oriented activities within Arengo Electronics which had become the main ones. At the same time, Arengo realised that even if they tried to complete the contract with SHB, they did not have the resources to further develop and sell the system as a general banking system to other customers. Additionally, the temporary increase in personnel due to the SHB order was worrying, considering the bad market outlook for military equipment.

A key observation here is that SHB, one of Sweden's largest banks, would not have accepted to place their large order in the hands of a small company. In their first attempt, they considered Addo, a company large enough to match SHB's requirements. In their second attempt, they considered Arengo, whose owner was Swedish Match, one of Sweden's largest companies at the time. Again, it ticked the boxes. It was not as simple as selling the SHB contract. SHB had to accept the new entrant into the agreement, or it would simply renege. Therefore, there were not many potential buyers of Arengo Electronics that SHB would have accepted. This, of course, put a cap on the valuation of Arengo Electronics during negotiations. There were also the usual concerns in such negotiations. Who puts trust in whom? Whose backs are covered, should the project backfire? It was, though, clear almost from the outset that the world's largest electronics company, Philips, would be accepted as the continuator of the project contract.

On April 14, 1969, Swedish Match agreed to sell Arengo Electronics to Philips Sweden. The agreement was endorsed by SHB. The contract stated that Philips would take over Arengo Electronics in Johannelund (Vällingby) and its subsidiary Swedish Computer in Gothenburg. In Philips' view, these were fairly small companies: Arengo Electronics had around 400 employees and Swedish Computer 115. Philips had 370,000 employees in 1969.

Through the agreement with Philips, the reduction in the workforce became considerably less than previously estimated. Arengo Electronics' personnel could be integrated into three Philips businesses. Simply put, Arengo Electronics had only owned Scienta and Swedish Computer for four to five years and they were not very integrated into the daily operations. This was particularly true of Swedish Computer which had remained in Gothenburg while Arengo Electronics was situated in Johannelunds industriområde (Industrial Park) in Vällingby, Stockholm. Scienta was transferred to Philips Industrial Electronics (PIE), Swedish Computer to the newly formed bank terminal division under Philips Sweden (later named PTS), and the rest, Arengo Electronics' military products, to Philips Teleindustri (PTAB).

The mother company, Arengo AB, which was a tooling and machinery company separate from Arengo Electronics, see Chapter 2, was only affected by the takeover in the sense that it more swiftly completed its previously initiated relocation of the mechanic businesses to Kalmar. The costs for continuing to be established in Stockholm had risen above the profit margins. Arengo's management could compare the costs in Stockholm and Kalmar, regarding premises as well as personnel – and Johannelund did not compare preferably in either category. The sales organisation was the same and the skills needed for mechanics development were easily met in Kalmar, while electronics skills were scarcer there.



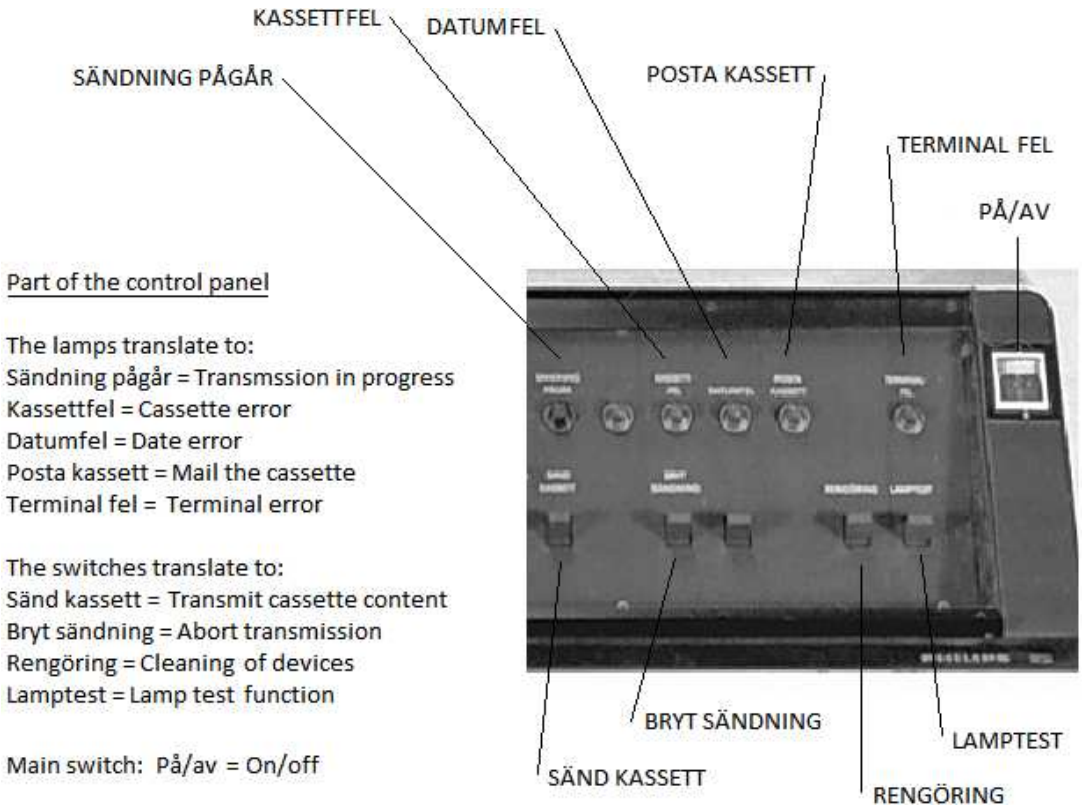
Engineers at work in the Arenco Electronics R&D division in 1969

Upon takeover, Philips cancelled the other Swedish Computer (SC) products. The most prominent was the betting totalisators which we met earlier. SC had a good market share in Europe, with a high-profile installation at Vincennes in Paris, home to the world's most prestigious harness horserace, Prix d'Amérique. The official reason for cancelling was that the SC system did not meet future real-time operation and reliability requirements without large investments. The real reason was, however, that it did not resonate well with the ethical and moral standards of the Dutch mother company.¹⁵

When Philips acquired Arenco Electronics, the hardware development was not finished, and the necessary software needed to be developed. Following both a change of CEO at SHB and the change of owners of Arenco Electronics (and thus a new supplier contract), the project was halted for a year in order for SHB to make a complete internal review of the potential gains in relation to costs and risks for this early computerisation of their front

¹⁵ But how was it then possible to manufacture and sell military equipment under the same standards? Philips explained this by claiming only to sell defensive weapon systems, not offensive ones. Where and how the moral boundary was drawn was hard to tell. Philips' goalposts would indeed be moved significantly, in a more ethical and moral direction, a couple of decades later. More on this in Section 9.6.

offices. After a year, the project got its go-ahead from the SHB CEO. After some delays and a year of pilot testing, the system was put into full operation in early 1973 under the internal name HTS (Handelsbanken’s Terminal System). It remained in operation until 1988 when a solution from Nixdorf replaced it. The Philips solution was designed to be continuously online, but in the event of a data communication failure, transactions were saved on cassettes to be transmitted later or, in the worst case, mailed.

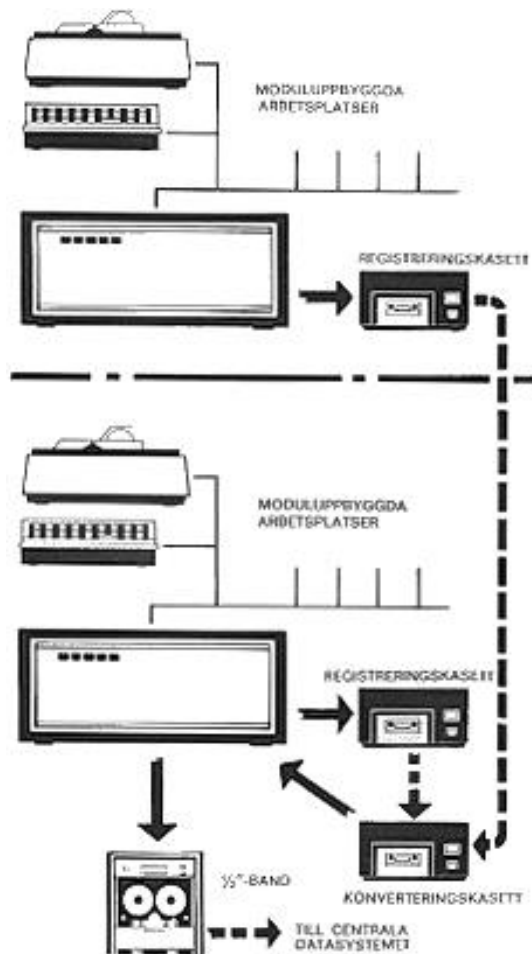


SHB HTS front panel with the “transmit cassette” switch to the lower left

3.4 Market Comparison

We have already seen the SHB tender/order process that began in 1966. In 1968, the Savings Banks in the Nordic countries sent a tender request to several Nordic computer companies for a system with the project name Nordisk Spardata. It aimed at connecting all the savings banks’ front offices in a nationwide data communication network similar to SHB’s. The

idea was to provide all offices with a minicomputer to communicate with the central computer system. Several terminals were to be connected to the minicomputer in each office so that all teller registers could communicate with the central systems. After review, Saab, with Facit as a subcontractor, won the contract in September 1969. The computer in this system was the Saab D5, which was being developed in parallel. Pilot systems were installed in 1972, with regular installations being made in 1973. Because of the delay caused by the SHB CEO postponing their automation project System 71 for a year, the Saab/Sparbankerna project became, in parallel with Philips, the first in the world to deliver a fully operational online front-office banking system, even though the Arenco/Philips contract was signed almost a year and a half earlier than Saab's.



That delay, however, had no impact on the companies' respective world market shares in the years to come, with Philips as a clear no.1 and Datasaab as no.5.

Philips and SHB were thus roughly on par with Saab and the savings banks considering mechanics, but as we saw in Chapter 1, Swedish Computer was clearly ahead of Saab in the electronics area. The architecture of the Saab solution was somewhat similar to Arenco's but with less capacity.

The future vision of Saab's (Datasaab's) banking division was a society where cash was withdrawn at drive-by machines that were more advanced than ATMs. Each citizen must have a bank ID card to be allowed to withdraw from those machines (in the image placed under a motorway). In a sense, this prediction was not too far from where we are today. The ATM era might be waning, but there was a period when the automatic teller was in its prime – even though it never took the form of drive-in banks. What Datasaab completely missed was the electronic transactions, e.g. point-of-sale

purchases done by payment cards, that have almost completely taken over the day-to-day purchases of most Swedish (and European) citizens in 2023. Their idea that every citizen must have a bank ID is not entirely here yet, even though a lot of banking services in Sweden today require some form of digital ID, mainly in the form of the Mobile Bank-ID phone app supported by all the major banks. Still, the person who wants not to be subject to those Big Brother tendencies or carry a modern smartphone can still withdraw cash from an ATM without a digital ID – the payment/credit card suffices. Thus, we are today not yet at the Datasaab vision from 1975, but rather close and possibly approaching.



Datasaab's future vision of banking systems in 1975

The initial order from Sparbankerna was worth 50 MSEK and consisted of bank terminals and IBM 3967 data communication concentrators. This was comparable to Philips' order from SHB, which was worth 50 MSEK for bank terminals plus 10 MSEK for IBM concentrators. Saab received additional orders from Sparbankerna, but that was the only banking order they received in Sweden. In the years that followed, Philips received orders from all commercial banks in Sweden except SEB (which went to Nixdorf), plus the Swedish Post. Thus, Philips had a much broader national customer base on which to build their internationalisation. In the coming chapters, we will see how Philips explored those possibilities.

4. Early Philips Computers

Philips was founded in May 1891 by Frederik Philips and his son Gerard in Eindhoven in the Netherlands. Their first products were light bulbs. In 1895, the brother Anton joined the business. Philips advanced to be Europe's third-largest light bulb manufacturer already by 1900. The business grew and in 1912, Philips became a limited company named Philips Gloeilampenfabriken. In 1914, Philips' research unit, Philips Natuurkundig Laboratorium (NatLab), was started. In 1916, the first factory was built, a glass factory for lamp manufacturing. The NatLab building was built on the factory site in 1923. Keeping up with the social ambitions of that era, the community Philipsdorp was built from 1910 onwards for Philips workers adjacent to the factory area. As Philips grew, new workers came from all over the Netherlands. In Philipsdorp, amenities such as a bakery, bathhouse and schools were established. This was not unique; competitors such as Siemens in Germany also built similar areas (Siemensstadt). PSV Eindhoven (Philips Sport Vereniging) was created as a company-sponsored sports and football club for the workers at Philips. It would later become one of the leading professional football clubs in Europe, based on Philips' funding.

An important step for the company was when it started manufacturing radio tubes in 1918 and began to expand worldwide. Shortwave radio was a major area of development in the 1920s. During the 1920s, more and more products began to be manufactured. In 1927, Philips began producing radios and in 1928, the first television sets were shown around Europe. Philips developed the first TV sets in the Netherlands, with a first broadcast in 1930.

Philips also expanded outside Europe. The business grew during the mid-war period. After the war, Philips developed during the 1950s into one of the major European electronics manufacturers. In 1953, a semiconductor business was started. In the beginning, transistors and diodes were manufactured. Record players, speakers and similar were manufactured as well as compact cassette players from 1963. At that time, Philips was mostly into consumer and industrial electronics but built no computers on their own.

4.1 First Dutch Computers

The first computer in the Netherlands was ARRA (Automatic Relay Calculator Amsterdam). It was built by the Mathematics Centre, part of the University of Amsterdam, in a set-up similar to Matematikmaskinnämnden (MMN) in Sweden. ARRA was equipped with relays, as was the Swedish BARK. At the inauguration in June 1952, the device was demonstrated, generating a table of random numbers. In a parallel to MMN's BESK, the ARRA II

was built in 1954. It contained radio tubes and a memory. This computer successfully carried out calculations for the Fokker aircraft manufacturer, although it was considerably slower than BESK.

1954 also marked the start of a second-generation computer, ARMAC, at the Mathematics Centre and in 1956 the computer was ready. New for this machine was the software perspective taken by the developers. As with BESK, this computer made use of transistors, a drum memory, and a kernel memory. ARMAC was used for societal planning purposes including the Delta Works, the dike construction to guard the Netherlands from the sea. But they had no nuclear programme to cater to.

After a while, two commercial research centres got involved in building computers: TNO and Philips Research Laboratory, NatLab. In 1955, TNO, a scientific and technical consultancy for the government and business, also built a computer, the VTH, a technically advanced analogue computer. Fokker used this computer to calculate aircraft movements and airflow and performed simulations.

In the fifties, Philips could not engage in the construction of commercial computers. This was due to an agreement with IBM in which Philips was a large supplier of components to IBM's computers. In return, Philips agreed not to build any computers of their own or in any other way use the knowledge obtained by being a component supplier. However, the NatLab built the non-commercial computer PETER, which became operational in 1958. It was followed by the PASCAL, which was put into use in 1960 and proved to be much faster and more reliable. However, a commercial version of either computer was never built due to the IBM agreement.

4.2 Electrologica

By the end of the fifties, the universities, notably the University of Amsterdam and Delft University of Technology, were done with building computers. After completing the ARMAC in 1956, the Mathematical Centre decided to cease all computer-building activities. In a parallel to Facit in Sweden, the team involved drew up plans based on the ARMAC to start a commercial company focusing on the manufacture of computers. But those plans needed funding. A venture partner was found in the Nillmij, the Netherlands Indië Life Insurance and Annuity Company, which was prepared to provide venture capital. The CEO of the insurance company had already taken steps to automation within the company and was convinced of a potential market for computer manufacturing in the Netherlands. Cooperation between the group of scientists from the Mathematical Centre and the insurance

company led in 1956 to the creation of NV Electrologica, the first Dutch commercial manufacturer of computers.



The Electrologica building in Rijswijk

Their first computer, X1, was presented in 1958. There were only 33 machines sold in total.

N. V. ELECTROLOGICA	NV/ANOC 23IR	1
The Hague,	X 1	33
Netherlands.		

X1 sales figures up to 1968 from R.H. Williams' book

Their development continued, and five years later, the X8 was announced, which was also sold in a few copies, less than 30. After that, the company began to produce variations on the X8 by manufacturing smaller versions of the machine, but those were even less successful.

N. V. PHILIPS ELECTROLOGICA	ELX 2	15
Computer Systems Division,	ELX 4	7
P. O. Box 245,	ELX 8	27
Apeldoorn, Netherlands.		

The later X2–X8 models' sales figures from the same source

Eventually, the development costs became too high, and there was a lot of competition in the mainframe market, mainly from American manufacturers such as IBM. Consequently, Electrologica sought collaboration with Philips already in 1965, and they subsequently took over the company and integrated it into Philips-Electrologica. That meant the end for Electrologica and the X-series, but also an end to the endeavour that had been started by the Mathematics Centre and had lasted 20 years. Although the X-series was the result of good engineering efforts, losses accumulated over the years due to continuously low sales volumes. The new owners, Philips, decided already in 1968 to close down Electrologica and write the investment off. Most personnel were transferred to the P1000 project but some of them were assigned the task of maintaining the X-series customer base and its service needs. Being a service-oriented company already back then, Philips knew that high-quality after-sales activities were paramount in retaining customers.



The operator console of the XI

4.3 Philips Computer Industry

When the IBM components agreement expired, Philips decided to start manufacturing computers on their own, and in July 1963, Philips Computer Industry (PCI) in Apeldoorn was incorporated with around 30 researchers transferred from NatLab. They started in an old renovated factory building on Molenstraat in central Apeldoorn.



The first Philips Computer Industry building being renovated

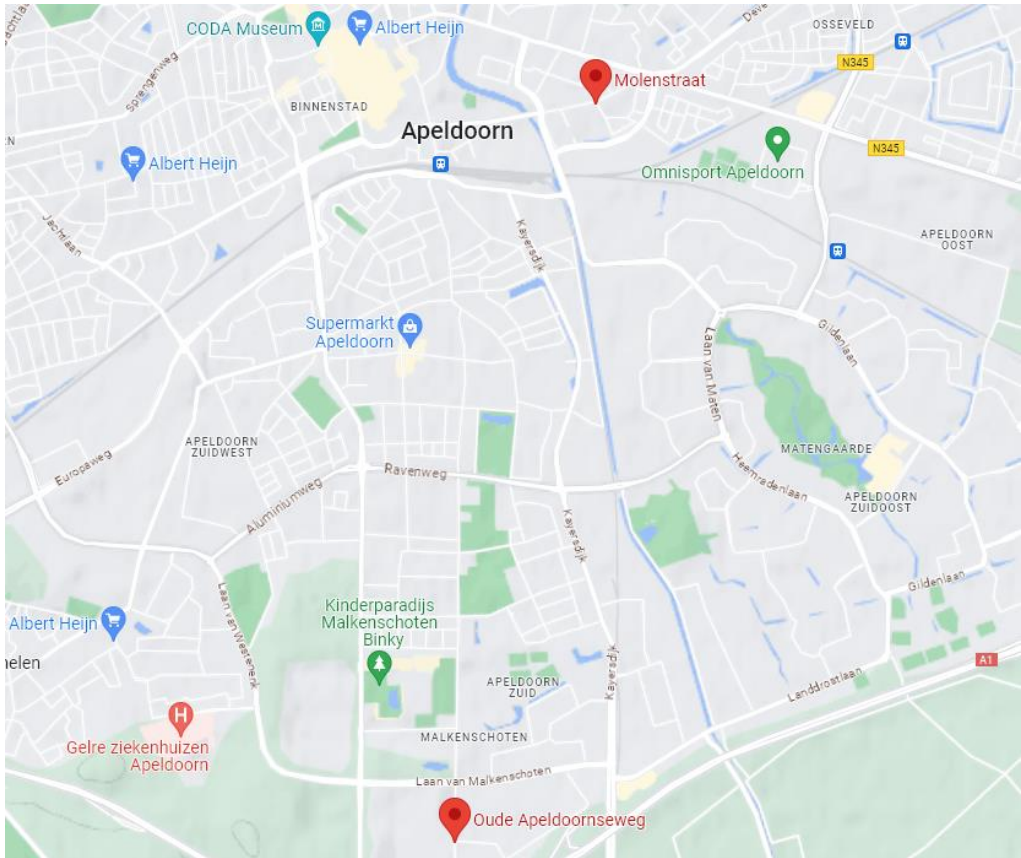
PCI began the development of an IBM 360-like (but not compatible) family of mainframes called P1000, consisting ultimately of four models: P1075, P1100, P1200 and P1400. These computers were designed with a lot of instructions to satisfy the demands of compilers of a vast range of programming languages – what would today be called a CISC machine (complex instruction set). This was on the suggestion of several theoretical computer scientists who worked for or were advisors to PCI. For example, the architecture allegedly had 49 stack instructions only for ALGOL implementations. Since IBM made no such concessions, this was already a sharp deviation from industry standards. Like IBM machines, though, the P1000 family had byte addressing and 16 4-byte registers. The software for the P1000 series was developed in collaboration with Computer Sciences Corporation (CSC) in the US. The partnership lasted until 1975, the same year the P1000 series was cancelled (production stopped in 1976) together with the experimental P2000 successor (later called P1800).

PCI quickly outgrew its small, centrally located factory and started looking for a real estate lot to build a much larger office and factory complex. They found a mud-covered farmland lot about six kilometres south of central Apeldoorn, in what was back then “in the middle of nowhere” (and still is on the outskirts of Apeldoorn almost 60 years later). The new factories were to be located on Oude Apeldoornseweg, where “oude” means old and “weg” means road.



The farmland acquired in 1965 for the future Philips Apeldoorn facilities

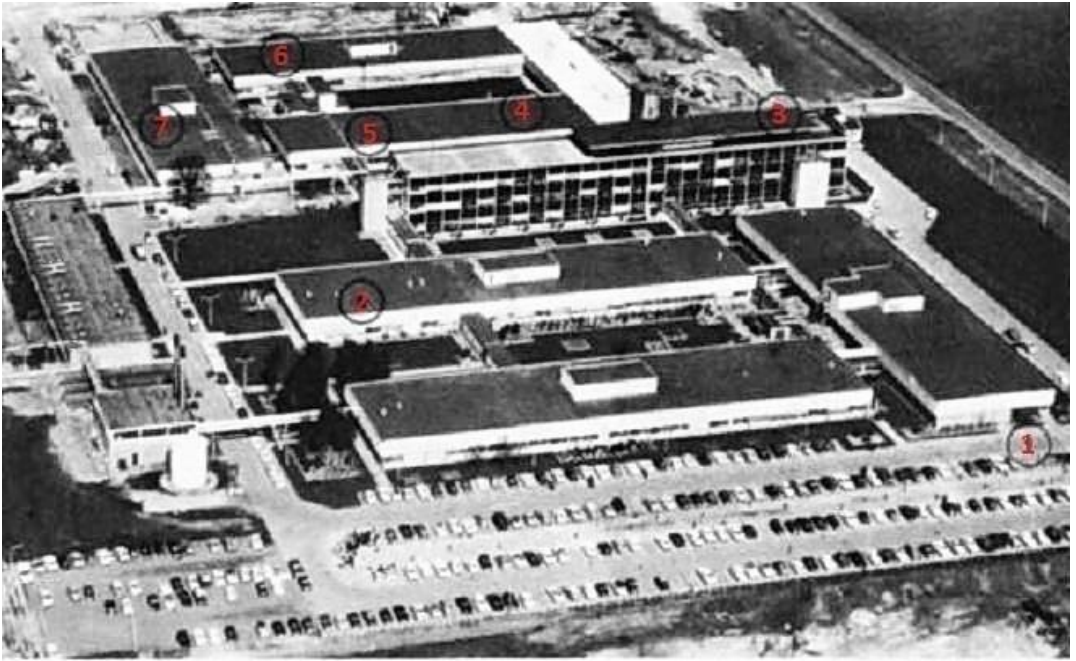
Many Philips PCI employees did not appreciate the move from central Apeldoorn out to the countryside, but since Philips was the only employer working with computers (or electronics of any sizeable scale) in the vicinity, there was not much to choose from. From a five-minute walk to the city centre to reach restaurants, shopping, etc. during the lunch break, it was now more than an hour’s walk each way, and thus infeasible unless driving by car.



Locations of the old (Molenstraat) and new (Oude Apeldoornseweg) PCI premises

4.4 Philips-Electrologica

After a few years, the first office building (the F building) and some adjacent factories were completed, and in 1968, the complex was first shown to the public. PCI was renamed Philips-Electrologica to signify the previous merger (which in reality was a takeover). Since Electrologica had a longer history in the computer business, it was seen to strengthen the brand to include them even after their series of computers were discontinued. What began in 1968 would later become many more offices and factories. At its heyday, Philips Apeldoorn facilities consisted of over 40 buildings in total, all built on the former farmland lot. There were over 2,000 people employed. While being quite large, it was less than PEAB (Philips Elektronikindustrier) in Sweden, which will be discussed in Chapters 7 and 8.



1968 Luchtfoto complex Apeldoorn



DEMONSTRATIES

1. Inging
2. Elektronische Ontwikkeling
3. Computer centrum, Gebouw F parterre
4. Jongens Nijverheids Opleiding
5. Mechanische werkplaats
6. Elektrische werkplaats
7. Demonstratiezaal

When the production of Electrologica computers was discontinued in 1968, Philips instead, in 1969, brought its P1000 computer series to market. The first machines were sold to the Dutch PTT (the National Post, Telegraph and Telephone Administration) to automate its banking system. Sales of many of the machines were mainly achieved through existing connections and networks rather than by open procurement. The Dutch government continually supported Philips by ordering computers in the P1000 series. For example, already in 1967, the state secretary of transport signed a contract between a Dutch Post-owned company and Philips for a P1100 machine, two years before the product even existed. In this and other cases, government agencies felt compelled to acquire a Philips machine. Famous computer scientists such as Edsger Dijkstra and David Parnas worked on the P1000 series. Dijkstra was even the Philips representative in an ECMA standardisation working group (TC),

ECMA being the European Computer Manufacturers' Association and TC meaning a technical committee. He later became a well-known professor of computer science at the University of Texas at Austin.

David Parnas, most famous for his resistance to the US “Star Wars” computer-driven nuclear missile shield, was a consultant for Philips-Electrologica from 1969 to 1970. He later became a professor at several well-known US and Canadian universities. Brilliant scientists as they were, though, that did not help Philips-Electrologica or the P1000 series in any industrial sense. Only 149 or 150 were ever shipped worldwide (statistics vary), which does not make the P1000 series successful at all globally. In 1975, the series was cancelled and in 1976, production was finally stopped when all pending orders had been fulfilled.



Philips P1100 installation

Relying on protectionist ideas, i.e. to have a “protected” home market, was not uncommon among European computer manufacturers. The larger the country, the more powerful the mechanism. However, smaller countries like Sweden and the Netherlands also used this approach to support domestic computer manufacturers. Unfortunately, this did not often

turn out well, and the Dutch Philips P1000 computer series was a case in point. If too large a percentage of the orders received were won without full competition in open procurement processes, the sales departments did not learn the market forces correctly. Subsidies always ended at some point in time, and then the sales force had to understand the actual market conditions under which they operated.

When it came to advertising, the following advertisement was surprisingly honest. It frankly declared that Philips was its own guinea pig in developing and selling the P1000 series, implying that most delivered systems were internal, governmental, or results of some other preferential treatment in the tender processes. It was definitely true, but few computer companies would have admitted that. Honesty did not, however, bolster sales.



PHILIPS

P1000 - unsere fortschrittlichste Serie der nächsten Generationenreife

Philips Electrológica GmbH - Geschäftsbereich Computer-Systeme
4 Düsseldorf, Liesegangstr. 35 Telefon: (0211) 35-6021 Telex: 6-987 556

“The guinea pigs of our own computer experiences were – ourselves”

In the Scandinavian countries, the P1000 series was sold by a rather strange mechanism called the “Philips Computer Idea”. This meant that Philips first acted as an independent consultant, collecting customer needs in a feasibility study. Based on the study, in the second phase, Philips would make an impartial recommendation to the customer on which computer system to acquire. A new sales unit, DMS (Datamaskinsystem, Computer Machinery Systems), was created in 1970 in Stockholm¹⁶ for these new sales, consisting of around 50 recruited employees and more than 50 consultants. The unit grew fast and became much too big for its modest office space in the Philipshuset head office in Stockholm and had to move 16 kilometres north from Stockholm to Näsby park in Täby municipality.¹⁷ During the few years the “Idea” lasted, it recommended the Philips P1000 series in none of its studies. Most recommendations went to IBM equipment. The only P1000 computer ever to run in Sweden was the one that PDS Apeldoorn forced Philips Sweden to use at its internal data processing centre. In cumbersome and expensive conversions, taking more than a year in each direction, all IBM programs were converted to P1000 in 1970–1971 and then back to IBM in 1977–1978 after the P1000 finally was discontinued. Since no sales were ever made, these conversions were to no avail.

4.5 European Computer Markets

To understand what European computer manufacturers were up against, we show some market sales figures from

British Commercial Computer Digest: Pergamon Computer Data Series - R. H. Williams

which claims to have recorded all computer system installations worldwide up to and including 1968. The important fact is not precisely which year is being considered or whether the numbers are exactly accurate or not – the point is the order of magnitude separating the American and European computer industries. Only a few selected manufacturers that are interesting to us, from the many tables in the book, are included in our excerpts. Those are Addo, Alwac, Digital Equipment, Facit, Honeywell, IBM, Philips-Electrologica, Philips Sciences et Industrie, Siemens, Siemag (acquired by Philips), and Saab respectively. All these companies figure in the book in one way or another.

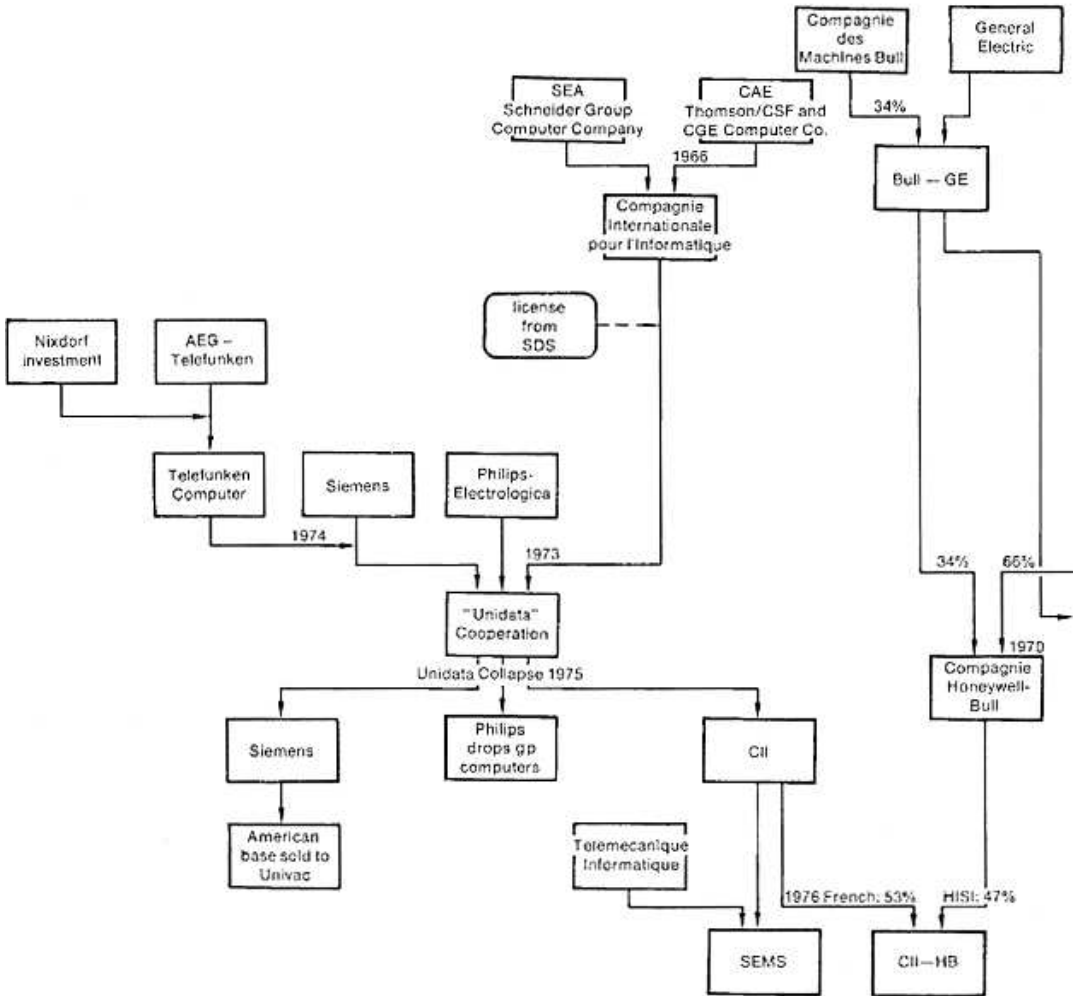
¹⁶ DMS was an offspring from the regular DSY (Datorsystem, Computer Systems) sales unit at Philips head office in Stockholm, itself created in 1968. Confusing? For us, too...

¹⁷ Incidentally, this location was less than one kilometre from the Täby Galopp horse racecourse, where Swedish Computer had one of its larger totalisator installations.

AKTIEBOLAGET ADDO Fack, Malmo 3, Sweden.	WEGEMATIC 1000	7
ALWAC COMPUTER DIVISION EI-Tronics Inc. 13040 S. Cerise Ave., Hawthorne, California, U. S. A.	ALWAC I ALWAC II ALWAC III ALWAC IIIE ALWAC IV ALWAC 800	1 2 2 1 1 1
DIGITAL EQUIPMENT CORP. 146 Main Street, Maynard, Massachusetts, U. S. A.	DEC/PDP 8 DEC/PDP 8S DEC/PDP 8/1 DEC/PDP 9 DEC/PDP 10	1300 950 500 250 20
FACIT ELECTRONICS AB Karlavagen 62, Stockholm, Sweden.	FACIT EDB 3 DS 9000	9 2
HONEYWELL INC. Electronic Data Processing Div. 60 Walnut Street, Wellesley Hills 81, Massachusetts, U. S. A.	HONEYWELL 110 HONEYWELL 120 HONEYWELL 125 HONEYWELL 200 HONEYWELL 1200 HONEYWELL 1250 HONEYWELL 2200 HONEYWELL DDP 124 HONEYWELL DDP 324 HONEYWELL DDP 416 HONEYWELL DDP 516	30 850 60 850 260 10 130 84 84 250
IBM WORLD TRADE CORP. 821 United Nations Plaza, New York 10017, U. S. A.	IBM 360/20 IBM 360/30 IBM 360/40 IBM 360/44 IBM 360/50 IBM 360/65 IBM 360/67 IBM 360/75 IBM 1130 IBM 1401 IBM 1401G IBM 1440 IBM 1620 Series IBM 1710 IBM 1800 IBM 7010	9000 8700 4500 100 250 200 400 180 7000 6400 1500 3500 1500 86 250

PHILCO CORPORATION C & Toga Streets, Philadelphia, Pa; U. S. A.	PHILCO 2000/213	29
N. V. PHILIPS ELECTROLOGICA Computer Systems Division P. O. Box 245, Apeldoorn, Netherlands.	ELX 2	15
	ELX 4	7
	ELX 8	27
	P 1000 Series	10
PHILIPS INDUSTRIE 105 Rue de Paris, Bobigny, Seine, France.	PR 8000	11
RADIO CORPORATION OF AMERICA Electronic Data Processing Division Cherry Hill, Camden 8, New Jersey, U. S. A.	RCA 330I	80
	RCA SPECTRA 70/15	250
	RCA SPECTRA 70/25	150
	RCA SPECTRA 70/35	200
	RCA SPECTRA 70/45	180
	RCA SPECTRA 70/55	20
SIEMENS & HALSKE AG 8, Munchen 25, Wettelsbacherplatz 2, West Germany.	SIEMENS 300	120
	SIEMENS 3003	36
	SIEMENS 4004	260
SIEMAG FEINMECHANISCHE WERKE Eiserfeld/Seig 5904, Postfach 17, West Germany.	SIEMAG DATA 4000	35
	SIEMAG DATA 5000	25
	SIEMAG DATA 8000	10
SVENSKA AEROPLAN AKTIEBOLAGET Linkoping, Sweden.	SAAB D 21	26
	D 22	4
	D 41	1

This should have constituted enough evidence to make European manufacturers think twice about being active in the large computer (mainframe) market segment. But at the time, it was the most prestigious one – and old dreams die slowly (if at all). Through many mergers and acquisitions, the Europeans tried to reach critical mass by taking over each other's markets in the first place and products second. The following excerpt is less than one-third of a mapping of European computer manufacturers' mergers and acquisitions in the early 1970s. Obviously, many of them had little understanding of the international computer markets and were at least partially driven by nationalistic arguments and reasoning. Philips had put high hopes and much faith into the P1000 series, and when it showed no signs of taking off, they too went the mergers and acquisitions route with – as it turned out – doubtful results. They continued to work with the P2000 (later named P1800), however, which was the P1000 successor, all the way until the cancellation of the P1000 series in 1975.



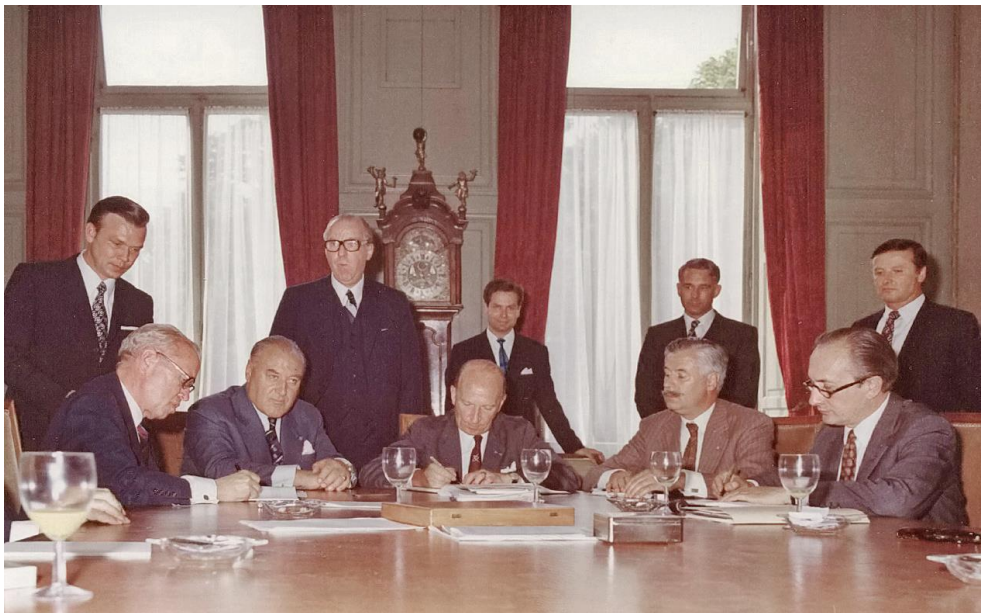
Excerpt from a chart of European mergers and acquisitions in the early 1970s

As an example, ICL (International Computer Limited) was created in Great Britain by a government initiative in 1968 through the forced merger of several companies. From that time, significant government support was given to the company. For example, in 1972, a decision was made to disburse £40 million of government funding during the period 1972–1976 as a contribution to R&D costs in connection with the development and introduction of a new generation of British computers.

In principle, a similar development took place in France in 1966. France left NATO in 1966, citing a need to be more independent and better control its military defence strategies. One part of the new strategy was to be self-sufficient regarding computers. This was implemented as the Plan Calcul. In doing so, CII (Compagnie Internationale pour l'Informatique) was formed through the forced merger of several companies. Since its inception, CII also received considerable government support. For the period 1972–1975, the support had a value of approximately 550 million francs. It was also gifted the former European NATO headquarters in Louveciennes as premises for developing a national computer industry.

4.6 Unidata

In the early 1970s, in what to some seemed like the only possibility at the time, many of the largest European manufacturers were prepared to give up their independent companies and form a Europe-wide organisation. The Unidata consortium was formed and subsequently signed by French CII, Dutch Philips and German Siemens in July 1973. It essentially joined the three manufacturers' large computer (mainframe) divisions into one large sales organisation in which each manufacturer agreed to supply computers and peripheral equipment. The minicomputer businesses were also included, almost as a side effect of the agreement.

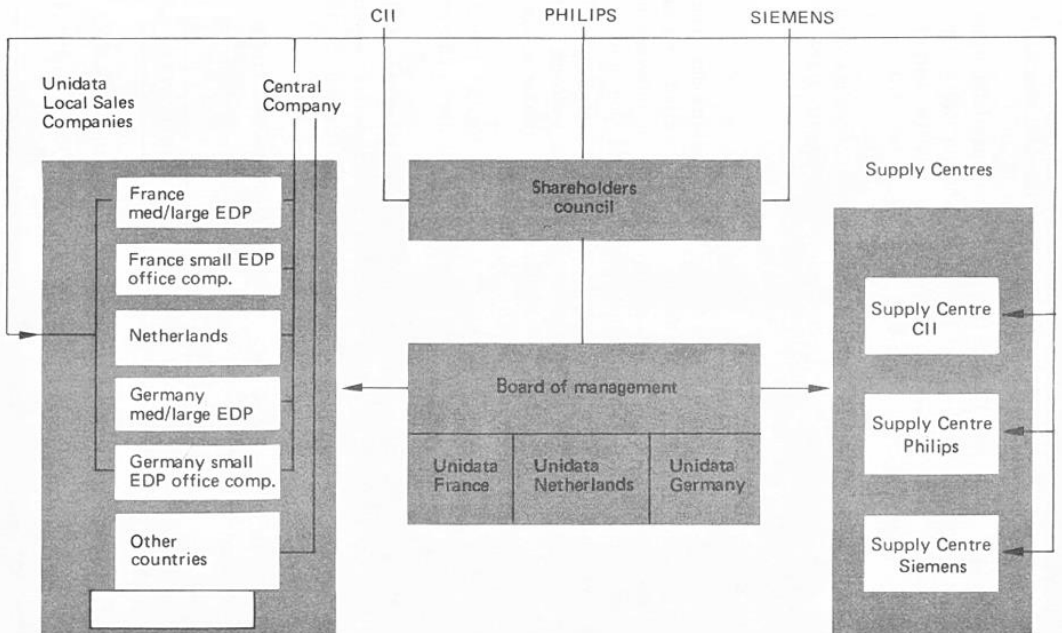


Signing of the Unidata consortium agreement in Amsterdam in July 1973

Unidata’s joint resources represented a total of more than 35,000 employees, of which 8,500 were in research and development, and had production facilities in several European countries. The marketing was intended to be worldwide. The product focus included general computer systems, office computers and data entry systems. The requirement of software compatibility likely hindered immediate product coordination.

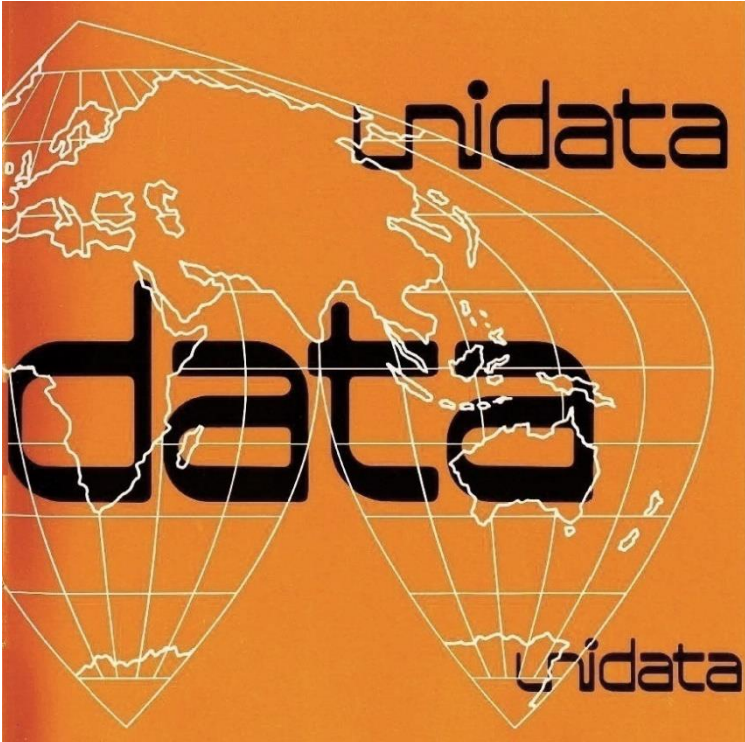
Unidata announced that they were, in principle, open to an expansion of the consortium and welcomed other European initiatives wherever these originated from. The most obvious candidate was ICL from the UK. From the British side, however, there were no signs of approaching Unidata; rather, they oriented themselves toward possible collaborations with West German Nixdorf and AEG/Telefunken instead. Due to the limited British interest in cooperation, Unidata’s offerings were not made available in the British market.

It was rather quickly realised, and even more so in hindsight, that this was an overcomplicated construction that was in essence three parallel organisations dressed up under one umbrella. Employees from the three companies should suddenly work together without any attempts to build a new corporate culture or even a “we feeling”. It was doomed to fail.



The complicated “Three Kings” organisation of Unidata

The Unidata organisation was managed by Unidata Management Companies located in Paris, Apeldoorn and Munich. The management consisted of the managers of the partners' computer operations. The three companies reported to a shareholders' council, where the boards of the co-owners were represented. The joint management concentrated the partners' commercial resources in a worldwide sales organisation. The intention was to establish local Unidata companies in every European market of importance, to begin with, except the UK. Such local organisations were established in Austria, Belgium, France, Italy, the Netherlands, Scandinavia, Spain and West Germany. These organisations took over responsibility for the partners' current product lines as well as future systems developed within Unidata.



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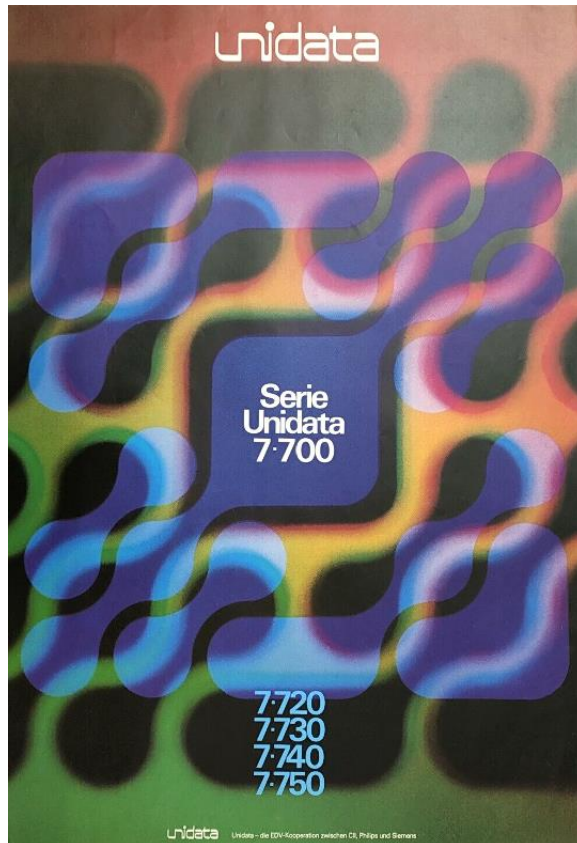
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The three equal Unidata head offices in Paris, Apeldoorn and Munich

In the Nordic countries, Philips was active in Denmark, Finland, Norway and Sweden, Siemens Data Scandinavia in Denmark and Sweden, and CII had no representation. The Unidata sales organisation became a Scandinavian organisation under joint management. The

organisation was divided into two divisions country-wise. Initially, Unidata established sales organisations in Denmark and Sweden to serve the Nordic countries. In Sweden, the organisation included approximately 200 people.

Unidata as an agreement and a company lasted only a few years. In May 1975, after domestic political turmoil in France, CII withdrew from the consortium to merge with Honeywell Bull instead. This meant the collapse of the consortium, and Philips almost immediately withdrew as well. Much has been written about Unidata and we will not add substantially to that. Almost none of the former Philips employees the authors have talked to during the years up until today wanted to say anything about the Unidata years. Thus, we will rely mainly on some newspaper and magazine clips to report on the product lines, etc.



Colourful Unidata sales material tried to cover up for a lack of products

Wij stellen u de eerste Unidata computer voor:



de Unidata 7.720

De Unidata 7.720 de eerste Europese computer, een product van de samenwerking tussen C.I.I., Philips en Siemens, introduceert nieuwe dimensies in kleine tot middelgrote computersystemen.

De Unidata 7.720 groeit met uw eisen

Modulaire structuur - centrale eenheid, geïntegreerde koppelingen, randapparatuur, software - verzekert u van flexibiliteit bij de samenstelling van uw systeem.

Het centrale geheugen kan in stappen worden uitgebreid van 48k tot 160k.

De Unidata 7.720 is concurrerend

De prijs/prestatieverhouding behoort tot de beste die thans op de markt voorhanden is.

Een compleet software pakket en een uitgebreide programmabibliotheek vervolmaken deze Unidata computer.

De Unidata 7.720 biedt maximale betrouwbaarheid

De betrouwbaarheid van de Unidata 7.720 wordt vergroot door ondermeer moderne technologie (MOS/LSI), ingebouwde diagnostiek door micro-programma's, automatische fout-signalering, bescherming zowel van reëel als virtueel geheugen plus het beproefde besturings-systeem BS 1000.

De Unidata 7.720 is compatibel

De Unidata 7.720 voorziet in compatibiliteit met de IRIS, de P1000 en de 4004 computer-series.

De Unidata 7.720 - een product waarin de grote ervaring van C.I.I., Philips en Siemens is verwerkt

In Unidata hebben C.I.I., Philips en Siemens hun hulpbronnen, technologische kennis, productievermogen en service-netwerken gekombineerd. Tot uw beschikking staan:

14 productie- en ontwikkelingscentra in 6 landen, verkoop- en service-organisaties in meer dan 30 landen en een staf van 35.000 medewerkers.


cii PHILIPS SIEMENS

The first (and, as it turned out, only real) Unidata computer offering (in Dutch)



A Unidata 7-720 that became Philips P430 after the split; see also page 293

- Aug 1971 Exploratory conversations with Siemens that just lost its partner RCA from which Siemens got licenses
- Jan 1972 Agreement between CII and Siemens to cooperate in general purpose civilian computers
- Apr 1972 Negotiation between CII, Siemens and Philips for building a common company Unidata
- Sep 1972 Conclusion of the agreement with Philips
- Jan 1973 Formal signature in Munich of the agreement between CII and Siemens AG
- Jul 1973 Formal signature in Amsterdam of the agreement creating Unidata
- Sep 1973 CII introduces the Siemens 4004, a derivative of RCA Spectra 70
- Sep 1973 CII absorbs Siemens computers activities in France and gives up its CII GmbH to Siemens
- Dec 1973 Dispute between the Fininfor (CII holding company) shareholders. CGE (48%) disagrees with Thomson
- Jan 1974 Introduction of Unidata 7-720 designed and produced by Philips
- Jul 1974 Telefunken is taken over by Siemens *Take-over made without Unidata partners consultation*
- Sep 1974 Introduction of Unidata 7-730 and 7-750 produced by Siemens and of Unidata 7-740 produced by CII
- Sep 1975 Philips leaves Unidata
- Dec 1975 Dissolution of the Unidata association

International

Unidata: Three More For Credibility

Almost more than business itself, Unidata, the European combine of France's CII, Holland's Philips, and Germany's Siemens, needs to convince the dp world that it is serious about competing across the board with IBM in the continental market. Once "belief" in the mind of the user is achieved, the European's preference for European equipment should guarantee Unidata reasonable market penetration. It's just possible that the European user would rather buy a third-generation "European" computer than anything IBM might offer in its next series, due out in either 1975 or 1976.

The mid-September announcement of three additional members to its first family of computers at the SICOB show in Paris is another carefully calculated move to achieve credibility. Though the systems—the 7.730, 7.740, and 7.750—are so far just a list of specifications (no

deliveries before late 1975), one senses a gathering force that tends to create enthusiasm in user shops. The model designations are not easy to use or remember, but a Unidata spokesman points out that if one thinks of Unidata as "five points better than the IBM models every time," it's easy to see that the 7.730 will compete against the 370/125, the 7.740 against the 370/135, and so on. Ominously, RCA did much the same thing in numbering its across-the-board series of IBM-competitive machines.

The systems all have the following common features: virtual memory, with an address space of 16 megabytes; integrated circuit and semiconductor technology throughout; main memory sizes ranging from 48 kilobytes to 2 megabytes; built-in automatic test and diagnostic routines run from microprocessors; integrated cpu/memory (IBM does indeed set the standard around the world), perhaps to quash any add-on memory market that might evolve; automatic instruction retry; and a host of application software packages originally

developed for the IRIS, P-1000, and 4004 systems that the new line displaces.

Multiprogramming

Deeper probes into the technology reveal Siemens-designed T³L logic, compatible with T²L logic, but with a Schottky diode added to hold noise levels down. This circuitry is being produced for Unidata by Texas Instruments, Motorola, and others. The memories are p-channel silicon gate technology using 1K chips. A more advanced 4K chip is in pilot production. The BS 1000 operating system for the series features multiprogramming on even the smallest models, remote job entry, automatic I/O spooling, data base processing, and data communication activity.

The 7.730 features memory expandable in several increments between 96 and 256K. Eight bytes of memory are referenced every 615 nsec, and the aggregate data rate for the system is an impressive 3 megabytes/second. Byte- and block-multiplexor channels are available on the new line.

The 7.740 is designed for use in somewhat different applications than the 7.730, where it can cope with relatively heavy batch workloads while running data communications tasks concur-

rently. It's claimed that the system's communications monitors and special data base software take advantage of the system's communication controllers. The 7.740 is expandable from 96-512 kilobytes, with the same eight bytes accessed during each 615 nsec memory cycle as the 7.730. The aggregate data rate is 4.5 megabytes per second.

More to come

The top of the Unidata line so far is the 7.750, with at least two models still in development that will probably compare to the 370/155 and 165 series. The 7.750 ranges in size from 128 KB up to two megabytes. There is apparently a choice in cpu architectures—one that accesses eight bytes during each 615 nsec memory cycle, or one that brings in 16 bytes. The aggregate data rate of 6 megabytes/second is sufficient to support hundreds of megabytes of disc storage and line printers as fast as 2000 lpm. The 7.730 and 7.750 machines will be built in Munich, and the 7.740 manufactured in Paris.

Trying to create a portfolio of Unidata offerings

The operations continued but not as expected. Almost no products were ready, and not much could be offered to prospective customers. In the following, we rely on a few excerpts from articles in industry-leading outlets such as Datamation since no stories were told to us by any of our sources. Rather, our sources seem reluctant to recall the Unidata period at all, instead resorting to some kind of suppressing strategy in which the Unidata episode either never took place or was of no significance whatsoever. Either way, it was not the best of times. But for historical reasons, we still give it some space in this book.

The long aborning Unidata partnership was formed in 1973 by West Germany's Siemens, France's Compagnie Internationale pour L'Informatique (CII) and Philips. Rather than a company, it has been a contractual arrangement in which the three firms divided marketing territories, development and other responsibilities in an effort to provide the European computer-using industries with an alternative to IBM's colossal offerings on the continent. Management of the partnership was by committee.

Earlier this year, one partner, CII, had upset the already shaky partnership by agreeing to merge with Honeywell-Bull. Despite continuing protests from CII that it would continue the Unidata relationship, the marketplace simply did not believe it. Sales by Unidata had already slowed during the months of rumor preceding the merger announcement and afterwards, they almost dried up.

Forced by CII

L. E. Groosman, a spokesman for Philips and Unidata, said in a recent interview: "CII forced us to announce these measures. After May 12 (when the

merger agreement formally was announced) the order intake for the Unidata 7.720 dropped sharply." Philips was the developer of this small general purpose machine—the low end of the Unidata line. It will stop manufacturing them "after we deliver the 160 machines ordered".

Groosman expects that Siemens and CII will take over the Philips marketing commitments for the line in Holland, Belgium and Scandinavia, where that firm ran the Unidata sales offices. He also believes that Siemens will do as it says and take over the support of the full 7000 line.

Philips itself will continue with its extensive line of minicomputers, office computers, small business computers, (including the 450 system marketed under the Unidata banner), bank terminals and data entry equipment. Nearly 20,000 of its small office computers are in or on order worldwide. This equipment accounted for the bulk of Philips data systems sales of 550 million guilders (roughly \$206 million) a year and, says Groosman, operated at break-even. Its own general purpose line (P-1000) and more recently the Unidata effort cost the firm 1.2 billion guilders (\$450 million) in unrecovered costs over the last dozen years. In each of the last five years alone, it reported some \$200 million guilders (\$75 million) in unrecovered costs.

Philips did not take the withdrawal lightly since over the next two years it will be forced to lay off a large number

of the 2,500 employees directly affected—a situation of grave import in Holland where labor laws are tough. Some will be relocated within the company, but it simply cannot absorb most of them. The labor unions and workers' councils must approve before Philips can bow out, but Groosman indicated that a "complex, extensive" memo had been filed with them to support the decision.

Western Europe is trying to find out today where cooperation can create better opportunities for its industry and where economic nationalism will have to take its course. It has suffered in the past from lack of a system like that in the U.S. that will financially support new companies. Some of the programs have been short-sighted, not taking advantage of market opportunities. Its efforts to create one computer company, Unidata, out of three strong-willed companies was a pipe dream.

Close to the disbanding, the constituting partners, in particular Siemens, were keen on continuing to sell the Unidata computers under their own brand. Needless to say, that was not a winning strategy.

develop enhancements to the two systems it now offers: the BS 1000 and BS 2000. Siemens will stick to the present line of mainframes, but concentrate on software applications that are more directly tailored to the needs of prospective customers (as opposed to the more generalized offerings of IBM).

Keep Unidata line

Related to all of this are its plans to pursue the Unidata line, which Sorg describes as offerings of the three partners to which are added "modes" of each other's computers. For instance, Siemens' model 230 medium scale computer has a CII and Philips mode that

makes its instruction set compatible with CII and Philips' offerings, and therefore is called the Unidata 7.730 (similar to the IBM 370/125). The Philips Unidata 7.720 machine has a compatible instruction set with the Siemens-made model 220.

Sorg said Siemens can make the entire Unidata line. It probably will introduce a more powerful version of the low end 7.720 (of which he said 100 are installed). The 7.740 is developed and manufactured by CII, but CII had some production snags and Siemens filled the first orders with a stripped-down version of the Siemens-developed 7.750, so it can be assumed Siemens can continue

The fall of the Unidata consortium was so severe that several sources speculated that Philips would stop producing and selling computers at all. While it was, in a sense, true for large mainframe computers, it was not at all a correct speculation about other computer segments.

Will Philips stop making computers?

SINCE the break-up of the Franco-German-Dutch computer company, Unidata, a spate of rumours have circulated the capitals of Europe about the surviving members of the organisation, Philips and Siemens. They came to a head again this week in Paris.

Philips has a computer history which looks fairly convincing on the small machine side. But since the introduction of the IBM System/32 machine in much the same price bracket, the Dutch firm has clearly had to think hard about its small computer policy. One thing is certain: the small business computer now fills a very different market from the one Philips entered when it bought the West German firm Siemag some seven years ago.

The rejigging of Philips's computer interests has caused some consternation within its own ranks. The Technical Development Centre outside Paris has just been completely re-managed and pointed in new directions. This centre had the major design task of producing new machines to follow the existing range. On the other hand, the company's Apeldoorn development complex is still investing heavily in the special applications software for the small business computer market.

Philips has tumbled to the fact that the internal architecture of small computers does not matter all that much when, in the final analysis, it comes to making a profit out of a market. "The question of reducing the cost of the basic hardware takes precedence over the shape of that hardware," says one company executive. The design of new and ingenious machines certainly seems to have been brought to a halt—hence the renewed spate of stories concerning the withdrawal of Philips from general purpose computer manufacture.

While there is a grain of truth in this, Philips is currently absorbed in producing new specialist terminals and new applications software for special industries. The actual machines these will run on are only of interest to the company insofar as they affect the margin of profit left to absorb the software and selling costs. Philips seems to have decided to concentrate on the component side of computers and providing full satisfaction to the end-user. All of which means that the company may now be ready to start buying in the basic computer machinery from the most competitive outside supplier.

Philips to stop making computers altogether was a click-bait-style headline

Why do we bring this up? For two reasons. First, this marks the end of the European main-frame era, by which we mean the fixation of every reasonably large European computer manufacturer to take on IBM and its smaller American cousins. Second, minicomputers were included in the Unidata agreement almost as an appendage. Thus, sound industrial efforts like Philips Terminal Systems, which we will discuss in Chapter 8, were almost suffocated in the complicated proceedings both when Unidata was operational (all focus was on large, general-purpose machine sales) and afterwards (homeless product lines without

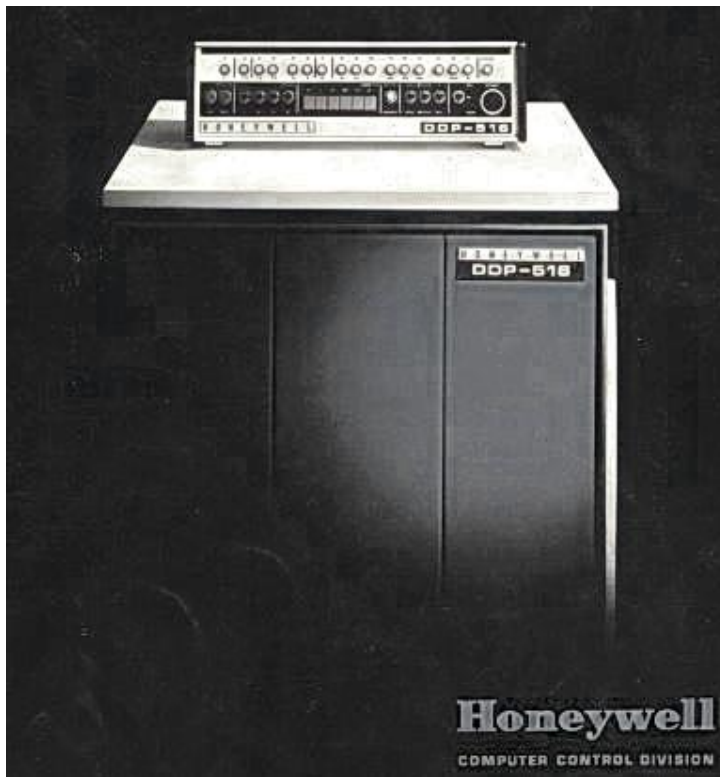
much support in some countries). For example, after the Unidata split, the Swedish Unidata office, located in Hallonbergen (“Raspberry Mountains”) in Sundbyberg municipality outside of Stockholm, became a Philips PTS customer project office. It was located there until 1978 when it finally, after four years, could reunite with the rest of the organisation at the Philipshuset head office.

To conclude the chapter, and in an attempt to connect back to the earlier parts of it, we will try to summarise Philips’ computer manufacturing organisation before and after the Unidata period. Before Unidata, Philips’ computer activities were organised in IGs (Industrial Groups). There were four or five IGs, depending on what counted as an industry: IG Computer Systems based in Apeldoorn (primarily P1000 and X1100 systems, in essence the original PCI from 1963); IG Peripheral Equipment based in Rijswijk (mainly the “parts bin” introduced in Chapter 6; informally started in 1965, formally in 1967); IG Office Machines based in Eiserfeld, Germany (the Siemag P300 systems, acquired partly in 1965 (40%) and entirely in 1969); IG Small Computers based in Fontenay-aux-Roses (the CTI P880 and P800 systems, started in 1968; a misnomer since these computers were actually more powerful than the P300 systems); and finally IG Data Information Services, a data centre based in Eindhoven, hardly an industrial group in a manufacturing sense and of little interest to this book. This organisation lasted until the Unidata agreement was made in mid-1973, by which all three companies’ computer divisions were concatenated based on perceived product line similarities. As discussed in this chapter, the Unidata organisation was never successful in any of the European computer markets. After the Unidata period ended, that organisation was disbanded and the remaining Philips units and product lines were reorganised into Data Systems (P800 and PTS 6000, later also P7000, but with P1000 and P880 discontinued) and Information Systems (P300, later also P400).

5. Philips Minicomputers

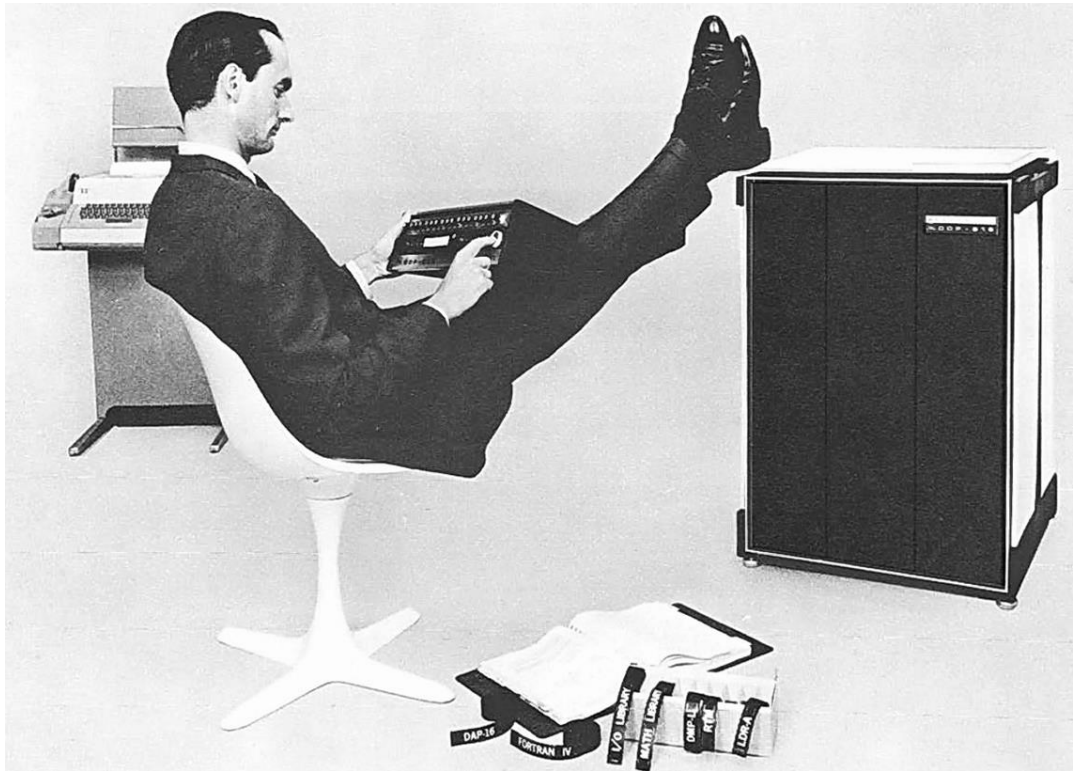
5.1 Honeywell

Initially, Philips had no eyes for anything in computing except IBM-sized mainframes. However, they started getting customer inquiries for smaller computers called minicomputers. In the mid-1960s, Philips began to import and market Honeywell minicomputers under their Philips brand. Honeywell had, in turn, earlier acquired CCC, the Computer Control Company, which had two product lines at the time of acquisition. One was a 24-bit series mainly intended for flight simulators. The other, newer and more commercially attractive, was a 16-bit computer called DDP-116, built from discrete components. After Honeywell took over, two models with similar architecture, DDP-416 and DDP-516, were developed in 1966 using integrated circuits instead.



Honeywell DDP-516 system

Those two models were imported and sold in Europe by Philips. Upon arrival, a Philips service engineer ran some test programs to see that the machine survived the Atlantic trip and then simply glued Philips stickers over the Honeywell logos, thus “producing” a Philips minicomputer called P9202. This was sometimes called “badge engineering”.



Testing and converting a DDP-516 to a P9202 (?)

The only significant difference between the 416 and the 516 was that the latter could do multiplication and division in hardware, making those instructions 30–55 times faster than software emulation. This made it much more popular among customers, and that observation would play an important role later as Philips designed and built its own minicomputers. Note that while the Philips logos on the computer cabinets are correct (those that are glued on), the plaintext capital letter logo on the manoeuvre panel (whose front was made separately by an independent contractor) is incorrect. This was not the only time the logo was incorrect; see page 173 for another example with larger consequences.

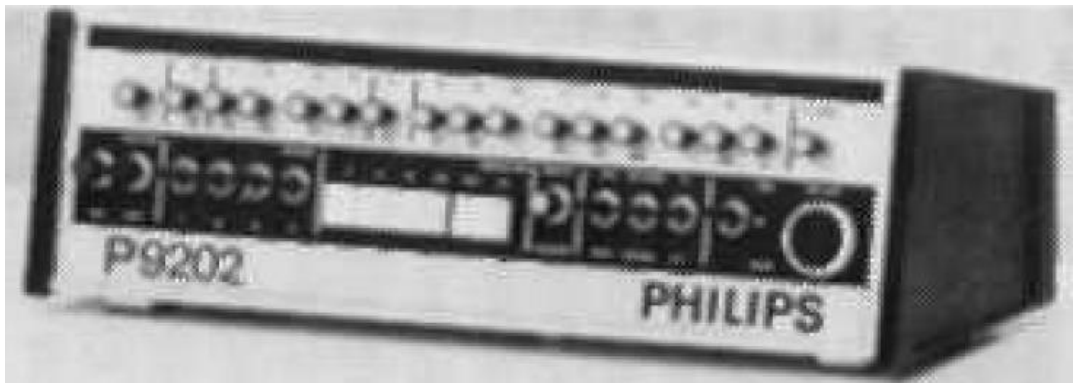
Computer	Microseconds						Cycle Time
	Multiplication		Addition		Division		
	Fixed point	Floating point	Fixed point	Floating point	Fixed point	Floating point	
Honeywell DDP 124	14.0	option	3.5	option	19.6	option	1.75
Honeywell DDP 324	14.0	option	3.5	option	19.6	option	1.75
Honeywell DDP 416	292.22 software		1.92		336.96 software		960 nsecs
Honeywell DDP 516	5.28	238.7	1.92	238.1	10.56	488.9	960 nsecs
IBM 360/20		sub-routine	174, 209	sub-routine		sub-routine	3.6
IBM 360/20-5		sub-routine	48, 58	sub-routine		sub-routine	2.0
IBM 360/30	228, 75	238-792	22, 28	50-80	413	293-635	1.5
IBM 360/40	60, 45		7.5, 10.63, 11.25		156.0-192.5		2.5

From an architectural comparison in 1968

The table shows that, more precisely, multiplication was 55 times faster and division 32 times faster in hardware (microcode) than in software. This, of course, came with a cost. The extra circuits, probably on a separate circuit board, made the DDP-516 more expensive than the DDP-416. And if a customer did not need fast arithmetic, there was no reason to pay for it. The DDP-516 was, however, the more popular of the two models since the price difference was not very large and customers wanted to be future-proof in their purchase.



A DDP-516 with Philips badges attached by glue



Close-up of a P9202 control panel with the incorrect Philips logo

In 1968, the 416 and 516 were to be superseded by the newly announced DDP-316, and Philips was once again offered to import and rebadge the new machine. The 316 was more modern and looked more like an office machine. Hence, this was an attractive proposal, but Philips was also at the same time beginning to think about producing minicomputers on its own, not only focusing on mainframes and IBM. Regardless, Philips was interested in Honeywell's proposal as a stopgap offering. Building a minicomputer on its own would require considerable time and effort. Honeywell offered Philips three versions of the 316: the rack version (left), the desktop version (middle), and the kitchen version (right). Wait... the *what?* The *kitchen* version? Yes, the console was offered as a kitchen computer. Although it was initially made for promotional activities, it was also made available for consumer purchase. Whether anyone actually bought the kitchen version is not known to the authors.



The three DDP-316 models

The DDP-316 in red was the first computer ever offered for home use. It was marketed as a kitchen computer and could be bought together with two collections of recipes (digitised cookbooks) and a matching red apron (!). A two-week programming course was also included. The front of the console made up a convenient cutting board for cooking. The advertisements for the kitchen model were a bit remarkable, though. The terminology “menu selection” suddenly gained an additional meaning.¹⁸



DDP-316 in a package with two digitised cookbooks and a matching red apron

Philips saw that the Honeywell minicomputers were being used in serious applications. The US military’s Advanced Research Projects Agency (ARPA) used those minicomputers to build Interface Message Processors (IMP) for the ARPA Computer Network. The older DDP-516 was in 1968 chosen to build the first-generation IMP machines to connect host computers to the ARPANET. The IMP was used to store and forward messages, which was the precursor to modern internet routers. If minicomputers were trusted with such tasks, they were a serious market segment to consider.

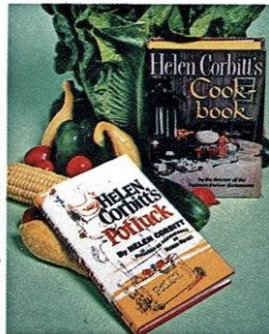
¹⁸ The slogan “If she can only cook as well as Honeywell can compute” raised one or the other eyebrow. Nevertheless, she seems prepared to cut the vegetables on the console cutting board. For some reason, the woman in the two advertisements does not wear the red apron, which at USD 28 would have been the authors’ favourite purchase. The kitchen computer at USD 10,600 was a bit off our budgets.



If she can only cook as well as Honeywell can compute.

Her souffles are supreme, her meal planning a challenge? She's what the Honeywell people had in mind when they devised our Kitchen Computer. She'll learn to program it with a cross-reference to her favorite recipes by N-M's own Helen Corbitt. Then by simply pushing a few buttons obtain a complete menu organized around the entrée.

And if she pales at reckoning her lunch tab, she can program it to balance the family checkbook. **84A** 10,600.00 complete with two week programming course **84B Fed with Corbitt data:** the original Helen Corbitt cookbook with over 1,000 recipes 5.00 (.75) **84C Her Polluck,** 375 of our famed Zodiac restaurant's best kept secret recipes 3.95 (.75) Epicure **84D Her tabard apron,** one-size, ours alone by Garden House in multi-pastel provincial cotton 28.00 (.90) Trophy Room



Advertisement for the kitchen version of the Honeywell DDP-316



The DDP-316 was called P9205 when it had a Philips sticker attached

5.2 Philips Sciences et Industrie

In 1968, the Dutch Philips headquarters finally realised it wanted to become a real player in the minicomputer market. Importing Honeywell computers was not enough any more, even though that would continue for a few years. Scanning its many subsidiaries all over Europe, it found Philips Industrielle et Commerciale in Bobigny, eight kilometres northeast of the centre of Paris. It had a division called Sciences et Industrie (S&I), located on Rue de Paris, which primarily built electronic measurement instruments for Philips and Fluke. But they had also developed a minicomputer called the PR 8000, which was of some interest to Dutch Philips since the company had not been very active as minicomputer architects in the 1960s.



Philips Sciences et Industrie, Rue de Paris, Bobigny

The Philips factory was housed in a locally rather famous former high-quality chocolate and candy factory, Klaus S.A., which had moved to a less expensive location. Therefore, the factory was known by the locals as Philips Chocolate.



A delicious assortment of chocolate on offer by Klaus

Dutch Philips top management paid Chocolate a visit to find out more about the minicomputer's development. It was of an older, discrete design that had premiered already in the fall of 1965. Further, it was intended for industrial control applications rather than office administration use. Technology-wise, much had happened since 1965, and sales of the outdated PR 8000 had been minimal. Thus, no successor was ever built or even considered. But the visitors found out that there was a lot of computer design competence at Chocolate, and hence decided to transfer the engineers to a different project – that of Philips' first real, powerful minicomputer.

LE SYSTÈME **PHILIPS**
DE TRAITEMENT DE L'INFORMATION
POUR LES APPLICATIONS
INDUSTRIELLES ET
SCIENTIFIQUES



CALCULATEUR P.R. 8000



The tiny PR 8000 minicomputer from Philips S&I in Bobigny

5.3 Centre Technique et Industrielle

To quickly get up to speed, Philips acquired the French company CTI (Centre Technique et Industrielle) and moved it, together with the PR 8000 designers from Philips Sciences et Industrie, to a rented building in Fontenay-aux-Roses some eight kilometres southwest of Paris city centre. This was a clever move for several reasons. First, even though CTI was not familiar with computers, they had done digital design for a while and such competence was hard to come by. Second, moving the PR 8000 designers into a new environment meant that they took their competence with them but not their old designs. Further, CTI's new location was only a few hundred metres up the road from CEA TFR, the French government's experimental nuclear fusion tokamak reactor, where many skilled but underpaid electrical engineers worked who might be tempted with higher salaries and more freedom.



Philips CTI office and factory on Avenue du Général Leclerc in Fontenay-aux-Roses



The location of Philips CTI in the proximity of the CEA TFR tokamak nuclear reactor

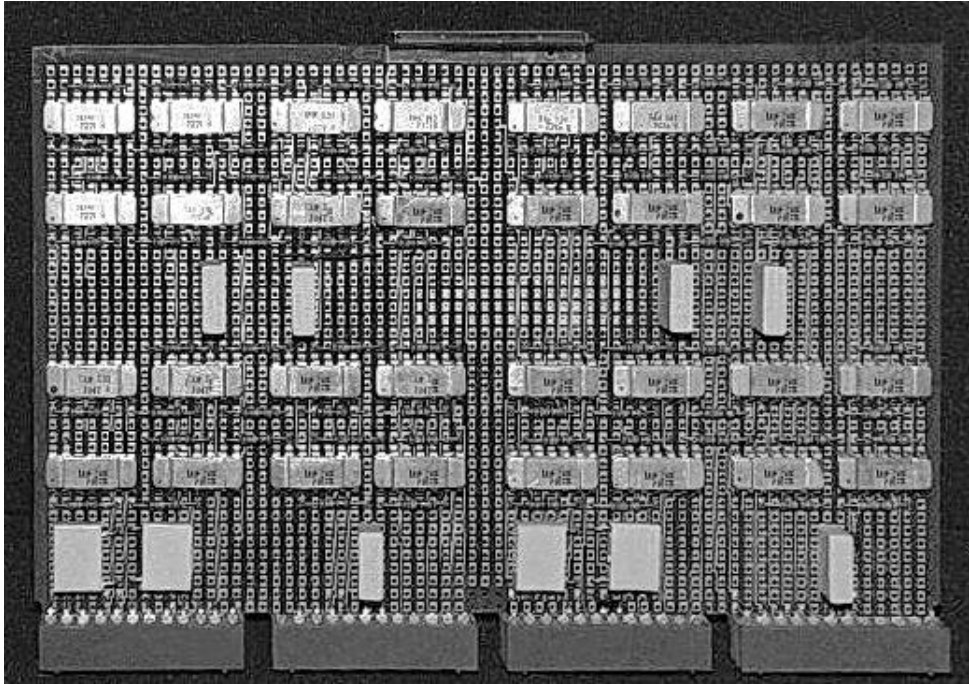
Five subdivisions were established at CTI: computer hardware, computer software, general electronics, general logic including simulations and CAD (computer-aided design). Four of the five managers for those subdivisions came from Chocolate in Bobigny, reflecting their computer design seniority but also the influence Philips wanted to have on the newly acquired CTI. Further, the new CTI CEO came directly from Philips in the Netherlands, reinforcing the power and control structure that was put in place with almost immediate effect.

While this leadership structure was neither good nor bad in itself, what was this new organisation supposed to produce? The notion of a minicomputer in France at that time was a bit vague. There was no strong home market as in the US, where computer manufacturers could constantly try their ideas in a strong and demanding market. This way, and by observing whose machines were in demand, US companies could learn about technology and the market in parallel. This interplay was a massive advantage for the US manufacturers since at the same time, the European players did not even resonate very well with their own smaller home markets.



P880 “minicomputer” demo installation

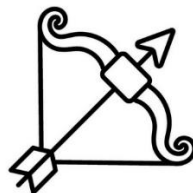
Philips CTI became operational in late 1968. As noted, most managers came from the Bobigny S&I operations and were thus loyal to Philips. But to most employees’ considerable disappointment, including the former Chocolate managers, control of the entire operations was immediately handed over to Dutch Philips-Electrologica in Apeldoorn, who assigned them the task of building a slightly smaller version of the P1000 and calling it a “minicomputer”. There was a certain amount of numerology in Apeldoorn, so the new mini must have a number lower than 1000. But the team from Bobigny brought with them a former project with an out-of-kilter number: 8000. This was, of course, due to Chocolate in Bobigny belonging to another Philips industrial group which was not mainly dealing with computers. So while Apeldoorn had no previous influence over the number series, that series could still not be tolerated. Since S&I came with an 8-series number, Apeldoorn gave the new project the product number 880. The P880 project was carried out by CTI as assigned, using the same old DTL technology as the P1000 at Apeldoorn’s request. But it was clear to CTI that a downsized P1000 called P880 would be no more attractive than the P1000 itself. The market demand would rather soon prove the engineers right.



P880 circuit board with old DTL technology and old-style circuit boards

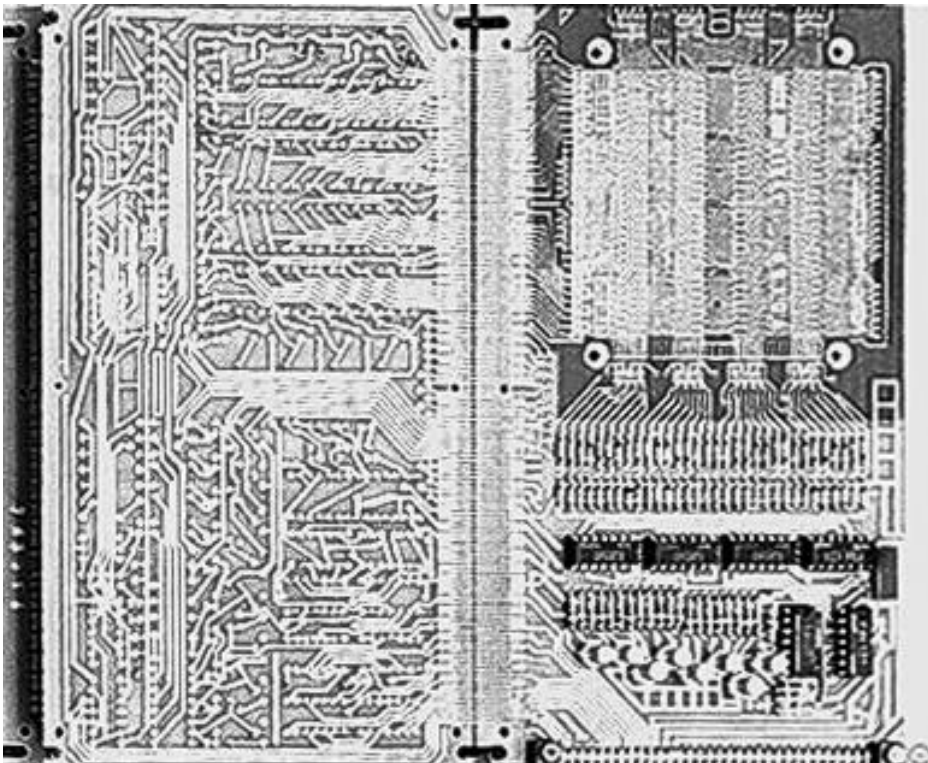
5.4 Sagittaire

The CTI newcomers had two options. Either change jobs, but there were not many computer design jobs out there at that time – especially not with the critical mass that CTI had accumulated. Or, the other option was to start a secret clandestine feasibility study on how to produce something along the lines of Digital Equipment’s (DEC) PDP-8, which was the most admired and popular minicomputer at the time. The project started in December 1969 and was named after that month’s zodiac sign, Sagittarius (French: Sagittaire), the archer.



The Sagittarius zodiac sign that became the symbol of the underground project

In less than a year, the team managed to – under the radar – build a functional proof of concept of a 16-bit minicomputer CPU using the latest TTL circuits and printed circuit boards, similar to what one could imagine that a first proof of concept at DEC or Data General would look like. It was nowhere near a complete CPU. For example, it was only an 8-bit processor (two 4-bit ALUs in parallel instead of four) to save board space and development time. Only the bus was 16 bits, so it had to “cheat” by fetching the 16-bit words in two cycles and then processing them in two steps of 8 bits each. Furthermore, it had no micro-controller and thus no microprogram. Therefore, there were a lot of instructions it could not perform since it could not loop. But that did not matter, Sagittaire demonstrated two things. First, the team was capable of producing a modern CPU design for a minicomputer, but they had also arrived at a proposed 16-bit architectural design that could be developed into a real one. After a while, the low interest in and sales figures for the P880 convinced Apeldoorn to give CTI the go-ahead to produce a minicomputer based on their proof-of-concept design.



One of Sagittaire's proof-of-concept circuit boards

With Sagittaire as a starting point, the real design was completed in record time. Already in spring 1971, the first prototype could be demonstrated to management. At this point, it became a “real” project in the eyes of the Apeldoorn marketing division and had to be given a product name. Still confined to the 8-series and with the requirement to be placed well below the P880 (which was not yet officially cancelled), it was christened P850.

5.5 First Generation P800 Processors

Getting closer to launch day, the Philips marketing department suddenly knocked on the door one day. They wanted this to be a *series* of minicomputers, not merely a single one, to show Philips’ commitment to the new segment. Since there was only one version in reality, what could be done? Marketing requested that the proof-of-concept design was dressed up to become a product on its own. With its very modest and underwhelming specifications, the engineers argued that it was an almost useless product and would only give a bad reputation to the real CPU in the series. Marketing of course won, and the Sagittaire prototype took over the P850 name.

Further, according to the marketing department, the “other two” should be named P855 and P860 to have a nice step between them. The Sagittaire 8-bit internals and no microprogram meant that the “new” P850 would have a rather different instruction set from the real CPU (P855/860). And some instructions that all CPUs shared would still behave differently. For example, in the microprogrammed P855/860, some instructions set the condition register (CR) while others did not since it was decided by how the microprogram ended each instruction. In the P850 (former Sagittaire), this was not possible. Without a microprogram, it had to finish each instruction in the same way, i.e. by setting the CR. This and other similar problems rendered the assembly code of the P850 and the P855/860 remarkably different, as if they did not belong to the same processor family (which, in actual fact, they did not).

P855M	P850M	OPC	P855M	P850M	OPC	P855M	P850M	OPC
*ABR	AB	1	CWR	CW	D	*LCR	TC	C
ADR	AD	2	DAR	-	A	LDR	TW	0
ANR	I	4	DSR	-	B	MLR	-	7
C1R	C1	F	DVR	-	9	*MSR	-	7
C2R	C2	3	ECR	EC	C	MUR	-	8
CCR	-	D	IMR	IM	2	ORR	U	5
*CFR	CF	E				*RTN	RT	E

*No CR setting

Partial instruction and opcode list for P850 and P855/860

instruction set

Memory reference instruction

LD	Load register
ST	Store register
AD	Addition
SU	Subtract
AN	Logical AND
OR	Logical OR
XR	Exclusive XOR
IM	Increment memory
C2	Two's complement
* ML	Multiple load
* MS	Multiple store
ABI	Absolute conditional branch
CFI	Call function
C1	One's complement
CW	Compare word
* CC	Compare character
LC	Load character
SC	Store character
RF	Relative forward conditional branch
RB	Relative backward conditional branch
** MU	Multiply
** DV	Divide
** DA	Double add
** DS	Double subtract

Register to register instructions

LDR	Load register/register
STR	Store register/register
ADR	Addition register/register
SUR	Subtract register/register
ANR	AND register/register
ORR	OR register/register
XRR	XOR register/register
IMR	Increment memory/register
C2R	Two's complement register
* MLR	Multiple load/register
* MSR	Multiple store/register
ABR	Absolute conditional branch/register
CFR	Call function/register
C1R	One's complement register
CWR	Compare word register/register
* CCR	Compare character/register
LCR	Load character/register
SCR	Store character/register
RTN	Return
ECR	Exchange character register/register
** MUR	Multiply/register
** DVR	Divide/register
** DAR	Double add/register
** DSR	Double subtract/register
TM	Test mask
TNM	Test not mask

Constant instructions

LDK	Load constant
ADK	Add constant
SUK	Subtract constant
ANK	Logical and with constant
ORK	Logical or with constant
XRK	Exclusive or with constant
* MLK	Multiple load constant
AB	Absolute conditional branch
CF	Call function
CWK	Compare word with constant
* CCK	Compare character
LCK	Load character
** MUK	Multiply with constant
** DVK	Divide with constant
** DAK	Double add with constant
** DSK	Double subtract with constant

Shift instructions

** SLA	Shift left arithmetic
** SRA	Shift right arithmetic
** SLL	Shift left logical
* SRL	Shift right logical
* SLC	Shift left circular
** SRC	Shift right circular
* SLN	Shift left normalize
* SRN	Shift right normalize
* DLA	Double length left arithmetic shift
* DRA	Double length right arithmetic shift
* DLL	Double length left logical shift
* DRL	Double length right logical shift
* DLC	Double length left circular shift
* DRC	Double length right circular shift
* DLN	Double length left and normalize
* DRN	Double length right and normalize

I/O Instructions

CIO	Control I/O
INR	Input to register
SST	Send status
OTR	Output from register
TST	Test status
** WMP	Write mask protection
* WM2	Write mask 2
RIL	Read interrupt line
WIM	Write interrupt mask

Miscellaneous instructions

ENB	Enable interrupt
HLT	Halt
RIT	Reset internal interrupts
INH	Inhibit interrupt
LKM	Link to monitor
* SMD	Set mode

The instruction set of the early P800 series

But what about a “third” model? How could it be pulled out of the magician’s hat? Some of the engineers had previously worked with the P9202 (Honeywell DDP-416 and 516). The major difference between the two Honeywell models was having multiplication and division in hardware (516), which was faster than in software (416) by a factor of around 30–50. Since the new processor had its multiplication and division hardware on a separate board, this was an easy distinction to make that also had worked in the market before. Thus, Philips prepared to go to market with this set of three CPUs: Sagittaire as P850, the real CPU stripped of multiplication and division hardware as P855 and the full version of the real CPU as P860.

Unfortunately, after the initial marketing material had been printed and distributed, the Apeldoorn marketing division realised that they did not like the distinction between P855 and P860. In their view, fast multiplication and division were not “cool” enough. But being able to brag about a memory cycle time below the magic one-microsecond level was, in their opinion, much cooler. Thus, since marketing almost always won, the meaning of P855 and P860 was changed a while after the introduction so that the differentiator was memory speed instead of arithmetics.

- ** P860 only - option
- These instructions are available with the P850 but will only shift one position
- 1 This is for use with P860 machines with greater than 16k store

The initial meaning of P855 and P860, refer to the previous page

- ** P855 and P860 - option
- These instructions are available with the P850 but will only shift one position.
- 1 This is for use with P860 machines with greater than 16k memory.

The subsequent meaning of P855 and P860, refer to the previous page

Was this confusing? Sorry about that, and unfortunately it will soon get worse. But before that, let us make a small table to clear up what engineering and marketing wanted for the first generation of “real” P850-series processors, i.e. the P855 and P860. In the table, ‘****’ means mandatory, blank means unavailable, ‘std’ means standard and ‘opt’ means optional.

The columns contain what the engineering department at CTI and the marketing department at PDS Apeldoorn, respectively, considered the most appropriate differentiators between the two “different” CPU models. The rows contain the actual processor properties.

		Engineering		Marketing	
		P855	P860	P855	P860
<i>Mult./div. instructions</i>	SW	***		std	std
	HW		***	opt	opt
<i>Memory speed</i>	1.2 μ s	std	std	***	
	0.7 μ s	opt	opt		***

After about a year and a half in the market, primary memory chips became less expensive and all real CPUs (not the P850) were, from late 1973, equipped with the faster memories; thus the P855 became meaningless. The engineers were not surprised, but marketing was. Pressure from above, though, dictated that the P860 name was too daringly close to P880 and had to be dropped. Thus, the P860 took over and became the new P855. It soon became the only remaining CPU being sold from the first generation of processors since the P850 was not a meaningful processor for real applications.

		Addressing types	Execution times in μ s	
			1.2 μ s memory	0.7 μ s memory
DA	Double Add	T4 - T7	5.6 - 6.9 μ s	3.9 - 4.8 μ s
DAR	Double Add Register	T1, T3	3.1 - 4.5 μ s	3.0 - 3.6 μ s
DAK	Double Add Constant	T2	4.4 μ s	3.2 μ s
DS	Double Subtract	T4 - T7	5.6 - 6.9 μ s	3.9 - 4.8 μ s
DSR	Double Subtract Register	T1, T3	3.1 - 4.5 μ s	3.0 - 3.6 μ s
DSK	Double Subtract Constant	T2	4.4 μ s	3.2 μ s
C2	Two's Complement	T4 - T7	5.3 - 6.5 μ s	3.5 - 4.4 μ s
C2R	Two's Complement Register	T3	4.0 μ s	3.1 μ s
IM	Increment Memory	T4 - T7	5.0 - 6.3 μ s	3.0 - 4.0 μ s
IMR	Increment Memory Register	T3	3.8 μ s	2.6 μ s
NGR	Negate Register	T1	2.0 μ s	1.9 μ s
CM	Clear Memory	T4 - T7	3.8 - 5.0 μ s	2.4 - 3.3 μ s
CMR	Clear Memory Register	T3	2.8 μ s	2.1 μ s
CW	Compare Word	T4 - T7	3.8 - 5.0 μ s	2.2 - 3.0 μ s
CWR	Compare Word Register	T1, T3	1.4 - 2.5 μ s	1.2 - 1.8 μ s
CWK	Compare Word Constant	T2	2.5 μ s	1.5 μ s

The difference in execution time for the two types of memory

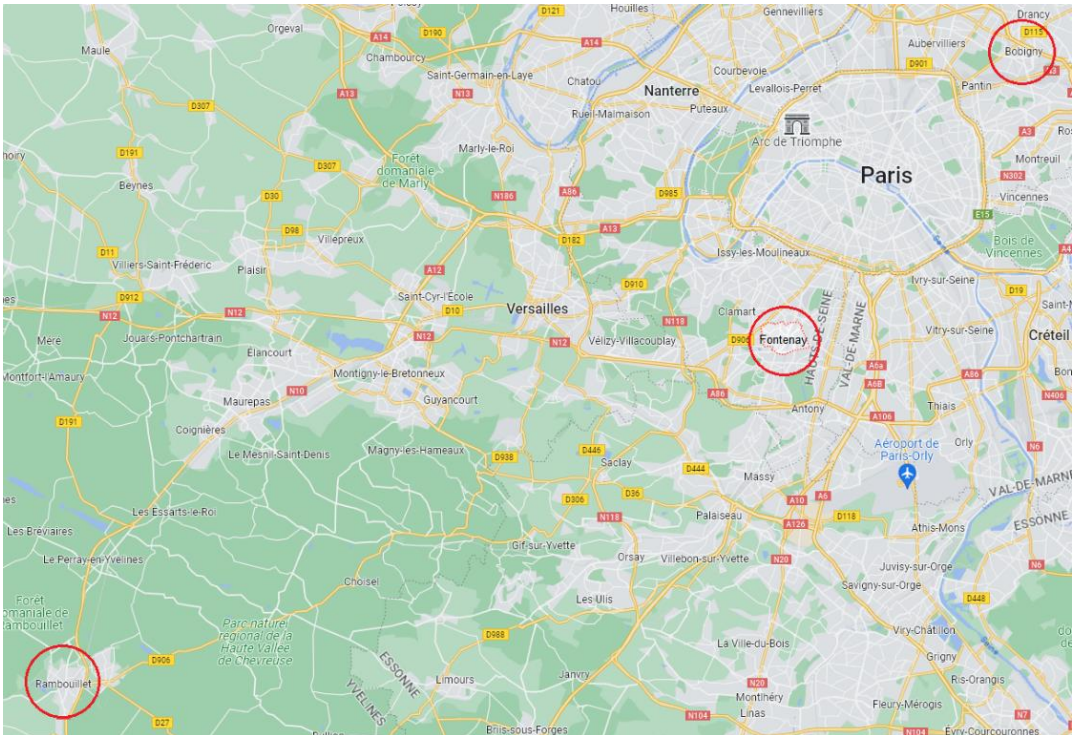
5.6 Radiotechnique

When Philips rented the facilities in Fontenay-aux-Roses to house CTI, the plan was to build the P880 there, which in essence was a scaled-down P1000 mainframe. All large computers at that time were built one by one in a craftsmanship style, think aircraft assembly. Thus, Fontenay only had the capacity to slowly build a few copies of any computer. However, one of the main ideas for the new P800 product line was low cost due to modern components and fast and simple assembly in an assembly line, think car manufacturing. CTI had no space or knowledge of setting up and operating such an assembly line. CTI turned to Dutch Philips for aid, and they assessed their possibilities. Philips had several electronics factories in the vicinity of Paris, but most of them were low-level component factories rather than product assembly lines. The chain of factories that Philips operated was called Radiotechnique and had been acquired by Philips shortly after the war. Wikipedia knows more than the authors on this matter, so let us ask it instead.

After the war Radiotechnique grew fast. Philips acquired total control of Radiotechnique in 1947. The Suresnes factory in 1951 produced half of France's reception tubes and 30–40% of the wireless telephony receivers. By virtue of its association with Philips it had the financial, technical and commercial resources to enter the television market when it developed in France, and later to enter industrial electronics. This phase was marked by financial restructuring, recruitment and training of managers and technicians, and by geographical expansion of manufacturing facilities. New factories were opened to the west of the Suresnes parent factory. The factory at Suresnes with 2,500 employees was followed by:

Year opened	Location	Products	1960 employees
1953	Chartres	Electronic tubes	1,147
1954	Rambouillet	Radio and television receivers	842
1955	Évreux	Electronic components	951
1956	Dreux	Television and cathode tubes	1,242
1956	Nogent-le-Rotrou	Spare parts	592
1957	Caen	Semiconductors	1,480

From the table, the apparent choice became Rambouillet since it was the only factory with a classic assembly line for somewhat more complex products. There was a worry, though, both at CTI in Fontenay-aux-Roses and at Philips in the Netherlands, that Rambouillet was situated quite far away, around 40 kilometres southwest of Fontenay, which could, in the era before internet and video conferences, be a stumbling block to obtain cost efficiency and high quality at the same time. After all, manufacturing computers was not the same thing as manufacturing radio and TV sets, so close communication was important.

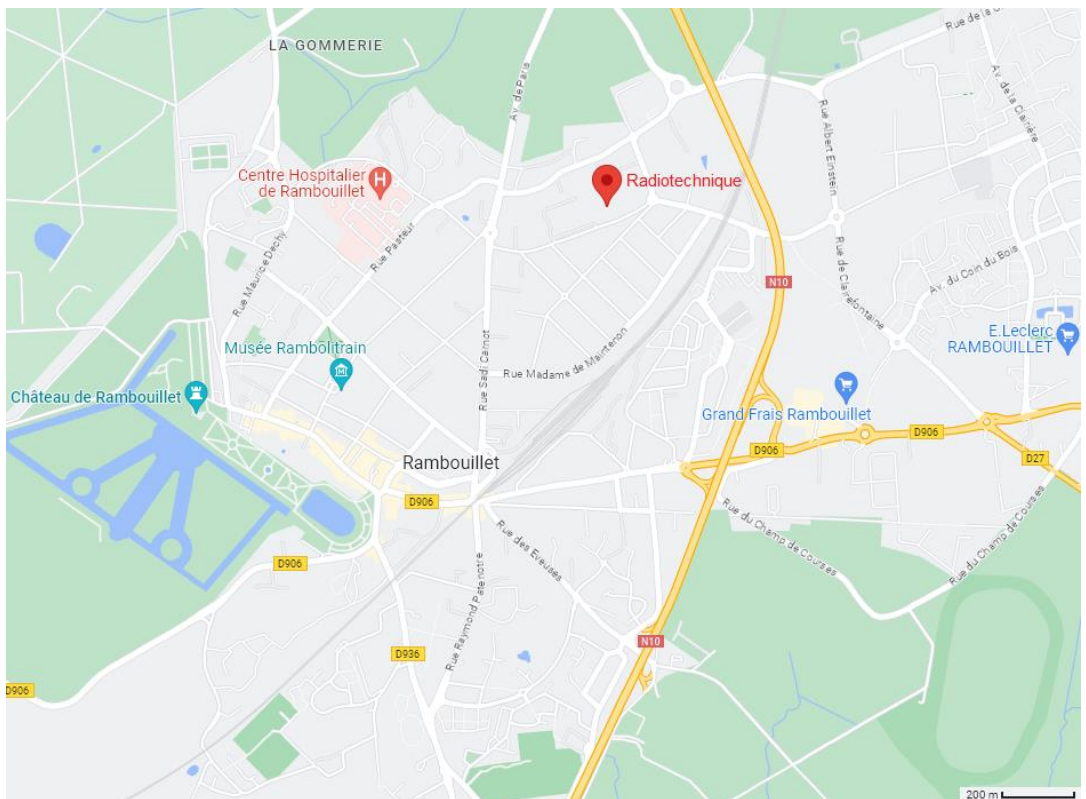


Distances between Rambouillet (left), Fontenay-aux-Roses (middle) and Bobigny (right)

Rambouillet was (and still is) a small municipality with only a few tens of thousands of inhabitants. When Radiotechnique established its factory there in 1954, it quickly became the main employer. And even though it was located only a few kilometres from the centre of the town, on Rue de Clairefontaine, it was built on farmland since it was on the very outskirts of the town. A P800 CPU production line was set up in this radio and TV set factory, including repairs. After a calibration period, the assembly and repair line worked

efficiently. It was operational until 1985 when, due to decreasing volumes, repairs started being made at PDS in Apeldoorn instead while production was kept at Rambouillet, although in batches with a lower frequency. From 1987, due to the implicit sales ban (see Chapter 9), production volumes were very low, aimed mainly at replacements when old processor boards were beyond repair.

The Rambouillet assembly line changed over the years as did the P800 CPUs. The first generation (P855/P860) was of a more complicated and fragile construction. Thus, the assembly pace was lower. In the beginning, this was interpreted by CTI as the assembly line not being efficient. After a while, CTI realised that their design was very good from an architectural perspective, but needed improvements on the industrial production side. Those insights were incorporated into the second generation, which became much more durable.



Even today, Radiotechnique’s building is almost on the outskirts of the town

There was a rather weak connection chain to Radiotechnique in Rambouillet from PEAB-T in Järfälla. The PTS product line used P800 equipment which was governed from Apeldoorn. They, in turn, used CTI in Fontenay-aux-Roses for the design and development of the CPUs, while all other electronics were either made in Apeldoorn (for the P800 series) or in Järfälla (for the PTS 6000 series). And from CTI as a design centre, there was one more step to the Radiotechnique factory in Rambouillet. Thus, none of the authors have ever been to Rambouillet, so we turn to Wikipedia for help with some facts about the town.

Rambouillet lies on the edge of the vast [Forest of Rambouillet](#) (*Forêt de Rambouillet* or *Forêt de l'Yveline*); it is famous for its historical castle, the [Château de Rambouillet](#), which hosted several international summits. Due to its proximity to Paris and [Versailles](#), Rambouillet has long been an occasional seat of government.

The [Château de Rambouillet](#), a former medieval fortress, was acquired by [Louis XVI of France](#) in 1783 as a private residence because of its ideal situation in the game-rich forest of Rambouillet. It became a *bien national* during the [French Revolution](#) of 1789, and one of the imperial residences of [Napoléon I](#) during the [First French Empire](#). At the time of the [Bourbon Restoration](#), the castle became a royal residence, and it is there that [Charles X](#) signed his abdication on 2 August 1830. Sometimes neglected at times of political unrest, the château de Rambouillet became the official summer residence of the French [President of the Republic](#) after President [Félix Faure](#) chose it as summer residence for himself and his family in 1896; Rambouillet thus became the official summer residence of the Presidents of the [Third Republic](#) and has retained its position ever since.

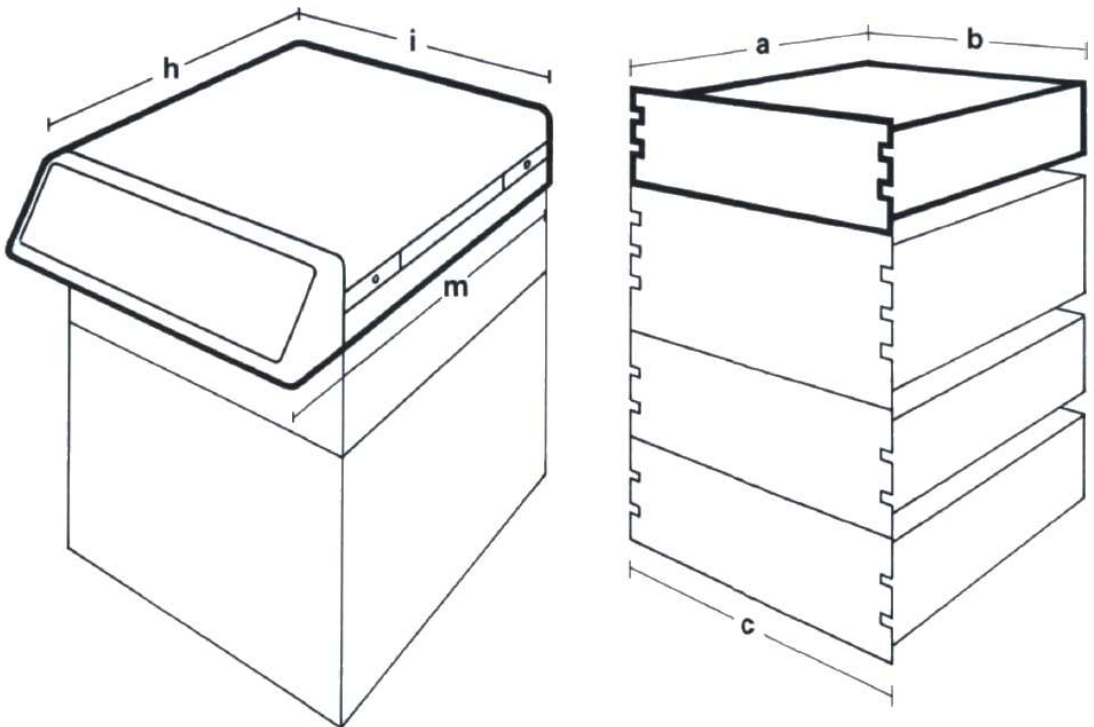
The [Palace of the King of Rome](#). In 1784, on a parcel adjacent to the gardens of the castle, Louis XVI had ordered the construction of the *Hôtel du Gouvernement*, which was restored during the reign of Napoléon I, and renamed *Palais du Roi de Rome* as the official Rambouillet residence of Napoleon's infant son [Napoleon II](#). Its entrance is situated in the rue Charles de Gaulle, Rambouillet's main street.



The Radiotechnique factory was built on farmland in 1954

5.7 First Generation Minicomputers

The next confusing distinction was between, say, a P855 and a P855. *What?* So far, we have discussed the P855 CPU, i.e. the processor at the core of a minicomputer. But in all their wisdom, the marketing department also named the complete minicomputers containing the CPU the P855 computer. Sometimes, the computer cabinet had an M (as in minicomputer) after its name, and we shall try to stick to that convention as far as we can. We will also sometimes collectively call all P8xx models the P800 series, which was what it became known as after a while. Thus, what about the *minicomputers* P850M, P855M and P860M? They were all available in both rack versions and desktop/floor versions.



P8xxM minicomputer series chassis, desktop/floor version (left) and rack version (right)

To get a feeling for their sizes, think of most configurations varying in height, from a washing machine to a full-size refrigerator. The marketing division, though, wanted the computers to look as small as possible in the marketing material. Thus, minimum configuration

sizes were specified as follows. The heights **j, k, l** are for the standalone version and **g, h, i** are for the rack version. They are the most interesting measurements when compared to marketing photos.

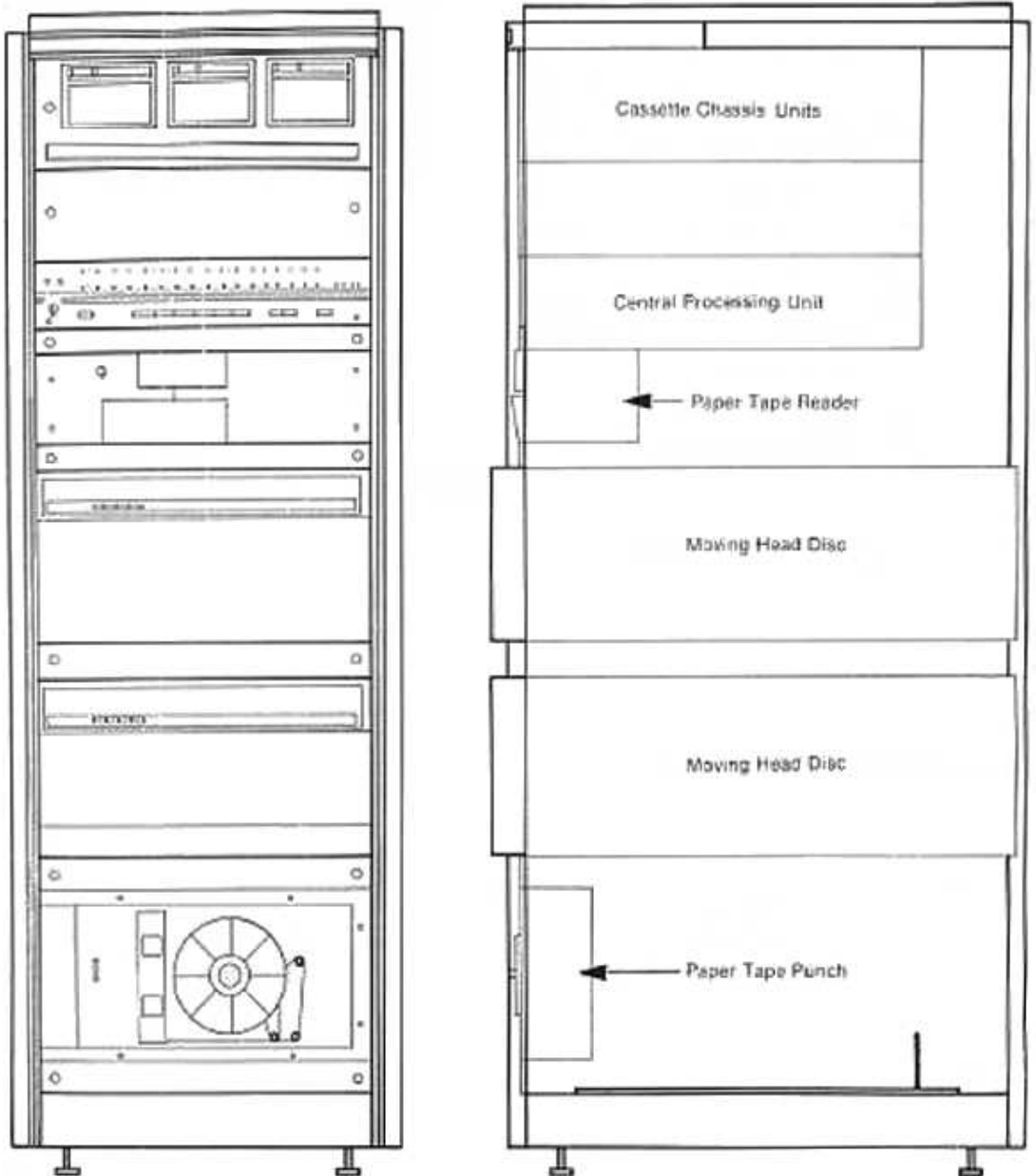
Stand alone	Rack mountable
h = 568 mm	a = 540 mm
i = 545 mm	b = 440 mm
j = 181 mm P850	c = 483 mm
k = 425 mm P855	g = 130 mm P850
l = 742 mm P860	h = 353 mm P855
m = 715 mm	i = 619 mm P860

Minimum sizes (especially heights) for P8xxM computers

The P855M, for example, has a minimum height of 425 mm in the desktop version. In the marketing pictures, however, it is no more than 300 mm, probably less. This was said to be because of trying to reinforce the “mini” message, but since very few knew the distinction between a large computer (mainframe) and a minicomputer, nobody really got the message.



Photo of a mock-up P855M from a sales brochure



A larger P855M or P860M system could easily reach from floor almost to ceiling

Philips Slates Worldwide Entry into OEM Minicomputer Market

APELDOORN, the Netherlands — Philips Data Systems, a subsidiary of N.V. Philips here, has entered the worldwide computer market with three 16-bit minicomputers for the OEM market, the P850, P855, and P860 systems.

Marketing emphasis, the firm said, will be on the U.S., with other operations in West Germany, France, the UK, Sweden, Japan, Finland, Denmark, Belgium, the Netherlands, Switzerland, and Italy.

The company, which is one of the largest electronic companies outside of the U.S., and ranks fourth on the *Fortune* International 200 list, will make its first big splash in the U.S. this week at the Fall Joint Computer Conference, where it will display the complete line.

The lowest unit in the line, the P850, comes with 500 words of 16-bit memory and features a 3.2 μ sec cycle time in the smallest configuration. It combines TTL technology and medium scale integration and the memory is expandable in 500 word increments, the firm said.

The P855 has a memory cycle time of 1.2 μ sec and a basic cycle time of 750 nsec, the firm said. Access time is 500 nsec, Philips added. Memories of 4K or 8K words plus four controllers are available in the smallest version of the 855, but memory can go up to 16K and the number of controllers can be increased to 11 in the larger version.

The top of the line, the P860, can handle from 4K to 32K words, expandable in increments of 4K of memory. It features a cycle time of 840 nsec for 16 bits and an access time of 300 nsec, Philips said.

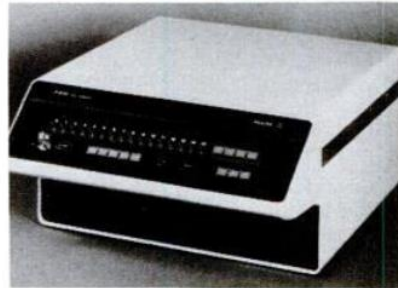
All models have 16 16-bit registers: 14 general purpose ones, an instruction counter, and a stack pointer. The P855

and P860 have a high-speed arithmetic option, which includes multiply, divide, double add and double subtract.

Software available includes 8K Fortran IV compilers, basic monitor, real-time monitor, one-pass assemblers, a mini assembler for the P850, linking loaders, edit routines, complete mathematical library, drivers for all peripheral equipment and a complete range of diagnostics and utility routines. All software packages are designed to be compatible with each member of the family, the firm said.

Peripheral equipment available ranges from teleprinters, cassette tapes and plotters, magnetic tapes and disks through data communication equipment and a line of controllers and interface capabilities to high-speed devices, all upward compatible, according to Philips.

The P850 minicomputer in a 500 word configuration will sell for approximately



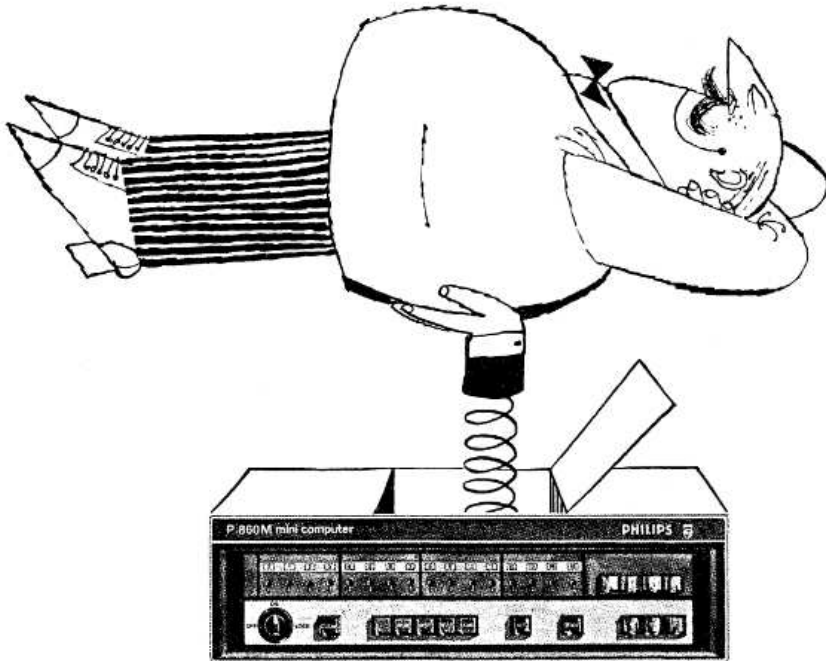
Philips P855 shown at joint

\$2,000, the P855 in a 4K word configuration for \$3,400, and the P860 in a 4K word 840 nsec configuration for approximately \$4,350, in OEM quantities.

Service will be available worldwide, the firm said.

Lots of press material was distributed at the launch in late 1971, which resulted in many newspaper stories being written. This one was from Computerworld in November 1971.

Philips resources: For OEM's who like someone to rely on!



If you are one of the many OEM's that accept out-of-the-ordinary problems, then you need to work with a computer company whose resources are out of the ordinary. And reliable. Philips mini computers offer an extraordinary and reliable combination of features:

- DMA PLUS genuine multiplex channel with 15 subchannels
- 63 interrupt lines on 48 levels
- 16 hardware processing registers
- Easy to interface
- Easy-to-learn assembler
- Complete software and peripherals
- World-wide service
- Installation included in price
- Low cost
- Philips quality

P850M 1/2k-4k with 3.2 μ sec cycle time
 P855M 4k-32k with 1.2 μ sec cycle time
 P860M 4k-32k with 840 nanoseconds cycle time
 PLUS up to 41% OEM discounts

NV Philips-Electrologica
 P.O. Box 245, Apeldoorn
 The Netherlands telex: 49142
 tel.: (0)5760 30123



PHILIPS

Philips had a rather peculiar communication style when trying to impress OEM customers

5.8 P800 Processor Generations

From their first launch in 1971, the P800 series processors were continually developed until 1982, sold until 1989 (actively until the end of 1986) and supported (repaired) until 1997. Here, we try first to describe the development by some capacity measures and then tell the story behind all model numbers. We start with a table of all CPUs in the series.

CPU	Syst.	Internal	PTS	Years	Memory	Tech	Board	Bus	MMU	FPU
P850	P850	Sagittaire		1971-73	4k	TTL	Belier	Sagit.		
P855	P855	P850 (!)		1971-76	64k	TTL	Belier	Sagit.		
P860	P860	P850 (!)		1971-73	64k	TTL	Belier	Sagit.		
P852	P852	CPA	6810-12	1974-79	64k	TTL	Belier	GP		
P856	P856	CPB		1975-83	64k	TTL	Belier	GP		
P857	P857	CPB	6813	1975-83	256k	TTL	Belier	GP	18-bit	FPU
P851	P851	SPALU*	6805	1976-85	64k	LSI	DE	GBUS		
P853	P853	CP1A		1980-89	256k	LSI	DE	UPL	18-bit	FPU
P857E	P854	CP7E	6925	1981-89	1M	LSI	DE	UPL	20-bit	FPU*
P857EB	P854	CP7EB	6927	1982-89	1M	LSI	DE	UPL	20-bit	FPU*
P857R	P858	CP7R	6814	1980-85	256k	LSI	Belier	GP	18-bit	FPU
P857RA	P859	CP7RA	6824	1981-85	1M	LSI	Belier	GP	20-bit	FPU
SPC-16	P870	FAST	6910-11	1979-89	64+64k	CMOS		UPL	SW/FW	

The columns in the table contain the following information:

- CPU** The external name of the processor itself
- Syst.** The external name of the P800 computer system containing the processor
- Internal** The internal CTI name of the processor (* P851 sometimes called SPALU/PLANET)
- PTS** The product name of PTS computers (see Chapter 8) using the processor
- Years** The years the processor was available
- Memory** Maximum size of the primary memory (in bytes)
- Tech** Circuit technology
- Board** Circuit board: Belier = Belier format, 19 x 19-inch board; DE = Double Eurocard board
- Bus** Bus generation: Sagittaire = Gen 1; GP (General Purpose) = Gen 2; GBUS = Gen 2.5, somewhat compatible with UPL; UPL (Universal Product Line) = Gen 3
- MMU** If MMU was supported: number of bits in the extended address range;
SW/FW = special non-compatible 16+16-bit memory management in FAST/SPC-16
- FPU** Whether floating point number operations were supported or not (* military trigonometry)

The instruction set of the original CPU (P855/860) was enlarged as new models came out. In the first generation, the 8-bit Sagittaire (renamed P850) had a rather limited set with no multiplication or division, no character handling, and no multiple load/store. Further, there were only a few shift operations and they could only shift one position. We also know the reason for this – it was only a proof of concept and had no microcontroller and, thus, no microcode that could loop. It should never have left the factory and was never meant to. As we saw earlier, following marketing department intervention, the P855 and P860 were the same machine, only with differing memory cycle times. They had instruction sets much more like the coming generations and even had some I/O instructions that were later removed. They also had the system/user mode distinction (unprotected/protected execution) to prevent inadvertent access to operating system memory.

In the second generation, the P857 was the flagship processor, incorporating as standard everything that was optional in the first generation; see the table. On top of that, it contained an MMU (memory management unit for extending the address range beyond 64 kbytes, up to 256 kbytes) and an FPU (floating point number unit) with corresponding extensions to the instruction set. The P856 was almost the same CPU as the P857 but without MMU or FPU and thus a slightly differing microcode. The P852 was the budget alternative, lacking multiplication and division, double-sized operations and multiple load/store. It had no system/user mode distinction and could be seen as a correctly implemented P850 in terms of the instruction set. The P856 was almost meaningless as a product from a market perspective, since the same functionality could be obtained by omitting the optional MMU and FPU boards of the P857. But the marketing department requested and got its three models again.



The P857 processor was the core of the P857M process control computer

As a later addition to the second generation, almost a generation 2.5, the P800 architecture was in 1975–1976 reimplemented as a set of five LSI chips called P851. The instruction set was a superset of P852 but a subset of P856 in that it lacked the system/user mode distinction but incorporated the rest of the P856 instruction set. Due to the much smaller chipset size, the P851 was delivered on Double Eurocard boards instead of the 19-inch Belier format boards used up until this point for the TTL CPUs.



The P851 chipset consisted of four 4-bit ALUs (SPALU) and a microcontroller (PLANET)

The third and last generation contained two development lines, both resting on the idea of reimplementing the P800 architecture using more modern (LSI) hardware of a generation later than the earlier-used TTL chips. The industry-standard AM2901 was selected for the core ALU functionality. This was the same choice as almost every leading manufacturer, such as Digital Equipment and Data General, made at the time.

8.5 CPU ARCHITECTURE CP7R

The CPU consists of three microprocessors linked together via internal busses, multiplexers, etc., and by the microprogram.

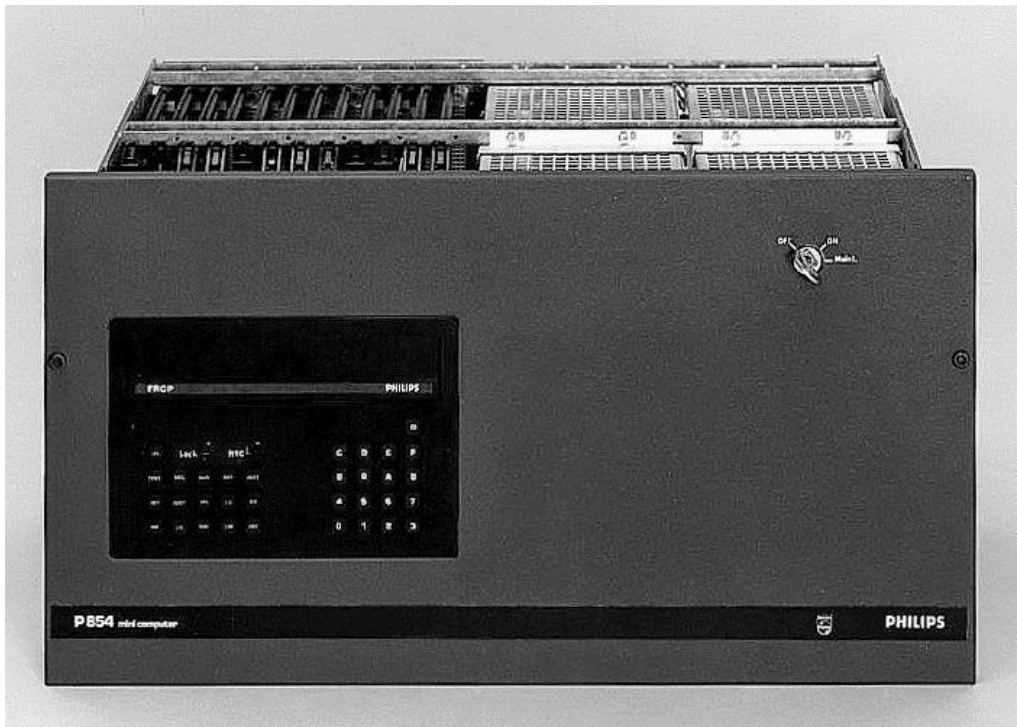
4 x MP 2901A: 4-bit microprocessor specially used for arithmetic operations. Contains SCRATCHPAD registers: A1-A15 (reg. 0 for internal use in the microprogram).
Q register: used for SHIFT instructions.

4 x MP 2932 : 4-bit microprocessor used for PROGRAM COUNTER, A0 register.

1 x MP 2910 : Used for microprogram control. Contains MICROPROGRAM COUNTER.
RTC COUNTER: for creating delay times, repeating certain actions a number of times.

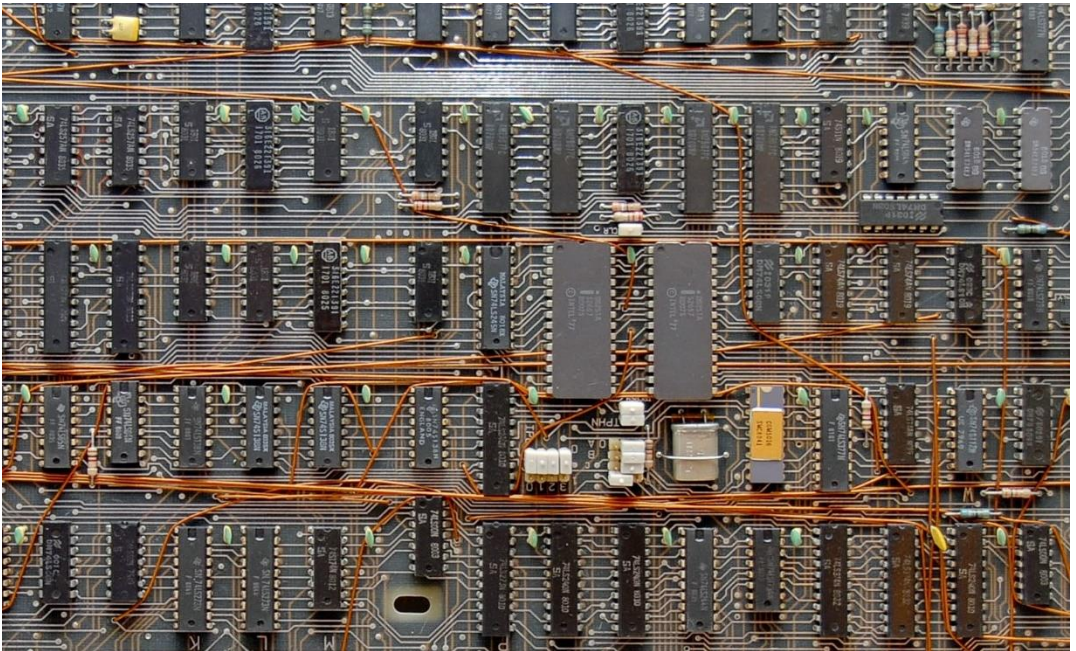
Specification of the chips used in the reimplementations of the P85x processors

The first major development line was the continuation from the P851 of the LSI reimplementations on the Double Eurocard format. This time, it was the P857 that was Eurocard-implemented since no 19-inch version was planned. For the P853, all instructions in the third-generation P800 architecture (except string instructions) were implemented. Thus, the P853 instruction set was a superset of P857. On the other hand, the newer P854 (internally called P857E with 'E' as in extended) had a proper superset even of the official architecture. In addition to all instructions found in the architecture, secret unpublished trigonometric functions were implemented only for military use (ballistic calculations). These instructions were, though, not hard to discover and map up since a simple program looping through the entire instruction set could easily record those unpublished instructions because they did not generate illegal instruction traps when they were supposed to. This was the largest the P800 instruction set ever became since the follow-up CP7EB (P857EB) CPU was the same as CP857E but with a cache memory added to speed it up. By deciding to keep the Double Eurocard format, that CPU had to be split into two boards, though.



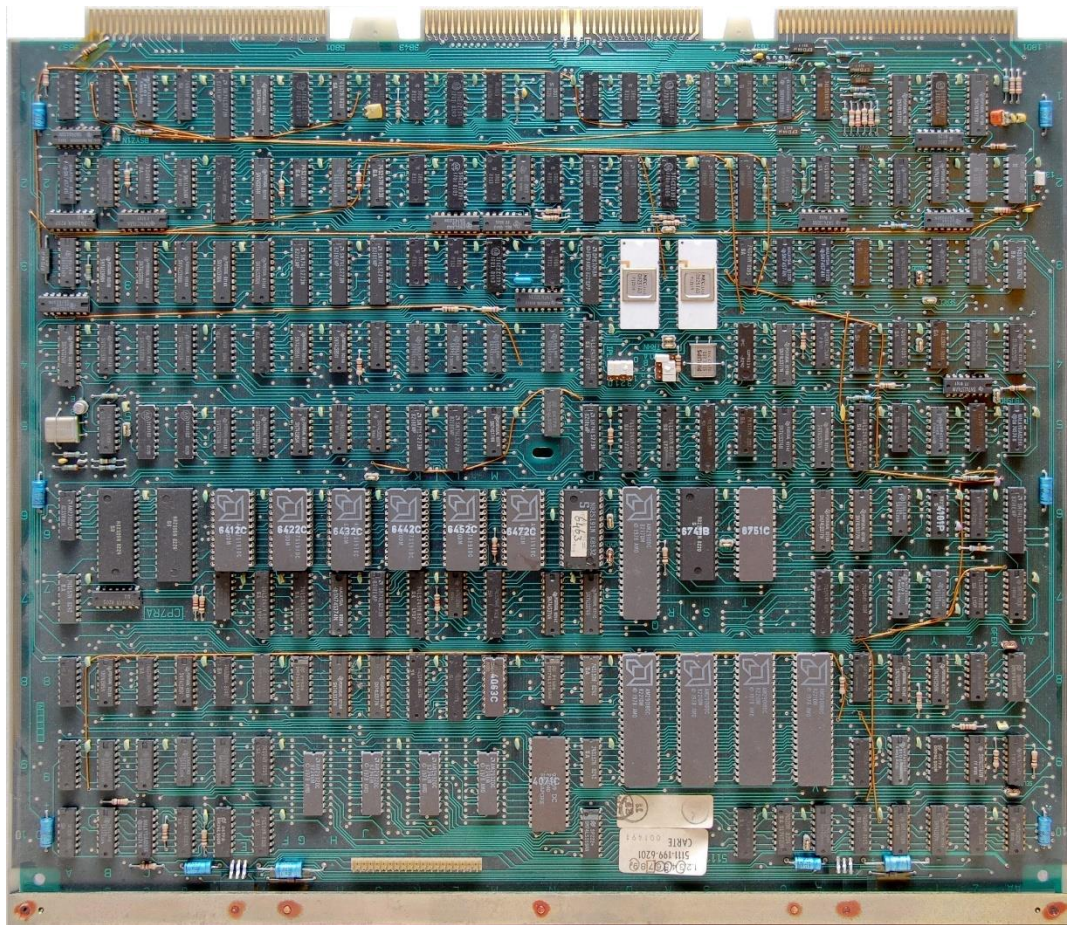
The P854 processor was the core of the P854M process control computer

The second development line was a straight continuation of the P857 on 19-inch boards. The two new CPUs were called P857R and P857RA, while the computer models were called P858 and P859, respectively. Contrary to some beliefs, there were never any processors called P858 or P859. To confuse things even more, the internal CPU names were CP7R and CP7RA. The new instructions in the third-generation P800 architecture, compared to the P857, dealt with bit testing, string handling, and explicit address loading. From the beginning, Apeldoorn did not want to develop the 19-inch Belier/GP bus CPUs further. But that would jeopardise the only really successful product line based on the processors, the banking systems; see Chapter 8. Thus, the CP7R (with 'R' as in redesign) was quickly conceived and developed. But it was of rather poor quality, with a large amount of patch wires to fix hardware bugs. In a CPU circuit board layout, a few patch wires can be used to simplify the design and bridge signals over large distances, but not that amount. The risks of failures at customer sites when handling fragile boards were magnitudes higher. This was not taken lightly by PEAB-T who had uptime, reliability and serviceability as strong selling points. Rather, it was a major point of distress for PEAB-T and its PTS product line.



Close-up of a part of a CP7R circuit board – all the orange wires are signal patches

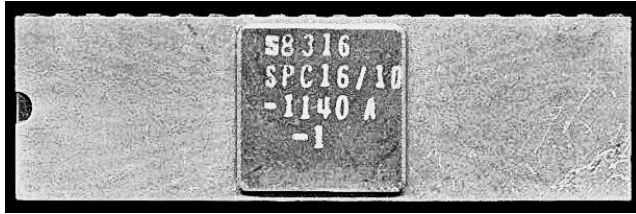
The subsequent redesign of the redesign was called CP7RA (P857RA, with ‘A’ as in advanced), and it was a better-designed and much less fragile processor.



CP7RA circuit board – significantly fewer patch wires

Finally, Philips already in 1979 implemented the P857 instruction set on a single chip called the FAST chip after the three Philips production facilities involved: Fontenay, Apeldoorn and Sunnyvale, ending in ‘T’ as in technology. Fontenay designed the architecture, Apeldoorn funded the project and Sunnyvale designed and manufactured the chip. Marketing, though, named it both Philips and Signetics SPC-16/10 instead, meaning 16-bit Single Processor Chip, albeit with the meaning of ‘10’ unknown. Due to it only having 40 pins and a

limited silicon area, it was accompanied by two support chips – the SPC-16/11 interrupt handler and the SPC-16/12 bus controller. Philips wanted to keep the P800 architecture intact even on a microprocessor, which meant that it had to support up to 63 interrupt levels. The main SPC-16/10 chip could only offer five pins for interrupts, which serviced four interrupt levels plus the auxiliary interrupt handler chip handling the rest.



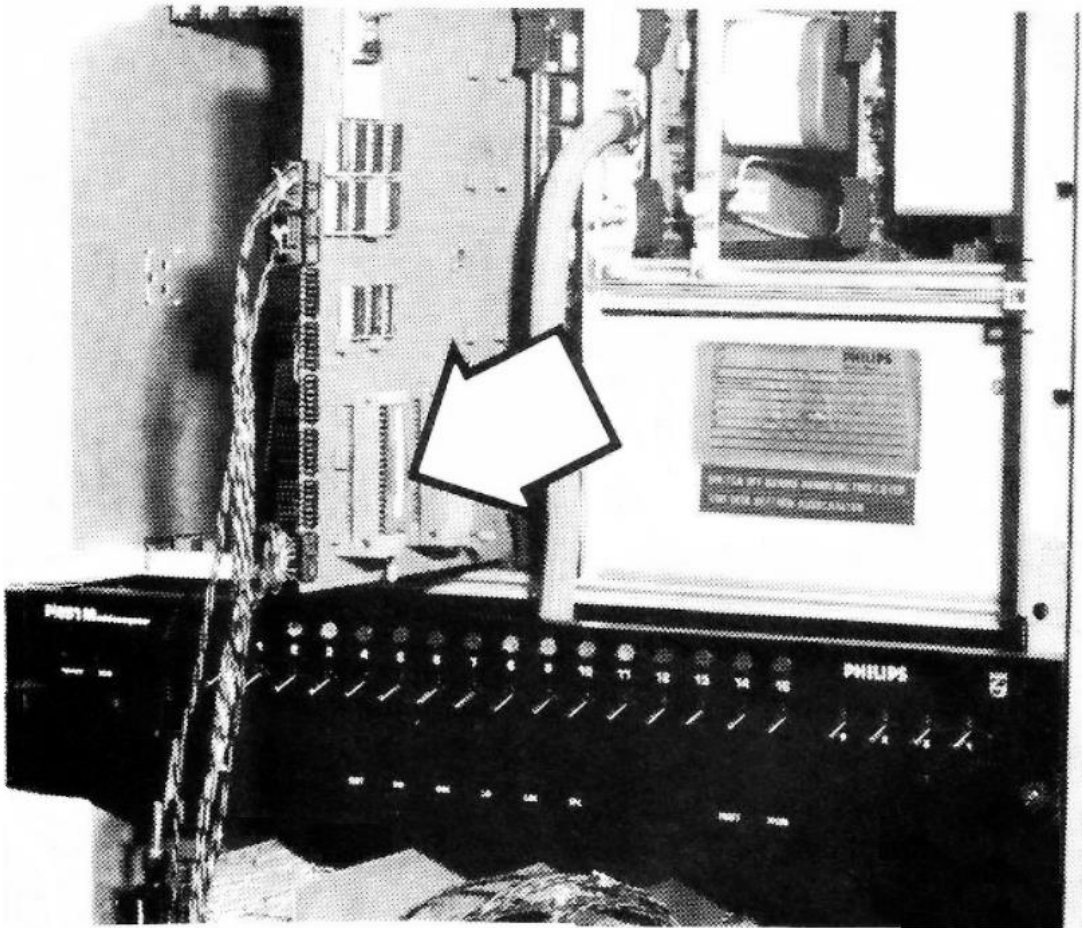
Signetics version of the SPC-16/10 main processor

The above processor is the Signetics version, not the Philips one (although identical in reality), which can be seen by the first character on the first row being a stylised **S**. Compare it with the **S** in the Signetics logo below. The number after the **S**, 8316, tells us that this particular sample was produced during week 16 of 1983, i.e. from Monday 18 to Friday 22 of April, in the semiconductor foundry in Sunnyvale, California.



The Signetics logotype (older S to the left)

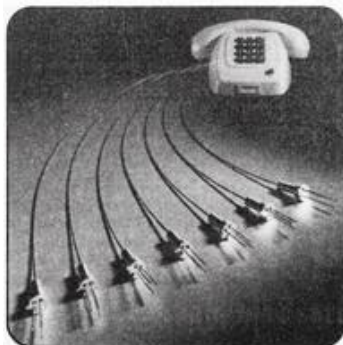
The SPC-16 chipset was so miniaturised that a circuit board containing the chips looked incomplete when tested in a P851M computer. The P851 chipset plus support chips took up an entire Double Eurocard board, and consequently the P851M chassis was built around that board size. When an experimental FAST (SPC-16) Double Eurocard board with the same functionality was inserted into a P851M, the circuit board looked almost empty. See the image on the next page where the arrow points to the SPC-16/10 processor, and behind the arrow is the SPC-16/11 interrupt handler. Most of the rest of the board was not used since the space was not needed. Such was the pace of the chip technology evolving at that time, enabling a large step in miniaturisation between 1976 (LSI SPALU/PLANET) and 1979 (CMOS FAST).



Two-thirds of the FAST chipset (SPC-16/10 and 11) mounted in a P851M computer

Philips was proud of its achievements, being able to keep pace with US minicomputer giants such as Digital Equipment and Data General, who during the same years also introduced multi-chip and single-chip microprocessor implementations of their main minicomputer CPU architectures. In profiling advertisements, it told the world of its accomplishments. On the next page, not only does the right part deal directly with the FAST chipset, but the middle part deals with the PM4000 hardware development and data logger workstation series powered by P851 LSI chipset CPUs. Philips was definitely on top of its game and on par with the world-leading 16-bit competitors of the day.

Getting down to the finer details of microelectronics

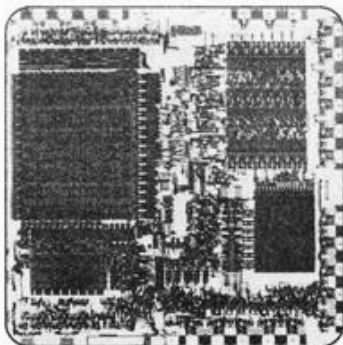


Long-haul optical transmission.

A 140Mbit/s optical transmission system utilizing the 5B/6B optical line code has been successfully completed in the Philips laboratories to demonstrate the feasibility of long-haul optical transmission. Intermediate repeaters, spaced 8km apart, were used to obtain a total length of 96km – the longest optical transmission run in the world! The system incorporates the remote alarm signalling, error monitoring and fault location facilities required for future operation. Presently, Philips is cooperating with the Dutch PTT in a 140Mbit/s field trial using 12-fibre armoured-type buried cable connected between two nodal exchanges.



Data logging. Thermal distortion due to solar heating of the 100 metre dish of the Max Planck radio telescope in West Germany, is measured by means of temperature sensing at strategic points about the structure to an accuracy of 0.1°C by Philips PT100 probes and recorded on a Philips PM4000 data logger. The logged data is used to indicate when error-free observations can be made without correction for thermal distortion.



16-bit microprocessor chip, based on the Philips P851 hardware/software interface, has been developed by Philips Data Systems; one of the few computer manufacturers to have done so. Containing 17,000 active transistors in a 36mm surface area, the new chip will be used as a central processor in future systems. In addition to increased processing speed, the fact that the software interface does not change with regard to existing software means that the costly, time-consuming task of rewriting software is eliminated.

Write for more information to: Philips Industries, C.M.S.D. Advertising, VOp, Room 22, Eindhoven, Holland.

Or telephone:

Athens 92 15 311, Brussels 21 91 800,
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ext. 471, Zurich 43 22 11.

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Philips working on advanced technology

A surprising result of the particular LSI process that Signetics in Sunnyvale, California, used was its radiation hardness. Much higher amounts of radiation could be exposed to the Signetics CPUs than any other ones in the market. As a consequence, they were used in satellite missions, and some chip samples are still orbiting Planet Earth to this day.

Abstract

The ever-increasing complexity of satellite on-board electronic systems cannot be realised without the application of microprocessors. In order to assess the pro's and con's of the high performance 16-bit microprocessors for space applications, a characterization programme was performed on two bipolar and three MOS 16-bit microprocessor families. The programme investigated electrical, functional and technological parameters. Special attention was paid to benchmark comparison and radiation hardness. One of the MOS microprocessors survived a total dose of 50k Rad (Si). With the obtained knowledge of the process and the processing flow, an attempt is made to understand this unexpected radiation hardness.

Table 1 lists the 16-bit microprocessors which were submitted to the characterization programme

Manufacturer	16-bit microprocessor	Technology
Ferranti	F 100-L	CDI (bipolar)
Texas Instruments	SBP 9900	I ² L (bipolar)
Intel	M 8086	H-MOS
Philips	SPC 16/10	N-MOS
Motorola	MC 68000	H-MOS

The present day complex architectural concepts of satellite on board electronic systems can only be implemented if powerful VLSI devices are applied. Amongst these devices microprocessors play an important role. They can handle large amounts of data and perform many control functions.

Since the behaviour of these chips in the hostile space environment was not known a characterization programme was started. This programme investigated the drift of electrical and functional parameters under environmental stress.

From a research paper measuring and analysing radiation hardness for space use. "One of the MOS microprocessors" is the Philips FAST (SPC-16/10) processor chip.

6. Product Lines

6.1 Philips Parts Bin

A computer is not only a central processor and its memory, memory management, input/output control and similar functions. To do some useful work, peripheral units are also required. Those were not conceived of or manufactured in Fontenay-aux-Roses, Rambouillet or even France. Philips had a very effective system of sharing peripherals among several of its product lines, sometimes internally nicknamed the “parts bin”. Some peripherals in the “bin” were of Philips origin, but most were purchased in large quantities from other OEM manufacturers and then adapted to each product line as required. For the P800 series, the following manufacturers produced the units on the list on the next page.

Peripheral Manufacturers

P841	Operator's Typewriter	- Teletype Corporation
P842	Matrix Printer	- Philips
P801/802	Paper Tape Readers	- Digitronics
P803	Paper Tape Punch	- Facit
P811/812	Line Printers	- Dataproducts
P806	Card Reader	- Documation
P831	Magnetic Tape Drive	- PERTEC
P833	Cassette Tape Drive	- Philips
P824	Moving Head Disc	- Diablo Systems
P825	Moving Head Disc	- Control Data
P818	Visual Display Unit	- Hazeltine

The list comes from a manual in the P800 product line, intended primarily for process control and similar applications. It is evident that only a few of the units are Philips-made. The rest come from large, well-known worldwide suppliers of such peripherals. Those were purchased centrally by Philips in large quantities and then made available internally to different divisions at a fraction of the time and cost it would have been for the divisions to acquire the peripherals themselves. For each product series, each peripheral unit received a unique name. Thus, the same hardware was known under many different names in the Philips assortment. Further, the interface between the general peripheral and each product line had to be specifically developed, most often by the receiving product line. The coordinating function, but not with exclusive rights to be the parts bin supplier, was the Industrial Group Peripheral Equipment in Rijswijk, just outside The Hague. See page 100 for an overview of the different Industrial Groups.

A comprehensive range of standard peripheral equipment is available for use within the system, and where it is required non-standard and customer-built devices may be connected either separately or in conjunction with standard equipment.

The standard peripheral devices include:

Input/Output Typewriters

- P841-101 Normal ASR typewriter including paper tape reader/punch, current loop interface.
- P841-105 The same as P841-101 but with V24 interface.
- P842-001 PER3100 Matrix printer with keyboard, V24 interface.
- P842-002 PER3100 Matrix printer with keyboard, current loop interface.

Punched Tape Equipment

- P801-001 Punched Tape Reader, 300 char per sec.
- P802-001 Punched Tape Reader, 600 char per sec.
- P803-001 Tape Punch, 75 char per sec.

Card Reader

- P806-102 Punched card reader, 300 cards per minute.

Line Printers

- P809-002 Matrix line printer, 200 lines per minute, 132 col.
- P811-001 Line printer, 245 lines per minute, 132 col.
- P812-001 Line printer, 670 lines per minute, 132 col.
- P842-003 PER3100 Matrix printer without keyboard, V24 interface.
- P842-004 PER3100 Matrix printer without keyboard, current loop interface.

Cassette Tape Equipment

- P833-001 Cassette tape drive, 7.5 ips, 800 bpi.

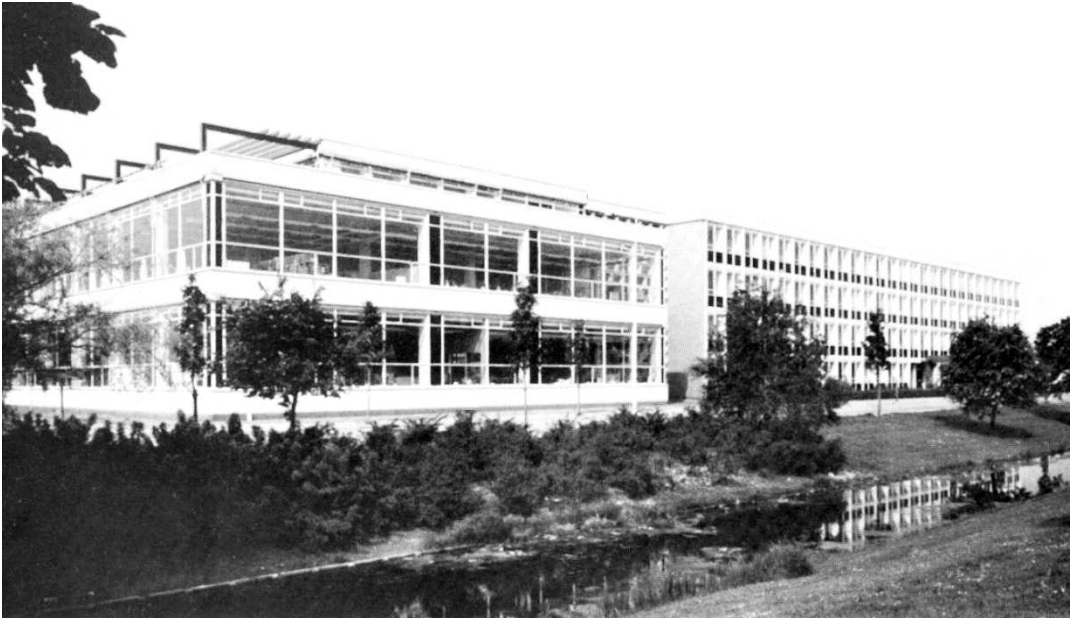
Magnetic Tape Equipment

- P831-002 Magnetic tape drive, 25 ips, 800 bpi, 9-track.
- P831-004 Magnetic tape drive, 45 ips, 800 bpi, 9-track.
- P831-006 Magnetic tape drive, 37.5 ips, 1600 bpi, 9-track.

Magnetic Disc Equipment

- P824-002 Moving head disc drive, 2.7M bytes.
- P825-007 Moving head disc drive, 40M bytes.

List of peripheral units available with the P855/860M minicomputer



Belgium:

S.A. Philips-Electrologica
1, Bd. Anspach
1000 — Brussels
Phone:02-191800

Denmark:

Philips-Electrologica A/S
Prags Boulevard 80
2300 — Copenhagen S
Phone:(0127) ASta 2222

France:

S.A. Philips Industrielle et Commerciale
Division Peripheriques
5, Square Max Hymans
75 — Paris 15e
Phone:01-7347759

Germany:

Philips-Electrologica G.m.b.H.
Mintropstrasse 14-18
4000 — Düsseldorf
Phone:0211-356021

Holland:

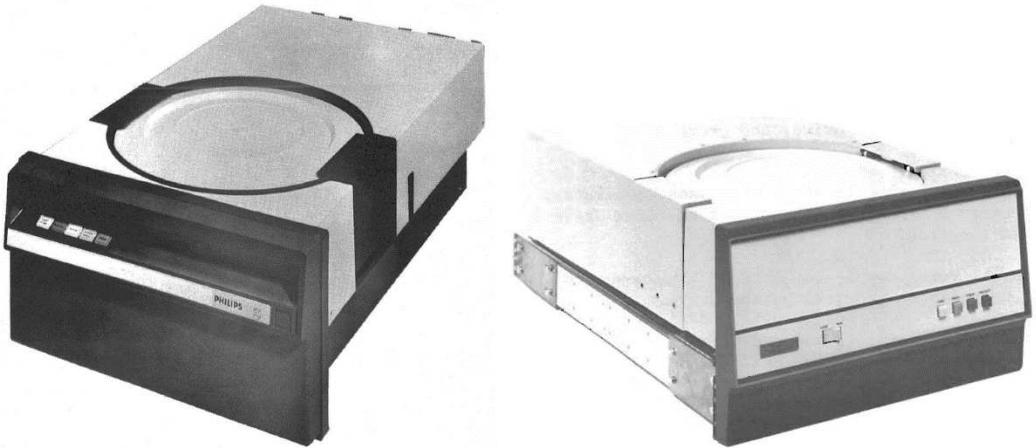
N.V. Philips-Electrologica
Industrial Group Peripheral Equipment
Bordewijkstraat 4
Rijswijk — (Z.H.)
Phone:070-906720

Sweden:

Philips Data Systems
Fack, 18303 Täby 3
Phone:08-7560020

The Industrial Group Peripheral Equipment building in Rijswijk outside The Hague

An example of a successful parts bin product is the Diablo 44 disk drive, which was used in almost all Philips minicomputer product lines during the 1970s. The front panel was custom-made for Philips in a generic format and then adapted to each product line's visual identity. Some internal Philips names for this disk drive were X1216, P824, P3434 and PTS 6876.



Philips generic front (left) and original Diablo front (right)

Diablo Redesigns 44

An addition to Diablo Systems, Inc. disk drives, the 44B has the same specifications as the firm's earlier 44, but has been radically redesigned, a spokesman said.

The unit has an internal power supply; the electronics that were on 15 boards now are on five; the firm has moved to "ramp heads" and the system weighs 25 lbs less than the 44, a spokesman said.

The system costs \$5,490 in single-unit quantities in comparison with \$6,065 for the 44.

Diva, Inc. announced two disk drive offerings. The 50, designed for Digital Equipment Corp. PDP-11 users, features hardware compatibility and software transparency with the 50, Diva said.

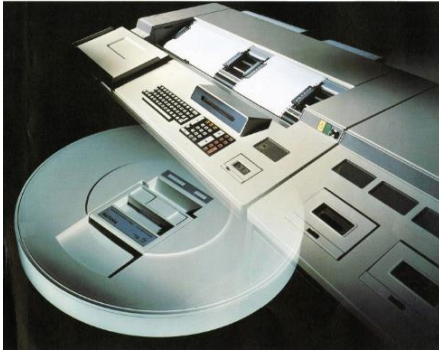
The unit can hold 27.7M bytes unformatted with a 6-msec track-to-track access time, Diva said. Burst transfer rate is 806 kbyte/sec, it said.

The unit costs \$13,600 with \$200 monthly maintenance charge; a dual-drive version costs \$19,600 with a \$280/mo maintenance charge.



The classic left-mounted Philips lamps (Diablo had them to the right)

P 410
Philips Computer



PHILIPS

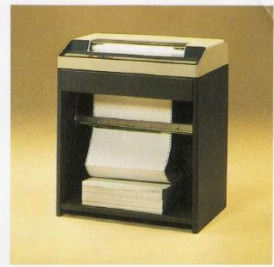


Stellen pro Sekunde bis zu 200 Zeilen pro Minute für Einzel- oder Endlosformulare;

durch die externen Datenerfassungsplätze P 171 und P 172, mit denen Daten auf genormten Magnetbandkassetten erfaßt werden können.

P 410 – die zukunftssichere Lösung

Die Installation eines Computer-Systems in der Größenordnung der P 410 ist eine Entscheidung auf lange



Direkte Datenverarbeitung/ Dialog-Verarbeitung

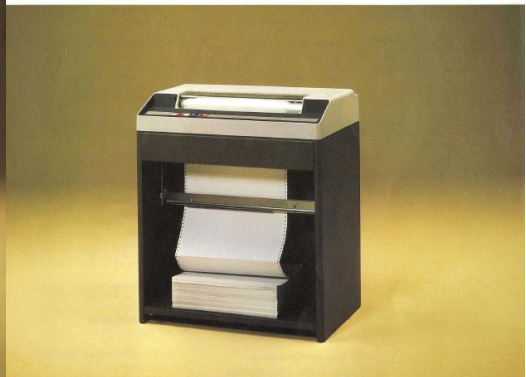
Alle über Tastatur eingegebenen Daten werden sofort verarbeitet. Auf Magnetplatten gespeicherte Datenbestände erlauben eine logische und sachliche Kontrolle dieser Eingaben. Die angesprochenen Dateien können dabei sofort auf den neuesten Stand gebracht werden. Dabei kann die Ausgabe wahlweise über Bildschirm oder Drucker erfolgen.

Magnetplatteneinheiten
P 3433/P 3434
Philips Computer



PHILIPS

Schnelldrucker
P3320
Philips Computer



PHILIPS

Example of a product line (P410; above) that uses generic peripherals (below); the P3433/P3434 originally from Diablo Systems and the P3320 from Dataproducts

PHILIPS DATA SYSTEMS



One of four great names contributing
to a whole new world of knowledge within
Philips Business Systems

The Data Systems arm of Philips Business Systems supplies and supports the most advanced range of office computers, small business systems, distributed data processing networks and financial terminals.

Now, together with its partners, Pyc TMC, Pyc Business Communications and Philips Business Equipment - Philips Data Systems contributes to a dynamic range of products spanning the whole spectrum of modern business systems.

PHILIPS

Simply years ahead



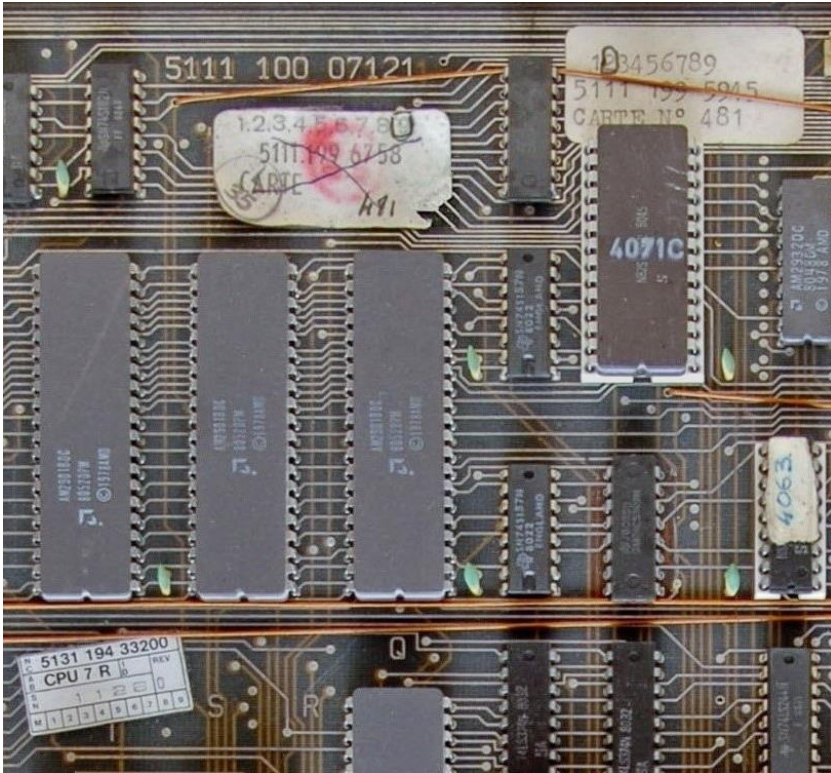
Example of several product lines that all use many parts bin components

6.2 12NC Part Numbers

Anyone who ever worked for a substantial period within Philips, be it with Data Systems or not, has probably been confused because of the universally applied 12-digit part numbers called 12NC that were assigned to every part, be it a computer or a nut, bolt, or resistor. Everything had a 12NC number. However, it did not stop there. Many items had 5–10 numbers depending on their use, and many had one number as a part and another when used to service equipment. One of the authors was working quite a lot with maintaining the inventory and parts computer system for the Philips Data Systems service centre in Sweden and had almost daily headaches when the 12NC mapping turned out to be wrong. What today might be nostalgic memories were something completely different back in the day. Even with that era’s rather limited computing power, why did Philips not provide a universal translation service for those pesky 12NC numbers? That would have saved much time and decreased the pain. For example, even simple parts like single resistors and capacitors had at least two 12NC numbers. As another example, the P857R/CP7R CPU board had four 12NC numbers, plus the last digit would vary depending on the version, so anyone dealing with that board had to keep track of at least ten 12NC numbers in total. If an 11-digit 12NC number was ever seen, it was because the 12th digit, the version number, should be read elsewhere. Such is the case in our example with the CPU board, where two of its four 12NC numbers only have 11 pre-printed digits and one final manually circled digit.

IDENTIFICATION			SERVICE			DESCRIPTION
CODE	NUMBER		CODE	NUMBER		
2122	011	00019	5322	103	10023	POTENTIOMETER 1K
2222	015	16109	4822	124	20697	CAP 10UF 25V FITCO
2222	015	17339	4822	124	20712	CAP 33UF 40V FITCO
2222	016	16101	4822	124	20701	CAP 100F 16V
2222	344	21334	4822	121	40257	CAP 0,33UF 100V 10%
2222	344	90002	5322	121	44328	CAP 0,1 UF 100V 10%
2222	629	01103	4822	122	30043	CAP 10NF 10%
2222	630	01102	4822	122	30027	CAP 1000PF 10% CER
2222	630	01221	4822	122	30094	CAP 220PF 10% CER
2222	630	01392	4822	122	30098	CAP 3900PF 100V 10%
2322	151	51009	5322	116	50452	RES 10E 0,125W 1%
2322	211	13102	4822	110	63107	RES 1K 0,25W 5%
2322	211	13104	4822	110	63161	RES 100E 0,25W 5%
2322	211	13121	4822	110	63083	RES 120E 0,25W 5%
2322	211	13123	4822	110	63136	RES 12K 0,25W 5%

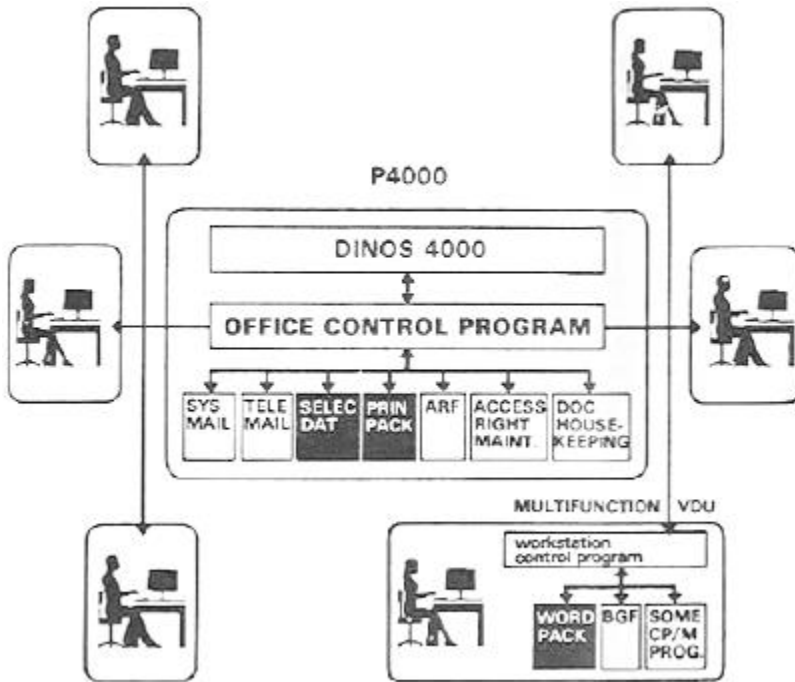
12NC numbers for resistors, capacitors and other small parts



Four I2NC numbers on a P857R/CP7R CPU board

6.3 P4000 Office Computers

This book is not about every Philips computer product line per se, this one not even belonging to PDS, but mentioning some of them here has to do with the clever and efficient handling of equipment reuse (the parts bin). The authors have no experience with the P4000 series but will highlight some apparent similarities with other PDS product lines. P4000 was a series of PTI office computers built in Germany for small and medium-sized enterprises for whom a minicomputer solution was sufficient for handling the company's administrative tasks. The series was created around the P800 family of processors embedded in separately designed cabinets, giving the product line its particular look and feel. Moreover, even though the P4000 series ran on familiar PDS hardware, it had its own PTI operating system (DINOS) specially designed for the office needs of small and medium-sized enterprises rather than real-time and interrupt-driven systems of process control or banking applications.

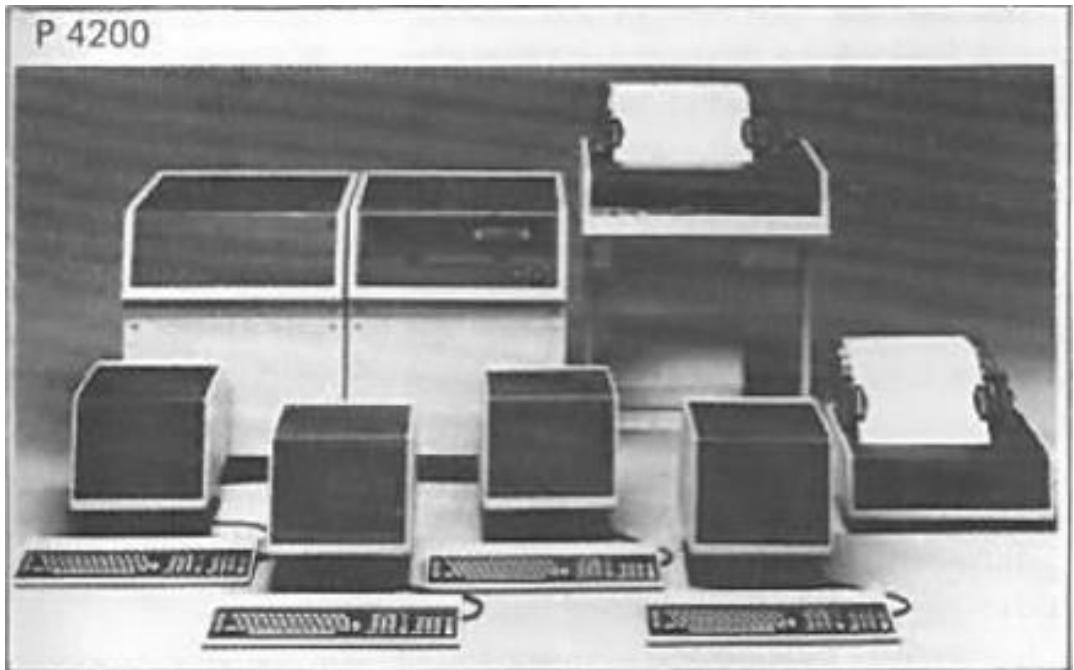


The DINOS 4000 operating system for the P4000 computers



P4000 office terminals that are in actual fact PTS 6000 equipment from the parts bin

The parts bin idea flows both ways, as we will see in the coming chapters. The P4200 was a relatively early product in the P4000 line-up and consisted of – as can be seen in the image – many components borrowed via the parts bin. When the PDS in Apeldoorn discontinued the P852 budget CPU from CTI, Philips banking/retail systems business (PTS in Chapter 8) was left without a less expensive alternative for smaller branch offices of banks and retailers. Then, as we will see in that chapter, the P4200 cabinet with the P851 CPU was borrowed via the parts bin and decorated with an orange strip to become a banking/retail computer.



P4200 computer and peripherals

6.4 P7000 Data Entry Systems

One component of the P1000 series of mainframes that Philips offered among their first products from the PCI – later Philips-Electrologica – mainframe division was the X1100 data entry console. Using that, data operators could enter data onto paper tape for later processing by a computer system, be it a Philips P1000 or any other. To Philips' surprise, the X1100 was more popular than the P1000 computers. Apparently, there was a market for data entry products. Soon, Philips made this a separate market segment by acquiring the

rights to use the Maestro software from its German developers, Softlab GmbH in Munich. Maestro was, to begin with, a key-to-disk data entry system but evolved over time, becoming more of an integrated software development environment. The only problem was that Maestro had been developed on a rather odd 24-bit computer system from Four-Phase, and it turned out to be complicated to convert to a standard 16-bit processor. The decision was then made to purchase Four-Phase IV/70 computers and rebrand them as Philips P7000, thus starting a new product line. All other units of that product line, such as peripherals, came straight from the parts bin. Philips keyboards and screens, Control Data (CDC) hard disks and Pertec magnetic tape stations were all fetched directly from the bin, thereby incurring minimal investment and development costs for the new product line.



The X1100 data entry system from 1970



The P7000 system, with all its peripherals emanating from the parts bin



A Four-Phase Systems 24-bit CPU in the IV series

6.5 Summary of Product Lines

A little has been written academically about Philips’ computer endeavours, but not everything is either complete or accurate. In the 2004 book *Information Technology Policy: An International History*, edited by Richard Coopey, there is a chapter by van den Ende et al. on Philips’ IT product strategy which goes through Philips’ different computer product lines and their impacts from 1967 to 1991, both in the markets and in terms of profitability. In their Table 8.6, see below, they specify “all” product lines together with the extent of the Dutch government interventions and estimates of their degrees of success. Besides the wrong product year ranges (corrected in the table below), they fail to include the most successful product line of all – PTS 6000, which we will discuss in detail in Chapter 8. For some reason, these authors seem only to have considered Dutch and German product lines.

	Product line/ research project	Government influence	Degree of success
1967–1975	P1000 series— mainframe computers	After introduction, procurement, extending life cycle of product line	Negative
1967–1991	P350/P4000/P5000/ P9000/P7000— office minicomputers	Marginal, procurement	Positive
1971–1987	P800—process control minicomputers	None	Neutral
1983–1990	YES/P3000—personal computers	None	Negative
1984–1989	MEGA-chip project	Large, considerable financial support	Negative

Table 8.6 from the book

This is despite those authors seemingly knowing about Philips Sweden’s acquisition of Arengo (they got the year wrong; it was 1969 – not 1970). They mention the acquisition of CTI but think that CTI processors were only utilised in the P800 process control product line, missing not only the PTS 6000 banking systems but also the P4000 office computers. In addition, almost all dates are inaccurate. For example, the computer division was not renamed Philips Data Systems until after the Unidata debacle in 1975–1976. Before that, Philips Data Systems was the product line’s name but not the company division’s. Only the

Swedish sales office had already in 1970 adopted that name when they moved from the Philips head office to a separate building north of Stockholm. They were the first to coin that name, which subsequently became adopted worldwide. Further, claiming the P9000 initiative to be a success when it ruined three product lines is somewhat surprising. Such misinformation makes it considerably more challenging to acquire knowledge about, and walk in the footsteps of, the Philips computer product ranges for those who were not a part of the endeavours back when they occurred.

1. As a consequence, losses were made and Philips decided to close down the Electrologica Company in 1968. Upon the acquisition of Electrologica PCI was renamed Philips-Electrologica. In 1968, Philips changed the name of the computer division to Philips Data Systems.

2. The French company, Centre Technique et Industrielle (CTI). Philips used this company to produce minicomputers for process control purposes. First Philips marketed a series of minicomputers from Honeywell under the Philips label, later the P800 series of computers was developed and manufactured by CTI. From this latter computer over the years about 10,000 copies were sold. Nevertheless these activities did not become profitable.²⁹

3. In 1969 Philips acquired the German Siemag, which produced the P250 desk calculator (stopped before 1970) and the profitable P350 office computers.³⁰

4. In 1970 the Swedish company Arenco was acquired to produce bank terminals.³¹

In the 1980s Philips continued its computer activities. The P800 remained in use, particularly in the industrial systems of Philips itself and in bank terminals of the former Arenco.³⁵ The successor of the P350 became the P4000 and the P9000. Philips sold the P7000, a product of Motorola, particularly for data entry systems. Philips also developed personal computers (YES, again semi-IBM-compatible and the P3000, at first non-IBM compatible, later IBM-compatible) but with no commercial success. Sometimes governments of other countries supported Philips, for instance the Canadian subsidiary Micom that produced the P3000 personal computers was funded by the Canadian government, which also applied a preferential procurement policy for these computers. In spite of all these efforts Philips computer activities did not become profitable and in 1991 Philips sold them to DEC. In total, losses from the company's computer activities over the years are estimated to amount to 4.5–6 billion guilders.

From pages 198 and 199 of the aforementioned book

However, at the same time, on page 199 of the book, they seem to know that the P800 processors are equipping the PTS 6000 computers. Still, they did not include PTS 6000 in their table. This is both confusing and misleading. We hope that this book can rectify some of the misunderstandings.

IG Computer Systems - Apeldoorn

Philips-Electrologica A/S
Prags Boulevard 80,
2300 Kebenhavn S, **Denmark**.

Philips
Division Ordinateurs
5, Square Max Hymans,
75, Paris 15e, **France**.

Philips Electrologica GmbH
Geschäftsbereich Computer-Systeme
Liesegangstrasse 15,
4 Düsseldorf, Western **Germany**.

Philips S.P.A.
Divisione Sistemi
Viale Fulvio Testi, 327
20162 Milano, **Italy**.

Philips-Electrologica Nederland NV
De Horst 4 (Postbus 2408),
Den Haag — Mariahoeve
The Netherlands.

Svenska AB Philips
Data Systems
Fack
183 03 Taby 3, **Sweden**.

Philips AG
Edenstrasse 20,
8027 Zürich, **Switzerland**.

NV Philips-Electrologica
Anspachlaan 1,
1000 Brussel, **Belgium**.

Addresses to Philips sales offices in Europe in 1971.

Only Sweden had yet used the name “Data Systems”; see also page 143.

We end this chapter with a note on Philips computer product lines in general. Some readers might miss one or more product lines in the book. This is probably because the book covers Philips Data Systems (PDS), but Philips had one more computer division, Philips Telecommunications and Information Systems (PTI). PTI, in turn, consisted of two main units: telecommunication systems and information systems. The latter emanated from the small office computer manufacturer Siemag in Eiserfeld in West Germany which Philips had acquired in 1969 (number 3 in the acquisition list on the previous page). Since this book deals with PDS and not PTI, we do not discuss PTI computer systems. We only mention them in passing in a few places: the P430 computer which was, under its Unidata name 7-720, the only Unidata computer that was ever sold in mentionable quantities in an open market; the parts bin examples on pages 145–146; and the P330, P430 and P5003 models that were fun props in the James Bond film in Appendix B. To a customer, not much signalled whether a

computer came from PDS or PTI, all had Philips logos. For completeness, we include a list of the PTI computers. Each product line (number series) consisted of several models.

Number series	Product line contents
P250	Desk calculators
P350, P300, P380	Small office computers (P350 was the oldest)
P400, P4000 ¹⁹	Small business systems
P2000	Portable and home computers
P3000 – P3400, :YES ²⁰	Personal computers (where P3x00 contained Intel 80x86)
P3500, P3800	Personal computer servers
P5000	Word processors (by Micom, Canada; P3000 in the US)

The PDS and PTI product divisions existed in parallel until Philips embraced the then much-touted idea of a convergence between computers and telecom devices; see Section 9.3 for a discussion and an organisational chart of the new TDS division, which in 1985 became the result of a merger between PTI and PDS. Plans had been on the way since 1983 and did have a very unlucky influence on the PDS product lines. PTI strongly influenced the future planning of computer products, and they were only interested in general-purpose computers. Thus, the joint 32-bit Octopus project that started in 1983 was supposed to be the successor



P252 desk calculator

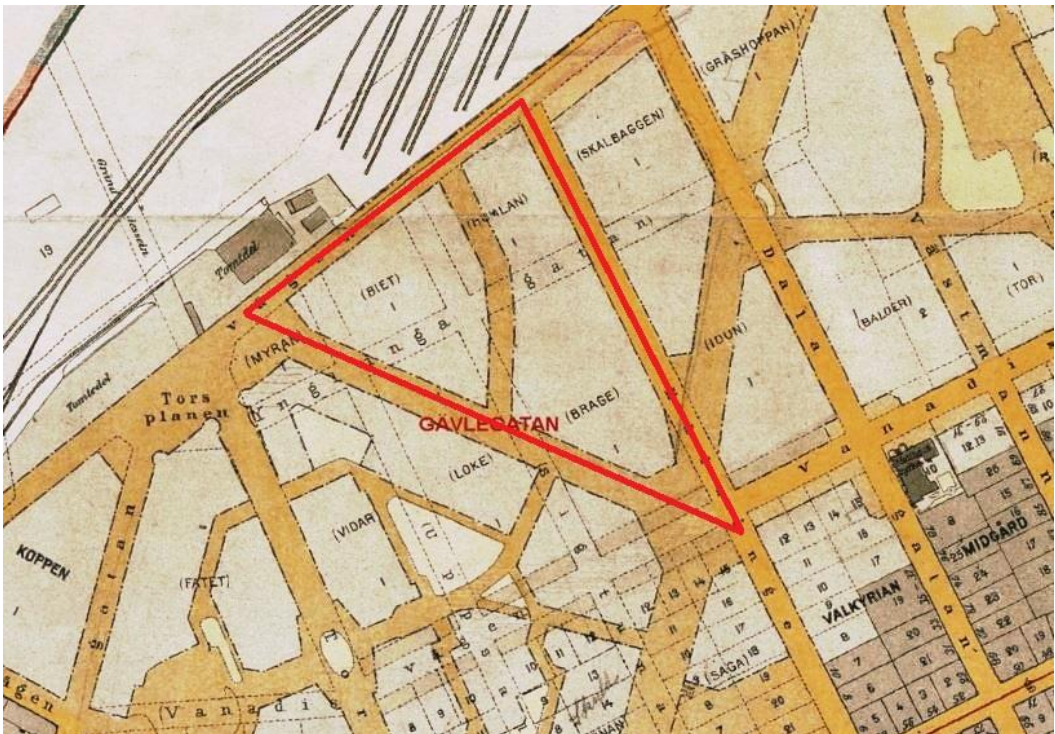
to the 16-bit PTI systems as well as the PDS systems. PTI never understood the requirements of either real-time process control systems (P800) or real-time front-office banking/retail systems (PTS 6000), which led to such properties regrettably being deprioritised in the joint project. Thus, the TDS reorganisation was seen as one of the factors that led to the demise of the PTS product line, which is why it has its own section in Chapter 9.

¹⁹ But why is the P4000 series mentioned in the book if it was a PTI product line? We regard it as a joint PDS/PTI effort for two reasons: it used PDS P800 processors and the P4200 was also sold as PTS 6805.

²⁰ The ':' as the prefix in the product line name ':YES' is not a misprint, it indeed had that strange name.

7. Philips Sweden

In the late 19th century, Stockholm as a city was proliferating. The city planners wanted all blocks to be rectangular and all streets to cross perpendicularly in a grid pattern. The plan for the northwest of the city district Norrmalm, an unbuilt territory at that time, was to build such rectangular city blocks. Those can be seen in lighter grey on the map below. Not even Sankt Eriksgatan, a street that crossed the planning area and emanated all the way from the Kungsholmen island (where Arenco, Formator and Facit resided) in a Broadway-like style, would be spared. The old city planners had a New York-influenced city view but wanted to go even further by not allowing one non-perpendicular street. But by the early 20th century, nothing had yet been built in that area, and European cities like Paris more influenced the newly appointed younger city planners. They suggested a pattern of streets that more closely followed the landscape and its undulations. In addition, cars and electric trams were being introduced, thus undulating streets were not nearly as much of a problem as before.

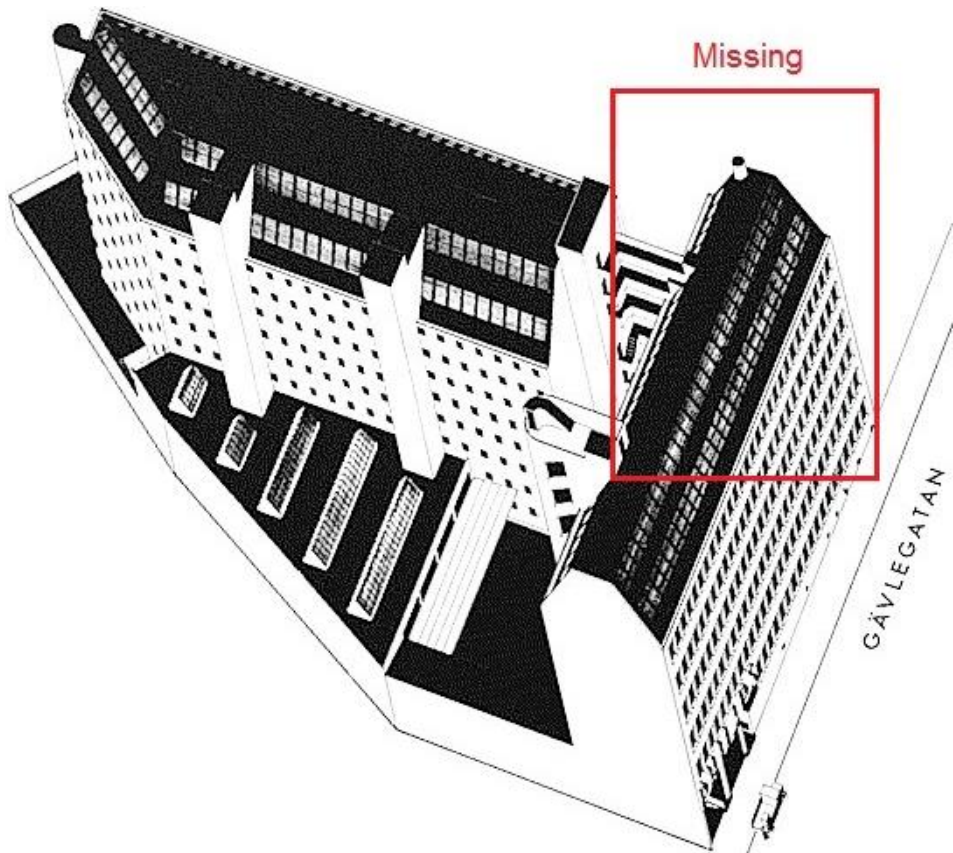


Old city plan (in light grey/brown) with new plan superimposed (in orange)

That meant height differences did not have to be decreased as much as before. The new city plan kept Sankt Eriksgatan, and the new blocks to the northwest had several non-rectangular shapes. One particular block, marked in red on the map, became triangular-shaped.

7.1 First Head Office

In 1919, Philips established its business in Sweden with an import agency for light bulbs. In 1923, Svenska Philips (Philips Sweden) was formed with 40 employees. Philips Neon was founded in 1925 as a subsidiary of Svenska Philips. It soon became a major supplier in the neon signs market. Philips planned to build an office building and a warehouse within the red triangle in 1929–1931, with the offices facing Gävlegatan.



The original plan for the Philips office (right) and warehouse (left) buildings

Due to an economic downturn and the uncertain political situation in Europe mid-war, only half of the office building was built (only the basement was built for the other half). The original plan was to connect the offices with the warehouse with a bridge construction so that all employees could easily reach the entire building complex walking indoors. For some unknown reason, the office half facing *away* from the warehouse was built instead of the other way around. Thus, they became two standalone buildings instead of two connected ones. In the picture, it can be seen where the missing connections should have been built. Stairs and door openings-to-be can be seen as slightly darker spots on the right building. It was not until 1950 that the gaping hole was filled with the other half of the planned office building. Thus, for almost 20 years, the employees walking between the office and the warehouse had to cross outdoors on top of the basement between the two separate buildings. In addition, the 1950 part of the building complex was designed in a slightly different style.



The completed Philips office (left) and warehouse (right) buildings in 1931

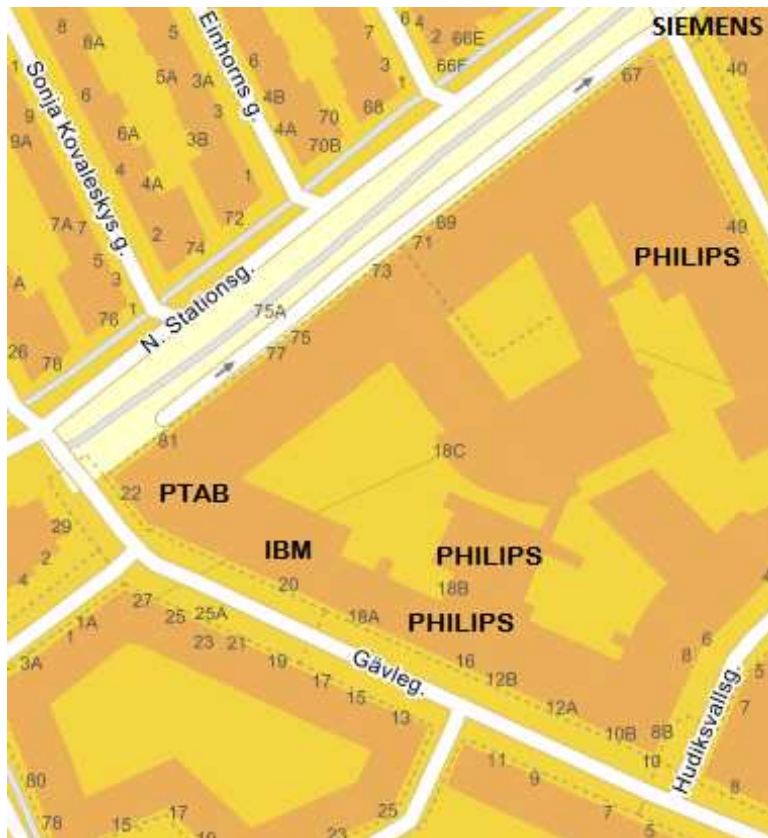


Philips office building – street view

The triangular block (later named Blästern) continued to prosper. In 1932, Philips together with Osram started the Ophinab lightbulb factory on Gävlegatan. During the Second World War, Philips received orders for military equipment and rented more office and factory spaces in the same block, in the corner of Gävlegatan and Norra Stationsgatan (marked PTAB in the map below), to fulfil these orders. In 1953, IBM moved to the closest neighbouring office building and had an IBM 650 computer on the top floor beneath the tiny tin roof (which made summer usage unstable due to a lack of cooling). Also in 1953, Siemens acquired a lot adjacent to the block for its new office and warehouse. They did not immediately build their premises, but this area was an electronics hotspot in Stockholm for a while.

When the war ended, Philips, like many others, wanted to make use of what they learned during that period. In addition, the Swedish government signalled that they would continue to spend a great deal of money on defence equipment. Thus, the Philips Telelab division was started in rented offices on Ynglingagatan, less than a kilometre from the Gävlegatan head office. The business grew rapidly and subsequently rented more office and factory spaces around Gävlegatan, the largest one being, apart from the earlier Gävlegatan–Norra

Stationsgatan building, Norrtullspalatset on Norra Stationsgatan, close to the first Telelab premises. After a few years, the Telelab business was organisationally transferred from Philips Sweden to independent companies, Jakobsbergs Elektrotekniska Fabriker (JEFA) in 1951 for manufacturing proximity fuses²¹ (in collaboration with Bofors) and Philips Teleindustri (PTAB) in 1953 for the manufacturing of communication radio, radar and artillery observing equipment. PTAB was incorporated in conjunction with its 1954 move from Gävlegatan to the Stora Essingen island in Stockholm, where it resided until 1968.



Placement of Philips (including PTAB), IBM and Siemens

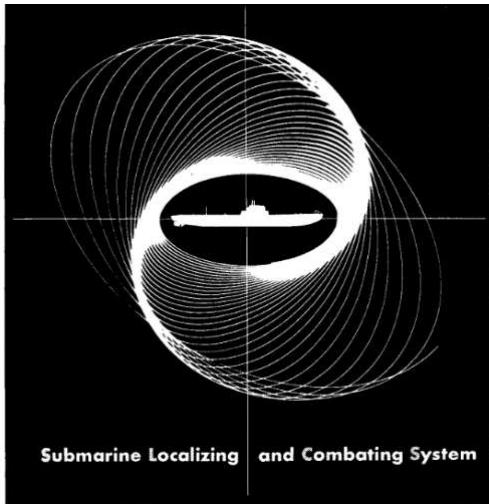
²¹ A proximity fuse was a trigger that detonated an explosive device automatically when it reached within a certain distance of its target. They were primarily intended for, at the time, elusive military targets such as aeroplanes and missiles.



PTAB's corner building (Siemens in the background, upper left)

7.2 Philips Teleindustri

From having the Swedish Army and Navy as primary customers, the PTAB export soon became more significant than the domestic orders. The Swedish military was willing to provide references when bids for international orders were made. This was the desire of the Swedish government, who realised that a small country like Sweden could only develop and manufacture world-class defence equipment if the sales volumes were substantially higher than the domestic military's needs. The greatest "problem" for PTAB was its rapid expansion. The neighbouring (now Alcadon) building on Stora Essingen was acquired and connected to the main building via indoor bridges. The next acquisition became the Esso building behind PTAB, and a pavilion was also built to house design engineers. After that, there was no more expansion space to acquire and no other buildings to rent in the vicinity. Only ten years after its move to Stora Essingen, PTAB had once more outgrown its premises – the only remedy available was to move again.



SLACS

– ett modernt elektroniskt elledningssystem för lokalisering och bekämpning av u-båtar.

SLACS är ett av de resultat som framkommit under Svenska AB Philips mångåriga samarbete med det svenska försvaret och utländska lärotag.

Många utrustningar, som Svenska AB Philips levererat till vårt försvar, har genom sin höga tekniska standard väckt stort intresse utomlands.

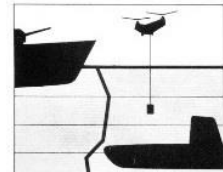
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Philips elektronik ger ökade försvarsresurser



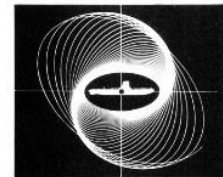
Navigation



Databehandling



Kommunikation



Eldledning



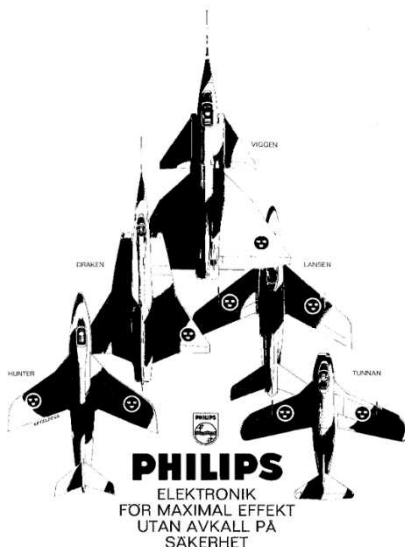
Bevakning



Precisionstillverkning

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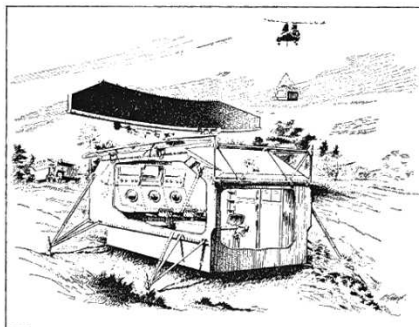


Elektronikens stora betydelse för flygtrafik och luftförvar är drivkraften i den internationella Philipskoncernens elektronikforskning och utvecklingsarbete inom

KOMMUNIKATION DATABEHANDLING RADAR NAVIGATION

Philips Teleindustri AB är inriktat på att uppfylla svenska flygväpnets materielkrav. Navigerings- och landningsutrustningar till flygplanstyper från J29 till SK 60 och AJ37 har utvecklats och konstruerats vid Philips Teleindustri AB i intimt samarbete med Kungl. Flygförvaltningen.

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Transportabel elledningcentral för kustartilleri

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Philips Teleindustri AB producerar:

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- Eldledningssystem
- Kommunikationsmateriel
- Radionavigeringsutrustningar för armé-, marin- och flygbruk såväl i Sverige som i utlandet.
- Några aktuella leveranser:
 - Hoppfrekvensradar för spänning och följning av luft- och sjö mål
 - Vapenkontrollsystem för torpedbåtar typ SP/CA, ubåtar typ S/OORMEN,

fregatter typ VISBY samt för fasta och rörliga kustartilleribatterier

- Navigeringsutrustningar för DRAKEN och SK60

Bakom Philips Teleindustri AB finns den internationella Philips-koncernens samlade resurser för forskning och avancerat utvecklingsarbete.

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PTAB office and factory on the Stora Essingen island in the middle of Stockholm

7.3 Second Head Office

Philips Sweden grew rapidly in many markets, consumer and non-consumer related. Even with the completion of the office building in 1950, and the move of PTAB in 1954, it was still starting to become overcrowded. Philips did not want to make the same mistakes as with Gävlegatan. This time, the building should not have to fit into a predetermined city plan with a limited number of floors. Philips instead aimed at a higher, more space-efficient office building. However, not all was bad at Gävlegatan. Having the warehouse interconnected with the offices had been a good idea, and it should be repeated. Further, repair centres should be housed near the offices to gain a better understanding of the faults and weaknesses of the products manufactured and sold. Plans for a new building were made and a lot was acquired close to Värtahamnen, which was considered to be on the outskirts of the city centre at that time. Construction of the new building called Philipshuset²² (“the Philips building”) commenced in 1962, and it was ready to occupy in mid-1964. It consisted of a 16-storey office section and a five-storey warehouse section.



Construction of the Philipshuset building in 1963

²² Cf. Svenska Philips-huset, which confusingly was the old building on Gävlegatan.



Philipshuset close to completion in 1964

The office building received several prizes for design, quick time to completion and modern and efficient use of resources. It had a modular design that allowed for rooms to be resized according to needs. From an onlooker's view, there was only one peculiarity. The building's name was misspelled. In Swedish, there is no space between a company name and what is being named. Thus, Philipshuset is one word. Despite this, the sign over the entrance to Philipshuset read "PHILIPS HUSET". Many people, including one of the authors, pointed out the misspelling, but Philips never bothered to move the "HUSET" part closer to the beginning. Philips itself spelled its building "Philipshuset" in text material, like everyone else, but saw nothing illogical in keeping the giant space when displayed in all caps over the building's main entrance.



The completed and inhabited Philipshuset in 1965



The “mis spelling” of the building

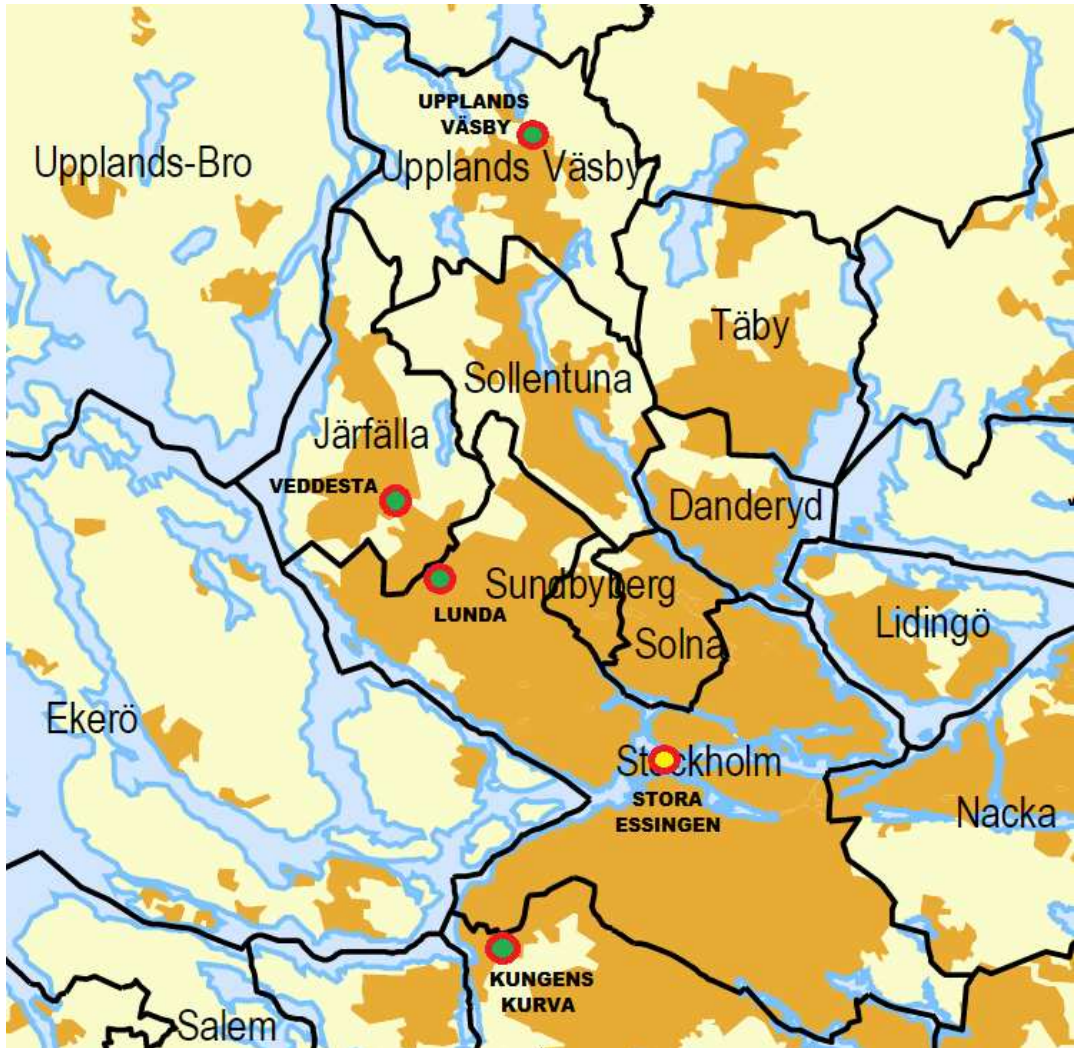
7.4 Philips Electronics Centre

When Philips Teleindustri (PTAB) moved to Stora Essingen in 1954, there was hope of acquiring nearby buildings or unbuilt lots to build on in order to concentrate all non-consumer electronics in one place, but this never came true to any large extent. The office space that could be acquired was not enough for the rapid expansion of PTAB. Philips Industrialelektronik (PIE, Industrial Electronics), which worked with power supplies, measuring equipment and similar, had already in 1962 moved from Gävlegatan out from Stockholm to Svet-sarvägen in nearby Solna municipality. There was no hope of them joining PTAB on Stora Essingen either. Thus, when the new CEO of Philips Sweden took office in 1961, plans were already being made for a “Philips Electronics Centre” containing all professional and industrial electronics. This time, a large piece of land should be acquired so as not to hit expansion limits in the form of other buildings, roads, etc., once again. Another requirement was cost efficiency; a third was that the lot must be bought, not leased. The latter was a principal requirement from Dutch Philips.

These three requirements led to a search quite far from Stockholm City. Four sites made it to the final round: Upplands Väsby, Järfälla (Veddesta), Lunda (all three north of Stockholm) and Kungens kurva²³ in the south. The problem with the Kungens kurva alternative was that the municipality was too occupied with establishing the first IKEA store in Stockholm and did not show much interest in another large establishment. Lunda was excluded when Stockholm was only open to a lease contract. Thus, when it was time to make a decision, the worldwide CEO of Philips only inspected two alternative sites on his visit. The

²³ Kungens kurva means the King’s Bend, named after H.M. King Gustaf V’s car crash there in 1946.

Swedish favourite was Veddesta, so that was visited first. Later the same afternoon, near sunset, Upplands Väsby was visited. “Unfortunately”, heavy rain started to fall and the primitive roads in the industrial park-to-be soon became muddy. The CEO quickly decided that Upplands Väsby was not the place for Philips, and thus, according to the Swedish plan, it became Veddesta. Philips Sweden acquired the lot to build on in early 1965.



Map of the four scouted locations (green dots) and the then-existing PTAB (yellow dot)



Veddesta seen from Järfällavägen in 1965; Philips' land to the left

The architectural drawings for the new electronics centre were completed in early 1966, and the contractor, SIAB, started the construction in the fall of 1966. In the image below, the two cranes that would be used on-site until the completion of the office buildings are being erected. It was decided that the facilities would consist of a higher office building directly connected to a lower factory building. The lower building did not need cranes for its construction.

The Veddesta buildings were being designed at the same time as PCI's move from Molenstraat. Thus, PCI in Apeldoorn followed the progress of the Veddesta design and construction project with considerable interest. When the architect's design was completed, PCI wanted to know the rationale for many decisions. The functional requirements came mainly from PTAB's experiences at Stora Essingen – what worked well and what did not. The Veddesta design was created from purely practical considerations and hence cost-efficient. This way, the Veddesta factory influenced the new Philips-Electrologica facilities in Apeldoorn, which in turn became a model for other Philips factories worldwide.



Beginning of the construction of the new buildings during the winter of 1966–1967



In the late autumn of 1967, the office building was about to have its roof constructed

The topping-out ceremony (*taklagsfest*) was held a week before Christmas in 1967. It is not uncommon that about one year remains from that point before a building is ready for use. But the contractor had promised and was sure that only half a year remained. That turned out to be true in principle, but with a small caveat that later turned out to become a big one.

The keys were handed over from the contractor to Philips on July 1, 1968, and PTAB moved from its earlier premises on Stora Essingen to the new ones during the summer holiday month of July, thus incurring minimal interruptions in the design and production of products. The official inauguration featuring H.M. King Gustaf VI Adolf and the CEO of Philips worldwide was planned to take place in September. However, shortly after the move to Veddesta, a hawk-eyed employee looked up at the top of the building from a distance. To his surprise, it was not the Philips logo that was mounted on the short ends of the office building. This can easily be seen by comparing the Philips logo on the image above with the PHILIPS text on the building. Especially the P and S are telling. For example, the P in



the logo has a much larger closed part than the P on the building. Panic! The worldwide CEO of Philips could not inaugurate a flagship facility that had an inaccurate logo as its neon signs. The inauguration sadly had to be postponed. A discussion was opened with the contractor over what the contract said: each short end should have a “Philips neon sign” of this-and-that size near the top of the building. To Philips, this obviously referred to the Philips logo, but the contractor had interpreted it as any neon sign that contained the capital letters P H I L I P S. Not having time on their side, Philips bought new neon signs and replaced them. Months delayed, the inauguration was held on December 1, 1968, with the King and the CEO present. So the inauguration was almost a year after the topping-out, after all.



The Järfälla facilities before the neon signs were replaced

One determining factor in selecting the Electronics Centre site, which has yet to be mentioned, was access to public transport. With several thousand employees planned to be working at the facilities, not all could arrive by own transport. Thus, good public transport connections were paramount, not least from Stockholm city. Philips had been informed that a commuter train line would be established in 1968 and that it would stop at the Jakobsberg

and Barkarby train stations, which were both nearby. In addition, a new bus line would connect not only the Jakobsberg and Barkarby stations with Veddesta. On top of that, the bus line would pass through several residential areas in western Stockholm, making it easy for many employees living in either flats or freestanding houses to commute to work using public transport.



The bus line 541 at a bus stop in Veddesta (Philips in the background)

In May 1968, two months before the move, a suburban train line (*förortståg*²⁴) opened between Kungsängen (some 35 kilometres north of Stockholm) and Södertälje (some 40 kilometres south of Stockholm). The very same day, bus line 541 started its operation, enabling public transport almost to the doorstep of the new Philips facilities. The politicians and the transport authority (SL, Storstockholms lokaltrafik) had kept their promises. The commuter trains and the bus line 541 keep running to this day, albeit with some destination changes.

²⁴ It was initially called *förortståg* (suburban trains) by the SL transport authority, and later *lokaltåg* (local trains), but from the beginning *pendeltåg* (commuter trains) by the general public. It was not until the 1980s that the authority finally succumbed and changed the official name to *pendeltåg*.

Thus, the farmland of a few years earlier had been transformed into an electronics centre, one of the largest design and manufacturing sites of non-consumer electronics in Sweden. Philips had finally found a place where they would not outgrow their expansion possibilities.



Satellite photos from 1963 and 2023. The railway in the upper right corner is the point of reference since it runs on the same embankment as before but has more tracks today.

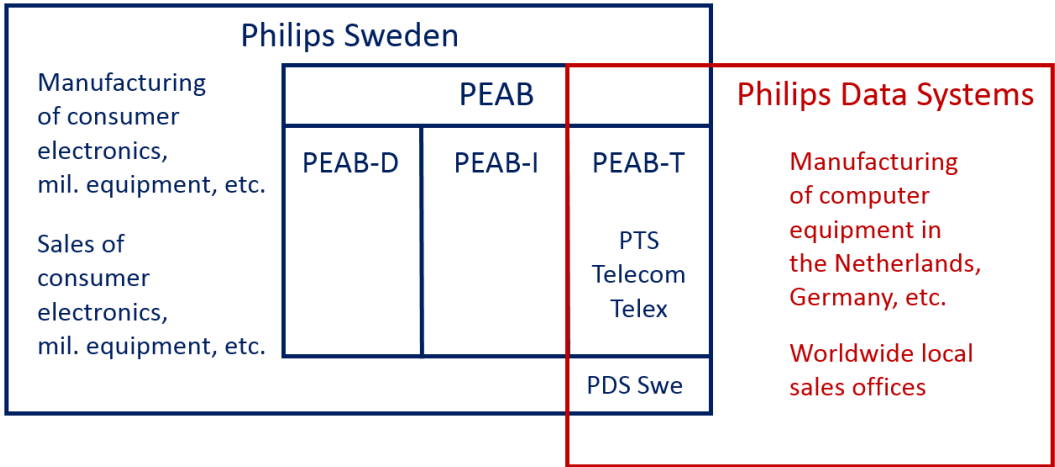
7.5 Philips Elektronikindustrier

To sum up, Philips' industrial activities in the field of professional electronics were concentrated in the Greater Stockholm area and included four units at this time: PTAB (Philips Teleindustri AB), Veddesta (Järfälla), PIE (Philips Industrielektronik AB), Solna, Sivers Lab AB, Västberga, and PTS (Philips Terminalsystem), Johannelund (Vällingby).

PTAB has been covered above and PTS will be the next chapter's subject. PIE was the international Philips group's development and manufacturing centre for electronic equipment in rapid pulse measurement technology. Typical users of these instruments were companies that developed equipment for telecommunications and computer industries, not unlike the segment Scienta was active in earlier. PIE was also the development and manufacturing centre for power supply equipment, which for example included stabilised mains voltage units for computers. In the field of medical equipment, computer systems for dose planning in high-voltage therapy and processing of information from scintillation, scanners and gamma cameras were produced.

To conclude the discussion on the Electronics Centre idea, it was fully materialised in the 1970s. According to plan, Philips now had lots of space to build new facilities, and it was in 1973 decided to collect all non-consumer electronics in one physical place. A new building was planned and constructed, and in 1975 PTS could move from Johannelund to Veddesta. PTS was about the same size as PTAB, and thus, their building complexes were of comparable sizes. The much smaller PIE was housed a little here and there, where there was space. At the same time, all three companies were merged into one. It was named Philips Elektronikindustrier (PEAB) and the former three entities became divisions: PTAB became PEAB-D, PIE became PEAB-I and PTS became PEAB-T. Sivers Lab was a radar component manufacturer that would not have profited much from an integration.

Philips worldwide had a highly decentralised way of organising their over 300,000 employees. The management in each country mainly made the decisions for all companies, divisions and units in their own country. However, if a unit was not a local sales unit but a unit with international responsibilities and substantial export, that unit also belonged to a global division, most often located in the Netherlands. Thus, PEAB-T, while being a division of PEAB was also a unit under the global Philips Data Systems with head office in Apeldoorn, the Netherlands. This was, in essence, a matrix organisation, however with a clear first and second command line – except when it came to very important decisions, such as an investment in an entirely new office and factory complex. The global head office in the Netherlands always decided those.



Organisational environment of PEAB-T

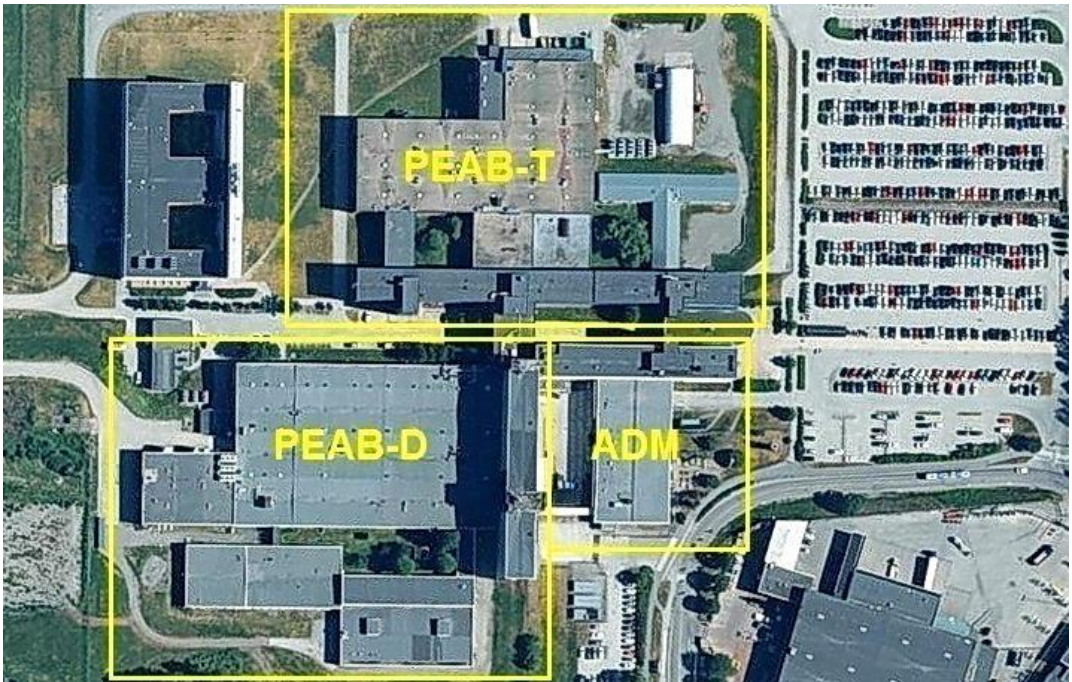
While the PEAB-T division had three subdivisions, as seen in the image, PTS was an order of magnitude larger than the others. Telecom produced modems and other general telecommunications devices. Telex produced different telex and teletex machines, which were rather popular ways of business communication back then. A particularly successful product was the PACT telex machine (Programmed All-purpose Communications Terminal), sold in large quantities to many telecom operators throughout Europe.



The telex machine PACT 200

A word or two about all these acronyms. When Philips bought Arenco Electronics, it was made a division under Philips Sweden called Philips Terminal Systems, PTS. At the same time, the product line was also called PTS, as in, for example, the first computer PTS 6110 or the keyboard PTS 6234. When PEAB was formed as a company in 1975, the PTS division of Philips Sweden was transferred to the new electronics centre PEAB, where it made up one of three divisions, PEAB-T. But the product line kept its name, so from 1975 on, PTS only referred to computer products and systems, not an organisation.

After PEAB was formed, all divisions expanded during the latter half of the 1970s. As the expansion continued, the offices became crowded and it was decided to move most of the administration to a separate new building ready for use in 1980. In a recent satellite photo of the site, the three large building complexes PEAB-T, PEAB-D and ADM are marked. The ADM buildings contained the administration (sometimes called PEAB-A), a canteen and conference rooms. To the upper left in the photo is an E-shaped building that did not exist when PEAB owned the buildings. It has a peculiar shape with a narrow part (a few metres wide and taller than the rest) and will make a surprise return in Appendix G.



Recent satellite photo of the former PEAB site

Some things can be noted if we compare the recent satellite photo with the 1984 aerial photo below. First, pavilion P03, located to the left of the PEAB-D main building in the photo, is now gone. It contained factory space for PEAB-D but also for the, in 1973, merged Jakobsbergs elektrotekniska fabriker (JEFA). The new owners obviously did not like that pavilion. Next, there is a large tent instead of a car park in front of the T-shaped pavilion P04,²⁵ closest to the camera in the aerial photo. It was just a car park when PEAB owned the site. And finally, the E-shaped building mentioned above did not exist earlier. The architect of that building might have misunderstood a key feature of the entire PEAB building complex. On cold, windy or snowy days (of which there are many in Sweden), you could put on your cardigan and slippers when you arrived in the morning, and then by walking indoors reach every part of every building. However, the new non-PEAB E-building was disconnected from all other buildings since it emanated from another era, mindset and ownership.



Aerial photo of PEAB from 1984 (PEAB-T is the closest half, darker)

²⁵ The pavilion was colloquially called the T-pavilion because of its shape, although its official name was P04. It mainly contained consultants for different customer projects within PEAB-T.

7.6 PEAB-D Defence Systems

Since PEAB-D was considered the “coolest” division, most PEAB branding and positional advertisements were based on the defence products. Even employment advertisements most often had defence content. When prospective employees contacted PEAB’s HR department, they were directed to the division having jobs of their interest, which might as well have been PEAB-T or PEAB-I. Needless to say, neither defence systems nor large bank terminal systems were sold by advertisements. Those were large sales projects and required the effort of many sales and sales support personnel over a long period of time. So the positional branding was mainly carried out to keep the perception of an exciting employer alive. Compared to chasing submarines or tracking fighter jets, how exciting is a teller job behind a bank branch office desk after all?

The organisational chart on page 177 shows that PEAB-D (and, for that matter, also PEAB-I) was not entangled in any dual-matrix organisation with two separate lines of control. Instead, PEAB-D could make its own decisions rather independently of the Dutch mother company. While the dual matrix was not a problem for PEAB-T either in the 1970s, it would become a large problem in the 1980s – more on that in Chapter 9.



BOZ 100 for Tornado

With more than twenty years experience as a designer and manufacturer of countermeasures for the Swedish Air Force, PEAB has developed into the leading European manufacturer of chaff and IR-flare dispensing systems. The reason for this is the unique capability of PEAB dispensers in terms of efficiency, endurance and programmability.

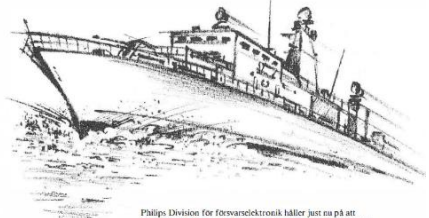
That's why, the PEAB BOZ 100 series of advanced dispenser pods has been specified as the standard ECM equipment on three major aircraft programs in Europe: the Viggen, Jaguar and now also the Tornado.

Philips Elektronikindustrier AB
 DEFENCE ELECTRONICS
 S-175 36 Järfälla, SWEDEN
 Tel. Nat. 0758-100 00. Int. +46 758 100 00.
 Telex: 115 05 PHILJJA S.

FRAMTID HOS PHILIPS



Sveriges intressantaste mjukvaruprojekt?



Philips Division för förvarselektronik håller just nu på att utveckla ett avancerat ledningssystem för nya kustkorvetter av typen Göteborg.
 Systemet omfattar flera datorer, i samband med en eller flera Motorola 68020 som integreras med LAN.
 För att utveckla dessa system söker vi dig som vill arbeta med:
 — MULTIPROCESSORILLAMPNINGAR
 — MOTOROLA 68020
 — DISTRIBUTERADE REALTIDSSYSTEM

Vi erbjuder dig ett självständigt arbete i en tekniskt stimulerande miljö. Du får arbeta i projektform där du under en inledningsperiod svarar utbildning med projektarbete.
 RING: Hans Gustafson, tel. 0758-223 24 så får du veta mer om arbetet. Du är också välkommen att ringa Hans Cederberg tel. 0758-90 00 på vår personalavdelning.
 FLER SKRYV TILL: Philips Elektronikindustrier AB, Personalavdelningen, Hans Cederberg, 175 88 Järfälla.
 BAKGRUND: Du har en god teknisk utbildning på högskolenivå och erfarenhet från arbetsoppgifter som innebär teknisk programutveckling.

PHILIPS ELEKTRONIKINDUSTRIER AB är ett företag med över 2 000 anställda av de flesta av Sveriges företag i Sverige. Av dem hade omkring 100 000 personer tillika en del av 1989 på export.

Det uttrycker inte att Philips har någon förbindelse med de nämnda företagen eller andra företag som nämns i denna reklam.

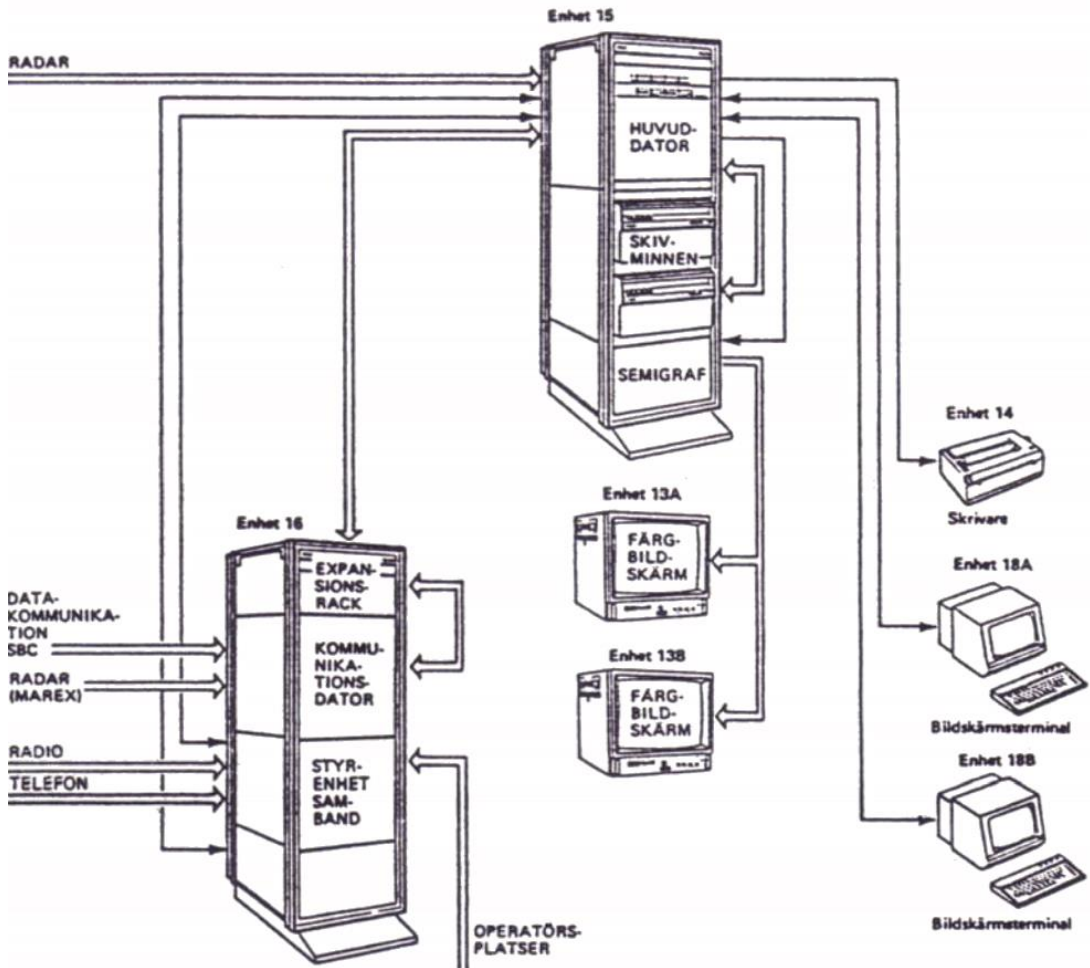
PHILIPS

Intriguing and action-packed advertisements for PEAB-D products and employment

Thus, within the global Philips matrix organisation, PEAB-T and PEAB-D belonged to the same company (PEAB) but were organised differently in international Philips since PEAB-T was formally also a part of Dutch Philips Data Systems. Still, PEAB-T and PEAB-D had a lot in common: similar management structures and shared technology.

An example of an excellent PEAB-D product, and of technology sharing, from the era we are focusing on is the well-known and very successful STINA system. STINA was an acronym for *Sjö- och Tullinformationsanläggning* (Sea and Customs Information System). One of the tasks of military bases and naval commands has always been to monitor and follow up on the situation at sea as a basis for managing operations. Well into the 1970s, this was done through large manual plots. The information came from radar stations along the coast, from ships, lookouts and other reporting sources. In the early 1970s, the Swedish Navy began to realise the need for and importance of continuous follow-up of traffic and operations at sea in order to obtain a movement baseline. This baseline would then form the background for detecting deviations that could indicate a threat of some kind. The concept of a maritime surveillance centre was thus established. In 1974–1975, the Navy headquarters decided to specify such a surveillance centre. To make use of the available radar information from radar tower stations, which were constantly in operation, a proof-of-concept project was initiated to see if it was possible to utilise narrowband radar plots from tower radars for surveillance. The radar stations were not originally built to provide complete surface coverage, but it turned out that they still provided valuable information. This proof of concept led to the specification of an entire control system for a maritime surveillance centre, and PEAB-D won the ensuing tender process. The first order for a STINA system came to Philips from FMV, Försvarets Materielverk (the Swedish Defence Materiel Administration), in 1977. It was for one system, and the order value was 1.7 MSEK.

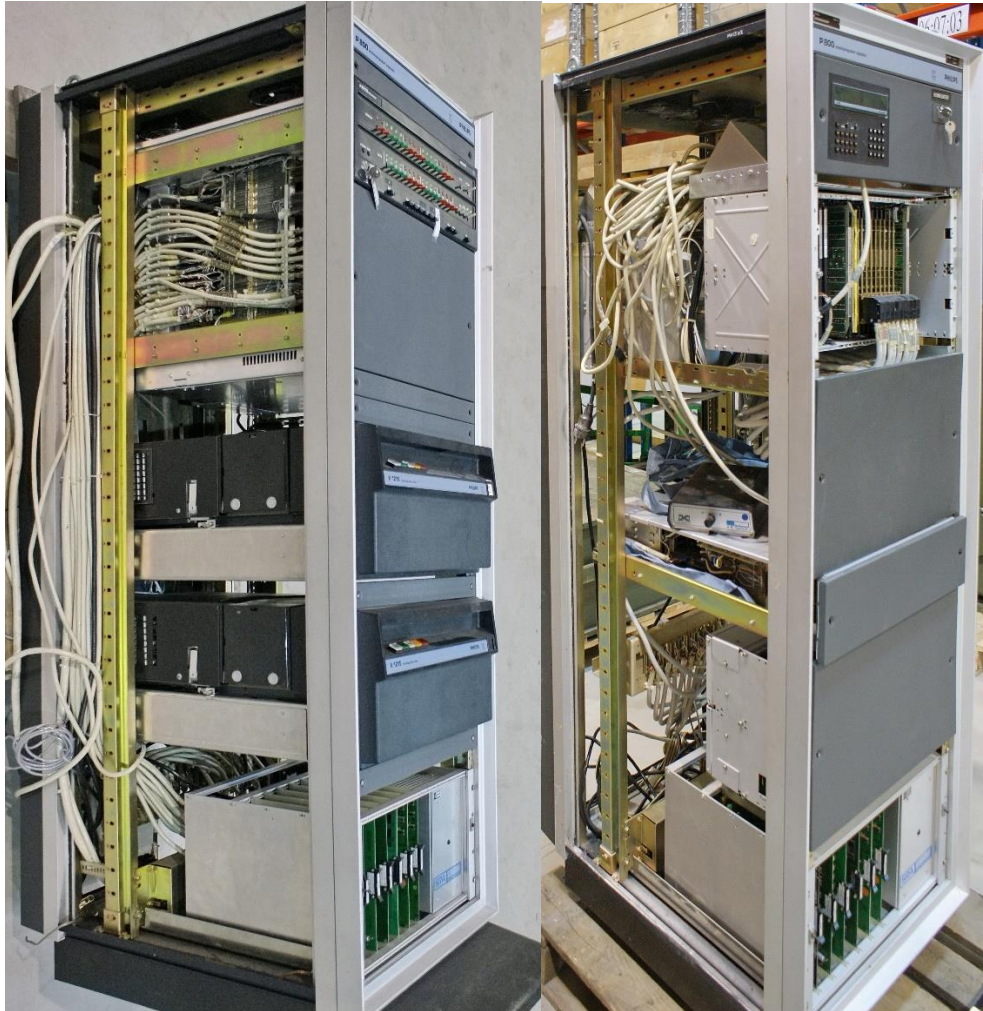
This project greatly illustrates the parts bin system discussed in Chapter 6. Since the order value was low, the only way to attain profitability was to reuse parts bin components. The architecture of the STINA system is shown in the image below. Its major parts were a central computer (*huvuddator*) and a communications computer (*kommunikationsdator*). Together, they processed incoming information on the movements of various vessels in the Swedish territorial waters. The processed information was displayed on custom-made workstations where various functions made tracking possible. This way, the military and coast could track the movements of all kinds of vessels and were alerted when some sort of divergent behaviour was being detected.



STINA's main architecture (in Swedish; not showing the operator workstations)

The central computer was a Philips P857M (128 kB memory using an MMU) mounted in a large (1.8 metres tall) P800 rack. The rack had the unmistakable light-blue ribbon of the P800 series at the top stating "P800 minicomputer system". Below the ribbon, the P857M extended SOP (system operator's panel) can be seen with switches for manual address input above switches for manual data input, both in 16-bit formats. Beneath the CPU, two X1215/P824/P3433/PTS 6875 disk drives with 2.7 + 2.7 MB disks each resided, one fixed and one removable. At the bottom of the rack a "semigraph" was installed, which was what

we would today call a graphics computer, displaying data on colour TV screens connected directly to the device. The semigraph was designed by SRA, a competitor to PEAB-D from the Saab/Ericsson camp but who, in this particular case, wanted a share of the STINA order. The communication computer was likewise a P857M (64 kB memory, no MMU), which acted as an interface between the main computer, the incoming radar, radio and telephony information, and the operator stations; see the overview of the main architecture.



STINA's main computer (left) and communications computer (right)

In actual fact, the communications computer to the right in the image above is of a more modern STINA generation (one of the later deliveries) since a P854M computer with the FRCP front panel (and the secret military-only trigonometry CPU instructions) can be seen installed at the top instead of a P857M. After the first delivery of a STINA system to the naval surveillance centre in Visby (Gotland island), there came additional orders for in total four more systems to be placed at the Muskö naval base in the southern Stockholm archipelago, then Karlskrona, Malmö and last (in 1983) Gothenburg. These new orders included some additional functionality, bringing the order value up to, for the final unit, 3.2 MSEK.

Five units were still not much of a total sales volume, according to global Philips, but the parts bin approach clearly helped the situation. In the main architecture drawing above, many PEAB-T PTS front-office banking devices can be seen, ranging from the PTS 6346 VDU (screen) and the PTS 6272 keyboard to the PTS 6321/PER 3100 printer. In larger projects, the parts bin devices were usually rebadged, but here in the STINA case, we can see the P800 light-blue ribbon and the PTS 6000 orange stripe both remaining untouched.



PTS 6346 VDU screen used in STINA, placed in a cut-out operator console

But it was not only hardware that was shared. The operating system in many of the PEAB-D's P800-equipped systems was TOSS (Terminal Operating System Software), developed by PEAB-T for banking and retail terminal use. The Philips P800 series from Apeldoorn had three operating systems to choose from. However, none of them had the real-time performance or data communications capabilities (such as HDLC) of TOSS, properties that were paramount in PEAB-D applications. It was a rule within Philips worldwide never to deny sharing any resource in a division with all other Philips divisions and companies – again, an aspect of the parts bin approach. Thus, PEAB-T was not asked but rather told to share its operating system TOSS with its sister division PEAB-D. In the end, that was a time- and cost-saving approach that contributed to the profitability of many projects. In comparison, a typical PTS project contained hundreds of computers and even more terminals.



STINA console with a PTS VDU (radar screen removed)

At the same time, STINA, albeit with a much more advanced I/O subsystem handling radar input and similar, still was only a five-unit project.

STINA was launched in 1979 and remained in operation until 1999, making it one of the longest-running and surviving P800 CPU-equipped systems. PEAB-T/PTS systems, which we will come back to in the next chapter, were also P800-powered but in comparison, they very seldom lasted beyond 1997 due to mismanagement by DEC which acquired the PTS business in 1991, first under the name Philips BCFI but after a few years changed to DEC BCFI. More on the take-over and its dire consequences in Chapter 9.

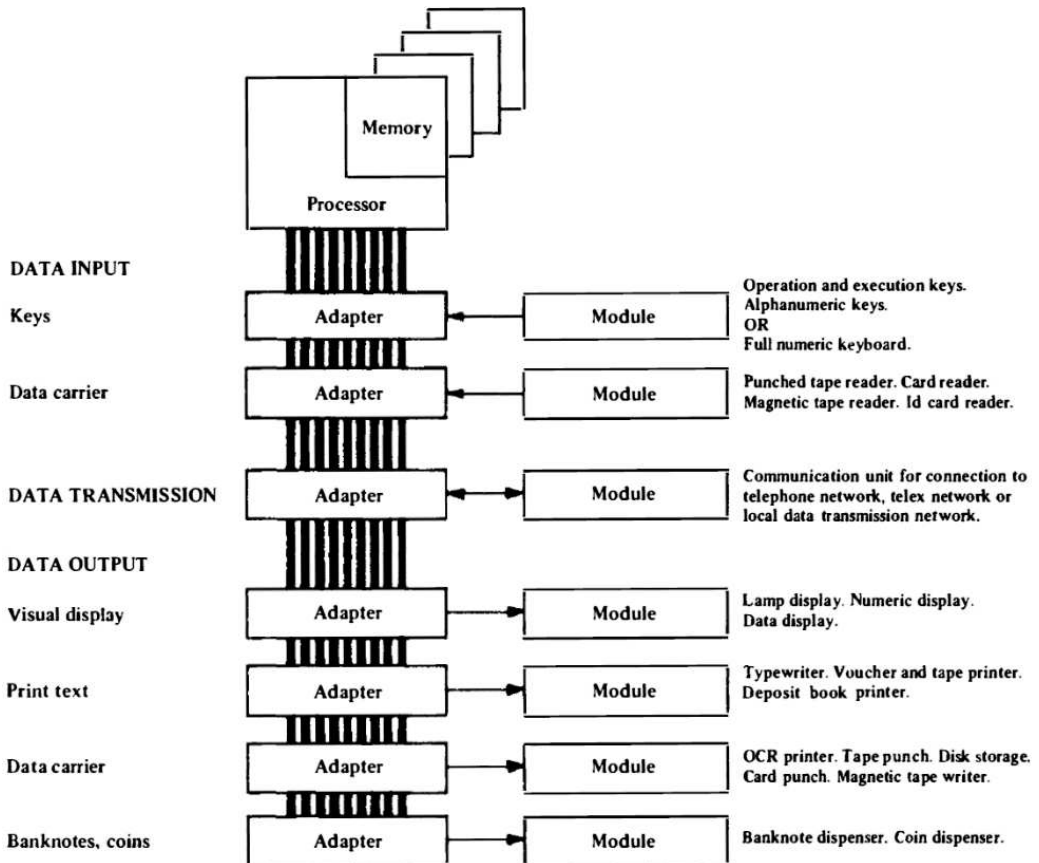
STINA was an important cornerstone in the Swedish naval coast defence system for a long time. A case in point is the Hårsfjärden incident, in which a foreign submarine was discovered in the Stockholm archipelago in the fall of 1982 and trapped, surrounded by naval vessels and stations, sonar tracking systems and activated underwater minefields. The newly installed STINA system at the adjacent Muskö naval base went on full alert. The submarine was discovered on September 30, 1982, by naval detection units and then verified by conscripts on board a ship from the Berga naval base who on the next day, October 1, saw a submarine periscope in the Hårsfjärden bay. A military helicopter almost immediately afterward tracked the submarine down by detecting its radar echoes. In the coming days, intensive reconnaissance work was carried out in the Hårsfjärden bay and several contacts with the submarine were made, which also led to repeated weapon deployments, not least at the Mällsten mine station further south in the later phase of the operation. Among other things, mines from the coastal artillery's fixed submerged mine defence lines were blown, and traces were observed on the water surface afterward. One of the authors did his military service at the Berga naval base during the last part of the incident and can attest to the military's confusion and panic during the period. For example, he had to spend the nights on the lookout for submarine periscopes or other movements, using amplified binoculars and other special devices, instead of sleeping. Needless to say, the quality of the conscripts' observations quickly deteriorated. During the entire incident, though, STINA made sure by intensive tracking that no surface support vessels of any kind could approach the trapped submarine. After the military operations ceased, on October 30, the Swedish government concluded that the submarine had made a successful escape from Hårsfjärden to international waters already on October 14.²⁶ This was in no way due to STINA, which made a very important and successful surface-tracking contribution during the entire four-week incident. On the contrary, this was one of STINA's moments of fame, a short period in the limelight, a pressure test it passed with flying colours.

²⁶ It was immediately speculated that the submarine had been let out by a 4-hour cease-fire command issued to the mine operators at Mällsten on the evening of October 14. This was allegedly to avoid a complicated diplomatic crisis, which a bombed submarine would have caused, were it from the Eastern Bloc or NATO – both origins have been mentioned in the speculations. To this day, the speculations continue and nothing is still known about the submarine's origin or mission.

8. Philips Terminal Systems

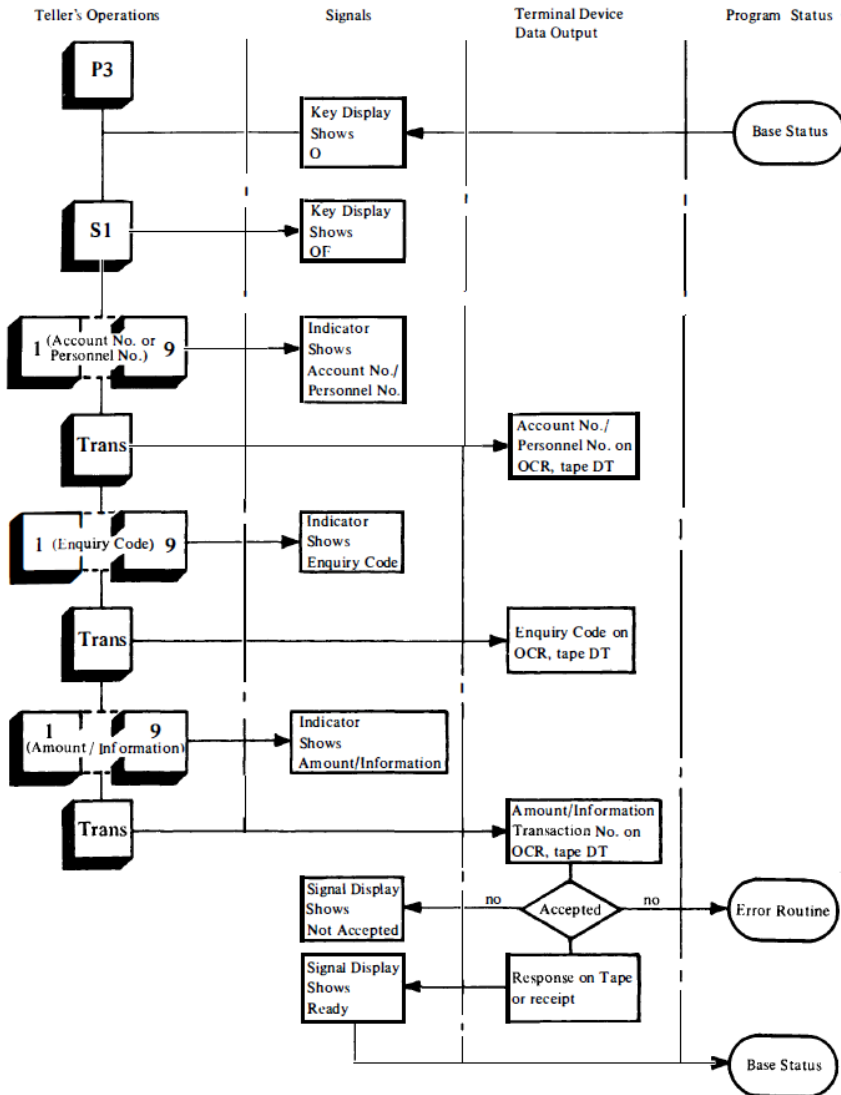
8.1 PTS Division

As we saw in Chapter 3, Philips acquired Arenco Electronics in April 1969. The primary reason was its contract to deliver bank terminals for Svenska Handelsbanken's (SHB) front offices. Under the new Philips PTS (Terminal Systems) flag, the banking unit of Arenco Electronics remained on their site in Johannelund until 1975, when they moved to Veddesta and were integrated into the newly formed Philips Elektronikindustrier (PEAB). However, the Philips takeover started immediately in 1969. Philips engineers joined the various Arenco teams to learn and ensure that the project met Philips standards and design goals.



Original Arenco Electronics architecture

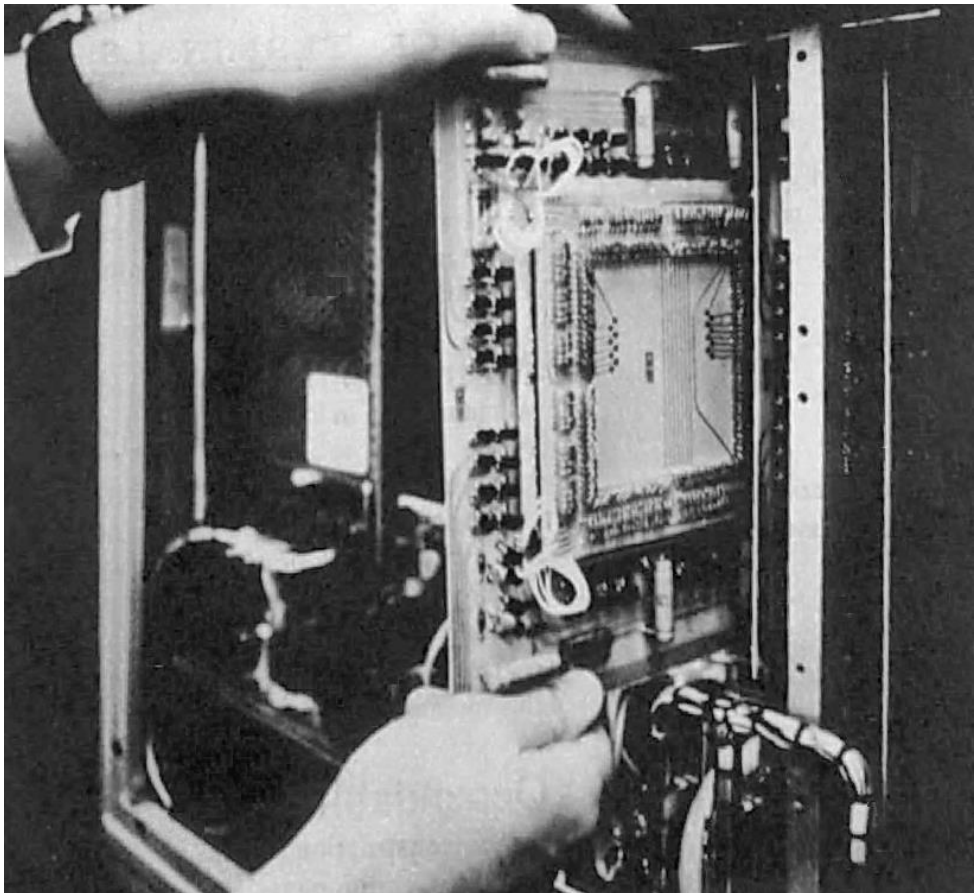
It rather quickly turned out that the project did not. The Philips engineers found the design too expensive and over-engineered, with one processor per teller terminal (from Chapter 3, repeated here). A study was immediately launched to reduce the number of processors to one per bank branch or, in the case of a large branch, one per four teller terminals.



Example of an Arenco Electronics program flowchart

Further, the software was behind schedule to the extent that it consisted only of flowcharts rather than computer code. This fact, plus the aim to concentrate the processing power within each bank branch, made redesigning the software architecture a high priority.

The fact that the new SHB CEO halted the project for almost a year was a blessing in disguise. Although Philips was officially disappointed, this was a real chance to deliver the project on (the new) time and, most importantly, with high quality. SHB's reason for stopping the project was quite another, though. The CEO wanted to find out if such an "advanced hi-tech project" was in the best interest of the development of the bank in general – which he found a year later that it was. Consequently, the CEO gave the second go-ahead signal.



A Swedish Computer circuit board being installed in a PTS 6110 computer

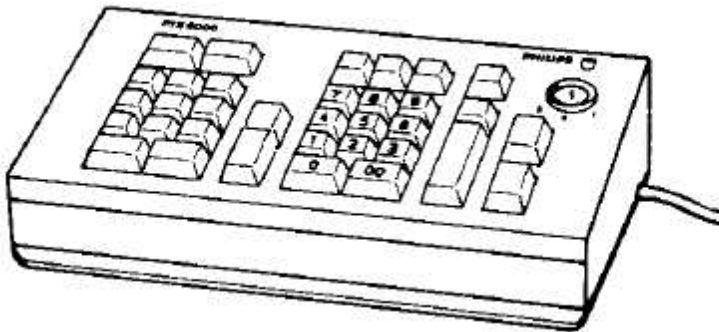
8.2 First PTS Generation

At the time of the takeover, Philips had no CPU in their own assortment that suited the project. Thus, the incumbent CPU was kept for the continuation of the project. Swedish Computer had developed the Arengo Electronics CPU for use in its horseracing totalisator equipment (see Chapter 2). It was a 4-bit CPU that had 4 kbytes of memory – enough for horseracing but not for an online transaction system. Thus, the program soon got too big and heavy, and the CPU had to be redesigned to make better use of the instructions. Since it was an in-house CPU (Swedish Computer, as a former subsidiary of Arengo, was now also Philips-owned even though it was still located in Gothenburg), the engineers came up with a new instruction repertoire and required modifications to the processor before the bulk of the programming could commence. Programmers were both hired and transferred from other parts of Philips. The programs were kept on punch cards in boxes that, after a while, became well over one meter long. They were transported by subway to a data centre across the city (the QZ university computer service centre) for compilation. Each box was taken daily to the data centre and compiled, the roundtrip from Vällingby to Gärdet and back took a couple of hours each day. The compiler was homebrew; it was a program written in IBM's assembly language and thus ran only on IBM computers, to which the project team did not have access in-house.

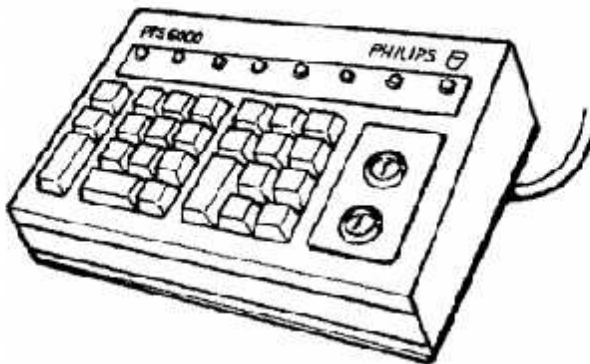
A CPU is only one part of a banking terminal system. Everything from displays to keyboards and printers, not to mention storage media, had to be either found in the Philips parts bin and adapted, or developed by PTS themselves. A first look in the parts bin revealed several Honeywell keyboards that could be adapted. Thus, there was no need for developing those. A couple of numeric and alphanumeric keyboards were chosen that became the PTS 6231, 6233 and 6234. Philips was early into ergonomics and found the keyboards too thick for comfort. Consequently, all customers (SHB and those that followed) were required to recess their keyboards into the desks.

However, with the thickness came reliability and ease of repair. The keyboard technology was not very advanced at the time, and keyboards had not yet become a consumer product. Thus, the development was consistent with the market size, which was small compared to a few decades later. However, one advantage of the Honeywell keyboards was that they were easy to repair, which most often meant changing individual keys that had stopped working. Back in the 1970s, the ratio between product value and repairman salary was such that it was well worth the cost to repair old PTS (Honeywell) keyboards.

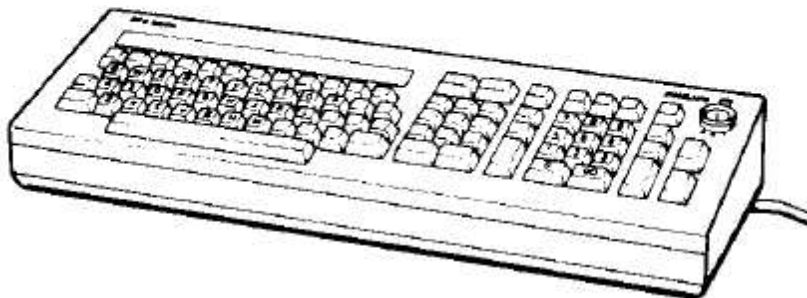
PTS 6231 Keyboard Numeric



PTS 6233 Keyboard Numeric



PTS 6234 Keyboard Alphanumeric



Available Philips-adapted Honeywell keyboards in the first PTS generation



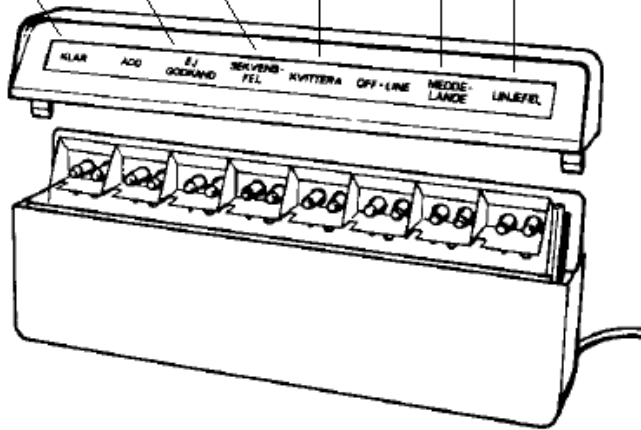
Recessed PTS 6233 keyboard in a Swedish Post installation

Then there was the eternal question of naming. At Philips Data Systems, all product lines had their own number series, i.e. their starting number, governed by Apeldoorn. Since the P1000 mainframe was not the success it was set out to be, it had at that time become conceivable to use four-digit product numbers for other product lines. Besides, PTS in Sweden was so far away from the Netherlands that it almost went under the radar. The five original Arengo Electronics teller workstation offerings had the numbers 6010 and 6020 for offline versions and 6110, 6120 and 6130 for online versions, with differences due to the keyboards and printers attached. Thus, the '6' number series, which happened to be free, was assigned to PTS products by Apeldoorn. The PTS solutions were online designs, and consequently, following Arengo's numbering scheme, 6110 was selected as the number for the terminal computer and, in addition, 62xx for peripherals such as keyboards, printers, etc.

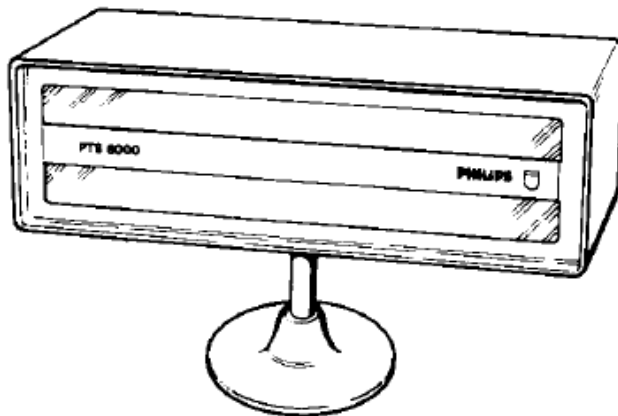
There were two displays on offer in the product line— a simple signal display and a more advanced numeric display combined with a signal display. The signal display part was the same in both displays and the additional numeric one in the advanced display was a further development of the numeric display, both using Nixie tubes, which Arengo Electronics showcased in the Karin demo. Both had readability and reliability as their main assets. There were some VDU screens on the market, but they were mainly TV sets or similar converted to computer screens. From an ergonomics standpoint, they were often terrible, much worse than the PTS 6241 plasma display. There was a trade-off between screen size and readability, and Philips' standpoint, which they thoroughly verified, was to minimise the strain the screen put on the employees assigned to sit in front of such a device for most of their working day. When the Swedish white-collar union TCO started ranking computer screens in the early 1980s, Philips always came out very well.

PTS 6242 Signal Display

Klar = Ready
Ej godkänd = Not approved
Sekvensfel = Sequence error
Kvittera = Acknowledge
Meddelande = Message
Linjefel = Communication error



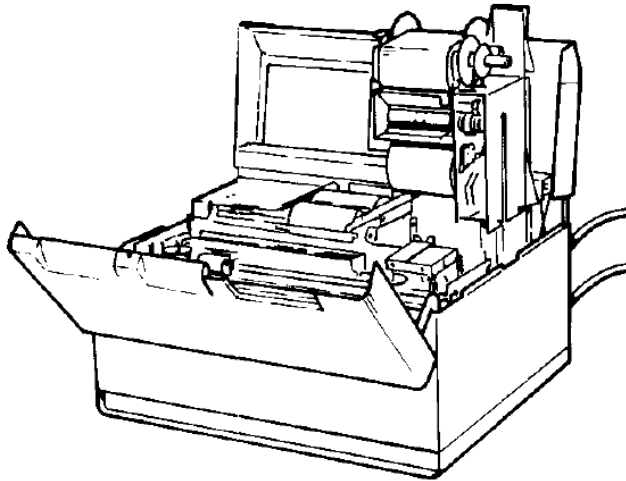
PTS 6241 Numeric and Signal Display



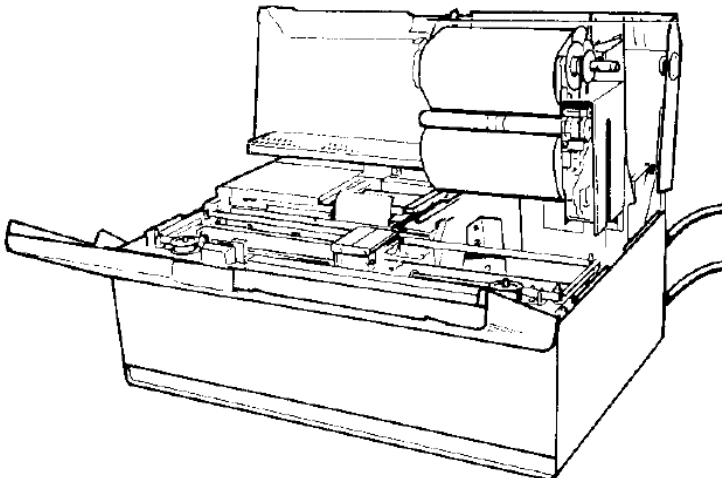
Simple signal display and advanced combined display

A significant component in a front-office banking system is a printer that can print everything from receipts and local paper logs to lines in bankbooks (passbooks). The PTS printers were initially designed and developed by Arenco Electronics but were further developed by Philips after the takeover.

PTS 6221 Teller Terminal Printer



PTS 6222 Teller Terminal Printer



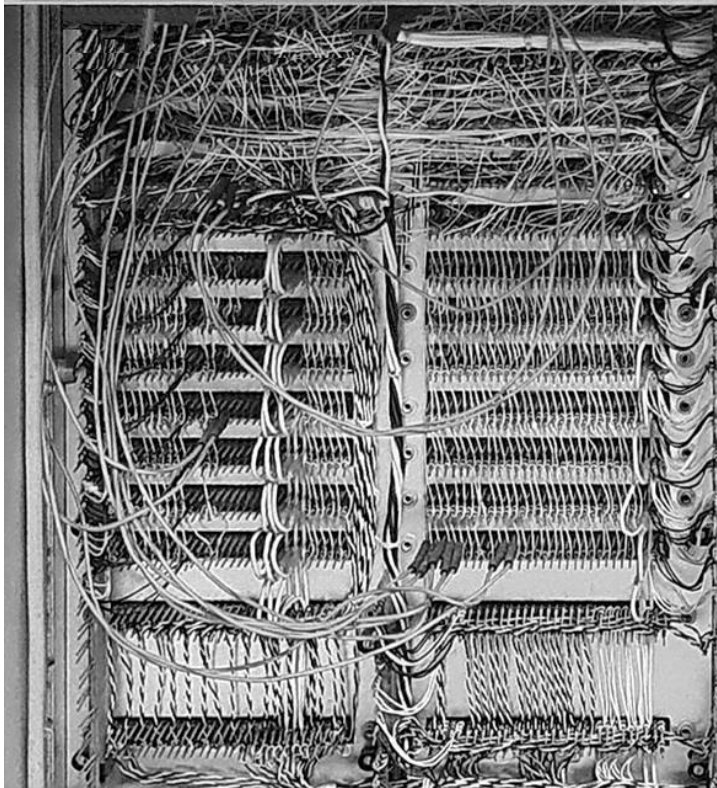
The first two printers offered by PTS



A PTS 6222 printer in real life

Since, unlike the Arenco 6110, the PTS 6110 was an architectural design with one processor serving several teller workstations instead of one, the demands of the CPU shifted considerably upwards. The Swedish Computer 4-bit device had a hard time coping. Time-wise in parallel, the minicomputer processors of the Philips parts bin were developed at CTI in Fontenay-aux-Roses, France. When the CPU load was becoming more and more extensive, PTS had a project group visiting CTI to be informed about its new 16-bit CPUs. They were yet to be released to the market but were available for internal demos and assessment. However, when the PTS team was shown a P855 demo CPU, they did not like what they saw. The overall processor design was too cluttered, with the backplane full of wires. That would not work in a product that was to be mass-produced to serve every single SHB branch office and possibly many more customers. Too large a risk for mistakes and failures, too hard to service. Thus, it was decided to keep using a (heavily modified) Swedish Computer CPU for the time being.²⁷ However, it was soon found out that the factory in Gothenburg was too small and lacked the quality standards of Philips, so it was decided to move the entire Swedish Computer operations to PTS in Johannelund, closing its Gothenburg facilities.

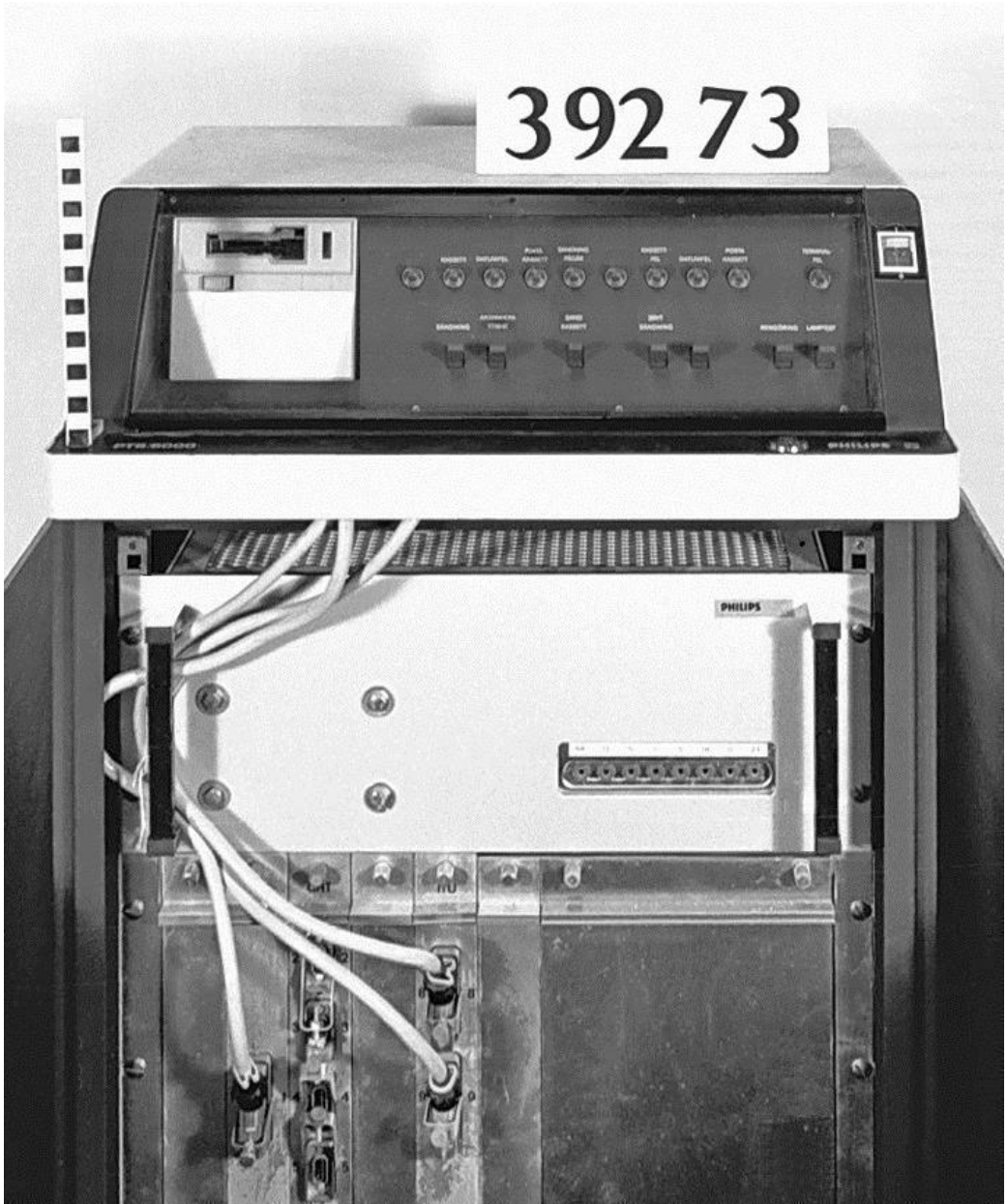
²⁷ PEAB-D was supposed to have considered the P855 CPU for some projects. But their projects had a different characteristic: larger projects with much fewer copies made – thus no mass-production worries. To the authors' knowledge, though, neither PEAB-D used CTI P800 CPUs until the second generation became available (P852, P856, P857). See, for example, the STINA project in Chapter 7.



Backplane of an early P855M minicomputer

The work with the 6110 processor slowly converged as the Philips engineers in Johannelund redefined its instruction set based on the progress they could see with the software. This was an unusual project, in which the hardware and software were truly co-developed. This was necessary to make the most out of the limited processing power and memory available to the designers, engineers and programmers. They were convinced that no one else could have done it better at that price point. The constraint in all such large system projects is that the hardware will be multiplied by many hundred copies while the software exists in one or, at most, a few versions. This imbalance was skilfully balanced by the Philips employees.

The only known surviving sample of the PTS 6110 computer and some of its peripherals used by SHB are located at Tekniska Museet (the Swedish National Museum of Science and Technology) in Stockholm. The items are kept in their collection but unfortunately stored away in a remote warehouse and thus not shown to the public.



PTS 6110 terminal computer

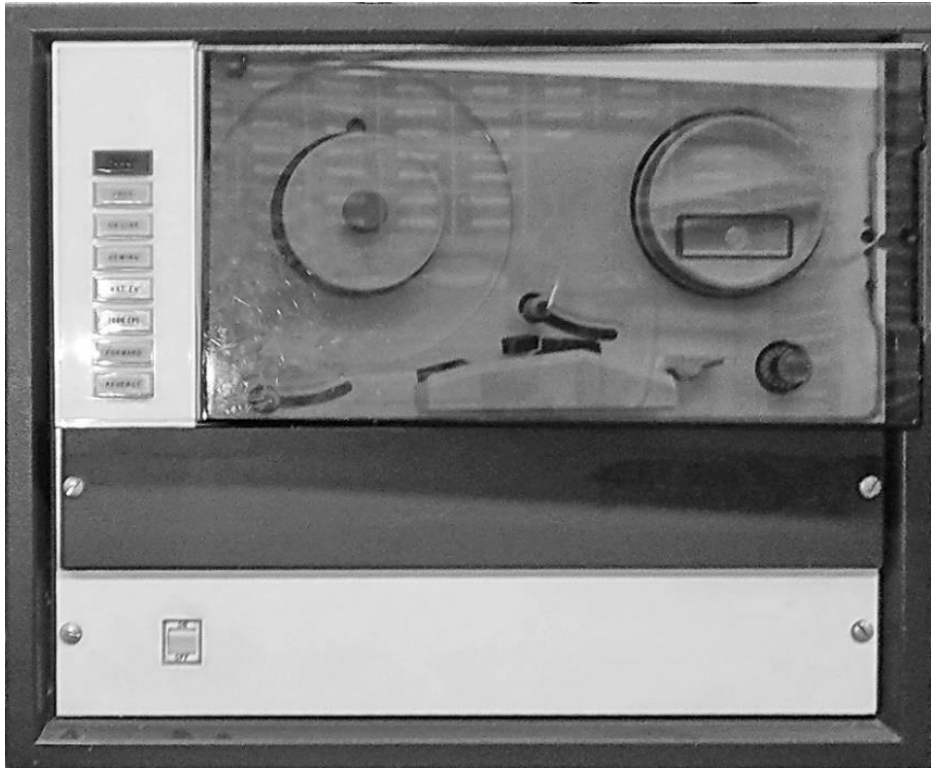


PTS 6231 keyboard, PTS 6221 printer and PTS 6241 advanced display unit

8.3 Second PTS Generation

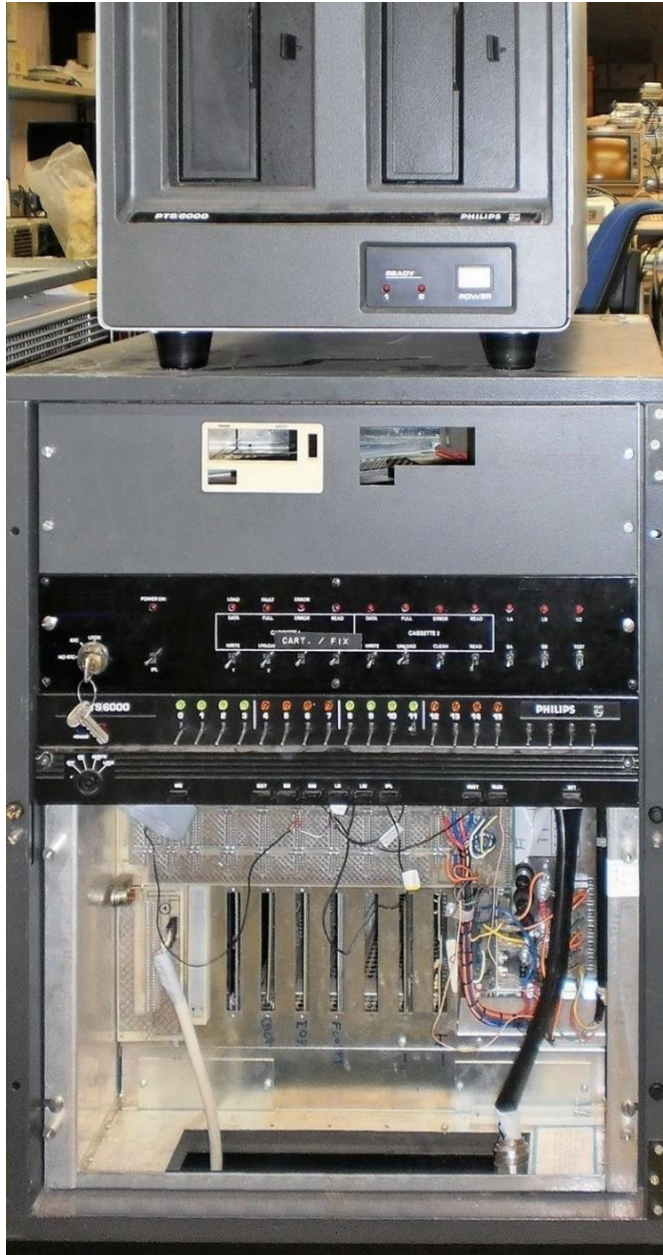
After the initial SHB order started shipping regularly, a management decision was made by Philips Sweden in May 1973 to make the PTS product line a much broader offering, nationally as well as internationally. The inquiries that kept coming in were clear indications of a large market segment in the making. In Sweden alone, inquiries and orders were piling up from at least five more banks (Götabanken, Skaraborgsbanken, Uplandsbanken, Werm-landsbanken and Stockholms Sparbank) for over 5,000 bank teller terminals, plus the Swedish Post which wanted 2,600 teller workstations for its 750 largest post offices.²⁸ Thus, attention was turned to the next generation of equipment. As a bridge to that generation, the PTS 6164 magnetic tape unit was developed for more extensive data storage, and it had interfaces both to the PTS 6110 computer and subsequently to the later PTS 6810 series. While cassettes were handy for smaller amounts of data, such as one day of transactions at one branch office, another technique was required for larger datasets. A suitable Pertec unit was found and adapted to the product lines via the parts bin. At the same time, the new industrial design look of the second generation equipment was premiered with this Generation 1.5 tape station.

²⁸ After a while, it turned out that every commercial bank in Sweden except SE-banken became customers of Philips PTS equipment. SE-banken used Nixdorf and the non-commercial Sparbanken used Datasaab.



PTS 6164 magnetic tape unit of a generation between first and second

PTS realised that the second generation would require a more powerful processor. As early as the autumn of 1972, PTS was shown a prototype of the next-generation processors by CTI. Besides better performance, the neater design with a better bus and much cleaner back-plane convinced PTS to make this CTI processor generation the workhorse of their next-generation banking equipment. The first processor to become available was P852. It was available internally within Philips already in the spring of 1974 (it was officially released in November). The PTS cabinet for that CPU was a new design that could contain up to ten circuit boards in the Belier format (19 inches = 48 cm) that the P800 CPU boards were built in. To signify the change of processor, the new computer was called PTS 6810 with the '8' in the hundreds position, as in the P85x processor names, replacing the '1'. There was soon a follow-up model PTS 6811, the only significant difference being that it was possible to connect an extension unit PTS 6863 with ten extra Belier slots for larger systems that required more than ten board slots (see, e.g., page 201 or the back cover of the book).



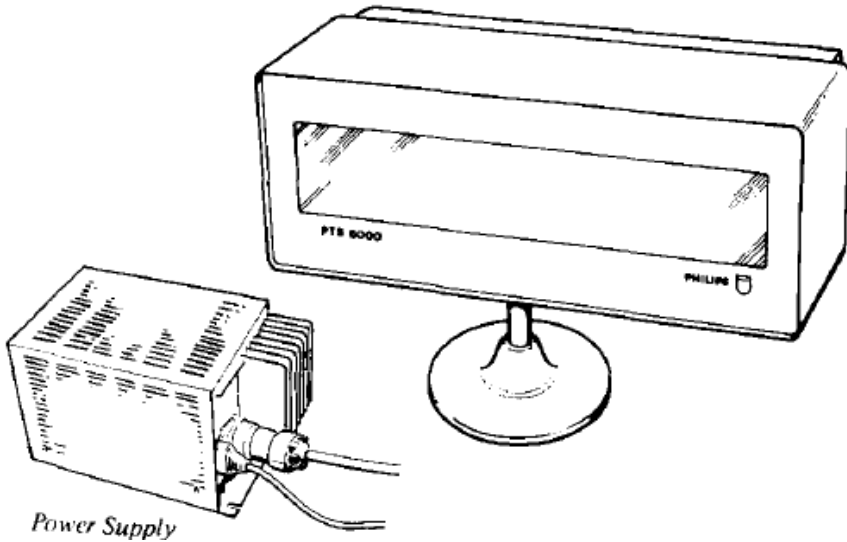
PTS 6811 fitted with a SOP (system operator's panel)



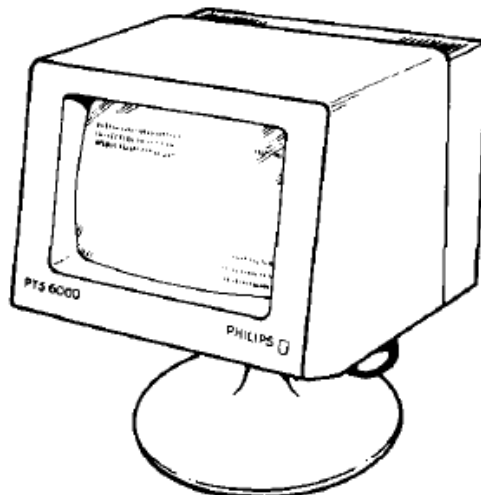
PTS 6863 extension unit with its front cover removed

The backplane of this generation of processors was much cleaner, which meant fewer things could go wrong in assembly as well as during field service.

The peripherals also underwent a generation change. Technology moved on at a fast pace and soon alphanumeric displays were available, obliterating the old displays at an instant. Most devices in this second generation were assigned product numbers in the 63xx series.

PTS 6351 Plasma Display Unit

The first alphanumeric displays were plasma units with eight lines of a maximum of 36 characters each. While a considerable improvement, a more significant step would soon be taken when video display units (VDUs) were introduced.

PTS 6346 Video Display Unit

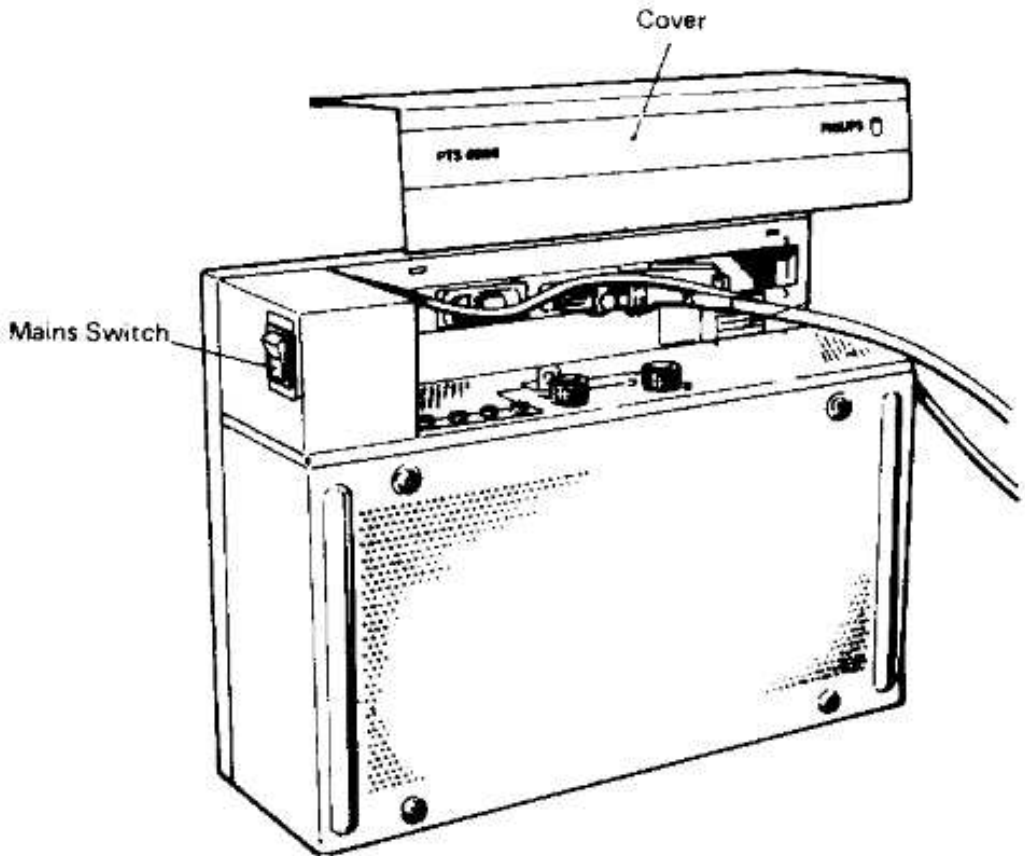
The PTS 6346 VDU had 24 lines on its screen with up to 80 characters per line, which was a big improvement. It was also a very ergonomic screen since the unit had an optional stand that could both swivel and tilt, thus allowing the adjustment of each workplace individually according to needs.



PTS 6346 VDU with an optional ergonomic stand

The PTS 6346 VDU, and matching keyboard and printer, were connected to the computer via a special adapter unit called SUM (selector unit modular), which came in several versions and constituted one exception to the second-generation 63xx numbering scheme.

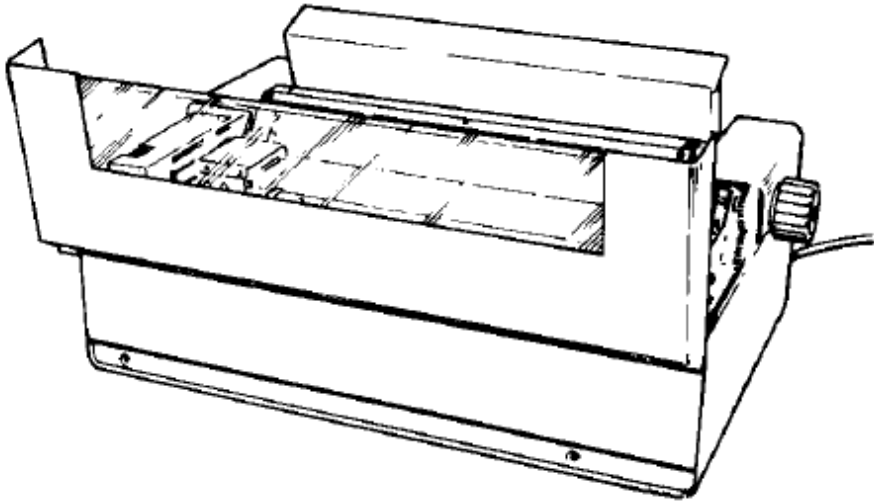
```
6X1X - XXX
      | |
      | | | Configuration, see Table 18.2
      | | | 0 = Local Connection, 1 = Remote Connection
      |
      | 1 = Non-modular 80 W unit
      | 2 = Non-modular 100 W unit
      | 3 = Reserved for future use
      | 4 = Modular 100 W unit (SUM)
      |
      | 2 = Teller Terminal Environment
      | 3 = General Terminal Environment or modular unit
      | 5 = Special Terminal Environment
```



PTS 6312 SUM-L

PEAB-T produced not only bank teller/passbook printers but also general printers that could be used as smaller line printers or as ticket printers due to their sturdy print heads. It quickly became popular, not only for banking purposes and not only in PTS systems. Due to the parts bin system, it found its use in many different application areas, of course under many names. Its most widespread name was PER 3100, and sometimes that name could also be seen on printers sold as PTS 6321. The model was also sold to other manufacturers as OEM equipment. Thereby, its production volume was kept high and thus the cost per unit became reasonably low. Its sturdy and durable print head made it popular for many printing tasks.

PTS 6321 General Terminal Printer



PTS 6321 printer with a PER 3100 label



Almost worn-out equipment: PTS 6321 printer, PTS 6346 VDU and PTS 6234 keyboard

As we saw in the previous chapters, the French CTI family of second-generation processors soon grew to three. Of the three available processors in 1975, P852, P856 and P857, PEAB-T selected the least powerful (P852) for smaller applications and the strongest (P857) for larger applications. The P856 CPU made no sense at all in their product line (or anywhere else, for that matter) since it was essentially only a P857 stripped of its possibilities to use the MMU and FPU expansion boards. The standard processor in the PTS 6810 and 6811 computers was P852. When P857 became available, PEAB-T designed a conversion kit to utilise the more powerful processor for heavier applications while letting the customers keep the rest of their hardware, including cabinets. The kit was named UK01 (Upgrade Kit 01).

8.4 Philips Data Systems Service

Since the number of PTS customers increased rapidly from 1974 onwards, only with a dip during the Unidata debacle, Philips built a service organisation with branches in every country having PTS installations. All PTS hardware was designed and constructed with serviceability in mind. The aim was that customers should have as little downtime as possible since

most customers had online- and time-critical applications. Good designs and high-quality assemblies primarily achieved this, but fast service was also an important cornerstone when some parts inevitably failed. By a modular design, entire modules were most often switched at the customer site and the faulty module was returned to a service centre for repair.

The aim of corrective field service is to find and replace faulty subunits in the shortest time possible. It is useless to try to create any kind of fault finding scheme, because every service technician has developed his own methods of troubleshooting. However, mind the following basic rules:

- Ask operators for symptoms; same or similar symptoms at several work stations indicate computer error.
- Use your eyes, ears and nose!
- Where available; run the diagnostics programs built into the equipment (subsections 4.2.2 & 4.2.3).
- If necessary; simplify the system by unplugging all unnecessary subunits. Load a few instructions via a service control panel and test the system instruction by instruction (chapter 3).
- Mind U-links and switches on subunits and on computer rack backpanels.
- Inspect "weak" components; fuses, switches, cables and lamps.
- After repair; run rest programs (chapter 5) to verify proper functions.

— CAUTION —

Switch off power before unplugging subunits. Bus transceivers are otherwise easily blown and may block the complete bus!



It is a bit unclear to the authors why the repairman has a red nose and sweat oozing out from his forehead, with puddles of sweat on the floor in front of him. Was it really that hard to repair PTS equipment back in the day?

CAUTION

Do not smoke while cleaning.
Do not touch head surface with fingers.
Do not leave residue or line on the head surfaces. Residual particles can result in a stored disc and/or loss of a head.

Maybe in the 1970s, it was necessary to remind the repairmen not to dirty the disk heads

8.5 The Development Environment

Programs for the PTS systems were developed on special stand-alone development machines. The hardware was the same PTS 681x computers sold to customers but with fewer peripherals connected. To the central unit, a disk drive PTS 6875 or 6876 was connected, together with either a VDU screen PTS 6346 and a keyboard PTS 6272 or a console consisting of a PER 3100 printer and an older Honeywell keyboard PTS 6234. Further, there was also a line printer connected, but nothing more. This was because the development systems used an operating system other than the one shipped with customer software. The development systems used the DOS operating system from PDS in Apeldoorn. PEAB-T prided itself on having a very efficient multitasking operating system (TOSS) for customer solutions that could handle a large number of workstations at the same time. But DOS was a single-user operating system, so one complete development computer could only serve one programmer at a time. There could be quite long waiting lists for DOS computers to edit programs. Then, after editing, compiling/assembling and linking, a programmer carried the binary file on a cassette or floppy disk to a test system configured precisely as a computer system at the site of the project's specific customer.

Some development teams were split into more than one location. If a programmer wanted to change locations for a day or be at a customer's site with the source code, it was necessary to carry around a 40 cm wide hard disk (or a magnetic tape if there was a PTS 6872 tape unit at the site). Since each PTS 6875/6876 disk drive contained two disks, one fixed and one removable, all files had to be copied to the removable one in order to change locations.

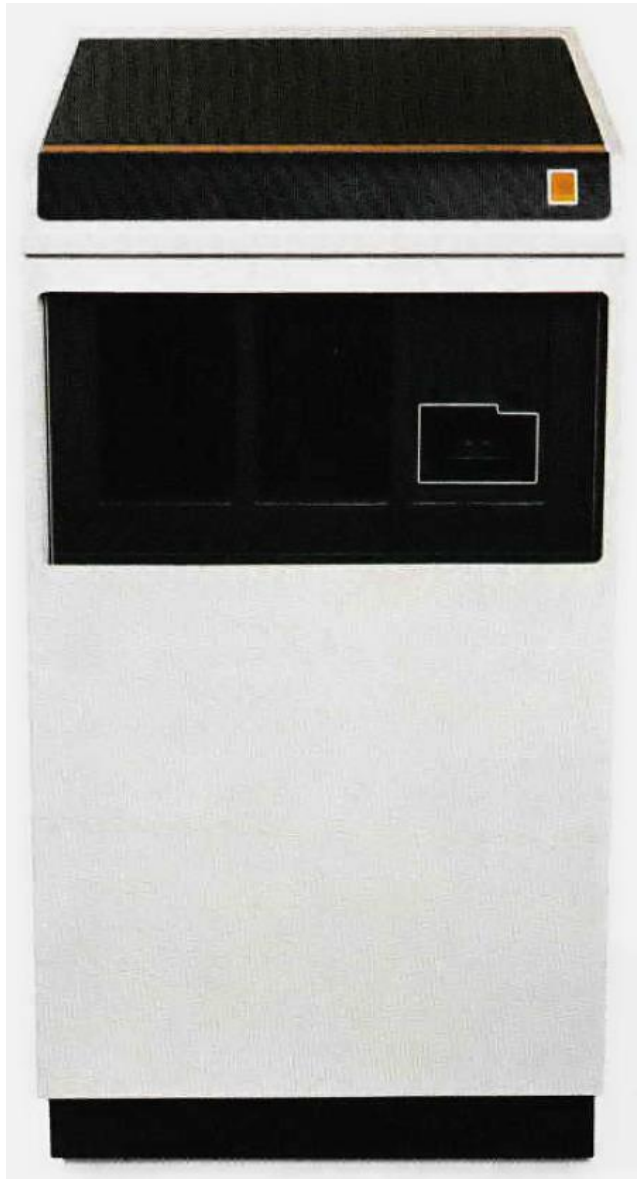


PTS 6876 Diablo hard disk with carrying case

The hard disks for the PTS 6875/6876 disk drives were “portable” but somewhat fragile, so they had to be carried in special carrying cases with cut-out foam to keep them steady. The disk capacity was 2.5 MB for 6875 and 5 MB for 6876, which resulted in a relatively small MB per kilogram ratio. But the arms of programmers became stronger.

PTS customers used other means of communication. For regular data communication, various electronic solutions were used. If there were more intermittent data exchanges, magnetic tapes were often the preferred solution. Some early data capture solutions used magnetic cassettes, a spinoff of the music cassette invented by Philips in 1963. However, when the programmers needed to transfer source code between sites, they were confined to carrying hard disks since there were seldom magnetic tape stations at the customer sites.

8.6 Third PTS Generation



Design study for the third generation of PTS computers

A new design style was sought for the third generation of PTS computers. The first generation (PTS 6110) did not have much of a deliberate design – it became what it became, with a manoeuvring panel at the top. The most important factor was that it was completed at all.

The second generation (PTS 6810 and 6811) had a more industrial design, signalling heavy durability, reliability and professionalism. That was the message that Philips wanted to underscore at that time (mid-1970s). But it was increasingly being criticised for not being very office-like or elegant, perhaps a bit too much on the industrial side.

When the third generation was planned (late 1970s), minicomputers were much more accepted in office environments and should thus blend in with other office equipment. A design study was launched with designers both from PEAB-T in Järfälla and PDS in Apeldoorn. The result of the study was a greyish, slightly brown-tinted cabinet with a black top and an orange stripe. Beneath the orange stripe to the right was an orange on/off switch that was lit when the computer's power was on. The upper part of the front door was transparent and the front behind the door was black (see image on previous page).



Design of an actual third-generation PTS 6813 computer

PEAB-T in Järfälla was happy with the design study, while PDS Apeldoorn was slightly less so. They did not like the orange on/off switch that especially the engineers at PEAB-T adored. It was a tribute to the first PTS computer, PTS 6110, which had precisely such an on/off switch. Since marketing departments and Philips Netherlands almost always won disputes, the orange switch was removed and replaced by a black switch marked ON and OFF; see the image above of a PTS 6813. As a token of consolation, the orange switch was kept on the SUM adapters since those were hidden away, out of sight under or behind desks.



Two SUM-L units with orange on/off switches

The design pattern established for PTS equipment was also used for other Philips products in different product lines. An example is the SOPHO-TEXT unit in the image below. The authors have no idea what such a unit does; the picture only serves as an illustration of how widespread the design pattern became.



SOPHO-TEXT unit with a circuit board in front of it

Thus, the third generation of PTS computers, PTS 6812 (P852) and 6813 (P857), used the second generation of the CTI P800 processors. When CTI launched its third processor generation, PTS stayed at its already established third-generation cabinet design but issued new models. The first new model was the PTS 6814 (P857R/CP7R), but as we have already discussed, the CPU was an underperformer and, thus, too risky to have as the workhorse of

a worldwide customer sales and maintenance operation. After lengthy discussions with CTI, the P857RA/CP7RA replaced the P857R/CP7R and the RA was a much better product. But why was the new PTS banking computer, based on CP7RA, called PTS 6824 and not PTS 6815 when the others were called 6810, 6811, 6812, 6813 and 6814 in succession? In reality, it was to point out that it was the second attempt at building the 6814 and that the first one barely counted. Since the P857R/CP7R was a weak processor, no mentionable volumes of either PTS 6814 (PTS version) or P858 (P800 version) were ever sold. However, the official claim was that PTS 6824 used CMOS memories instead of ferrite core memories, thus warranting a step up at the '10' position. The number series PTS 682x was initially reserved for memory modules (all circuit boards were 68xx), so the 6824 memory board had to be re-labelled 6825 when suddenly 6824 became the name of a computer instead.

Type Number	Description	6810/11/12	6813/14
PTS6822 P843-108	Memory module 8k 16-bit words of read/write core, cycle time 1.2 µsec.	X	X
PTS6823 P843-116 P843-216	Memory module 16k 16-bit words of read/write core, cycle time 1.2 µsec.	X	X
	Memory module 16k words of read/write core, cycle time 0.7 µsec.	X	X
PTS6824 P843-232	Memory module 32k words of read/write core, cycle time 0.7 µsec.		X

PTS memory module descriptions

Many new peripherals were developed for the third PTS generation. Philips in general, and PEAB-T in particular, was much into ergonomics. They had since long observed that their keyboard offerings (Honeywell OEM from the parts bin) were much too thick, but the technology of that day required a certain thickness. As the 1970s progressed, however, much slimmer parts and solutions became available and PEAB-T designed one of the world's thinnest keyboards, which they rightfully were very proud of. It first came in an alphanumeric version, PTS 6272 having 99 keys, and was later followed by a numeric version

PTS 6271 (40 keys, essentially the right half of a 6272) which even later became a base for the retail cash register FT80. The PTS 6271 keyboard will make a surprise appearance in Appendix B.



PTS 6272 alphanumeric keyboard

As seen in Chapter 5, PDS decided in 1976 to follow the global trend to take existing architectures, until then built with TTL technology, and put them onto a few, much denser LSI chips. This was, for example, what Digital Equipment did when they took their immensely popular PDP-11 architecture and shrunk it into an LSI chipset, suitably called LSI-11. Philips PDS did not want to be laggards in this race and commenced on a similar project, to be carried out by Signetics which was a silicon chip foundry in Silicon Valley that Philips had acquired. Said and done. As discussed in the previous chapters, Signetics together with CTI produced the SPALU/PLANET chipset containing a complete P800-architecture processor. Surprisingly, PDS Apeldoorn immediately decided to use this chipset to design a successor to the least powerful processor of the second generation, P852, and call it P851 since it was slightly less powerful.

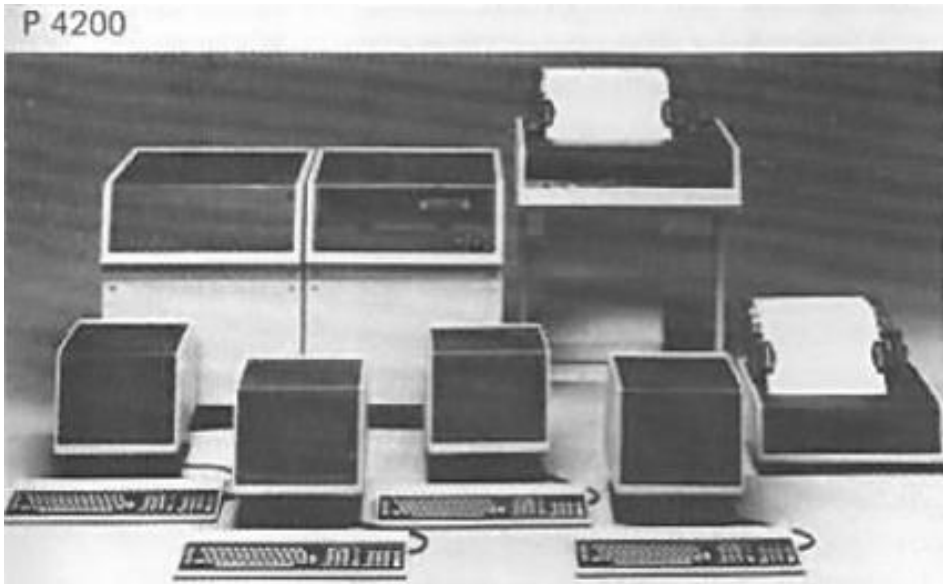
The problem for PEAB-T was that the new CPU board and the computer designed around it, P851M, was of another size. Instead of the bulkier Belier boards, P851 was built on much smaller Double Eurocard (6U) boards and with a different bus, so it could not fit into the PTS product line. And since P852 was going to be discontinued, there was no longer any low-end product to offer PTS customers. How could PEAB-T solve this dilemma? Once again, the parts bin concept came to the rescue. The P4000 series was a product line consisting of office computers for smaller enterprises; see Section 6.3. In the series, the P4200

model was equipped with the P851 chipset and was thus architecturally compatible with all the other P800 processors. This machine was “borrowed” from the P4000 series via the parts bin and given the name PTS 6805 since it was around half as powerful as the old PTS 6810. Its design was not exactly like the larger PTS 6800 computer product line models, but it was close enough to be acceptable as a substitute to projects, developers and customers.

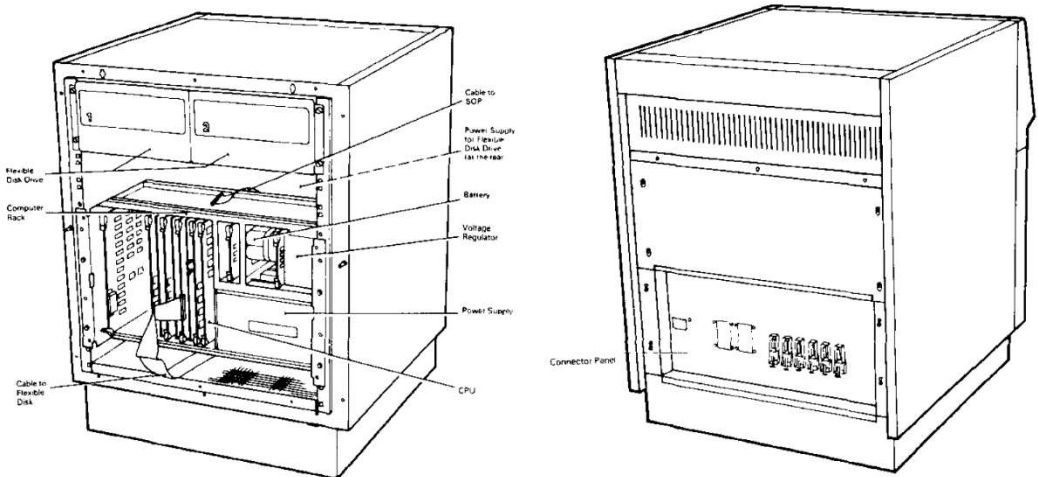


PTS 6805 (middle), PTS 6876 disk drive (left) and part of an “alien” P4700 (right)

It can easily be seen in the images above and below that the P4200 and the PTS 6805 are indeed the same machine. On the other hand, the P4200 keyboards and printers were PTS equipment that “went the other way” in the parts bin exchange system.



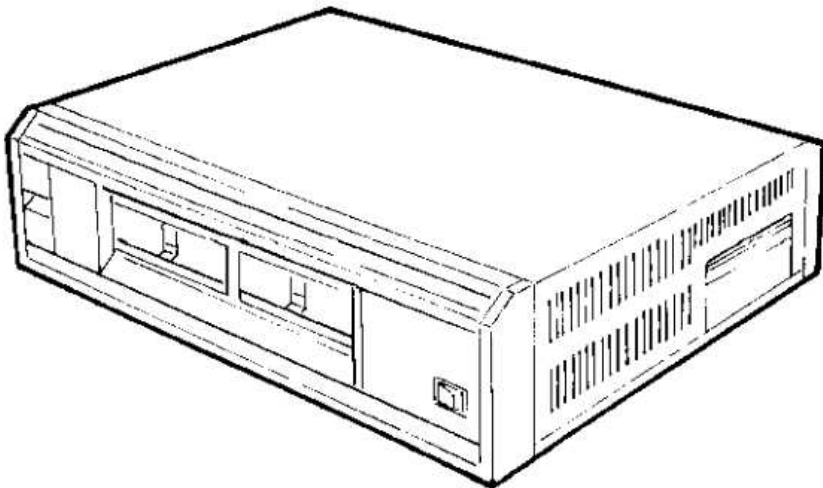
P4200 office system



PTS 6805 computer from the front (left, cover removed) and back (right)

8.7 Workstations

As a general technological trend, the miniaturisation trend continued. After a few years of sales, leading minicomputer manufacturers such as Digital Equipment were no longer satisfied with their five-chip LSI solution (LSI-11) but wanted a one-chip version of their PDP-11 architecture. That chip was called J-11 but in reality needed two more chips to be fully functional due to the limited chip area and number of pins available on a single chip package. Philips did precisely the same thing and implemented the P800 architecture in a single chip, the SPC-16/10. Unsurprisingly, it also needed two more chips to function as a complete processor: the SPC-16/11 interrupt handler and the SPC-16/12 bus handler. PEAB-T decided to build an entirely new computer (workstation controller) based on this new chipset and discontinue the PTS 6805 (P4200) which, as we saw above, was not a PEAB-T computer in the first place. The new computer was of an entirely new design and thus of a new generation. It was named PTS 6910 after the SPC-16/10 chip, with the '9' indicating a breakaway from the older Belier design generations. Internally called WS10/WS11 during its development (WS for workstation controller), the main difference between the two was memory size, and with increasing memory requirements driven by more extensive software specifications, the WS11/6911 became the more popular version. Both contained 5¼-inch floppy drives instead of the old 8-inch ones previously used by PTS equipment and could handle up to four terminals. Developed independently of the reigning design doctrine, the engineers were able to fit an orange on/off switch to the right of the chassis front.



PTS 6911 with two 5¼-inch floppy disk drives and an orange on/off switch

8.8 Model Numbers

Model numbers were always an issue for the P800 series due to the PDS numerology. From the original designation of the first CPU as the P850, we saw that marketing immediately invalidated the numbering scheme since it wanted three different computers in a “series”. The 8-bit Sagittaire proof-of-concept prototype, never intended for serial production, became the “new” P850. The real first-generation CPU became both the P855 and the P860 when marketing forced the engineers to “conceive” two more versions. As we recall, the engineers decided that the extended arithmetic capabilities of multiplication, division, double shifts, etc., should be the difference. Marketing scrapped that idea and made memory cycle time the differentiator instead. Thus, the P800 series went to market with the model series consisting of P850, P855 and P860. Central product planning in Apeldoorn was not happy about the P860 name since it was “too close” to the much larger and different P880, which was still on sale. When the further development of integrated circuits advanced at an increasing pace, only the faster memory made any sense, and all computers sold were the faster P860. However, Apeldoorn saw its chance to increase the model number gap to the P880 and mandated that the only remaining computer in the series (the P860) should be called P855, and no future product should go above P85x. Thus, instead of the PTS numbering scheme where the central processor was PTS 6110 and the peripherals 62xx and 63xx, the peripherals of the P85x processor control computers were relegated to the number series P801–P849; see, for example, the list on page 142.

We will now discuss the P800 series from another perspective, that of the buses (data and address, respectively). This was important since a product line, consisting of a number of CPUs and memory boards, also contains a vast number of communication adapter boards for peripherals as well as data communication. Thus, a product line such as PTS was very susceptible to changes to the bus. Such changes could trigger many redesigns and even the closure of a product line due to the redesigning costs.

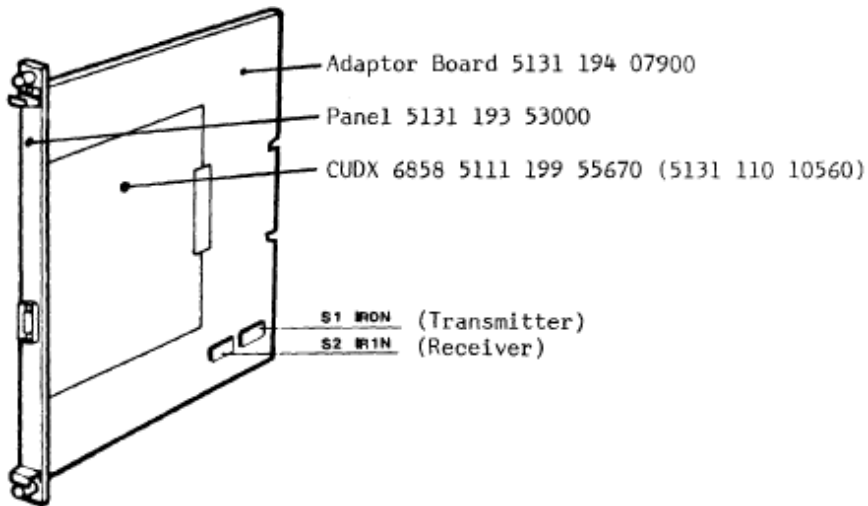
The first generation of P800 computers was equipped with the Sagittaire bus, which was kept from the prototype Sagittaire computer. Given the time-to-market plans made for CTI by Philips PDS in Apeldoorn, there was not enough time to redesign the bus. The result was mediocre bus transfer capacity and cluttered back planes due to an inefficient bus design, a key reason for PTS not adopting that generation.

A new bus, the Belier GP bus (where GP stands for general purpose), was developed for the second generation. This time, there were plans for two different CPUs already at the outset. PTS was immediately much more interested. Key processor differences would be advanced

integer arithmetic (again – a second try from the engineers), a separate floating point processor (FPU) for non-integer arithmetic, and an MMU (memory management unit) giving the capability to address more memory than the 16-bit addresses allowed (64 kB). To signify that these were substantial upgrades to the first generation, while still staying within the designated P85x range, the product numbers were increased by two. The low-end P850 successor was named P852 and the P855 successor became the P857. Thus, there were two steps up for both. The simpler P852 was ready to ship already in November 1974 while the P857 shipped almost a year later. Again, though, marketing got the idea that they needed a third model in the new second-generation series, and thus the P856 was born. It was simply a crippled P857 in that it lacked the MMU capability and the floating point processor but retained the advanced integer arithmetic, the multiple load/store instructions, and all other features of the real P857 CPU board, internally called CPB (= Central Processor model B). In essence, it was a P857 CPU board but without the extra MMU and FPU boards made available. This was, again, a meaningless product distinction since it was as easy to buy a P857 and not take up the MMU and FPU options. Internally, the P856 was also called CPB since it was the same as P857; see the table on page 131. PEAB-T only used the two real models in their computers: P852 in PTS 6810, PTS 6811 and later in PTS 6812; P857 in PTS 6813 and UK01, which was a kit that upgraded a PTS 6810 or PTS 6811 with a P857 processor, making it similar to the PTS 6813 in performance while letting the PTS customers retain the rest of their hardware in the earlier generation's cabinet.

It was getting more densely populated in the P850 number series. Numbers were not to be reused since many older machines were still in use by customers. With ever-shrinking chip dimensions during the 1970s, Philips decided (along with many other leading computer manufacturers such as DEC) to make their own LSI version of their P850 architecture. The 5-chip chipset was based on the P85x architecture, about midway between the P852 and P857. No MMU or FPU to save silicon real estate, the chipset consisted of 4 4-bit ALU units called SPALU and a controller unit called PLANET. When implemented in the P800 series, since it was much smaller and had a lower processing capacity than the P852, it was named P851. Due to the size reduction, the P851 was built on Double Eurocard circuit boards, which were substantially smaller than the previously used Belier boards (about 1/6 or 17% of Belier's size which were 19-inch/48-cm square-shaped boards). The bus was no longer the Belier GP bus but rather an intermediate bus (GBUS). For both reasons, the P851 boards did not fit into the PEAB-T product lines. The bus war was, though, about to break out. Apeldoorn signalled that the Belier GP bus was on its way out. To emphasise that fact, PEAB-T was no longer allowed to design their new peripheral or communications boards

in the Belier format – they must adhere to Apeldoorn’s Double Eurocard format. As a case in point, the Datex X.21 communications circuit board PTS 6891 was not allowed to be constructed in the Belier format, even though its use was confined to the Nordic countries, being the only ones in the world to use the CCITT X.21 protocol. It simply had to be produced as a Double Eurocard board (called PTS 6858 without the adapter and 6891 with it). Thus, they had to be supplemented with an adapter from Double Eurocard to Belier. Apart from higher cost, reliability was also negatively affected by the more complicated and delicate construction. Needless to say, it was assigned a lot of 12NC numbers...



PTS-6891-002

This Channel Unit is a combination of :

- GP Bus Adaptor Board, 5131 194 07900
- PTS-6858-003, CUDX, 5111 199 55670
- Panel, 5131 193 53000

The assembly is identified with 5131 194 90500

As chip speed increased and miniaturisation continued during the latter part of the 1970s, CTI decided to update their main CPU series by changing the older 74181 ALU units for AM2901s, a trend that almost all minicomputer manufacturers such as DEC and Data General did as well. Philips Apeldoorn decided that the new boards would only be built in the smaller Double Eurocard format and were allotted the numbers P853 (replacing P852) and P858 (replacing P857). These new CPUs would feature the new, corporate-wide UPL bus (UPL stands for Universal Product Line). PEAB-T voiced strong concerns over this plan

since they would be left without any CPUs as P852 and P857 were being discontinued. In a late move, it was decided to indeed build a new CPU using the new AM2901 ALUs on a Belier board with the familiar GP bus to fit the PTS banking computers. This bought PEAB-T some time, but they were warned that this would be the last time the Belier format and GP bus was going to be supported.

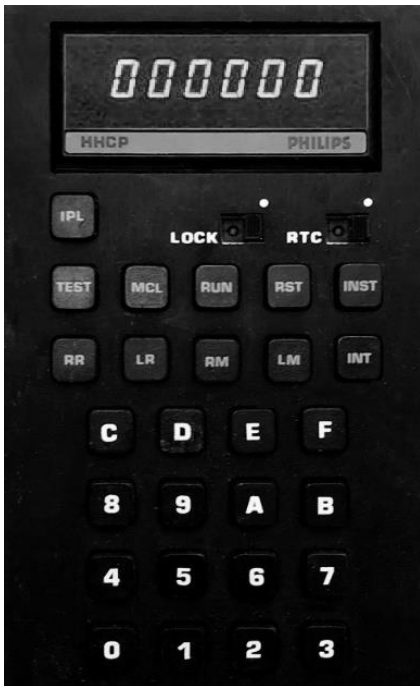
This change in product planning at CTI messed up the number series a little. It was decided to move the most powerful Double Eurocard CPU down to a P854 label from P858 (just above the weaker P853) and place the new Belier board at P858 (the new de facto successor to P857, not least size-wise but also bus-wise). To have their message sent loud and clear, though, the internal name of the P854 was P857E (where ‘E’ stood for extended), signifying that this was the “real” successor of the ageing P857 according to PDS Apeldoorn.

The P853 was the first of these third-generation CPUs to debut, followed by the P858 whose unplanned design was rushed. The P858’s internal development name was CP7R or P857R (where R stood for redesigned), underlining that it was considered a stopgap solution until the Belier format could be discontinued forever. Unfortunately, the rushed design yielded an inferior product that was slower than anticipated and contained a lot of bugs and patch wires to circumvent design errors, thus also being more fragile and less reliable in field use at customers’ sites. The P857R was reluctantly adopted by PEAB-T; what else could they do? The original P857 was said soon to become unavailable, so the PTS 6813 (P857) computer was replaced by the P857R in a computer that was called PTS 6814. Since the P857R did not have any of the newest features of the P854, such as 1 MB (20-bit) addressing or the ability to handle CMOS primary memory, this only added to the dissatisfaction. In a final plea to save the Belier format for the time being, it was agreed by Apeldoorn to have CTI re-redesign the P857R, not only because of design errors but also to handle CMOS memories, addressing 20 bits, etc. The new board, which had a much better design, was internally called CP7RA or P857RA, and as a separate P800 product it was called P859. Being a much better CPU, it was put in a newly designed PTS 6824 computer cabinet with battery backup for handling CMOS memories. The other CPU boards in the Belier series, such as the IOP (input-output processor), were never redesigned from the original second-generation (P857) era. The P857R/CP7R processor and P858/PTS 6814 computers were quickly forgotten. By now, all numbers in the 850 series had been in use, although that was definitely not what ultimately sealed the fate of the P800 or PTS 6000 series.²⁹

²⁹ Near the very end of the 16-bit era, with no more upgrades to the P800 processors, PEAB-T was forced to use the most powerful processors P857E and P857EB in their last stopgap computers PTS 6925 and 6927.

8.9 Turf Wars

As the reader might have guessed, many turf wars were going on. PEAB-T in Järfälla and PDS in Apeldoorn did, on several occasions, have different points of view on this or that matter. The orange on/off switch was only one case in point. Some turf wars were amusing, others were mostly silly. The control panel introduced with the third generation of processors was a silly one. The first two generations had lamp-and-switch-based control panels (SOP panels) with which it was possible to read and write to memory, single-step the processor, etc. But the third generation had control panels with buttons and numerical displays. The Apeldoorn P800 series offered a handheld control panel (HHCP) with limited functionality and a chassis-mounted one with full functionality (FRCP = front rack control panel).



Data Systems

PHILIPS

Field Support Manual

Hand-Held Control Panel

P843-500/PTS8890-001

A PUBLICATION OF
PHILIPS DATA SYSTEMS
APELDOORN, THE NETHERLANDS

PUB. NO. 5122 991 29681

DATE September 1980

Great care has been taken to ensure that the information contained in this handbook is accurate and complete. Should any errors or omissions be discovered, however, or should any user wish to make a suggestion for improving this handbook, he is invited to send the relevant details to:

PHILIPS DATA SYSTEMS
SERV. DOC. AND TRAINING DEPT.
P.O. Box 245, APELDOORN,
THE NETHERLANDS.

Handheld control panel (HHCP)

The chassis-mounted version was offered in, for example, the P854 computer. However, it did not fit into the design of the PTS computer cabinets. PDS Apeldoorn then decided that only the HHCP should be available in the PTS product line. But PEAB-T refused to accept

this due to its limited functionality and designed a large box by which the FRCP became “handheld” and fitted a 10-metre-long cable, much longer than the HHCP’s, to allow the technicians to move around if the computer was situated in a hard-to-reach place. Further, PTS did not include the HHCP in their product line at all. This did not go down well with Apeldoorn, so they invented their own PTS product number for a product PEAB-T did not sell. Since PEAB-T owned the 6-series of product numbers, Apeldoorn invented the (totally out-of-line) item number PTS 8890 for the HHCP, even though it was never on offer.



Front rack control panel (FRCP)

8.10 PTS Market Share

As we have seen, both Datasaab and Philips took their front-office banking solutions to the world market. While Datasaab was indeed successful, being the world’s fifth-largest manufacturer, they never made much profit from their endeavours. The reasons were manifold. They did not have access to a parts bin like Philips had (see Chapter 6). This meant that the cost for the peripherals included in a customer contract became much higher. Further, they were not able to reuse the software in the way Philips did, leading to larger software costs in their projects. Philips stayed out of the US market and tried to conquer all other world markets, while Datasaab lost a considerable amount of money trying to establish themselves in the one market where the most computer competence by far resided and the banking

system was immature. Datasaab also had problems with software quality, not being able to replicate the quality of the mostly error-free software that came out of Philips projects. This, of course, led to costly software revisions and long test periods. To cite a professor in computer science in the US who was involved with PTS software in the early-to-mid 1980s.³⁰

Because assembly programming was laborious, systems remained small. We added things one instruction at a time and didn't throw in extra features on a whim. Philips Terminal Systems (PTS), where I worked later, produced teller terminals for banks. Their software had the wonderful property of being correct; once installed, it performed without a glitch. Such were some dedicated systems of old. This one ran a single teller terminal application—albeit with multiple tellers—under the custom operating system TOSS.

To sum up, the world market for front-office banking equipment during 1975–1985 consisted of the following companies in market share ranking order:

- 1. Philips**
- 2. NCR**
- 3. Nixdorf**
-
- 4. IBM**
- 5. Datasaab**

Of these, the three first had around 50% of the world market, with Philips having more than 20% on its own. The other suppliers, and there were many of them, shared the other half of the market. The reason IBM was not higher on the list had nothing to do with resources but was simply due to the fact that in their home market, the US, the banking system was scattered and somewhat antiquated (or at least immature) with different rules and regulations per state, thus not making up a large home market as they enjoyed with general computers.

PEAB-T and its distributed sales organisations kept close contact with its front-office banking customer base, both with current and prospective customers. Thus, soon after the introduction and proliferation of the IBM PC and clones, it was understood that this was the new industry-wide basic “all-terminal”. PEAB-T’s problems, though, were two-fold. The Philips PCs were neither very good nor (in the beginning) IBM-compatible and fairly late to market. They were also rather expensive, being built in Austria, while many competitors built theirs in newly industrialised countries with much lower labour costs. In addition, there was an

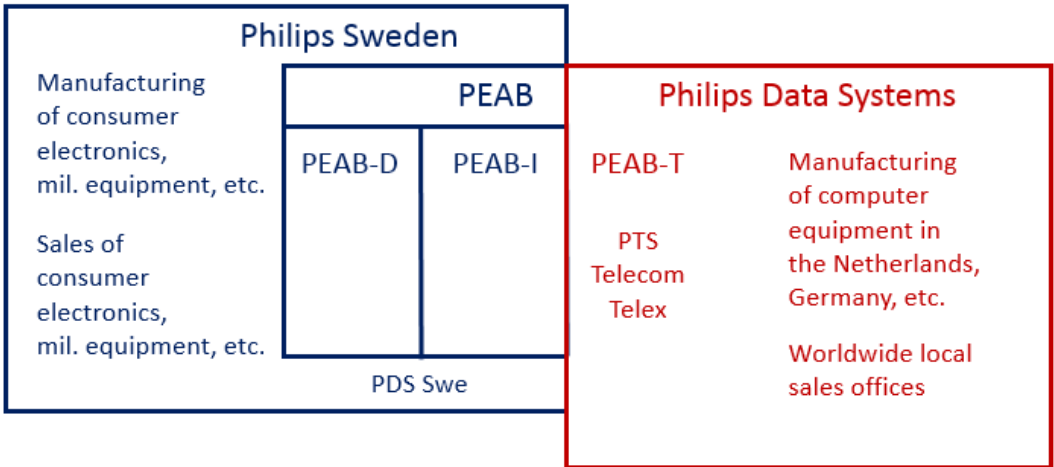
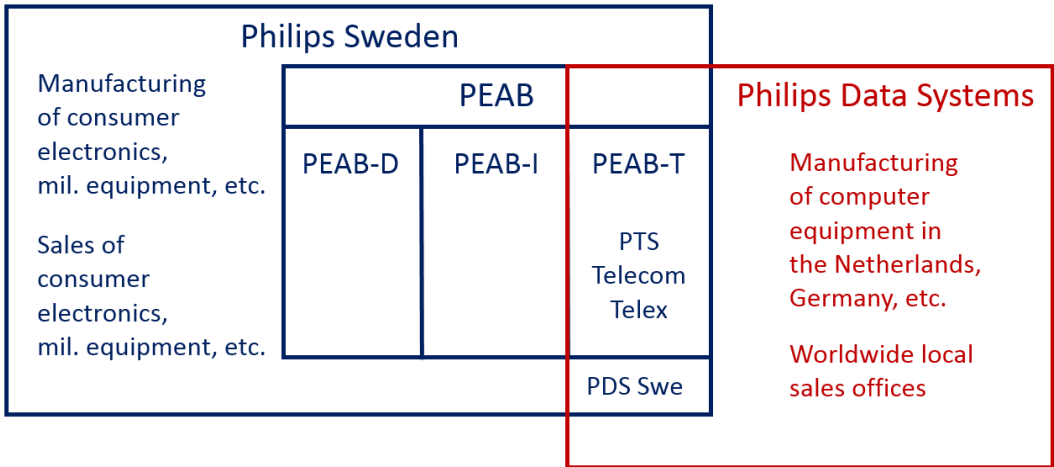
³⁰ From Design of Multithreaded Software by Bo Sandén, one of the three PhDs working in the DIDAS project discussed in Section 9.1 and the one finalising the Banpais solution.

implicit development ban on the 16-bit systems; see Chapter 9, so that interface electronics for PCs as terminals could not be developed, not even for internal tests. PEAB-T, being less clandestine than CTI whom we met earlier, unfortunately obeyed the policy. While it was recognised that some applications, such as the SMART travel reservations project in Appendix A, needed much more advanced screens than a mid-1980s PC, many banking applications were content with displays having 24 lines of 80 characters each. The ergonomics of Philips' early PCs were class-leading, so they could have charged extra for those screens in PC-based front-office systems sales. And even though the "coolness" of the banking advertisements in Chapter 9 (two of three showing PCs as terminals) was criticised, internally as well as externally, the approach of using PCs as terminals was the proper one and never doubted. The tone in sales advertisements and the factual product strategies were two very different aspects of keeping a product line alive.

The order value of large computer systems sales contracts, such as front-office banking systems, laid mostly in the complete solutions sold in which customers did not have to worry about or bother with the technology or its advancement at all for the extent of the contract. Instead, they put their trust in the supplier's competence. In other words, there was a considerable premium paid for receiving a turn-key solution complete with lifetime development, updates, service and repairs. Replacing custom-made VDU screens with in-house PC clones in customer projects was an entirely viable option at around the time, 1984–1985, when PEAB-T's decline began. The most viable option for PEAB-T would have been to acquire IBM-compatible OEM PCs via the parts bin and use Philips screens together with them. However, as we saw above, that would have meant designing new 16-bit interface electronics. This should have been the overall strategy – modernise the 16-bit product line as far as possible while planning for a gradual move over to 32-bit products. In the same way that Intel 8088 harboured a 16-bit CPU in an 8-bit environment, PTS could have introduced 32-bit hardware in an evolutionary process. Even if the IBM PC appearing on the world stage was being touted as a major nail in the PTS coffin, it was in actual fact not. Of course, the Philips PCs (or some other, cheaper OEM PCs) would have had to be modified and developed into special versions for PTS use, including full IBM compatibility according to customer's requirements, but that was mostly software and BIOS development and could have easily been carried out under a standard parts bin exchange within Philips. PEAB-T was used to modify incoming parts bin equipment for front-office banking use in very large sales projects. It was one of their specialities and a requisite for survival. For a real explanation of the decline, however, we now instead turn to Chapter 9 for the next (and last) chapter of the PTS endeavour.

9. Data Systems Decline

In the beginning of the 1980s, some worrying signs started to appear. PEAB-T seemed no longer to be in complete charge of its decisions. The decision-making power slowly and gradually drifted away from Järfälla to Apeldoorn. This was related both to decisions on the content of the product line and to the development of software packages.



The original organisation (above) and the new one, gradually enforced (below)

The original matrix organisation with different roles, in which Philips Sweden was the host of the business through PEAB-T and Dutch Philips Data Systems in Apeldoorn was the market coordinator, was step-by-step being replaced with a command structure where Dutch Philips Data Systems in Apeldoorn was more and more in command, and PEAB-T became a factory mainly obeying orders. It took a couple of years before the shift was completed and possibly more before it was fully realised in the PEAB-T organisation, but it was already troublesome when it started. From an organisation in full control over its products, PEAB-T slowly morphed into a remote-controlled factory. That change would later prove to be catastrophic. Compare the organisational charts above – originally from Chapter 7 (repeated here) and the enforced one.

9.1 Software Packages

An immediate result of the power shift was that larger new software packages should be developed in Apeldoorn, or at least controlled from there, not as before at PEAB-T in Järfälla who knew their own products and markets. Two of the largest packages affected were EDM, an advanced file management system, and DIDAS, a distributed database.

PDS Apeldoorn headed the EDM development with some assistance from PEAB-T in Järfälla. The two existing PTS file handling packages, SDM and ADM, developed in Järfälla, were deemed unsatisfactory by Apeldoorn. SDM was Standard Data Management which efficiently implemented normal file handling functions. It was the choice for most applications that needed to handle files, i.e. most customer projects. ADM was Abridged Data Management and implemented a subset of SDM's file handling for applications that were short of memory (recall that these were 16-bit systems, some without MMU, thus having a very limited address space of 64 kbytes). However, it was decided that a new package, EDM (Extended Data Management), was necessary for the largest and most complex applications. Its main (and possibly only) advantage was the ROLLBCK command (yes, no 'A') which could roll the content of the file system back to its latest commit point if something had gone wrong. It sounded nice in theory, but such functionality was not too hard to implement in the application itself if SDM was being used instead. EDM was mainly developed over 1300 kilometres away from PEAB in another country by people who did not know the PTS software architecture or development culture very well. This arrangement resulted in a product that was unstable and felt very peculiar. The manual for EDM made for some strange reading. For example, the EDM package could, on purpose, signal "All OK" (= condition register 0) while in reality a fatal error had occurred. Its error signalling was different from

and counter to every other PTS software package – which were all cast in the same form. Two excerpts from the EDM manual serve as examples:

10.2.2 Condition Register and Status Word

The relation between the values of the Condition Register and the bits set in the Status Word is as follows:

Condition Register Value	Status Word Bits
2	0 + any other bit, except bit 2 or 3
2	any of the bits 9 - 15
1	3 or 0 + 3
3	2 or 0 + 2
0	in all other cases

NOTE: Under EDM it is possible that a fatal error has occurred but the Condition Register is zero. Bit 8 is set in the Status Word, and the Return Status and Supplementary Return Status may be read to obtain more information.

NOTE: If bit 8 is set in the Status Word to indicate that more information can be obtained from the Return Status, this is not necessarily indicated by the value of the condition register; this may still have the value zero.

9.3.4 File Status

The first byte of the I-file indicates the status of the I-file (correct or corrupt). The value of this byte is set to 1, indicating corrupt, when the Monitor detects an I/O error during a block split in the I-file or EDM detects an inconsistency. When the file is accessed and found to be corrupt, the request is completed with bit 0 and 8 set in the Status Word and with Return Status indicating I/O error. In that case, the only order that will be accepted is Close File. The files may have to be recovered from the backups with the information from the function log file.

Intermittently, EDM would signal that the entire file system was corrupt. Nobody understood where that came from, and no information was available other than the dreaded first byte of the index file containing 1 instead of 0. The only thing to do was then to restore the file system from a backup. Quite a few of the projects that adopted EDM later reverted back

to the much more stable and lightweight SDM and, if necessary, handled rollback in the application instead by using checkpoints and transaction logging.

Finally, software developers and engineers were also perplexed when they encountered the following error code during runtime, either during system tests or at customer sites.

```
- Internal EDM error.  
  These will only occur during testing of EDM itself, for example  
  when a special version has been generated.
```

DIDAS (Distributed Database System) was another software package developed mainly in Apeldoorn. It was supposed to be even more advanced than EDM and implement a distributed file system that could completely recover if one node went down or became corrupt. An excellent idea that the PDS sales forces worldwide immediately sold to a lot of customers. Three of the relatively few computer science PhDs in Sweden at that time were hired to design and implement DIDAS. But as the development initiative drifted away from PEAB-T in Järfälla to PDS in Apeldoorn, there was not much they could do in reality. Unsurprisingly, DIDAS was never completed. Instead, it unfortunately imploded during construction. The sales forces worldwide had to renegotiate the contracts that promised DIDAS. Many customers accepted a modification of their order in exchange for a substantial price reduction. Thus, DIDAS was expensive not only from a development point of view, it was even much more so from a sales ditto. Two customers, however, were unwilling to renegotiate their contracts: the National Bank of Greece (which was, despite its name, a commercial bank and not a governmental central bank) and Banpais in Mexico – for these two, special solutions had to be created. The National Bank of Greece had less competence in their project team, so they (unknowingly) accepted a special version of EDM as “DIDAS” and consequently got their fair share of EDM problems to handle. For Banpais, an application layer solution had to be developed to act as “DIDAS”. Two of the three PhDs hired in Järfälla for the real DIDAS development had by that time left PEAB-T since the project they were hired to work on had been “kidnapped” by PDS Apeldoorn. The third PhD was asked to develop an application layer solution for Banpais, which, in essence, was a way of storing each message locally before it was sent, combined with clever ways of recombining messages if some were lost either in transmission or because of a hard disk error. The Banpais solution went live in 1985, and that marked, in effect, the end of any substantial cooperation between PEAB-T and PDS Apeldoorn regarding software packages. From a PTS point of view, it had been a tortuous and expensive adventure. The Banpais solution was used for almost ten years until the bank failed due to mismanagement, and all the bank’s offices were seized.

The Mexican government took over and when Banpais was sold at an auction two years later, the buyer's IT systems were being used instead. But in 1995, the Banpais system was one of the last PTS front-office banking systems still running outside Europe.

By The Associated Press

Aug. 30, 1997

The Monterrey-based financial concern Grupo Financiero Banorte has been awarded an 81 percent stake in the failed bank Banpais S.A., the Mexican National Banking and Securities Commission said today.

In a statement, the commission said Grupo Financiero Banorte would pay 678 million pesos - the equivalent of \$87.2 million - to Fobaproa, the Government's deposit insurance fund.

The commission said the payment was equivalent to 1.14 times the book value of Banpais.

Banpais was seized by Mexican Government authorities in March 1995 amid allegations of mismanagement. It was put up for auction on Aug 4.

The commission said Banorte would temporarily manage Banpais as an independent entity, ahead of its eventual merger.

The fate of Banpais, Mexico

9.2 Cool Advertisements

Many oddities emerged as PDS (and later TDS) took over more and more of the PTS system marketing decisions. The commercial advertisements went from few and factual to many more and "cool". However, neither PEAB-T nor the customers recognised this new style. It was not that way systems sales were conducted; those were rather multi-year efforts primarily building mutual trust and understanding. The cool profiling only confused and distracted customers who wanted to know if any substantial real changes were happening within the PTS product family and if so, which? Below are three examples of those advertisements.

The first shows an angry-looking bank customer facing a teller who inconsiderately looks away from the customer. Her keyboard is not in front of the teller position or the screen, so the ergonomics is terrible. What a way to (not) show PTS' strong ergonomics engagement.



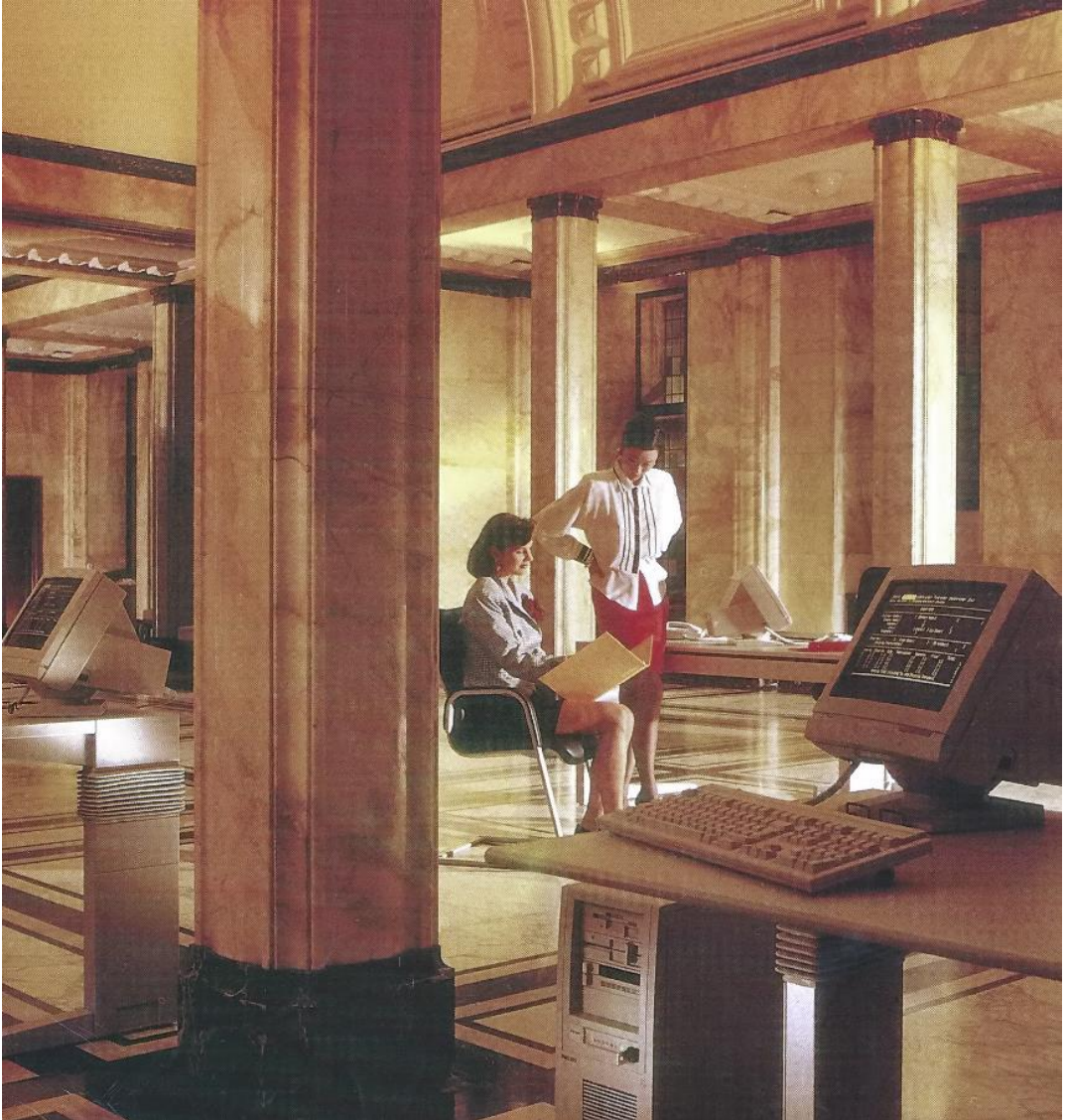
Cool advertisement number 1

The second cool advertisement shows a bank teller looking away from his Philips PC while keying at a keyboard not in front of the computer. The computer screen is facing away from the teller, who could not have seen much had he wanted to. For the ergonomics-conscious PEAB-T, this was adding insult to injury. Even though the picture shows a Philips PC, not a PTS terminal, the message to the large bank customers was the same. The idea for the next generation front-office systems was to use PCs instead of tailor-made terminals, for cost reasons but also for versatility. This style was a remarkable shift away from the very successful marketing activities of earlier PTS front-office banking and retail sales teams.



Cool advertisement number 2

The third cool advertisement shows two bank tellers in a huge marble palace without customers or other employees. Up front, there is a P9100 computer (we will come to those shortly) but none of the tellers engage with any computer screen.



Cool advertisement number 3

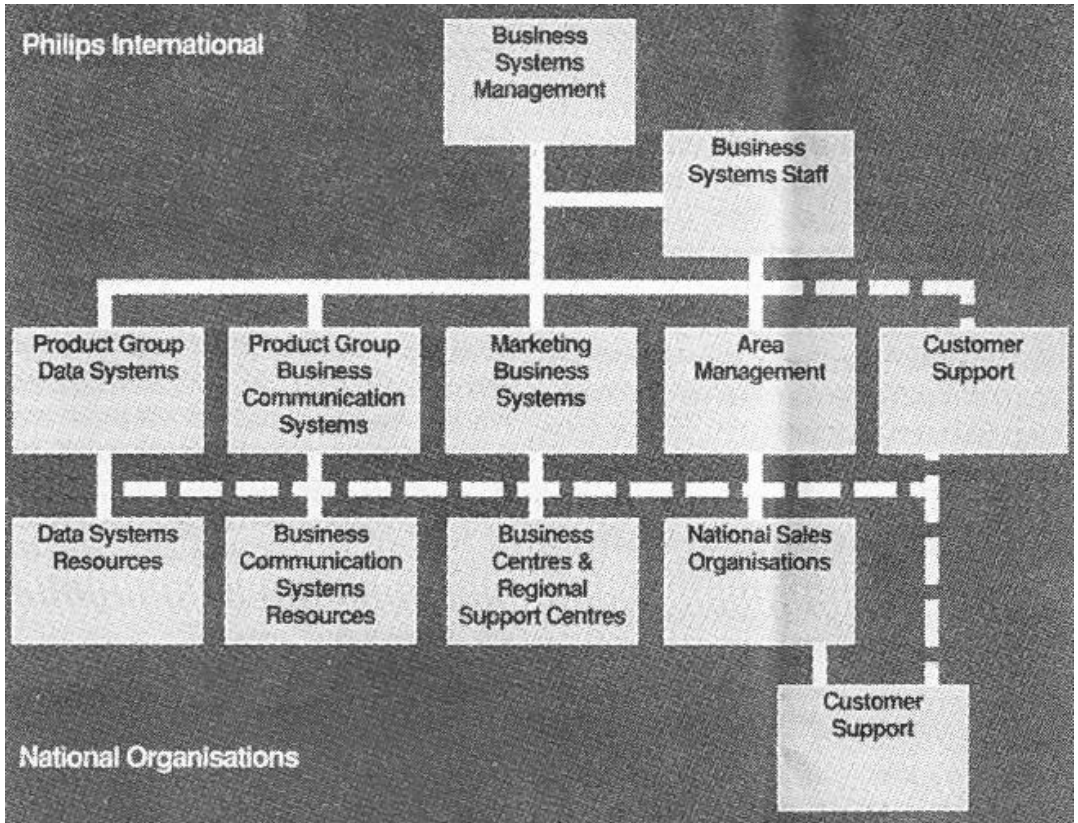
9.3 Reorganisation

In the computer industry, and as observed by market watchers, there was, at the beginning of the 1980s, a lot of talk about “the convergence”, which meant that telecommunication switches and gear were, to an increasing extent, containing computers. The functions of specialised relays and switches were increasingly being taken over by computers that could perform the same functions in software that required a lot of electro-mechanics in older-generation telecom switches. Thus, the underlying technology of telecom switches and computers was increasingly becoming the same, i.e. converging. This was by Philips erroneously interpreted as the *markets* converging. This was not true – telecom and computing had their different market logics and sales procedures, but Philips decided to merge the Data Systems (PDS) company with the Telecommunications and Information Systems (PTI) company, creating an unhappy TDS (Telecommunications and Data Systems) company. Conceived in 1983–1984, the reorganisation was fully implemented in 1985 and was almost a PTI takeover. The further away from the centre of the new organisation, the less attention and resources. Thus, PEAB-T and PTS 6000 were even more out in the cold. Still trying to operate as two separate companies but with unified management, TDS was an unhappy marriage that lasted for four years until it was dissolved in 1989. What the newly-divorced Data Systems company could have achieved never became known since all of Philips’ computer activities were taken over by DEC only two years later, in 1991; see Section 9.8.



The TDS reorganisation was likewise implemented in the Nordic countries, but there it went further. All the Nordic national organisations were merged into Philips Nordic, even though there were five separate markets that worked in similar but not identical ways. As a consequence, all telecom and computer activities were collected into one sales unit, with the Swedish head of computer sales Lars Nyberg as the new Nordic head of TDS. He stayed for four years and later described those years as taking more than five years out of his lifespan. This is remarkable when considering his further appointments, which included being the worldwide CEO of NCR (National Cash Register), one of PTS’ fiercest competitors in the front-office banking systems world market, and later CEO of Telia, the privatised former Swedish government monopoly telecom operator. There must have been something clearly wrong with the TDS organisation and how it was controlled from the Netherlands, combined with the 16-bit PTS implicit sales ban and catastrophic Octopus pilot projects (Swedish Post and later PK-banken). The TDS organisation

was dissolved both globally and nationally in 1989, by which time, unfortunately, there was not much left of the PTS business. Old customers were still being served, but not many new ones were acquired.



A complicated and convoluted TDS organisation that was never fully understood

9.4 32-bit Processors

PEAB-T, like every major computer manufacturer, could observe some new trends in the early 1980s. After the 'LSI implementation' and 'computer-on-a-chip' trends, it was clear that the world was moving on from 16-bit to 32-bit processor solutions. PEAB made a study trip to the US in 1982, visiting the leading processor chip manufacturers of that time, Intel, Motorola and Digital Equipment (DEC), to see what they had to offer. With a more narrow customer base than the computer giants, it did not seem likely to Philips that they would be

able to repeat their 16-bit success at the 32-bit level by designing and developing their own processors. It was better to seek cooperation. The project team went on the trip with only one instruction: “Make any inquiries you like and make any suggestions you like in your travel report, as long as it recommends Motorola”. The background was that Philips had, in 1981, globally signed a five-year agreement with Motorola to produce their MC68000 microprocessor series as a second source through Signetics, and the deal also included co-development of different computer chips and hardware development environment systems.



Motorola MC68000 P10 chip (=10 MHz clock frequency, originally 8 MHz)

The study trip went well in the sense that they met with the top management, the chief design engineers and the global marketing managers of all three companies. Philips was the world's largest electronics manufacturer and was well-received everywhere. At Intel, they saw the iAPX 432, a 32-bit microprocessor that had been in the making for quite a long time. It was some three years delayed and showed signs of being overcomplicated and thus slow. Visiting Motorola, they saw the MC68020, the first full 32-bit version in the 68000 series. Finally, they met with DEC, who showed them the MicroVAX (Seahorse), but it was only at a design stage and risked becoming too expensive and/or being delayed. So, it was not too hard to recommend Motorola for the next generation processors. Unfortunately, soon after their arrival back in Järfälla, due to the power sliding away from PEAB-T, PDS Apeldoorn announced that PEAB-T should not make their own computers any more. The next generation should come directly from Apeldoorn. This essentially put a cap on any development efforts at PEAB-T. In the years that followed, they waited, and waited, and waited... But the market did not wait. The demand for PTS front-office banking solutions was still very robust, and many systems were sold every year – the world's number one spot in front-office banking systems was being held on to, even if the lack of 32-bit computing power started to have an impact. For example, in Sweden the new Svenska Handelsbanken order was lost to Nixdorf in 1985 when no 32-bit system could be offered. This was especially sad for some older Philips personnel for nostalgic reasons since Handelsbanken had been the very first PTS customer, and the success of that project became the basis on which the entire PTS worldwide business was built.

An example from September 1986 shows incoming orders for around 50–60 MEUR in today's exchange rates (in Dutch, but system names and order amounts are easy to read). And most orders still came from Europe, not from other parts of the world where automation had not gone as far. Thus, the PTS product line was still attractive to fastidious European banks, not least because of their very extensive, durable and easily serviceable peripheral offerings, mostly specially made for or adapted to the requirements of online front-office banking systems. Not bad for a computer systems series that started well over a decade earlier.

Belangrijke (banking) orders

Philippijnen.

De Far East Bank and Trust Company (FEBIC) in Manilla bestelde 15 Philips ATM's (Automatic Teller Machines) voor installatie in de hoofdstad, Cebu City en Baguio City.

Frankrijk.

Door het GCB (Groupement des Cartes Bancaires), het consortium van alle Franse banken is een basiscontract getekend voor de levering van ruim vier miljoen Smart Cards (waarde circa 130.000.000 Franse franks).

Eén van de grootste commerciële bankinstellingen van Frankrijk, Crédit Commercial France, bestelde 600 werkstations ter waarde van 45.000.000 Franse franks.

Nederland.

Het administratiekantoor van de Nederlandse PTT plaatste kortelings de eerste definitieve order voor PTS6000 apparatuur: 350 front-/back-office werkstations.

Engeland.

De Halifax Building Society - het grootste bouwfonds in de wereld - plaatste een aanvullende order ter waarde £5.5 miljoen voor 150 werkstations, 384 PTS6925 terminal computers en 100 ATM's.

Schotland.

De oudste klant van Philips Banking Systems, de Scottish Trustee Savings Bank, heeft ter vervanging van het oude systeem een order geplaatst voor de levering van 1430 werkstations met een gezamenlijke waarde van £6.5 miljoen.

Italië.

De Cassa di Risparmio di Venezia gaat eveneens het oude machinepark vernieuwen en tekende daartoe een order voor 28 PTS6824 en 12 PTS6927 systemen.

Credito Italiano, op twee na de grootste bankinstelling in Italië, bestelde apparatuur ter waarde van 4.000 miljoen lires.

Incoming orders in September 1986 (in Dutch, "belangrijke" means important)

In October 1986, Philips still showcased all of its 16-bit systems at an exhibition fair in Amsterdam. But only a few weeks later, a message was out from the Netherlands that after the end of 1986, 16-bit systems sales were no longer viewed favourably. The future only contained 32-bit systems. While true in the longer run, an almost immediate sales ban would mean that the sales forces had nothing to sell since Octopus, see the next section, was years behind schedule. This, in essence, killed the PTS 6000 product line as well as other Philips TDS computer product lines.

De Philips-deelname aan de Efficiencybeurs in de RAI-Amsterdam (van 6 t/m 15 oktober 1986), gepresenteerd in de stands 114 t/m 119, stond geheel in het teken van "Informatie en Communicatie".

Getoond werden onder andere:

Personal computers.

De toenemende rol van personal computers (P3102, P3200 en YES) als intelligente werkstations in grotere systemen (P3800, P4000, PTS6000 en P7000) kwam eveneens duidelijk tot uiting.

Banking.

Veel aandacht is er besteed aan Philips systemen die mede vormgeven aan de moderne dienstverlening door financiële instellingen.

Eenzijds door het tonen van de mogelijkheden voor zelfbediening (geldautomaten en een zelfbedieningsterminal), anderzijds door het demonstreren van systemen voor "personal banking" door middel van personal computers, gebruikt op basis van nieuwe software voor PTS6000 systemen.

Tekstverwerking.

De nieuwe Philips tekstverwerker, de P5040, werd eveneens gedemonstreerd.

Gekoppeld aan deze tekstverwerker (maar ook geschikt voor de P5020) werd een geruisloze laserprinter getoond, die drie tot vier maal zo snel is als een daisy wheel printer en een betere grafische kwaliteit biedt (300 dots per inch).

Office computers.

De nieuwe modellen in de P4000 business computers serie, de P4400 en de P4700, werden nu op de beurs getoond. Naast het voordeel van de geringe afmetingen is ook de verder doorgevoerde modulariteit van de P4000-serie een aantrekkelijk facet van deze nieuwe types.

Koppeling van P4000-systemen in een netwerk biedt nu ook de mogelijkheid om vanuit ieder in het netwerk aangesloten werkstation op deze systemen te werken.

The last order received for PTS 16-bit equipment was from the bank Första Sparbanken in Sweden, which ditched its non-functional Datasaab/EIS system. It was signed on December 17, 1986, only a few weeks before the implicit sales ban. It was perhaps fitting that the first and last orders for PTS 6000 equipment both came from Sweden where it all started.

Belangrijke orders Banking

Philips Nordic heeft een order ter waarde van 19 miljoen gulden ontvangen van de Första Sparbanken in Stockholm voor de levering van 700 bankterminals, in de loop van 1988-1989 te plaatsen in de 30 kantoren van deze bankinstelling in Stockholm en Gotenburg.

Op 17 december 1986 werd door de heren Sjöstrand, directeur van Första Sparbanken in Stockholm (Zweden) en Bos, directeur van Philips Nordic, het contract ondertekend.

De Philips organisatie in Taiwan en Mercuries Data Systems hebben gezamenlijk een order ter waarde van 5,6 miljoen gulden ontvangen van de PTT in Taiwan voor de levering van 253 PTS6000 werkstations en 29 terminal controllers.

Deze apparatuur zal in juni dit jaar worden geplaatst in 103 bijkantoren. Met deze order komt het totaal van PTS6000 apparaten welke Philips aan de PTT Taiwan levert op 567.



De heren Bertil Sjöstrand van Första Sparbanken (links) en Hiltjo Bos van Philips Nordic (rechts) tijdens de ondertekening van het contract.

The last order ever for PTS 16-bit equipment (in Dutch)

The PTI 16-bit P4000 system had its implicit ban lifted for a while in 1987 since those systems were much smaller and consequently had considerably shorter sales cycles. No such luck for either the Swedish PTS 6000 front-office banking product line or the Dutch P800 process control product line. Thus, the latter two both essentially died at the end of 1986, even though after-sales and repair services would continue for almost a decade afterward.

Unix premiere and extended P4000 family

27.03.1987

Philips Communications Industry AG, office and information systems, presented their products and services at this year's CeBIT under the motto "Information management with prospects".

The P4000 dialogue system, which was on display again this time, offered a number of new functions. With the P4700 and P4800 models, up to 70 terminals can be operated in parallel instead of 36 thanks to the team processor concept (it enables parallel processing) and newly revised system structures. A new menu user system and new LAN-capable screen terminals can be seen for the first time for the P4000 family.

Short-lived artificial respiration for P4000 as P9000 systems were poised to take over

9.5 Octopus

PDS and PTI decided to put all eggs in one basket, in the form of the P9000 computer series with the codename Octopus, and with PTI possibly the more influential of the two. The 9000 numbering was the highest so far (except P920x), and the sky was the limit. PDS and PTI decided already in early 1983 to develop a new family of computers using the MC680x0 series of microprocessors. It was not a bad choice at all; Motorola was leading the microprocessor technology frontier at that time. But there were some large problems. First, many other manufacturers were also building very similar machines using the very same MC680x0 processors. How could Philips stand out? Nobody knew. Second, Philips had previously been notoriously bad at selling general-purpose computers, compared to many of its competitors. The PDS successes had been found in niche markets where they could prosper because of specialisation – PTS banking being one example. But now, Philips would again build general computers (old dreams die slowly, if at all). Third, neither front-office banking systems nor process control systems could do with general computers. They needed computer hardware and operating systems with specific real-time properties that general computers did not have. Neglecting these facts led PDS (and later TDS) down a rabbit hole.

To add insult to injury, the P9000 project was delayed from the outset and kept being more delayed as time passed. It should originally have been ready in early 1985, then in late 1985. But in August 1985, it was announced that it would not be available until late 1986 and then only for internal use. With release 1.1 in April 1986, 1.2 in July and 1.3 in December, it finally became available (1.3 was the first release internally outside the project team) even if it was only to other Philips divisions. Based on the 1.3 internal release, almost all 16-bit sales were immediately banned despite the fact that there was still nothing to sell. It was said that the filled order books would keep the operations afloat during the generation shift.



TDS Apeldoorn Octopus project symbol

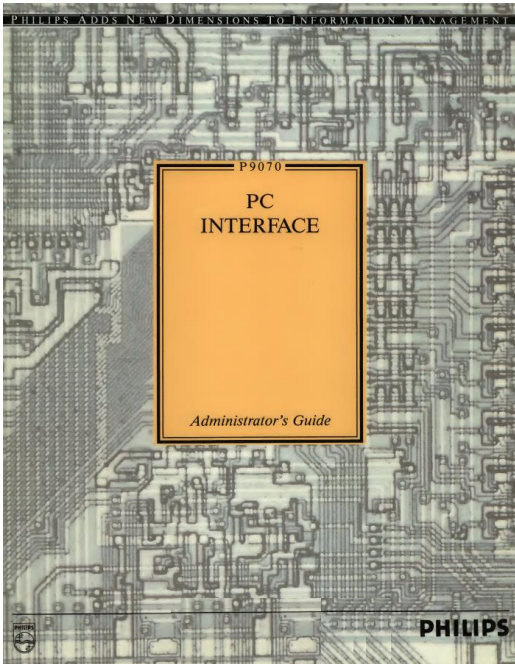
PEAB-T had been given special permission to sample the earliest release 1.1 because TDS needed some demo projects to show off to prospective customers. The two banking demo projects that were decided on were the Swedish Post and the Hong Kong Shanghai Bank. Both projects quickly ran into large problems since the P9000 series was neither ready nor suited for front-office banking applications. The Unix-derivative proprietary operating system MPX had to be heavily modified along with the hardware.

Since the original P9000 series was late, overcomplicated and expensive, TDS started looking for another solution for the mass market. The solution became to buy ready-made computers from its chip partner Motorola and rebadge them, exactly as they had done with the Honeywell minicomputers DDP-416, 516 and 316 some 15 years earlier. Thus, the P9000 series was split into two halves. P9x00 were the original Octopus computers in three versions, while P90x0 were rebadged Motorola 8000 computers (initially the 8600/8620/8640 models). The first of the Motorola offerings was named the P9070, followed by the P9050 and the P9090. Not much later, this became even more confusing when TDS launched the P9000i computer series equipped with Intel x86 processors. Now, there were three completely different product lines with a P9000 label. This did not make sense, neither to developers nor to customers. However, it did not end there. In an effort to gain market shares, TDS also launched the P9070r which was equipped with the Motorola MC88000 RISC processor, i.e. harbouring a third instruction set within the P9070 label. Since this was confusing to TDS insiders, imagine how confusing it must have been for customers.



Motorola 8000 rebadged as Philips P9000 (model P9070)

The few incoming 32-bit PTS 9000 orders in Sweden, the Swedish Post (a worldwide demo showcase) and PK-banken, were severely delayed (multiple years!) and ultimately failed from a business perspective after requiring an eight-fold increase in the primary memory (from 2 MB to 16 MB) without being able to confine the runaway projects' software. Long in the making, the Swedish Post system finally shipped in 1988 but made almost no profits.



PC Interface Administrator's Guide

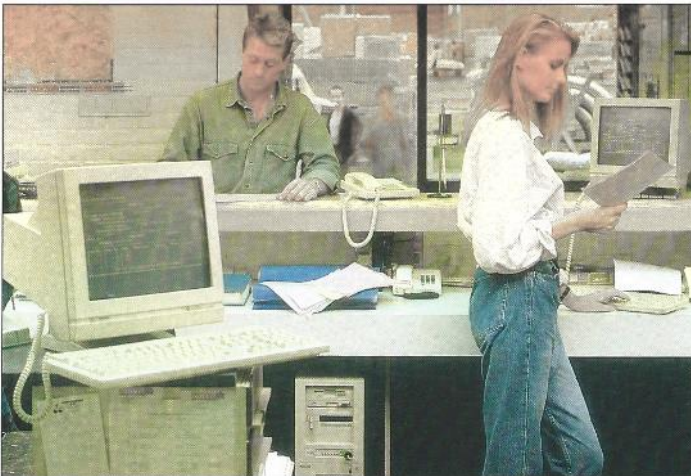
**UNIX System V
Motorola 8000 Computers**

87601909A
September 1986

Version 2.7

Motorola Computer Systems, Inc.

Philips TDS was not at all shy about admitting the rebadging. Turning the front page of a P9070 manual, all other pages immediately showed that it was a 100% Motorola manual and thus computer. They were good, but why buy them in a procurement detour via Philips?



Het Philips P9100 multi-user systeem is uitgerust met een uitgebreid software pakket, dat veel biedt voor uiteenlopende bedrijfstakken. Reisbureau's, huisartsen- en tandartsenpraktijken, advocatenkantoren, garages, verzekeringsbedrijven en makelaarskantoren kunnen in dit pakket oplossingen vinden. Het P9100 systeem kan vanzelfsprekend ook alle taken binnen een bedrijfsadministratie, zoals tekstverwerking, orderregistratie, facturering en dergelijke uitvoeren. Dankzij de multi-tasking mogelijkheid van Unix kan het systeem deze taken, en nog meer, gelijktijdig verrichten vanuit de verschillende werkstations die op het systeem zijn aangesloten. De minimale configuratie is bedoeld voor één tot vier gebruikers, maar het systeem verdraagt een uitbreiding tot 16 werkstations.

The P9100, P9200 and P9300 computers were primarily targeted at smaller offices and were never suited to be workhorses in either banking or process control. The authors have had problems finding people to talk to about Octopus. Some did not want to talk about it; most had already left or were in the process of leaving since very few orders were incoming. We will instead try to follow the process through some press clippings from 1987 and on.

February 18, 1987

BETTER LATE THAN NEVER – PHILIPS ENTERS THE UNIX MARKET

Philips UK yesterday launched its first Unix-based machines in the UK – and although it claims them to be new, Unit-C (now out of business) claimed to have a remarkably similar product from Philips late last year. The P9000 comes in two versions, the P9070 and P9X00. The P9070 is a 68020-based VME bus product from Motorola running the V/68 implementation of Unix. The P9X00 uses a proprietary Philips bus, PGP-Bus, and is based on the Motorola 68000 series. For the P9300 and P9200 the Motorola 68010 and 68020 are available but the P9100 can only use the 68010. The P9300 has either one 8 or two 5.25 hard disks; up to two 5.25 floppy drives; one 45Mb streamer tape; and a PGP-bus with 20 slots. The P9200 has up to two 5.25 hard disks; 45Mb tape streamer; and a PGP-Bus with 10 slots. The P9100 is supplied as a diskless or disk-based unit and has four PGP-Bus slots. The P9X00 uses Philips' own MPX implementation of Unix (Multi-Processor UNIX), claimed to be superior to System V although conformant to the SVID and X/Open portability guide. It has proprietary tools and transaction processing enhancements for service industries. The P9070 is aimed at P7000 users and the P9X00 at PTS 6000 users.

Very few orders were coming in during 1987. They were so rare that they made headline news. The first UK order was for a general information system, not a front-office system.

August 24, 1987

BANK OF SCOTLAND GIVES PHILIPS ITS FIRST UK UNIX ORDER

The Bank of Scotland will be taking UK£11m worth of Philips Business Machines Unix-based systems for use in its CABINET project. It was Philips' reputation for banking systems that won it this first UK order, and amongst the first worldwide, for the P9000. CABINET, Customer And Branch Information NETWORK, will provide general information services to the bank's branches for customers and accounts and ultimately will include balance sheet analysis functions for loan activities with companies. The P9000 Financial Business Systems will be connected to the bank's IBM mainframes using SNA. The Bank

of Scotland decision to take Philips' Unix-based machines was based not only on its reputation but also because it could offer Unix and a system that could mesh with its existing computer systems. The P9000 Unix implementation has been specifically developed for banks, and includes security and data integrity features. Seven pilot branches are currently operational and from September 20 branches a month will have their systems installed. The software for the IBM mainframe side of the project was developed using the Maestro Integrated Project Support Environment. The Bank of Scotland is planning to use Maestro to develop C code for the P9000, which will be the first time C code has been developed using Maestro in the UK although it has been done a couple of times before on the continent.

In addition to their two Octopus product lines, the homebrew P9x00 and the Motorola-re-badged P90x0, both based on Motorola MC68000 processors, TDS was looking into another product line using the Motorola MC88000 RISC architecture chip. That made the customer offerings even more confusing and the prospective volumes lower for each product line.

March 28, 1988

PHILIPS EYES 88000 CHIP, MAESTRO UNDER UNIX

Philips Business Systems was showing off its first 68030-based P9050 Unix supermicro at the Hannover Fair last week, but the Dutch company is looking towards RISC microprocessors to provide a performance step-up in its next generation systems. Software Productivity Systems marketing manager John Williams said that the evaluation process was still continuing, but that he would be very surprised if the company did not choose Motorola's forthcoming 88000 RISC processor – Philips' Signetics chip shop is an official second source for lower-level members of the Motorola 68000 family. Williams said that higher performance systems would be necessary to allow Unix to compete in installations involving computer aided software engineering tools such as its Maestro Integrated Project Support Environment. Philips recently signed a deal to supply five Maestro systems to the UK's Automobile Association, linked to a central IBM mainframe and supporting 212 proprietary Philips workstations and micros. Unix systems will eventually be integrated into this and similar projects by a communications sub-system. The intention, says Williams, is to gradually put more and more functionality into the Unix box, with Maestro under Unix being the ultimate aim.

A year into offering Octopus to the market, the first sale in Australia made headline news. Again, it was only a sale of general-purpose computers based on Philips' earlier credibility from selling PTS 6000 systems, which incidentally Philips also points out. The problem,

though, was that very many competitors also offered general-purpose computers. Thus, margins were much smaller and profitability low.

August 29, 1988

PHILIPS WINS \$3m UNIX SYSTEM CONTRACT FROM AUSTRALIAN BANK

While it is not widely seen as a general-purpose Unix systems supplier, Philips Telecommunications and Data Systems is gradually placing more and more emphasis on selling its Unix based P9000 series systems into its traditionally strong market areas. The banking world is one such niche, and now Philips has gained its first major success in Australia. The recently established Tasmania Bank has ordered some 50 P9200 systems, with 300 workstations for its 45 branches throughout the island state. The installation is due for completion by October of this year, using software developed with Philips' Text Form (TFM) and Workstation Management (WSM) development tools. The P9000 series was launched in Australia at the end of last year, but Philips says that it has PTS 6000 automatic teller machines and front and back office terminals installed with 39 Australian financial institutions.

To add further to the confusion, the different Octopus product lines used different versions of Unix. The P9x00 line used the homebrew MPX while P90x0 used Unix System V.3.

October 4, 1988

PHILIPS READY WITH 68030 MODELS FOR ITS P9000 UNIX FAMILY

Philips Business Systems first previewed its Motorola 68030-based P9050 systems at the Hannover Fair back in March, but has only just got round to announcing the full range of its next generation P9000 Unix departmental computers in Paris: the first UK airing will be at London's Government Computing Exhibition on November 16. The new processor gives a boost to the price performance of the current P9050 and P9070 boxes, which are supplemented with a new high-end model, the P9090. The low-end model uses a highly integrated single board VME-compatible computer which includes a 20MHz processor, floating point processor, and 4Mb on board memory. The top-end models use a more conventional board with just processor and memory, but with faster clock speeds and high speed off-processor memory. The Unix System V.3 compatible systems range from the 4-terminal P9050 to the 100+ terminal P9090, with 390Mb disk and up to 40Mb memory. Low-end system shipments have already begun around Europe, and the P9090 will be ready by January 1989.

We are slightly ahead chronologically here, but want to point out that in 1990, the newly-divorced PDS introduced yet another Octopus product line, this time based on Intel 80386 and 80486 processors instead of Motorola. The particular contract below had a high order value but sent the money down a fourth product line. And the profitability in the Intel-based server segment was low to none while production costs were higher at Philips than at many of its competitors. Further, since this was again a general-purpose computer order, there was no need for the PEAB-turned-PFBS-turned-BCFI equipment that distinguished PDS offerings in the front-office market segment.

June 12, 1990

PHILIPS LANDS \$100m IN BANK CONTRACTS

Philips NV announced a major Unix sales in Belgium yesterday with Banque Bruxelles Lambert, the country's second largest bank, and Aslk-Cger-Bank, the largest building society. The Banque Bruxelles Lambert order is for 5,800 80386- and 80486-based models in Philips' P9000 Unix line; the Cger order is for 1,200 P9000s. The combined business is worth \$100m over five years. Banque Bruxelles wants the machines as branch controllers and controllers for its Self-Bank system. Three of Belgium's five biggest financial institutions have now nailed their colours to the Unix mast.

9.6 Defence Withdrawal

The next knife stab in the back of PEAB-T and its PTS product line came when the board of directors of Philips worldwide in late 1987 secretly decided to sell off or close down all its military defence divisions and operations for ethical and moral reasons. The largest one worldwide was PEAB-D, located in Järfälla, Sweden, in the same building complex and belonging to the same company as PEAB-T. To facilitate the sales of PEAB-D – by offering its premises together with the company – the two other divisions (PEAB-T and PEAB-I) had to move out without understanding why. For that purpose, PEAB-T was made into a separate company, Philips Financial Business Systems (PFBS), and PEAB-I later became Philips Kistaindustrier for the same reason. The latter continued to build measuring instruments, mainly for Fluke, but was downsized to only 50 employees and sold to GE Capital in 2005. In 1989, PEAB-D was put up for sale and was acquired by the military equipment company Bofors to become Bofors Electronics, which then became NobelTech Systems in 1991 and NobelTech Electronics in 1992 before being acquired by Celsius Industries in 1993 to become CelsiusTech Systems. It does not end there, though, since in 2000, Saab acquired Celsius and thus the old PEAB-D and its premises became SaabTech Electronics,

which it (almost) remains to this day in the sense that it is still Saab-owned even if the company name has changed. Confusing? For us too...

So PFBS (old PEAB-T) was forced out of its home and returned to Johannelund (Vällingby) where it originated from 15 years prior. With not much to sell, it was constantly downsizing and mainly serving old customers. Many employees who had the opportunity left the company. From more than 1,400 employees in its heyday, only 460 remained at the move.

9.7 Divorce and Downsizing

The unhappy marriage of the Data Systems (PDS) and Telecommunications (PTI) divisions in 1985 was dissolved by divorce only four years later. The fatal misunderstanding of what the much-talked-about convergence between computers and telecom equipment was about led to an organisation in which neither part understood the other or was even interested in doing so. Another primary reason for the split was to dress the brides to sell either or both more easily, should that become a reality. Which it did.

December 17, 1989

PHILIPS FIRMS PLANS TO SPLIT TELECOM, DATA SYSTEMS

Philips Gloeilampenfabrieken NV has firmed up its plans to split asunder its Telecommunications & Data Systems unit, which was formed only four years ago to pursue the chimera of convergence of computers and telecommunications. The plan, foreshadowed here last month, is intended to improve operating efficiency, sharpen management effectiveness and enhance profitability in fiercely competitive markets, the company says – the computer side of its business is currently unprofitable. The combination of the businesses failed because it burdened top divisional management with the task of balancing diverse demands for resources and attention from line managers dealing with differently behaving markets and profit potential, slowing decision-making at the divisional level and preventing middle managers from reacting fast to shifting industry trends. Philips Data Systems has been an indifferent performer for so many years now that this could well be the last chance it gets to come good before Philips decides to give it best and seek a buyer for the unit.

If anyone at Philips PFBS/BCFI in Johannelund had not seen the catastrophe coming, it was now painted large on the walls. PDS wanted to stop building the homebrew P9x00 computers, the only ones with a shadow of the real-time properties and capacities required for front-office banking. The P800 process control systems had similar requirements, but that product line seemed already to have died entirely and been buried.

June 20, 1990

PHILIPS ANNOUNCES 210 JOB CUTS: MOST HARDWARE CUT OUT

Philips NV yesterday committed to bringing its information systems division back into profit by 1992, but the moves will require drastic surgery and the company is going to phase out most hardware manufacturing and development. As a first step, 210 of the 700 people at its Dutch computer division in Apeldoorn are to go, but in the longer term it will buy in much of what it now makes which suggests that personal computer manufacturing will be the first to go. The company says that it has not yet decided on the future of the P9000 Unix family. Currently, it consists of Intel APX-86 family-based models at the bottom, 68030 models – with 68040 ones planned – in the middle, and Edgecore-based 68020-compatible models at the top. It has also been planning for the introduction of the Motorola 88000 RISC. Now any such move is likely to be via bought-in product as it switches its research and development efforts over to systems integration and vertical market applications development. The proprietary P4000 office computers, which competes in the IBM System 36 market, are also likely to go.

9.8 Digital Equipment Corp.

The third knife stab came in 1990 when the newly appointed CEO of Philips decided to get rid of everything that had to do with computers globally. That, of course, included PFBS (Philips Financial Business Systems), the former PEAB-T which had been renamed Business Centre Financial Industries (BCFI) in an attempt to dress the bride. Philips BCFI was included in the sale of all computer-related businesses to Digital Equipment (DEC) in July 1991. From this third stab wound, the PTS business would never recover – it only went downhill afterward. An immediate redundancy programme was launched at BCFI by DEC, with the sole aim of reducing the number of employees by at least 100 regardless of strategic competence. After that, the number continued to decrease through further downsizing efforts and employees looking for jobs elsewhere. It is hard to find any traces from that time because it was still legally named Philips BCFI until April 1993, when DEC BCFI was finally incorporated. The latter incorporation coincided with a move back to Veddestavägen in Veddesta, only 1.5 kilometres south of Nettovägen where PEAB-T (then called PTS, a division of Philips Sweden) had previously been located for many years. But now we are getting a bit ahead in time. Let us first have a look at how Philips put PEAB-T/PFBS/BCFI and all other computer businesses worldwide on the market and what the result became.

By leaking stories like this, Philips was in effect putting its computer businesses up for sale. A too direct approach, using a mergers and acquisitions firm, could have put pressure on the market value since it would have (correctly) signalled some degree of desperation.

May 16, 1990

THE ASSETS – AND LIABILITIES – PHILIPS OFFERS WOULD-BE PARTNERS FOR ITS COMPUTER ARM

Philips NV's problematic information systems business account for some \$1,100m of the company's \$30,000m turnover for 1989. The computer side of the business is split into five product areas – personal computers, optical storage systems, minicomputer systems, Unix systems and the strongest area of the computer side globally, systems and terminals for banks and building societies. Sales to the financial sector account for 38% of all information system sales, the bulk of this is taken up by sales of financial terminals – so that that will clearly be a key inducement for any eventual partner, and would offer ICL an very attractive extra string to its bow. Sales to small businesses account for 34% of all information system sales. In product terms, of the information system sales in Europe personal computers represent 23%; minicomputer systems 38% (many of these are used as financial terminal controllers and network nodes); and Megadoc, the optical filing system, accounts for 6%. No figures are available for Unix systems or products for the financial sector. But in the UK, sales of Unix systems account for almost 100% of all information system sales. Manufacturing is split between West Germany, the Netherlands, and Canada. Minicomputers and Unix systems are made in hideously expensive West Germany, in Holland there is a systems software development centre, and personal computers are made in Canada – Philips entered the dedicated word processor market with the acquisition of Montreal-based Micom Ltd back in 1982. Dedicated word processors gave way to personal computers and Philips had to follow, by which it has had an unhappy time in personal computers, typically coming out with attractive-looking, well-engineered machines, originally made in high-cost Austria, that were simply too expensive. Despite the pain in its computer business, Philips was still expanding that side of its business as recently as last year, acquiring Headstart Technologies in an effort to become a major player in the US market. There would be clear benefits to ICL in taking control of the Philips business, with little overlap after manufacturing is rationalised, and the UK company must be interested – it looked closely at Nixdorf Computer AG before Siemens AG exercised force majeure with a German solution, but it is not certain that the elder statesman in Eindhoven would stomach a sufficiently radical restructuring.

And about a year later, DEC had swallowed the bait.

July 23, 1991

DEC ADDS PHILIPS INFORMATION SYSTEMS TO ITS TROPHIES

Digital Equipment Corp has duly come out on top in the bidding for Philips Electronics NV's Philips Information Systems, and will add the company to its other big European acquisition, Mannesmann-Kienzle GmbH, which it bought late last year. DEC is paying an undisclosed sum for everything except Philips' personal computer business, Smart Card operations and dictation systems, but needless to say will leave Philips to sort out the Eiserfeld factory in Germany. The German plant was in large part responsible for the downfall of Philips, because the cost of manufacturing there made its products uncompetitive. The two most interesting elements DEC gets are the banking terminals and the Megadoc document image processing system, which is claimed to be the European market leader. It will take on the 7,000 non-manufacturing employees – 620 in the UK – and gets a business said to be doing annual sales of almost \$1,000m. In addition to the transfer of the information systems activities, Philips said that it will explore further possibilities for co-operation with DEC in the areas of personal computers, components, and compact disk interactive. At present, DEC buys its personal computers sold in Europe OEM from Olivetti. No doubt Philips would like to take on that business. There is little product logic in the acquisition. Philips these days buys most of its computers OEM from Motorola Inc. and Sun Microsystems Inc. – and the fact that Motorola failed to buy the company raises a question mark over how serious the chipmaker really is about making it in computers. Philips' OEM agreement with Motorola Computer Systems is to be continued for a transitional period.

DEC had no idea what to do with BCFI and mainly let it decay. BCFI diligently serviced their old PTS customers, but all of them realised from DEC's behaviour that they unfortunately needed to phase out their PTS systems as soon as possible. There were some market activities, but DEC's more aggressive marketing and sales activities tended to turn happy PTS customers into unhappy DEC BCFI customers, many of whom elected to switch suppliers earlier than initially planned. It was also a question of uncertainty whether and for how long spare parts and repair services for PTS equipment would be available. This fear abruptly came true when Compaq acquired DEC in 1998. Compaq was only interested in sales of general-purpose computers and showed no interest in BCFI. Their complete lack of interest in PTS equipment very soon turned it into expensive electronics scrap.



DEC head office in Maynard, MA



DEC-rented office space for BCFI on Veddestavägen in Järfälla



The net movement of PFBS/BCFI was rather small, only 1.5 kilometres

The new DEC organisation was very complicated and few understood it. Previously, PEAB-T had been the worldwide banking competence centre within Philips. Now, DEC had an organisation where, apart from the main headquarters in Maynard, which governed the overall systems sales businesses, Retail Banking Worldwide was located in Boston, the Financial Industry Expertise Center Europe was in London, and Retail Banking Europe was in Järfälla. The downsizing continued, as did the rebadging. The Philips-rebadged Motorola 8000 computers were now re-rebadged Digital Equipment. But they did not sell more because of that. For example, the following official statement from DEC was supposed to be clarifying but had the opposite of the intended effect, at least in Sweden.

Digital Business Centre Financial Industry handles FBS abroad, and this Stockholm, Sweden-based unit, along with Comtex Information Systems of New York, will sell and support FBS in the United States.

Example of a confusing press release from DEC BCFI



Re-rebadged Motorola 8000 computer

BCFI was perceived as a rather strange organisation, even within DEC; sometimes being on their own odd missions and, as one example, applied for trademarks that did not include the DEC logo at all. This was not popular with DEC in the US. Old PEAB-T personnel mostly did not feel at home in the new organisation, they even felt estranged. There was not much company culture in place or efforts made to counteract such feelings. The trust in DEC BCFI, by customers as well as employees and head office, was at a very low point.

European Union Trademarks filed by Digital Equipment BCFI

APPLICATION#	TRADEMARK	FILING DATE	CURRENT STATUS	TRADEMARK OWNER	
	000526491	Logo	Apr 22, 1997	Registration expired Feb 24, 2008	Digital Equipment BCFI AB Järfälla SWEDEN
	000526459	Logo	Apr 22, 1997	Registration expired Feb 24, 2008	Digital Equipment BCFI AB Järfälla SWEDEN

Strange trademarks filed as late as 1997, the year before DEC folded

It was not only the taken-over Philips banking division, or for that matter the entire Philips computer operations, that was unsuccessful for DEC. Their whole business failed almost completely within a few years, and in 1998, they were taken over by the upstart PC manufacturer Compaq. Compaq had almost double the turnover compared to DEC but with half the number of employees. However, turnover is not the only key business indicator – there is also something called profitability. Especially large system sales, like those of PTS equipment, while taking a lot of initial effort, once signed the profit margin was good if the generic/reuse aspect of both hardware and software was kept in mind (which Philips but not Datasaab succeeded with).

Unfortunately, Compaq had even fewer ideas on what to do with a banking division and the front-office market, so they almost immediately put BCFI up for sale. A Swedish innovator, the same one who once designed the banknote dispensers for the PTS ATMs (see Appendix A), bought BCFI in 1999 and renamed it BanqIT. With only 160 employees remaining (the downsizing had been brutal), the idea was to build a new generation of ATMs where it was also possible to deposit cash, not just withdraw it. In an interview from 2001, BanqIT saw no risk of debit/credit cards taking over from cash as the primary payment method within the coming 20 years. In fact, they foresaw no decrease at all in the world market demand for cash, not even the slightest. Unsurprisingly, most of BanqIT failed and it was acquired by the Norwegian consulting company EDB in 2005. By that time, almost every trace of the original PTS endeavour had been lost and PEAB-T had already been largely forgotten.

Det svenska företaget är ett dotterbolag till brittiska De La Rue Plc vars kärnverksamhet är just sedeltillverkning och automatisk sedelhantering. De La Rue tillverkar sedlar åt över hundra länder och säljer utrustning för sedelhantering i hela världen. Den brittiska koncernen räknar definitivt med en fortsatt ökning av antalet sedlar i världen och att kontanthandeln inte ersätts av betalkort, internetbanker och andra elektroniska lösningar.

- Såväl våra egna utredningar som utredningar gjorda av oberoende organisationer visar att kontanter förblir populära och användningen i världen förväntas inte minska påtagligt, säger Kevin Bond.

Det brittiska företaget hänvisar till undersökningar bland annat i Storbritannien och hävdar att den utveckling som tagit fart i Sverige de senaste åren inte är representativ för utvecklingen i resten av världen.

Från den svenska branschorganisationen Svensk Handel kommer nämligen uppgifter som definitivt innebär att sedlarna nu snabbt tappar mark inom den svenska detaljhandeln. Betalkortens andel växer med så mycket som 25 procent per år, uppger man. Med så hög tillväxt dominerar snart betalkorten i Sverige.

Men varken det brittiska företaget De La Rue eller den svenska bankomattillverkaren Banqit AB räknar med att den svenska trenden skall få snabb spridning i omvärlden.

- Jag tror inte att sedelhanteringen i världen kommer att minska. Volymen kommer att vara kvar de närmaste tio till tjugo åren. Människor vill inte ändra sina vanor, säger den välkände entreprenören Leif Lundblad, som idag är huvudägare i Banqit.

- Det gäller att sänka bankernas kostnader för sedelhanteringen, säger Leif Lundblad som ser en mycket stor global marknad för produkter som automatiserar sedelhanteringen.

“No decrease within 20 years”, from the newspaper Ny Teknik in April 2001 (in Swedish)

A sad ending to a formidable endeavour spanning decades. At the same time and at the other end of the story, Compaq was acquired by Hewlett-Packard (HP) in 2002 and that, in some sense, brings this entire story back full circle since HP started out as an electronic instrument company much like Scienta Scandia did (see Chapter 2), also a long time ago.

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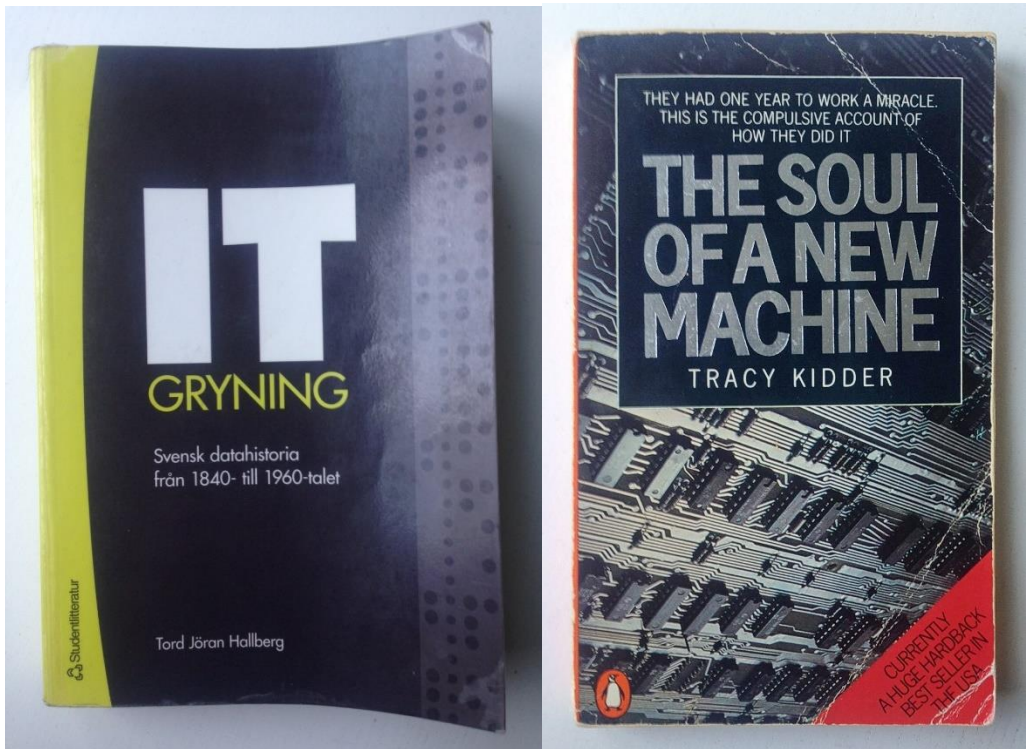
By this, we have reached the end of the story and thus the book. We hope you have enjoyed it, and while the main text ends here, there are several appendices with a lot of interesting information and some images worth having a look at.

Thank you for reading this far!

The authors, Stockholm, May 2023

References

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Two recommended books (one in Swedish)

Since this is primarily a picture book, we do not supply an extensive reading list. We also do not have any formal references since the text builds primarily on notes from many years of PTS experiences and conversations with older and wiser colleagues. But we do recommend two books (of very different nature) for further reading, plus one PhD thesis.

1. Much has been written, especially in Sweden, about Facit, Datasaab, and the other companies in that genealogy tree. We recommend one thorough book – IT-gryning by Tord Jöran Hallberg – which, though, is in Swedish. It covers the years up to 1969 and reportedly took almost six years to write. To the authors' knowledge, it is the most extensive and well-covering account of early Swedish computer history. Since our focus is from 1969 and on (when Philips took over Arengo Electronics), his book is time-wise an excellent complement and it is also very well-written. But there is also ample free material covering the same time period in both Swedish and English, for example series of papers by different organizations and Saab supporter groups, which can be found by searching the internet.

2. The other book recommended is, in the view of the authors, the best novel ever written about computer development. Tracy Kidder describes the birth of the Data General 32-bit computer Eclipse MV/8000 in *The Soul of a New Machine*. This is one author's most lent-out book by a wide margin, and it is a mystery how the glue on the back still holds the pages together reasonably well. We turn to Wikipedia for a summary of the plot of the book. It bears quite some resemblance to the CTI Sagittaire project, even though that one was more an underground clandestine project than a skunkworks one. Both were carried out by creative and heroic teams, though, who were not given compasses from above to navigate.

The book opens with a turf war between two computer design groups within Data General Corporation, a minicomputer vendor in the 1970s. Most of the senior designers are assigned the "sexy" job of designing the next-generation machine in North Carolina. Their project, code-named "Fountainhead", is to give Data General a machine to compete with the VAX computer from Digital Equipment Corporation (DEC), which is starting to take over the new 32-bit minicomputer market. Meanwhile, at the corporate headquarters at Westborough, Massachusetts, the few remaining senior designers there are assigned the much more humble job of improving Data General's existing products. Tom West, the leader of the Westborough designers, starts a skunkworks project. Code-named "Eagle", it becomes a backup plan in case Fountainhead fails, and then the company's only hope in catching up with DEC. In order to complete the project on time, West takes risks: he elects to use new technology, and he relies on new college graduates (who have never designed anything so complex) as the bulk of his design team. The book follows many of the designers as they give almost every waking moment of their lives to design and debug the new machine.

3. The PhD thesis *Ledning av Fusionsförlopp* (Managing Fusion Processes), in Swedish, by Göran Dahlgren and Per Witt from the Stockholm School of Economics. In 439 pages, they describe Datasaab before and after its merger with parts of LM Ericsson to form Ericsson Information Systems (EIS). The thesis was completed in 1988, the same year that Nokia acquired EIS, which is why that is not covered in the thesis. But it gives thorough and initiated insights into Datasaab and EIS, not least into their front-office banking business which is of particular interest to this book. For our purposes, the thesis ending in 1988 is definitely good enough. There was not much left of Philips PTS by that time, either.

R.1 Museums

One reason for researching and writing this book is a lack of balance in available documentation regarding the two major Swedish computer manufacturer family trees; on one hand Saab/Stansaab/Datasaab/Facit/Addo/EIS/etc. and on the other Philips/PEAB. In addition, the same imbalance unfortunately holds also for museums. Tekniska Museet (the Swedish National Museum of Science and Technology) is responsible for collecting all kinds of technical and engineering devices, including computers. But in the early 2000s, a new museum was announced called IT-ceum with the explicitly stated purpose of collecting and preserving computers and everything around them nationwide in Sweden. They opened in 2004 and created a sizeable collection of computers and items over the years, although, when it came to non-consumer devices, mostly from the Saab family tree. Tekniska Museet possibly cut down on collecting computers at the same time.³¹ This resulted in IT-ceum having collected large amounts of equipment from Saab and its descendants but nothing at all from the, at least equally strong, market competitors Philips Sweden. The only device from Philips that the authors know of in the IT-ceum collection is a PTS 6321 (PER 3100) printer, but it was collected as a part of a closed-down SJ (Swedish railways) SNAP 2 railway ticket reservation system, not for being a Philips PTS device as such.³² The only known additional Philips minicomputer collected by any Swedish museum is a STINA naval surveillance system, based on the Philips P800 control computers, which can be found in the collections of Marinmuseum (the Swedish Naval Museum) in Karlskrona. It resides, though, in a remote storage rather than being displayed to the public in an exhibition.

³¹ This might be a misunderstanding, but the authors have no other explanation for the lack of Philips computers in their collection as well.

³² IT-ceum has been closed for renovation for a couple of years but is scheduled to reopen in late 2023. Since the museum is currently closed, the authors have not been able to receive any comments from it.

IT-ceum
 Informationsavdelningen, LiU
 Magnus Johansson

Brev till Veteranklubben Alfa, 2003-03-18

Efter inledande kontakter med Erik Åhman vill jag rikta följande uppmaning till Veteranklubben Alfas medlemmar. Frågan rör möjlighet att bidra med underlag i form av information, dokumentation och historiska föremål i uppbyggnaden av IT-ceum i Linköping.

Vad är IT-ceum?

För närvarande finns långt framskridna planer på att bygga upp ett gemensamt data och IT museum för hela Sverige i Linköping. Projektet har arbetsnamnet "IT-ceum". I programförklaringen (se <http://www.itceum.org>) beskrivs projektet på följande sätt:

IT-ceums uppgift är att bevara och levandegöra historien i form av tekniken, människorna bakom den, användarnas perspektiv och drivkrafterna. Med detta som fond, mitt i en miljö där morgondagens teknik skapas vill vi också vara en arena för diskussion och reflektion över nuet och morgondagen.

Det innebär lite mer konkret att IT-ceum ska innehålla tre delar: en utställning tillgänglig för allmänheten, en publik arena för samtal och debatt om datateknikens roll i samhället, och en forskande/dokumenterande del. Själva museidelen av verksamheten ska sträva efter att visa fram "datorns svenska historia" på ett så komplett sätt som möjligt, och sätta in denna för samhället så omvälvande teknikutveckling i ett sammanhang av människors aktiviteter. Fokus är inte bara på själva prylarna – artefakterna – utan lika mycket på hur människors behov och önskemål möts av (eller kolliderar med) tekniken i dåtid, nutid och framtid. Det är samspelet teknikutveckling – samhällsutveckling som utgör grunden för arbetet.

[...]

Eftersom det i dag inte finns någon nationell kulturinstitution som på ett systematiskt sätt bevarar, dokumenterar och beskriver datorns svenska historia, är ambitionen att bli DET SVENSKA DATAMUSEET. Därför är all svensk datahistoria intressant att dokumentera.

Example of IT-ceum claiming a national role as a computer museum (in Swedish)

The end result is that almost no PTS equipment seems to have been collected by Swedish museums despite its Swedish origin and significant impact on and success in the banking front-office world market, where, as we have seen, PTS was number one in the world for many consecutive years. The only PTS items at Tekniska Museet known by the authors are shown in this book: items 39273 (PTS 6110 and peripherals), collected in 1984 (erroneously stated as 1978 on their website), and 42074 (PTS ATM machine), collected around 1990. Of the museum's 517 items marked Philips, those are the only ones from PTS that the authors have found. Almost all the others are consumer products except for a few that constitute military Philips equipment from PEAB-D, which are of minor significance to this book. This is a very sad fact given the PTS product line's industrial importance in Sweden.

Surprisingly, there are some more extensive collections of PTS equipment outside of Sweden. Probably the most complete one in the world is at Dansk Datahistorisk Forening's (Danish Computer History) museum, located between Copenhagen and Roskilde in Denmark, which has a large collection of equipment from all PTS generations. Some of the images in this book are from their collection. They have published a list of the content of their collection which, in our view, beats all other collections. Naturally, there are also some collections in the Netherlands, but they are disappointingly few and small. Not even the official Philips museum in Eindhoven seems to have much, if anything at all. The authors have contacted the museum but have not visited since they replied that they have nothing in terms of PTS equipment. The same unfortunately also holds for the Philips Historische Producten Museum, also in Eindhoven, where a single P330 computer represents the entire era that this book covers. Some private collectors in the Netherlands have a few items, but those are more focused on the P800 process control systems. A surprise find is the PTS 6805 computer and PTS 6876 disk drive displayed at the Nationaal Brandweermuseum (the National Fire Brigade Museum) in Hellevoetsluis, around 10 kilometres from both Rotterdam and The Hague, which we have an image of in this book. Finally, a few vintage computer museums around the world have images of PTS equipment, but sadly not much in terms of physical hardware.

On the other hand, scanned and uploaded manuals of both PTS 6000 and P800 equipment, hardware and software, can be found relatively easily in different archives around the internet. Since they might move around occasionally, it is easiest to locate them by general searches on the internet using an established search engine. For a PTS enthusiast, they are fun reads and bring back memories. Around 80–100 different scanned files should not be too hard for enthusiasts to collect with a little effort.

6161	Digital Cassette Recorder	
6162	Digital Cassette Recorder	
6164	Magnetic Tape Unit	
6211	Selector Unit Local	
6212	Selector Unit Local	Selector Unit Local (1x terminal printer, 2x 6232, 1x 6241)
6221	Teller Terminal Printer	
6222	Teller Terminal Printer	
6225	Teller Terminal Printer	Journal / tally roll / voucher printer
6231	Keyboard Numeric	34 keys
6232	Keyboard	
6241	Signal Display	
6242	Signal Display	
6261	Badge Card Reader	Reads track 2 (ABA)
6262	Badge Card Reader	Reads tracks 2 and 3
6266	Magnetic Strip Unit	Reads tracks 2 and 3, writes track 3
6271	Keyboard Numeric	40 keys
6272	Keyboard Alphanumeric	99 keys
6311	Selector Unit Local	
6314	Selector Unit Modular	
6321	General Terminal Printer	50 cps
6331	Keyboard Alphanumeric	
6342	Video Display Unit	12 x 80 or 24 x 80
6344	Video Display Unit	20 x 64 or 24 x 80
6346	Video Display Unit	20 x 64 or 24 x 80
6347	Video Display Unit	20 x 64 or 24 x 80
6351	Plasma Display Unit	8 x 36 or graphic 80 x 256 pixels
6371	Terminal printer	Document / journal printer
6374	General Terminal Printer	
6375	General Terminal Printer	
6385	Alphanumeric Display Unit	1 X 40 characters
6386	Plasma Display Unit	6 x 40 characters
6387	Video Display Unit	12 x 40 characters
6411	MDA	Modular Device Adaptor LWSI / RWSI
6431	PSU	Used by 6266 and 6386
6471	Transfer Unit	Concentrator for 2 Selector Units
6812	Terminal Computer	
6817	EFP	Extended Full Panel
6825	CMM	Core Memory Module 32K
6827	Multiplexor	Prerequisite for 6875, 6876
6842	CHMT	Channel Unit for Magnetic Tape
6843	CHLP	Channel Unit for Line Printer
6844	CHDU	Channel Unit for Hard Disk
6845	CHDU	Channel Unit for Hard Disk 6877
6847	CHCD	Channel Unit for Line Printer and Card Reader
6848	CHFD	Channel Unit for Floppy Disk
6862	Console typewriter	50 char/sec
6864	EXU	Expansion Unit
6868	CHFD	Channel Unit for Floppy Disk
6872	MTU	Magnetic Tape Unit
6875	Disk Unit	2 x 2.5 MB, requires 6827
6876	Disk Unit	2 x 5 MB, requires 6827
6877	Disc Unit	80 MB Control Data, requires 6845

List of Philips PTS equipment in Dansk Datahistorisk Forening's collection as of 2023

R.2 Image Attributions

Originators	Pages
Arenco	45, 340
Brenac & Gonzalez et Associés, FR	354–355
Computerworld, US	129
Dansk Datahistorisk Forening, DK (some images located at vaxbarn.com)	135–136, 195, 199–201, 206, 211–212
Département de la Seine, FR	109
Eniro kartor	161, 169, 175, 178, 252
Google Maps, US	81, 113, 122–123, 355
Google Street View, US	21, 49, 251, 343, 347–350, 358, 360
Järfälla kommun	356
Järfälla kommuns bildarkiv	170–174
Kalmar läns museum	43–44
Marinmuseum	183–185
Moatti et Rivière, FR	352–353
Museum of Information Technology at Arlington, US	152
Mölnåls stadsmuseum	56
Nationaal Brandweermuseum, Hellevoetsluis, NL	209, 216
Norges Postmuseum, NO	192
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Stichting Electrologica, NL	78
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The CPU Shack Museum, US	133, 137
Upplandsmuseet	54
VGP Apeldoorn, NL	82–83

Yveline County, FR	125
Östergötlands museum	19

List of image attributions, with country if not Sweden

A. Non-Bank-Office Projects

The PTS product line was mainly sold to banks for use as front-office banking equipment. However, a fair share was made up of other projects such as ATMs and various retail applications. To showcase the width of PTS installations, a few examples of the latter categories will be discussed in this appendix. It was no coincidence that the PTS customers came, apart from banks, from the broader segments of health care, insurance, energy, and travel since those were among the first sectors to invest in large central mainframes that could automatically process the information to be captured in the various branch offices and establishments, be it travel agents or petrol stations.

There was constantly an ongoing debate within PEAB-T/PTS and its worldwide network of sales forces and engineer squads. Should PTS be focusing only on bank front-office terminal systems, its mainstay? Or should PTS make more attempts and inroads into other markets? It was evident to most that the market success and dominance of the banking segment would not be possible to repeat or attain in the same way in any other market. But were only number-one-spot markets worth pursuing? In some markets, such as West Germany (but not the Nordic countries), attempts were made to sell the PTS 6000 product line for plain office use under the name P8000. This was before the P4000 office systems existed, but those attempts were never very successful. The diversification was an internal debate among salespeople and engineers alike. While no conclusion was ever reached, it kept the thought processes going. The projects in this appendix represent one vote for the diversification side. But what finally capped the discussion was the void created by the gap at the generation shift between 16-bit and 32-bit solutions. That was where the momentum was ultimately lost.

A.1 ATM Machines

Sweden, as well as many other Western countries, had experienced waves of urban bomb explosions when ATMs were blown apart by criminals looking for cash. To counter this trend, PEAB-T decided to design a new ATM machine around a bomb-proof safe from the British safe manufacturer Chubb. In addition, there was a problem when some bank customers claimed that they got too little or no money from a withdrawal at an ATM, and the actual circumstances were most often hard to prove or disprove. However, a Swedish inventor had come up with a solution that was much more reliable, relying on the friction between banknotes to count them. Therefore, the note dispenser from Inter Innovation was used in the much-improved ATM design. Since this was not a regular PTS bank office design, it was built around the smaller P851 LSI chipset computer and its Double Eurocard

latest and security guards were contracted and paid by the hour. It was also a hassle to count all the money at the end of every test session since every note had to be fully accounted for and kept in a safe vault between tests.

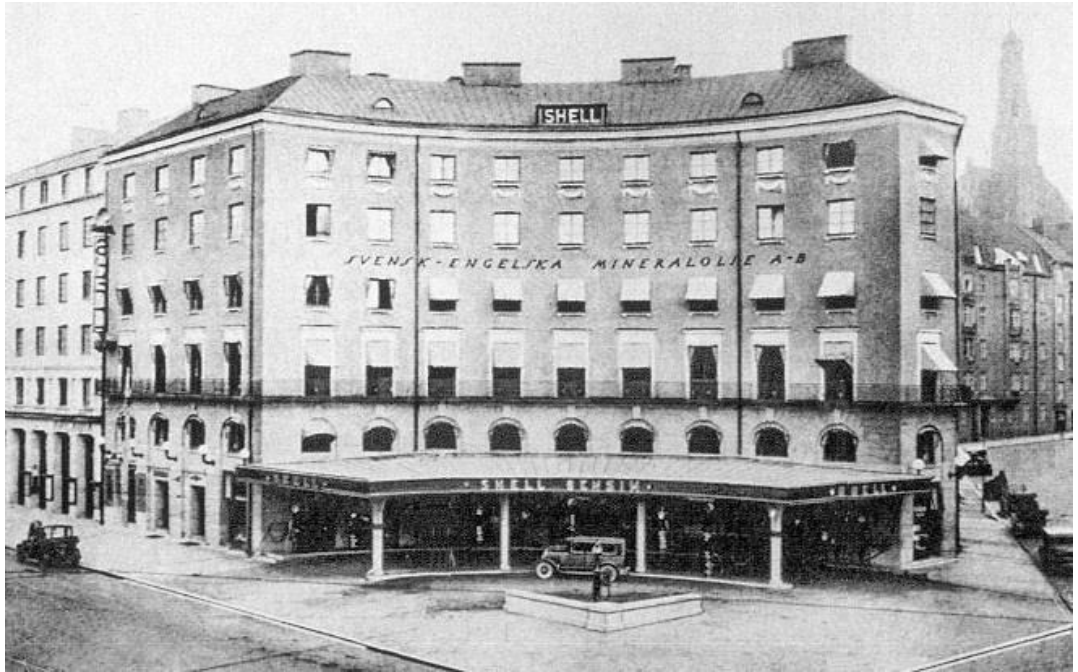
Suffice it to conclude that the dynamics of software development, the inflexibility of bank managers and the bureaucracy of security firms did not go hand in hand. Testing in other countries meant even more logistical troubles, but none of the authors were ever involved in that. Stories of PTS personnel caught in customs with briefcases loaded with cash meant for ATM testing were circulating. One or two days in jail were not uncommon for those developers or test engineers.



Philips homemade banknote

A.2 Retail

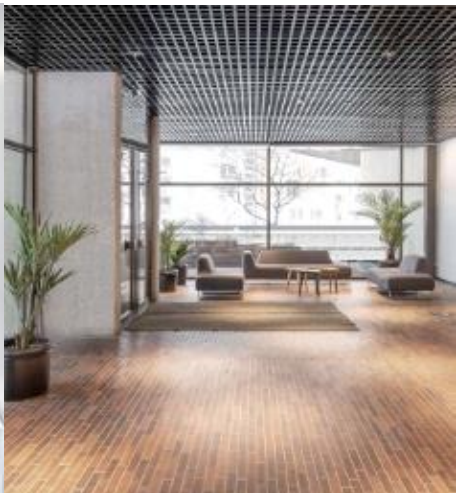
Shellhuset (the Shell building) is a building at Birger Jarlsgatan 64 in central Stockholm. The building was erected as the head office for Svensk-Engelska Mineralolje AB (which in 1939 changed its name to AB Svenska Shell). It had been established already in 1912 as a subsidiary within the Shell group and previously had premises at Skeppsbron in central Stockholm. In 1927, construction began on the modern office building at the corner of Birger Jarlsgatan and Rådmanngatan. The building, with its characteristic rounded shape, was an adaptation to the built-in petrol pumping station on the ground floor and a canopy erected in front of the building. The classicist facade was decorated with bronze lamp holders and a decorative wrought iron railing that ran the entire facade on the second floor. The Shell logo can still be found in the upper parts of the windows on the same floor. At that time, only two-storey buildings were allowed on top of petrol stations for safety reasons, based on earlier disasters involving fires at petrol pumps. However, the Shell building was given an exemption, allowing it to be seamlessly integrated with the surrounding buildings.



The early Shell head office building at Birger Jarlsgatan 64

The Shell Sweden head office building quickly became famous for its architecture. One of the authors remembers roaming the corridors as a young kid since his father worked there. The author was most impressed by two things: the bent corridors and the intercom system that made meetings and discussions possible, even between floors, without leaving the respective attendants' rooms. Shell's expanding business in Sweden soon required additional office space, and several other offices were rented in various locations in the northern part of Stockholm and surrounding municipalities. In 1970, this was deemed untenable and a decision was made to locate all of Swedish Shell's offices in one single new location.

According to the 1965 Stockholm subway/metro plan, a new metro line was planned to pass through Solna municipality where Shell had already rented offices (Svetsarvägen, Industri- vägen, and more). The decision was made to build a new head office on Armégatan in Västra skogen in Solna. The construction started in 1972 and was completed in 1974. The building was, however, a shock for many employees. From the classic and beautiful Stockholm premises to a neo-brutal ultra-modern building where steel, glass and unpolished concrete were the design elements. In addition, the new building had almost no windows.



The neo-brutal Shell head office at Armégatan 38 in Solna

The new premises were criticised by not only a lot of employees but also the union which claimed that the concrete-and-steel design combined with an almost total absence of windows led to an unhealthy work climate. The Shell building was one of the first experiments in Sweden using an open-plan layout, i.e. nobody had a room to sit in. Since the building had almost no windows, it also had no rooms.³³ Desks were placed all over the four floors above ground, each a couple of thousand square meters in size. The desks were separated only by screens designed to be no higher than a medium-sized person. Thus, anyone could look over them and stare at a co-worker's desk anytime – the exact opposite of privacy. The



Exterior and staircase of the Shell building

³³ Except for top management, of course. And the computer centre, which for obvious reasons was behind locked doors in an air-conditioned environment.



One of Shell's over 850 petrol stations, connected to the station network

The PTS cash terminal/register FT80³⁴ was developed in cooperation with the Shell project and soon piloted also in a couple of other projects such as SLL (Landstinget) and Systembolaget (the state liquor store monopoly). This was typical of PEAB-T's approach to human-centred design – not only to have customer projects as pilots but also to develop key functionality and ergonomics in cooperation with end users.

The Shell online petrol station system was one of the first in the world, probably the first, to be entirely online. A few other systems, including Esso in Sweden, had earlier done authorisation and/or transaction logging online, but only for its own loyalty cards. To the authors' knowledge, the Shell system was the first large, nationwide online real-time retail network system in the world that also accepted all debit/credit/payment cards on the market (MasterCard, Visa, American Express, etc.), with PIN verification of all cards, and also carried out the daily local reconciliation process completely online. Further, there was a "velocity check", meaning functionality to trace cards that changed buying patterns – indicating that they were probably stolen together with their PIN codes or otherwise illicitly used. It was not uncommon at the time for groups of younger motorists to approach a remote

³⁴ Regrettably, the authors do not have access to an image of an FT80 despite having worked with the device for several years.

petrol station at night, cut its telecommunication wires, and then start filling everyone's cars, even selling slots in the queue to passers-by for a "discount". But the Shell system had a reasonably clever solution for that as well, saving remarkable amounts of money.

The system had a function that evaluated blacklisted cards regarding their seriousness. If it was a general payment card (debit or credit), the purchase was simply denied and the attempt was recorded. This was true both for outdoor purchases at a petrol pump and indoors in a shop. But if it was a Shell loyalty card, the agreement between Shell and the customers stated that the loyalty cards were Shell's property. Thus, if a loyalty card was found on the online blacklist with a high enough severity, the prompter on the indoor cash terminal should display "SEIZE CARD". Within 15 minutes of the first live test run at the first pilot installation (Kanalvägen, Sollentuna), that message popped up. The Philips and Shell test personnel looked at each other, astonished. Could that really be correct, or was it some kind of bug? But the cashier promptly told the customer that his card was seized and would be kept. A few silent moments followed as everyone held their breath. But then suddenly, the customer dashed out of the shop, confirming with a very high probability that it was not a software bug. Luckily for one of the authors, who was the main architect of that system.

The Shell station network consisted of over 850 petrol stations connected to a cluster of central PTS 6813 and 6824 computers located at Armégatan, Solna, via the newly launched Datex X.21 circuit-switched data network running at 2400 bps. The system had fault tolerance and load balancing built-in and experienced a downtime of two hours in total during its 12 years of operation.³⁵ Those two hours occurred when the telecom operator Televerket had a total electrical blackout at its main operations centre in Stockholm and thus, no transactions reached the central cluster even though it was itself fully operational. The response time at a petrol pump from the moment the customer had keyed in his or her PIN code and pressed OK until the pump was released for filling was 0.7–0.9 seconds. This included the pump talking to the pump controller which in turn talked to the station computer (PTS 6805 or 6911). The station computer called the central computer cluster using X.21, and when the call came through made a request for a blacklist check. After having consulted the blacklist, which due to memory restrictions resided on disk,³⁶ a go/no-go message was sent back to the station computer which immediately, in parallel with disconnecting the communications line, told the pump computer to release the pump if the reply was positive.

³⁵ During which time the station network operated as normal from the viewpoint of the customers.

³⁶ A cleverly designed blacklist hash table made it unusual to have to actually access the disk anyway.

The system remained operational until January 1997.³⁷ Shell had in 1995 decided that the maintenance situation since DEC took over PTS (see Chapter 9) was too unpredictable to continue operations.



National (left) and international (right) Shell loyalty cards for petrol station purchases

A.3 Travel Reservations

Travel reservations and ticketing were also early adopters of fully computerised front offices and retailers. The infrastructure was there in the form of large central computers that kept track of the reservations in real-time.

At the same time, in the early 1980s, there were two travel reservation systems involving the Swedish state railway SJ (Statens järnvägar) under development in Sweden. Why? The SNAP 2 system was intended for use by SJ's own agencies, while SMART was a multivendor system initiated by, among others, SJ and the airline SAS for use by third-party travel agencies and ticket bureaus, i.e. for agencies and retailers outside of SJ itself.

SNAP 2 was named after the original SNAP system from 1970, *Sveriges och Norges automatiska platsbokningssystem* (Sweden's and Norway's automatic ticket reservation system). The catchy name was kept, even though Norway soon withdrew from the first SNAP consortium to join the Danish counterpart instead. The name was also kept for the second generation, SNAP 2, which was going to be fully computerised with modern terminal equipment from Philips PTS.

³⁷ For fun, one of the authors measured the same response time when filling a car up recently at one of the major Swedish petrol station chains in 2023. Despite having access to almost infinitely much more processing power and faster data communication, it took that system 10.5 seconds from pressing OK to pump release.

SNAP

i praktiken



Direktör Åke Korsberg, SJ, inviger den nya automatiska platsbokningen och matar in data på ett av bokningsdonen på Centralstationen i Stockholm

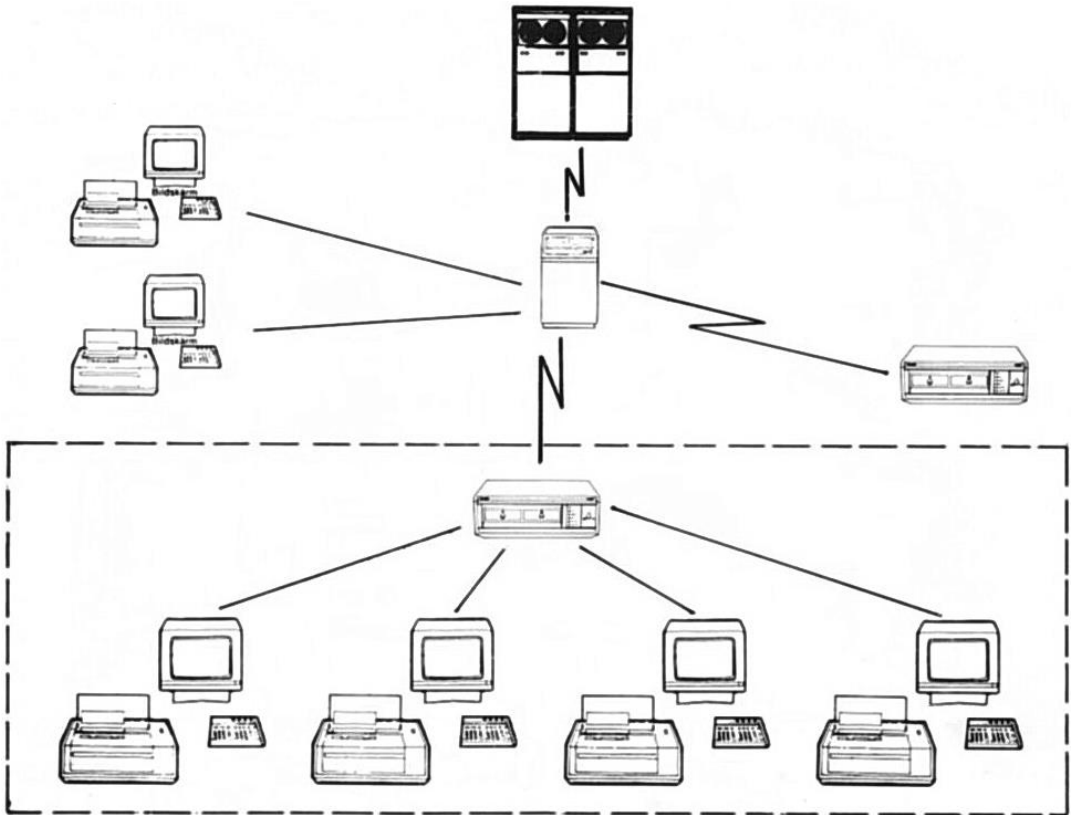


Premiärbiljetten blev riktigt utskrivet, konstaterar direktör Korsberg

□ Den 1 april startade SJ ett datasystem som i många avseenden är helt unikt. Det är landets hittills största datasystem för behandling av verklig tid och har redan under det mångåriga förberedelsearbetet uppmärksammats runt om i världen. I helt utbyggt skick — klart i februari nästa år — ska det möjliggöra automatisk bokning av sitt-, sov- och liggplatser i alla svenska tåg inom landet och i de tåg som från Danmark och Norge är destinerade mot Sverige.

The first electromechanical SNAP system from 1970

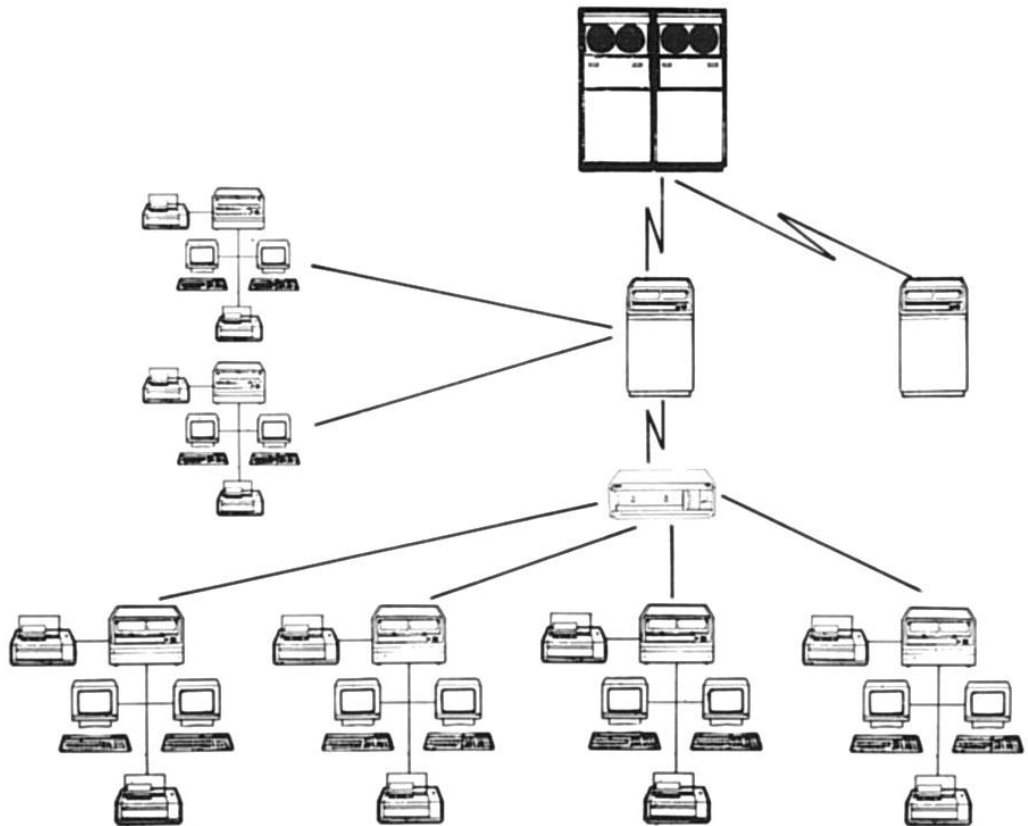
The SNAP 2 system was in reality two subsystems. The first was the ticket reservation system, where travel agents could book and print railway tickets. Up to four ticket-handling stations, consisting of a PTS 6346 VDU, a PTS 6271 numeric keyboard and a PTS 6376 ticket printer (as in the image), were handled by a PTS 6911 workstation controller. All workstation controllers were connected to a PTS 6824 communications computer that communicated with a central IBM mainframe placed in Stockholm. The data communication was handled by the IBM SNA/SDLC protocol. It used SJ's internal communications network that was carried by cables running in parallel with the train tracks that covered all of Sweden. This subsystem consisted of around 400 ticket terminals in total.



SNAP 2 ticket reservation and sales subsystem

The other SNAP 2 subsystem was the reporting system, where all economic activities at the sales points were recorded and reported. Up to four workplaces, consisting of a PTS 6346 VDU, a PTS 6272 alphanumeric keyboard and a PTS 6376 printer (as in the image), were handled by a PTS 6911 workstation controller. Again, all workstation controllers were connected to a PTS 6824 communications computer that communicated with the central IBM mainframe using the same method as above. This subsystem contained around 600 reporting terminals in total.

While the reporting subsystem in principle looked similar to the ticket reservation subsystem, there were differences in the configurations due to much higher real-time requirements on the reservation computers where there could be competition for seat reservations.



SNAP 2 reporting subsystem

In early 1981, the SNAP 2 system was piloted in Stockholm. 400 terminals were initially ordered, but the conclusion of the deal depended on a successful pilot installation and subsequent evaluation.

The PTS SNAP 2 solution was put into regular use in July 1981 and remained in operation until October 1994. SJ had already in 1990 decided that the future maintenance situation for PTS equipment was too unpredictable since PEAB-T had been thrown out of its PEAB premises and the risk of Philips closing the PTS product line could not be dismissed (see Chapter 9). Thus, it was too unsafe to continue operations, and SNAP 2 was in 1992 replaced by a system called Petra, based on standard IBM-compatible PCs. The Petra system is, in a much-modernised form, still in operational use today and gets its fair share of bashing when it breaks down, for example during the release of train tickets for the latest (2022) Christmas

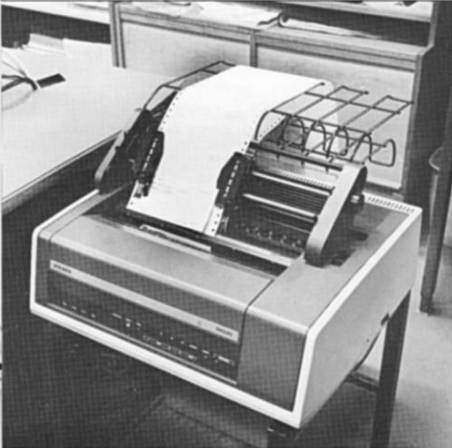
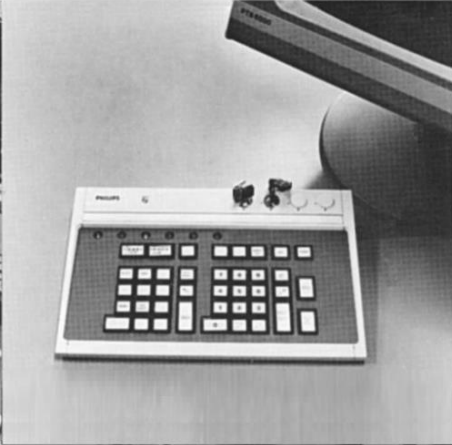
holidays. In Sweden, being a large country when it comes to distances, it is popular to travel home during Christmas to family and friends by train, not least taking into account the possibly dire winter/snow weather/road conditions. But with more than 30 years of Petra experience notwithstanding, it still crashed severely and ticket reservations became a total mess.



PTS SNAP 2 reservation equipment in the foreground, old SNAP 1 in the back

SJ:s nya terminalutrustning
för platsbokning, biljettför-
säljning och rapportering

Extra tunt och lättplacerat
tangentbord



Bildskärmen är vridbar i
höjd- och sidled

Specialkonstruerad mekanism
för snabbare biljettavrivning



**Data
Systems**

PHILIPS

However, the SNAP 2 system was not the only ticket reservation being developed in Sweden by PEAB-T at that time. SNAP 2 was intended for internal use at the SJ-owned travel agents and train stations. But for general travel agencies, another system was being designed and built, also by Philips, in parallel but by completely separate software project groups. It was called SMART, and we borrow an overview of the system from Wikipedia. The text is well-written, obviously by someone with extensive knowledge from within the project group.

SMART, Scandinavian Multi Access Reservations for Travel Agents, is a computerized system for ticket reservation.

It was created in 1979^[1] by [SAS](#), [Braathens](#) and [Swedish State Railways](#). Many travel companies had computerized their systems at the time, and provided terminal interfaces for travel agencies. Each had their own system, often involving widely different codes and procedures. It was cumbersome and expensive for a [travel agency](#) to have multiple terminals, each one connected to a different provider. SMART solved this, by providing a single interface over the public data network [Datex](#).

It worked by having a Host Interface Processor (HIP) at each travel company. These would emulate a number of terminals, translate the messages, codes and addresses, wrap them in SMART's own [communications protocol](#), and provide the interface over [Datex](#) to the various travel agencies. There was, of course, functionality to limit access.

On the travel agency side, there would be SMART Terminal Equipment (STE) with the reverse function, emulating a server and providing interfaces for terminals. Now however, a travel agent could easily switch between screens for the different companies. The interfaces were similar to those for direct connections, but provided some standardization for codes to ease the transition between the systems.

The STE would also allow printing of documents, tickets, bills and similar, as well as interfacing with the accounting system.

SMART could utilize some of [Datex](#) extra features like queuing and group numbers, and a logical connection (session) was not dependent on the physical connection (which could go up and down for instance during idle times to save money). Parallel sessions could be held with different or the same provider.

SMART spawned off into a company centered in [Stockholm](#) in 1984, SMART AB, with the subsidiaries SMART Sverige AB, SMART Danmark A/S, and SMART Norge AS (in Sweden, Denmark and Norway respectively).

SMART is still in use, though not over [Datex](#). It has been widely replaced by [Amadeus](#), by the same company. In 2003, SMART AB changed its name to [Amadeus Scandinavia](#).

***Abstract:** This article describes the integration of an expert system shell (AllRound Expert System, AR/XPS) with a Unix-based 4GL application generator (Task Flow Management, TFM). TFM supports the client-server architecture of distributed applications and provides access to several relational databases, including Informix and Oracle. A short overview of the major features of TFM is given, with special regard to characteristics relevant for the integration of an expert system. The main focus lies in the architecture of AR/XPS, which contains rule-based and frame-based knowledge representation methods and which was implemented in Prolog; the user interface is totally unified with that of TFM, so that the user sees only one system and need not be aware that an expert system is present. AR/XPS has access to all features of TFM and to any databases present, so that an expert system can take decisions according to the current status of the database. At the end of this article a description of the Knowledge Base Creator is given and some remarks are made regarding our experience with pilot applications.*

in cooperation with the SMART consortium. Another co-development between PEAB-T and SMART was software to allow customers to easily design their own workflow, menus and screen layouts. PEAB-T developed two packages called WSM (workstation management) and TFP (text form package). WSM let customers design the workflow between different parts (screens) of an application, defining conditions for the flow paths. TFP was a software to create the various forms (screens) that WSM stipulated the work processes would flow through. Both these ideas were relatively new and advanced at the time, and

The SMART project was one of those projects where PTS equipment was being developed in cooperation with a customer. Of course, every manufacturer of computer equipment had pilot customers who were the first to try new equipment, but PEAB-T had a more involving way of working, not least with respect to ergonomics and HCD (human-centred development). One of SMART's requests was a much smaller computer than the, at the time, current PTS 6805 branch office computers. The small workstation controllers WS10/WS11 (PTS 6910/11) were developed

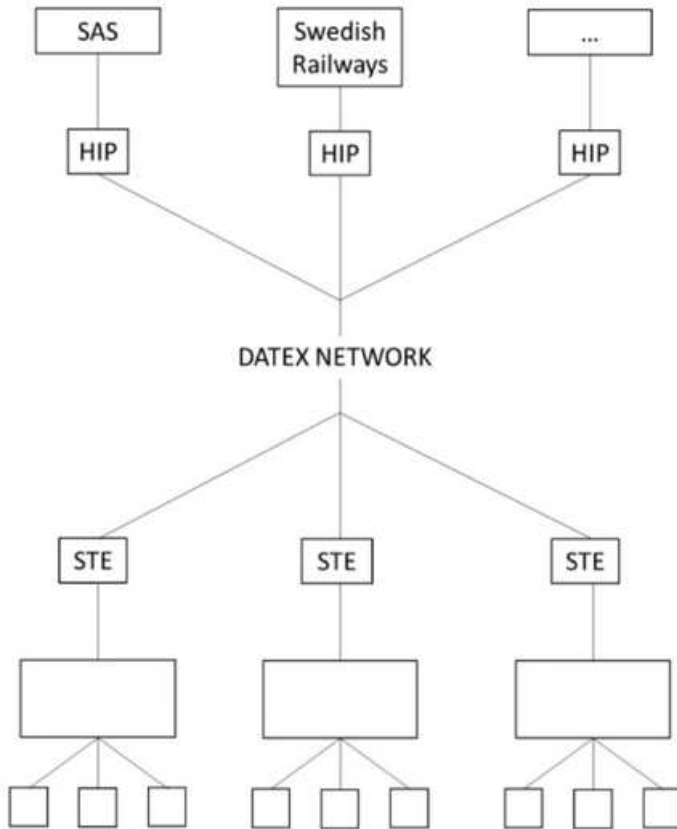
and some years later they were combined into the TFM product (text form management) and integrated into a 4GL (fourth generation language) tool based on an expert system which was at the frontier back then. It received considerable attention as well as generated a lot of sales during the 16-bit PTS era. Since WSM

digital™

Software Product Description

PRODUCT NAME: TFM (Task Flow Management) for Windows

and TFP were parts of a Swedish customer project, there was minimal interference from PDS in Apeldoorn. The combined TFM software tool was subsequently taken over by DEC (see Section 9.8 about the acquisition) but was unfortunately lost in their product maze.



The main architecture of SMART, except for the SCC control centre

As can be seen from Wikipedia, the Host Interface Processors (HIP) and SMART Terminal Equipment (STE) were the two main components seen in daily work. But there was also a third subsystem called SCC – the SMART Control Centre. This operations centre could remotely control, configure and reboot SMART STE installations. Software distribution, automatic or manual restart (IPL or boot), reconfiguration when units were added or removed, tests for malfunctioning equipment or communication and statistics collection were all part of SCC. Already in 1981, more than a year before the official start of the national

Datex X.21 data communications network in Sweden, one of the authors distributed software online and rebooted remotely the PTS 6911 workstation controllers (STEs) situated at the (then experimental) travel agencies. To the authors' knowledge, this was the first time in Scandinavia, perhaps in Europe, that a complete software configuration, updating and restarting sequence was performed remotely and entirely online without any intervention.

The first HIP nodes to be connected already at SMART launch time were the Scandinavian SAS airline, the Swedish SJ railways and the Norwegian Braathens SAFE (South American & Far East) airline.³⁸ Soon after that followed some of the leisure travel agencies in Sweden, such as Vingresor and Fritidsresor and from there, the SMART system just grew. The first three HIP interface processors were separately developed for SAS, SJ and Braathens, but soon after, a general HIP was defined in order for new customers to keep the implementation costs down. Modifications still needed to be made, but they were often minor.

While the STE computers were the newly-designed PTS 6911 workstation controllers (to which likewise newly-designed VDU screens with a white background and 75 Hz refresh rate to eliminate flicker were connected), the HIP computers were the workhorses PTS 6813 and 6824. The latter ones were placed in clusters at the respective customer sites, be it SAS, SJ or Braathens. The clusters were load-balanced by the Datex X.21 network itself, which offered that service to large customers. It was the same computers and network solution that Shell used in its petrol station network.



³⁸ The authors do not know if there was some pun intended by the SAFE acronym.



SNAP (previous page) and SMART SJ train tickets – same printer model, different layouts

There was some terminology confusion since the SJ reservation system had one name as seen from the operators, SNAP (without numbering them 1 or 2), and then from 1994 it was called Plats94 (*plats* meaning seat). But the underlying computer system was first SNAP (which we call SNAP 1) and then SNAP 2 (the Philips PTS equipment) followed by the PC-based Petra which used SNAP 2 as its booking core for a while, by which time the authors had definitely lost track of all their systems and versions. Even this might not be entirely accurate... There were claims of the PC-based solution being called SNAP 3 for a while. But was it a nickname or an official name? We do not know. And then there was the SMART system, which sales personnel at non-SJ travel agents connected to by a SMOD number (SMART origin destination). The SJ SMOD was 01, which was not in alphabetical provider order, and had almost no relationship to the SNAP system. Confused? We were too...

A.4 Non-Banking Project Work

We end this appendix by providing a few snapshots from working with non-banking PTS projects. The PTS 6910/6911 was a new workstation controller introduced in the SMART, SJ/SNAP and Shell projects. The computer was built around the FAST/SPC-16 processor chipset, which was architecture-wise compatible with all other P800 family processors and had almost all the instructions in the P800 instruction set. Thus, one could have thought that the transition from PTS 6805 to 6910/6911 as the low-end machine would have been as smooth as that from PTS 6812 to 6805. But this was not the case for two reasons. First, SMART required that the computer could be placed on the desktop, much like the first PCs, but additionally without a fan – a requirement not even the first PCs could fulfil although

they were much less powerful. The compromise became a stand-up version (“tower-style”) with a very silent but much more expensive fan. The SMART consortium confused small size with low processing power and initially thought each workplace had to have its own PTS 6911, while it could handle up to four.

Second, the FAST architects had meticulously adhered to the P800 instruction set but not its memory handling. All other P800 processors with extended memory, before and after FAST, had a traditional MMU, in which 64 kbytes of non-consecutive memory could be addressed at any given moment, selectable from a larger total memory space in chunks called pages. FAST instead had the processor running in two different modes, firmware mode and software mode, each with 64 kbytes of non-overlapping memory space. So while the total memory addressable was 128 kbytes, it could not be used as a continuous memory. Besides putting a constraint on the total memory size available to user processes, those could not tell the difference between FAST and others and were not harmed by the chip design.

For the operating system, though, things were completely different. Some privileged instructions could only be run in firmware mode and some interrupts arrived in firmware mode which became a kind of second system/user mode while keeping the original system/user distinction. Thus, the TOSS operating system, which was the same for all PTS computers except FAST, had to be split down the middle into a special FAST version. The code became much less readable when some parts resided in firmware memory, separately assembled and linked, and others in the more traditional software memory. Debugging of the operating system also became much more complicated and convoluted since the available debugger only worked in (and had knowledge of) the traditional software memory. It was almost as if a magician suddenly and invisibly had performed certain tasks that should belong to the traditional TOSS but the code was not there – still, the tasks had been performed. Certainly a strange experience for developers, such as one of the authors, who occasionally had to debug the operating system’s inner workings. Easy to do in all machines except FAST-based ones where it was nearly impossible. This was the only disadvantage of the FAST processor, which was brilliantly conceived and designed – except for this incompatible interrupt and memory management solution. It was argued that the problem was related to the limited 40 pins on the SPC-16/10 chip which necessitated a separate SPC-16/11 interrupt handler chip. And while not totally untrue, it could have been solved in a less incompatible way, even if not completely compatible. Evidently, the chip designers had limited experience in operating system design, otherwise they would not have selected the solution they did. Ignorance per se was not to blame, though, but not contacting the most significant user of the P800 CPU family, PEAB-T, and its operating system team was inexcusable.

B. Film Star

It was in late 1981, and one of the authors had worked with Philips PTS computers for less than a year. The sales department suddenly reached out and offered tickets to the newly-premiered James Bond 007 film *For Your Eyes Only*, starring Roger Moore. This offering was apparently due to product placements made by Philips in the film. It was quite commonplace already in the early 1980s to use that form of advertisement, and filmmakers were happy to partly finance their films in that way. Philips had paid a handy sum for showing off a set of consumer electronics products in the Bond film. Every TV set, radio, loud-speaker, dictation machine, etc., in the film was manufactured and sold by Philips.

Those of us who got tickets were told to look out for Philips products. Little did we know that not only would lots of consumer products appear but also Philips PTI and PDS computer equipment! It turned out that the film's producers had reached out to Philips, asking to borrow some "hi-tech looking" computer stuff for certain scenes. These were not paid product placements, but it was natural to ask Philips for those devices as well because of its large placement contract for consumer goods.

The film opens with a scene in which a fishing trawler turns out to be a spy (command) ship in disguise. On board this ship is a secret command central operated by MI6, seemingly containing around ten operators. One of them is using a Philips P330, which was an accounting computer for small and medium-sized enterprises in real life.



The P330 can be recognised by its typical form factor. In the background of the same image above, a P5003 word processor can be seen. Or rather, the screen part of it since the bulkier processor part had been removed. In the image below, the P330 can be seen from another angle with its characteristic shape and positioning of its screen and its large, flat, slightly sloping keyboard area.



To the left of the P330 operator in the first image, another operator (behind the man in the white shirt, quite hard to see) sits in front of a backlit wall-mounted map on one wall and a set of 16 white tiles on another. The map itself is easy to spot, as are the tiles. Below the map is a vertically mounted keyboard, but it is rather hard to see it in detail. The same goes for the keyboard below the tiles. This is especially true in a fast-paced sweep by a motion-picture camera. Why the keyboards are wall-mounted is a bit hard to understand. The ergonomics-conscious Philips would not have done that at a customer installation, and why would something as mission-critical as a command centre have hard-to-use keyboards?

A few moments later, though, the camera shows a close-up of the man with the map. Now, it is quite a bit easier to see that it is indeed a Philips PTS 6272 keyboard. Well, at least if you were given the opportunity to rewind and freeze the frame using a VHS video cassette copy of the film a couple of years later. VHS might have been a rather low-resolution medium, but compared to a short, non-rewindable glimpse in a cinema, it was an affirmative sight. The keyboard seems to miss some keys or be without keytops. The keys are black underneath if the tops are removed (which is easy to do).



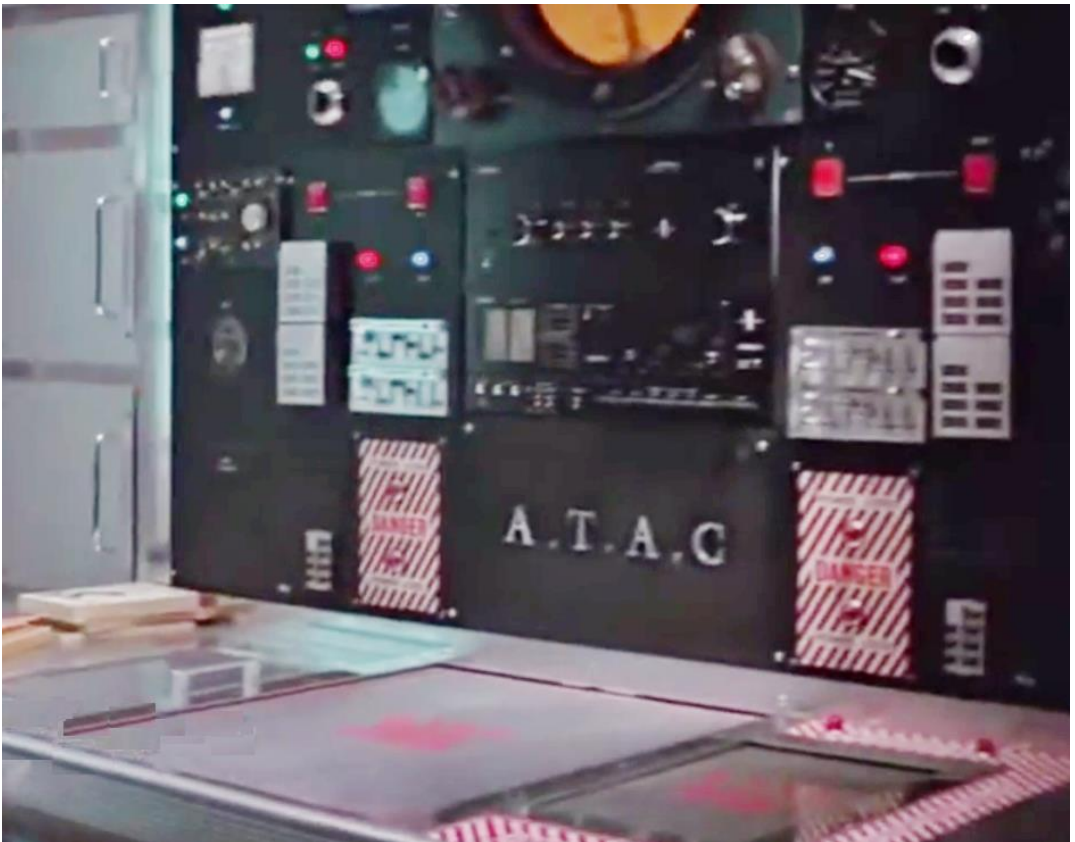
A few seconds later, there is a close-up of an emergency alarm button. Now, the unmistakable characteristic look of a Philips PTS 6272 keyboard can be spotted, even from a distance in a cinema. The design, the key layout and the position of the physical lock keys are giveaways, even at motion-picture speed. The spy ship is thus equipped with at least three vertically mounted PTS 6272 keyboards.



The sight of this 6272 keyboard was an instant wake-up moment for anyone working with Philips computer equipment in general and PTS computers in particular. Apparently, the spy ship was partly PTS-equipped. But there was more to come, much more.

It was not until the film became available on VHS cassette that it was possible to identify additional PTS equipment that was shown all too fast to be possible to identify in a cinema setting. For example, when an MI6 operator enters the secret area from an airlock, he walks by a rack of removable cartridge hard disks (for PTS 6876/P3434 hard disk drives). Behind the rack, a PTS 6346 VDU screen can be seen (lower left corner). Since it is lit up and displaying some text (it has 24 lines with 80 characters each), it is obviously connected to something. This ‘something’ cannot have been a regular P330 computer since they were incompatible.

Next, the ATAC console is shown in the film. ATAC is short for Automatic Targeting Attack Communicator and is a device for coordinating all British Polaris submarines worldwide. It exists in only one copy and turns out to be a very attractive device for many countries to possess, especially some in the Eastern Bloc. In its normal (resting) state, the central ATAC controller is recessed into the console. The vertical part of the ATAC consists of two mirrored halves and a centre part that reads A.T.A.C.



When there is a need for submarine coordination, the central controller is activated by the operator and automatically erected once the cover has been withdrawn. The central controller is situated in a red docking station with a large red-and-white button to the right. The controller itself turns out to contain – **lo and behold** – a Philips PTS 6271 numeric keyboard with 40 keys in an unmistakable configuration. At this point in the film, the eyes of everyone working with PTS equipment popped out.



The 6271 keyboard was a rather new product in the fall of 1980 when the film was being shot. It was designed and manufactured by PEAB-T in Järfälla. Although it would, as usual, become available to all of Philips through the parts bin system, it was still a bit rare in 1980. As Appendix A shows, Philips Sweden (rightfully) bragged about the keyboard in its 1981 advertisement campaign featuring the Swedish Railways (SJ). On top of the non-PTS part of the ATAC is a metal plate with “ATAC” embossed to identify it when disconnected from its docking station. A fun fact is that the prop makers apparently felt that the 6271 was too thin (which was one of its major ergonomic strongholds) and added some extra height that perhaps was supposed to contain the ATAC computing device – who knows?

In any case, the operator (who has to be chained to the console in order not to fall away from it in case of bad weather or an emergency) keys in new commands and coordinates using the keyboard after activating it by turning one of the physical keys. In the film, of course disaster strikes. The ship runs into a giant sea mine that explodes and it begins to sink. Some other operator presses the large alarm button beside one of the vertical 6272 keyboards, and hell breaks loose. At this instant, another cover retracts and a handle protrudes upwards to the right of the ATAC console. The handle is marked with various warning texts and bordered by polka-striped red-and-white tape. When pulled, the handle activates a mechanism that eradicates the ATAC in order to prevent it from falling into enemy hands. Of course, the operator fails to do this before seawater floods the operating room. The ship sinks with the ATAC on board, so it is still up for grabs if unharmed after being submerged in saltwater.



After this opening scene, the story of the rest of the film revolves around recovering the ATAC. In classic Bond style, this is both complicated and violent.

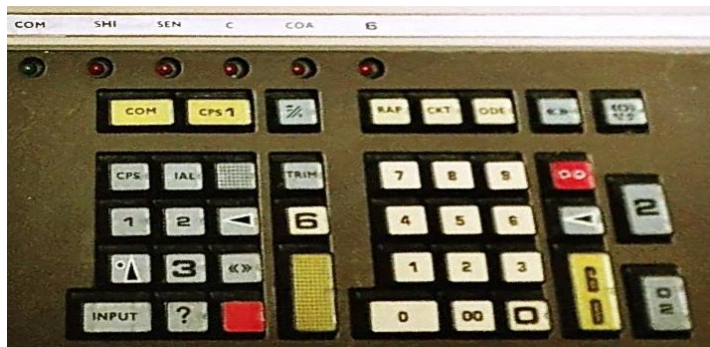
In order to identify one of the villains, Bond, a bit later in the film, requests the help of Q (head of MI6's R&D department) on a visit to the MI6 headquarters. Q has an "Identigraph", which is a computer that can generate sharp and accurate facial composite images ("police sketches") from text-only input data. The computer turns out to be a Philips P430 office computer equipped with a microphone, a P3434/P824/PTS 6876 hard disk drive (in front of Bond) and a P3320/P809/PTS 6858 line printer (to the right of Q) also attached to it.



Midway through the film, Bond finds out the location of the sunken spy ship. He and an assistant use a mini-submarine to recover the ATAC from the bottom of the sea. Of course, some enemies looking for the very same device appear, but after a hard struggle, the ATAC is in the possession of Bond. The recovered ATAC seems relatively unharmed by the long exposure to saltwater and marine life. One can even clearly see the Philips brand name and logo on the 6271. The quality of PTS products must indeed have been amazing.



The ATAC keysteps are a mixture of conventional keys and made-up ones. The right numeric key set consists mainly of the traditional numeric keys in the original PTS font. The left key set, though, contains very imaginative arrows, numbers and symbols.



Close to the end of the film, the ATAC is captured by some villains who are about to sell it to the Russian KGB intelligence service. It is kept in a monastery on top of a mountain.



Bond and compatriots climb the mountain to reclaim the ATAC, but the KGB is already there. The film ends with Bond throwing the ATAC off the mountain so that neither party can make use of it, thus resolving the stand-off situation.

To sum up, the centrepiece and real star of the film is not Bond (sorry, Roger) but instead the PTS 6271 keyboard.



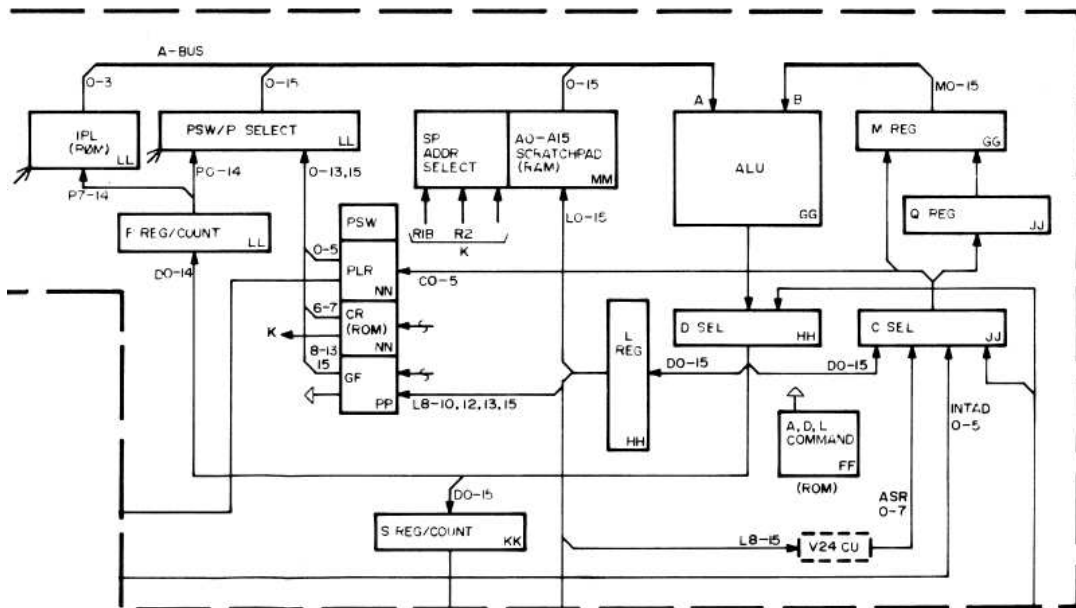
C. Hardware Bugs

The class-leading Digital Equipment PDP-11 computer had eight general-purpose 16-bit registers named R0 to R7. R6 was also the stack pointer (SP) and R7 was the program counter (PC). It featured register-oriented little-endian, byte-addressable addressing modes. The PC was a general-purpose register, and constants were loaded using an indirect mode which loaded the 16-bit word following the current instruction and then incremented the PC to the next instruction before fetching. The SP could be accessed in the same way, and any register could be used for a user stack. A program status word (PSW) register held the results from the instructions that had been executed. Adjacent registers could be grouped into a 32-bit register for multiply and divide instructions. PDP-11 addresses were 16 bits, limiting the program space to 64 kbytes. However, an MMU could be used to expand the total address space (18 to 22 bits in different PDP-11 versions).

The PDP-11 was highly inspired by its predecessor PDP-8 and so was the P800 architecture as well. The P800 family of processors (the 8-bit Sagittaire-renamed-P850 does not count) had a similar RISC-like microcoded instruction set with 16 general purpose registers, where A0 was the program counter (PC) and A15 was the stack pointer (SP). All instructions used the same 5-bit opcode field and were partitioned into two types: single-operand or dual-operand instructions. In the former case, the operand was constrained to A0–A7. In the latter case, the first operand was a register but the second operand could be either a register or memory, and the results could be stored in a register or in memory. Immediate or direct addressing was done as in the PDP-11 by specifying the PC as the second operand, but in the P800 family the PC was auto-incremented. The stack supported subroutine linkage and 48 priority hardware interrupts (levels 0–47) plus 15 software interrupts (levels 48–62). A 16-bit program status word provided status and control information such as current interrupt level, interrupt control and condition register. The P800 CPUs could directly address 32k 16-bit words of primary memory (= 64 kbytes; up to 1 Mbyte with the MMU), 256 external registers and 64 I/O devices. The instruction set had eight addressing modes and operated on byte, word or double-word data types. The instruction set of the higher models (all except P850 and P852) included hardware multiply and divide, multiple shifts and rotate, and load and store of multiple registers. An extended instruction set (third generation processors) also contained test and set/reset operations on bit strings.

Despite their similarities, the PDP-11 and P800 architectures took different paths regarding the miniaturisation of processors when the LSI technology arrived in the mid-1970s. The LSI-11 from 1976 was a microprocessor implementation of the PDP-11 using the Western

Digital MCP1600 microprogrammable CPU, i.e. they used another company's existing CPU and added their microprogram to it. Philips (CTI and Signetics) chose another route for the P851 and designed a separate 4-bit ALU (SPALU) and a microcontroller (PLANET), where the latter – as its name hints at – was a network of PLAs (programmable logic arrays). In any case, the Philips/CTI/Signetics solution was more of a custom-made solution than LSI-11 and, staying closer to its origin, was able to avoid introducing hardware bugs.



Block logic diagram of the P857 processor

C.1 Division Instructions

Of the 97 instructions in the P800 instruction set, the only instructions suspected to contain bugs were the three DV (divide) instructions. One known bug was already documented in the assembler manual as follows: If the most significant half of the dividend (residing in register A1) is equal to the two-complement of the divisor (residing in a register selected by the user), the result given is erroneous. As we will see later, this is a complicated way of saying something rather simple; see the discussion on T3 and INT_MIN below. We will also find out that there were more bugs hidden inside the DV instructions.

DV

Divide

DV

P851M
P856M
P857M

Syntax: [label] □ DV [*] □ m [, r2]

The contents of the registers A1 and A2 are divided by the contents of the effective memory address. The quotient is placed in register A2. The remainder in register A1.

The sign of the remainder is equal to the original sign of A1, A2, except when the remainder is equal to zero (always positive).

Overflow occurs when the quotient exceeds 15 bits. In that case the contents of A1 and A2 are destroyed except when the division is equal to zero.

Type	Function	O	R	MD	Syntax
T4	{A1, A2} / { m }	→ A2	A1	10	DV m
T5	{A1, A2} / { m + (r2) }	→ A2	A1	10	DV m, r2
T6	{A1, A2} / ((m))	→ A2	A1	11	DV* m
T7	{A1, A2} / ((m + (r2)))	→ A2	A1	11	DV* m, r2

Condition register:

- CR = 0 if (A2) = 0
- 1 if (A2) > 0
- 2 if (A2) < 0
- 3 in case of overflow

bit	0	1	4	5	8	9	10	11	14	15		
	1	1	0	0	1	0	0	0	0	MD	r2	0

Note:

An erroneous result is given when the most significant word of the dividend is equal to the two's complement of the divisor.

In earlier days, back in the 1970s and 1980s, the divide operation used to be performed in hardware by a so-called restoring algorithm. It is actually a clever extension of the manual decimal division that we all learned in school. Decimal division by hand works by considering number positions one by one, starting with the most significant. From Wikipedia, we fetch the examples of decimal dividing 500 with 4, resulting in 125 with no remainder, and binary dividing 26 (11010) with 5 (101), resulting in 5 (101) with 1 as the remainder. It is the same principle regardless of the number system base.

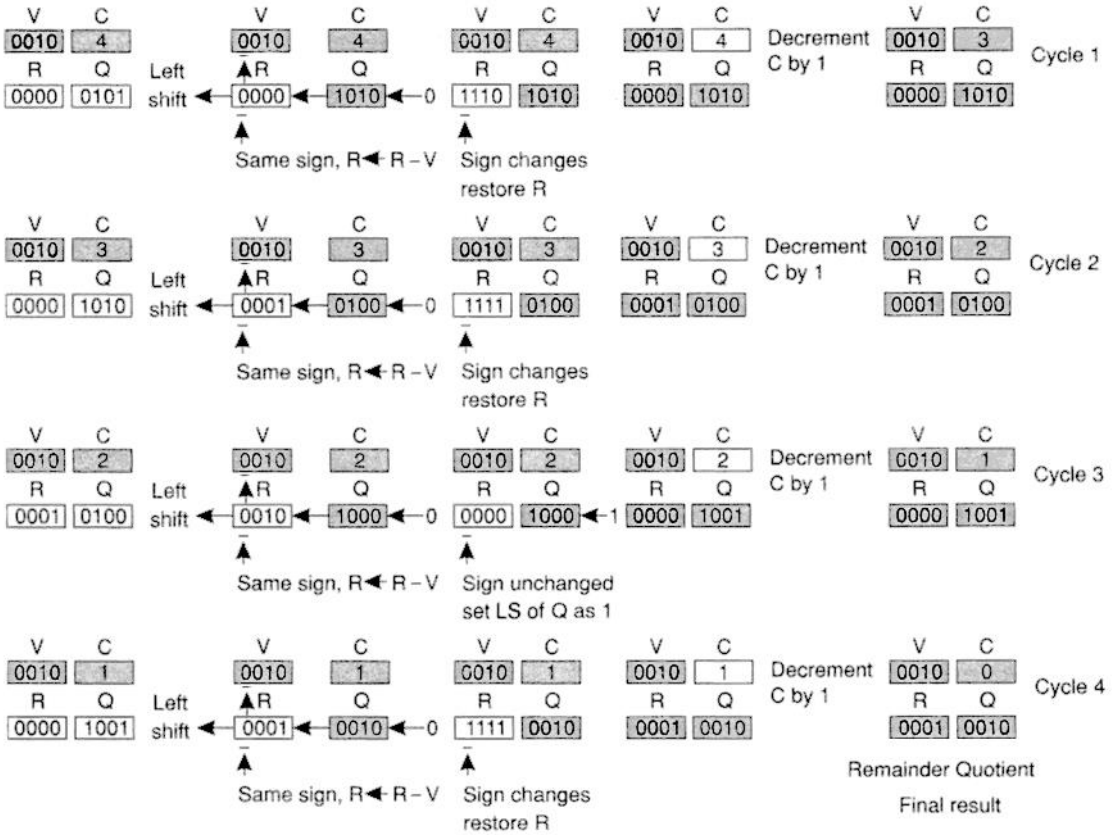
$\begin{array}{r} 125 \\ 4 \overline{)500} \\ \underline{4} \\ 10 \\ \underline{8} \\ 20 \\ \underline{20} \\ 0 \end{array}$	$\begin{array}{l} 4 \times 1 = 4 \\ 5 - 4 = 1 \\ 4 \times 2 = 8 \\ 10 - 8 = 2 \\ 4 \times 5 = 20 \\ 20 - 20 = 0 \end{array}$	$\begin{array}{r} 101 \\ 101 \overline{)11010} \\ \underline{101} \\ 11 \\ \underline{00} \\ 110 \\ \underline{101} \\ 1 \end{array}$
---	--	---

Decimal (base 10, left) and binary (base 2, right) division examples

Thus, the basic idea of binary division is the same, albeit with a few observations and caveats. Instead of dividing in each step, it is sufficient to perform a right shift since it is equal to dividing by two which is the base of the binary number system. For a more thorough explanation, refer to any textbook on binary arithmetic such as books on computer hardware or other digital systems. Additionally, with clever use of internal CPU registers, only three registers plus a counter are necessary for dividing a double-precision integer by a single-precision one and being able to obtain both the quotient and the remainder.

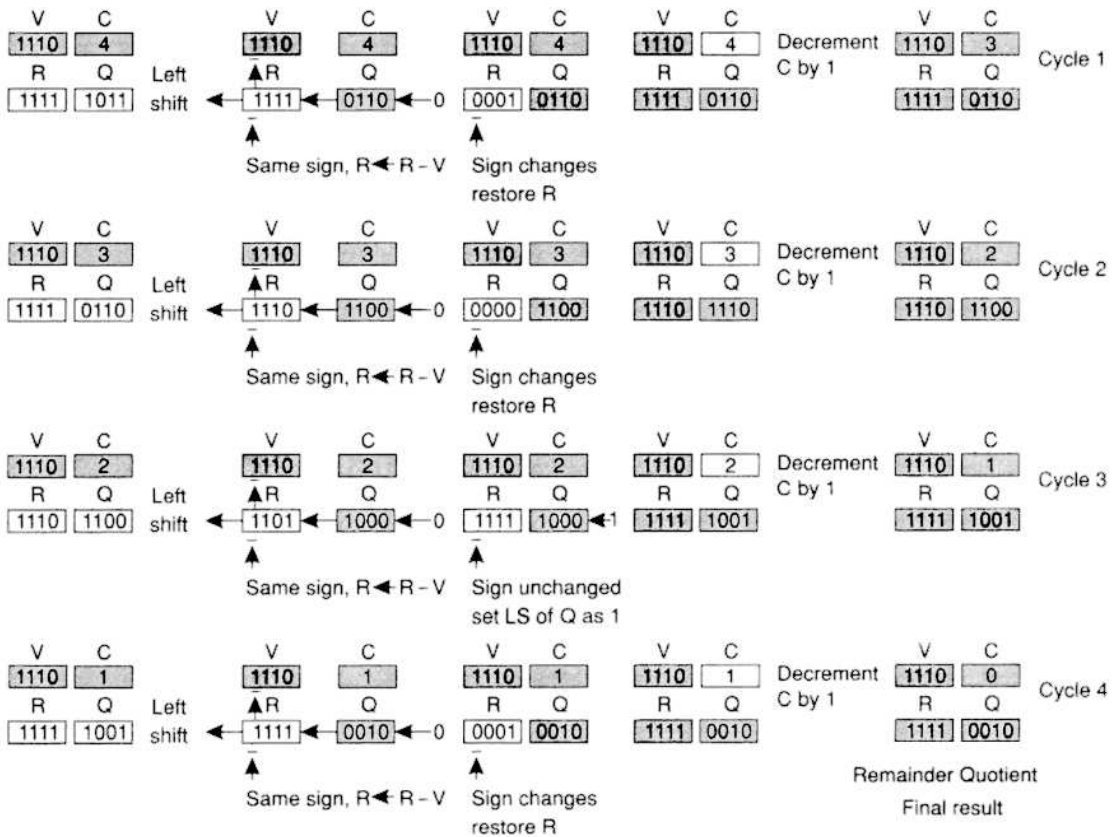
Back in 1970, when the first P800 processor was designed (not counting the Sagittaire proof-of-concept that had no microcode and therefore could never have had a division operation), every manufacturer had to discover its division operator by itself. No textbooks were available on computer architecture in general or hardware arithmetic in particular, even if there were research papers written and conferences to attend. What the manufacturers discovered was the restoring algorithm, which comes in two variants depending on where in the inevitable loop the algorithm begins. The microcode loop shifts one step per cycle, thus dividing the dividend (numerator) by two each time. Nowadays, there are of course textbooks available and two of the most popular elementary ones are Ghoshal: Computer Architecture and Organization and Stallings: Computer Organization and Architecture. Both books present

the same algorithm. We borrow two examples of a restoring division algorithm from the former book. The first example shows how to divide 5 by 2, resulting in a quotient of 2 and a remainder of 1 since $2 \cdot 2 + 1 = 5$.



Process showing $5/2 = 2$ with remainder 1

Such division algorithms were originally conceived to handle only positive integers, but it turns out that they also function relatively well for negative integers. But not perfectly. They act as if negative integers are very large positive ones, larger than the highest possible one. This most often turns out as a correct computation, but not always. We will study the cases that turn out bad, but first another correct computation. The next example shows how to divide -5 by -2 , resulting in a quotient of 2 and a remainder of 1 since $2 \cdot (-2) + (-1) = -5$.



Process showing $-5/-2 = 2$ with remainder -1

The examples are a bit deceptive, though, since the algorithm described works only if the numerator and the denominator have the same sign. If they have different signs, the resulting quotient must have its sign changed (the absolute value is correct). This is known as the quotient sign flip rule and is unfortunately not mentioned in the textbooks. The remainder, though, has the correct sign in all cases. If this was the only correction needed, it would be a simple algorithm. But more complicated corrections are needed as a consequence of feeding negative numbers into an algorithm that was intended only for positive numbers.

As an illustration, let us introduce a more compact form for studying the algorithms. We trace the contents of the registers after each cycle. Then $5/2$ would look like this:

R	Q	V	ALU	A2	C
0000	1010	0010	0000	0101	4
0001	0100	0010	1111	0101	3
0000	1001	0010	0000	0101	2
0001	0010	0010	1111	0101	1

Without getting into details, the result is $Q = 0010 = \text{decimal } 2$ and $R = 0001 = \text{decimal } 1$ which is correct. Further, $-5/-2$ would look like this.

R	Q	V	ALU	A2	C
1111	0110	1110	0000	0011	4
1110	1100	1110	0000	0011	3
1111	1001	1110	1111	0011	2
1111	0010	1110	0001	0011	1

The result is now $Q = 0010 = \text{decimal } 2$ and $R = 1111 = \text{decimal } -1$ which is again correct. If we as a third example try $5/-2$, it would look like this:

R	Q	V	ALU	A2	C
0000	1010	1110	0000	0101	4
0001	0100	1110	1111	0101	3
0000	1001	1110	0000	0101	2
0001	0010	1110	1111	0101	1

This time, we get $Q = 0010 = \text{decimal } 2$ and $R = 0001 = \text{decimal } 1$ which is not correct. We need to do the Q flip as a post-processing step to obtain $Q = -2$ and $R = 1$. But this is a well-known property and can easily be compensated for by a simple sign test. It gets worse, though. Next, we try $-5/-8$ which does not involve the Q flip.

R	Q	V	ALU	A2	C
1111	0110	1000	0000	0011	4
0110	1101	1000	0110	0011	3
0101	1011	1000	0101	0011	2
0011	0111	1000	0011	0011	1

Now, we get $Q = 0111 = \text{decimal } 7$ and $R = 0011 = \text{decimal } 3$ which is far from correct. We expected $Q = 0000 = \text{decimal } 0$ and $R = 1011 = \text{decimal } -5$. What happened?

This is where the two variants of the algorithm mentioned above come into play. Let us call the Ghoshal/Stallings version above D1, and it operates as in the examples. The other one, we call it D2, of course has the same operations but different entry and exit conditions for the microcode loop.

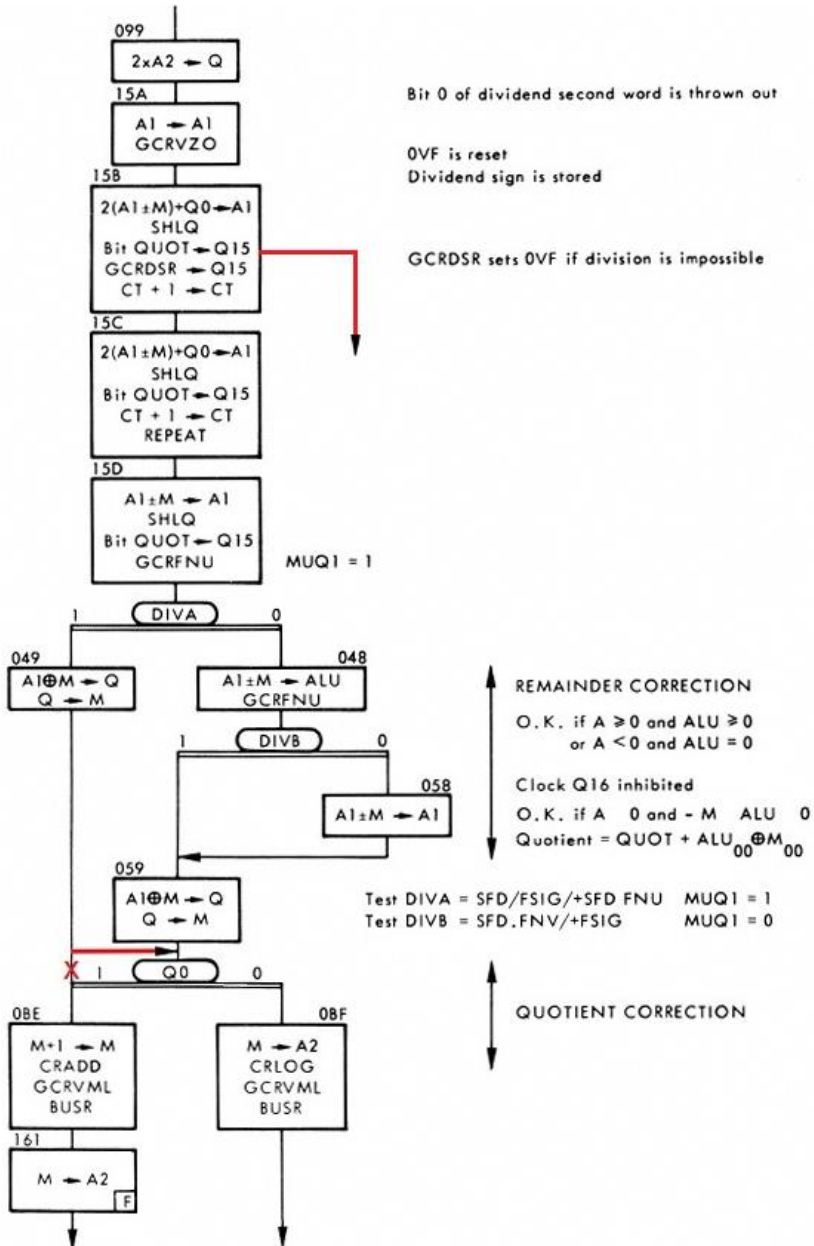
For positive integers, D1 and D2 yield the same results for all input since that was the data they were originally conceived to work with. Ideally, the division algorithm should be a partitioning algorithm with the property that for a dividend T , a divisor N , a quotient Q and a remainder R , the following always holds: $T = Q \cdot N + R$.

The documented P800 division microcode is shown in Appendix D. It is from the hardware service manual but is unfortunately problematic. First, the flowchart contains some errors, such as the flow from instruction /049 should end before the Q_0 test and that the /15B instruction, when detecting a zero as the denominator (divisor), jumps to the end. Those flows are not depicted in the flowchart. The latter is recognised in the assembly manual: [When] overflow occurs, [...] the contents of [the registers] A1 and A2 are destroyed except when the *division* is equal to zero. By “division” is most certainly meant divisor, and this is discovered by the microcode test GCRDSR in instruction /15B. From /15B, there should be a path to the end of the instruction which is not shown in the flowchart.

However, these are minor documentation problems and were easily discovered. The red flag is, though, that the rest of the documentation is not up-to-date either. The authors’ hypothesis is that the division algorithm ran into some correction problems during its development and that the main approach was subsequently changed from D1 to D2. This hypothesis is supported by some facts in the hardware, such as which conditions trigger hardware signals used in the microcode. Since the hardware is finished before the microcode, corrections in the microcode algorithms sometimes cannot be mirrored by hardware changes.

The four correction problems not disclosed by textbooks are the following. Let us label them T0–T3 to give them some names to refer to.

T0 is the quotient sign flip that we have already discussed. Any algorithm must do this, and indeed, the P800 DV instruction flowchart has a part called quotient correction with a test named **Q0**. However, the paths from the test do not contain code for flipping quotient signs, so these are wrong operations shown in both paths. We can safely assume that this is a documentation error and not in microcode, since otherwise all computations with opposite signs for dividend and divisor would be wrong, and that could not have passed any tests. Sadly, the DV documentation shows quite many signs of sloppiness due to being rushed.



Flowchart of the DV instruction in microcode (some drawing errors in red)

T1 is the observation that, although the invariance $T = Q \cdot N + R$ holds, sometimes upon exit from the microcode loop the remainder R is too large, or rather its absolute value $|R|$ which should be less than the denominator N in a correct result. Think of division as repeated subtraction (much like multiplication can be viewed as repeated addition). Keep removing (subtracting) chunks of N from T until it is not possible any more. Depending on the sign of T , the loop should halt at $-N < R \leq 0$ or $0 \leq R < N$. But sometimes, the algorithm stops one step too early. This has to do with the asymmetric representation of integers but we will not go into details here. Suffice it to note that it occurs when $|N|$ is a factor in $|T|$ for $T < 0$. Thus, a prime number factorisation quickly enumerates all the cases. We denote the cases $N > 0$ as T1A and $N < 0$ as T1B, but they fail in the same way. For a D2 algorithm, the detection is always when the equality $|R| = N$ holds, but for D1 it can be $|R| \geq N$. Since the P800 hardware checks for $|R| \geq N$ instead of $|R| = N$, this is a clear indication that the developers were on the D1 route to begin with.³⁹ For T1 cases, the algorithm sometimes must do an extra loop operation in addition to the number determined by the word size. It is easiest to do this separately and the step can be found in the middle of the P800 DV flowchart marked remainder correction. The conditions for the correction are incomplete in the flowchart and also wrong, indicating that this was changed late in the development process when the focus was changed from D1 to D2.

Let `INT_MIN` be the most negative integer that can be represented in a word. For a 16-bit architecture such as the P800, this is the number -32768 . For reasons that can be found in any textbook on computer architecture, the largest positive number is one numeral less, so `INT_MAX` is $+32767$. This asymmetry and its overflow behaviour, i.e. the fact that `INT_MAX+1` suddenly becomes `INT_MIN` rather than a larger positive integer, lies behind some of the division algorithm correction issues.

T2 is the next observation – when the denominator is `INT_MIN`, if the numerator is negative and the remainder is non-zero, a correction similar to T1 must be made. However, this was not discovered by the CTI developers and missing T2 conditions are an undocumented bug in the P800 family.

Finally, T3 is the observation that if the resulting quotient is `INT_MIN`, then the Q flip rule T0 is ineffectual when dividend and divisor signs are opposite. The Q flip is a two-complement operation in hardware and the two-complement of `INT_MIN` ($= -32768$ in our case)

³⁹ The hardware manual even says “greater than” for the detection of the condition which is obviously wrong, but the kinder interpretation “greater than or equal to” is only consistent with the development of a D1 algorithm. D2 needs only “equal to”. See Appendix D for a more elaborate discussion.

is, by definition, the same number since +32768 cannot be represented with 16 bits. This is all fine, and the division algorithm works the same way. Thus, T3 should not be a real problem at all. However, according to the P800 assembler manual, an “erroneous result is given when [...]” (a complicated expression that is simply the same as the quotient being INT_MIN). In this case, all should be fine but the condition register should not test for overflow. The hardware signals CR=3 (overflow) when the C2R (two-complement) instruction operates on INT_MIN. The mistake might have been to reuse the same microcode operation CRADD as in the C2R instruction when it should have been CRLOG. The flowchart hints at this, even though it is completely wrong when it later comes to the quotient correction and mixes this up with remainder correction. The authors guess that the numbers out of DV are correct but that the wrong condition register value is set. But it might be worse, we do not know.

If the DV microcode algorithm is closer to Ghoshal/Stallings D1, however, then the results are, for some pairs of numerator and denominator, much worse in the sense that the output result does not fulfil the invariance condition $T = Q \cdot N + R$ and is thus not reasonably possible to compensate for (much too complicated). In such a case, the only feasible solution would be to detect the two-complement condition and then abort the algorithm.

A problem with a D1 algorithm approach is that in some cases, it needs to do more than one remainder correction. Introducing a repeat here instead of a simple sequence carries an unnecessary performance penalty. The incurred penalties for the corrections are already over 13% for the selected P800 solution (which went from D1 to D2) and it does not even accomplish all of what it set out to do.

Unfortunately, the authors do not have access to any P800 CPU hardware, nor to an assembler and linker. But if we ever will, or if some readers have and are prepared to run a small test program (on as many CPUs in the P800 family as possible), there will almost certainly be a second edition of this book with the results obtained for each of the processors. The program DIVTST exploits bugs known from the assembler manual (one) and from a thorough study of the P857 hardware documentation (two). But are there more, and were they kept in the latest, completely redesigned AM2901-based CPU generation? Or have they all been eradicated? Or were new ones introduced?

While this is of course only of historical interest, the work spent by the designers and engineers back then was as creative and required as much talent and skills as today’s designers and engineers, even if they now have an immensely much larger knowledge base to rely on. Thus, it is worth to draw some attention to those long-forgotten heroes.

```

IDENT    DIVTST    \ TURN KEY TO RTC OFF
AORG     /0200    \ PGM MEM START

START    EQU      *
LDKL     A4,NUMSTA \ DIV DATA START
LOOP     EQU      *
LDKL*    A1,A4+N_HI \ GET NUMERATOR (HI_BITS+SIGN)
LDKL*    A2,A4+N_LO \ GET NUMERATOR (LO_BITS)
LDKL*    A3,A4+DENO \ GET DENOMINATOR (DIVISOR)
DVR      A3       \ A1A2 / A3 -> A2 (QUOT), A1 (REM)
STR      A2,A4+QUOT \ STORE QUOTIENT (CR UNCHANGED)
STR      A1,A4+REMA \ STORE REMAINDER (CR UNCHANGED)
LDK      A5,3     \ GUESS OVF (CR UNCHANGED)
RF(3)    *+1     \ CHECK CR FROM DVR OP
LDK      A5,0     \ ADMIT NO OVF
STR      A5,A4+CREG \ STORE OVF FLAG
ADK      A4,SIZE  \ NEXT DIVISION DATA
CW       A4,NUMEND
RB(L)    LOOP
HLT
END      START    \ DONE -> READ MEMORY
                          \ RESTART AFTER MASTER CLEAR

* DIV DATA STRUCTURE
N_HI     EQU      /0    \ NUMERATOR (HI_BITS+SIGN)
N_LO     EQU      /2    \ NUMERATOR (LO_BITS)
DENO     EQU      /4    \ DENOMINATOR (DIVISOR)
QUOT     EQU      /6    \ QUOTIENT
REMA     EQU      /8    \ REMAINDER
CREG     EQU      /A    \ CONDITION REGISTER
SIZE     EQU      /C    \ DATA STRUCTURE SIZE

AORG     /0280    \ DIV DATA START

NUMSTA   EQU      *
*        REGISTER  A1  A2  A3
*        DIV DATA N_HI N_LO DENO Q R CR
*        -----
DATA     /8000,/0002,/7FFF,0,0,0 \ -1073741822 / +32767
DATA     /8000,/0001,/8000,0,0,0 \ -1073741823 / -32768
DATA     /8001,/0000,/7FFF,0,0,0 \ -1073709056 / +32767
DATA     /8001,/7FFF,/8001,0,0,0 \ -1073676289 / -32767
DATA     /8001,/7FFF,/7FFF,0,0,0 \ -1073676289 / +32767
DATA     /7FFF,/7FFF,/7FFF,0,0,0 \ +1073741823 / +32767
DATA     /8001,/7FFF,/0000,0,0,0 \ -1073676289 / 0
DATA     /0000,/0000,/0000,0,0,0 \ 0 / 0
DATA     /0000,/0000,/8000,0,0,0 \ 0 / -32768
NUMEND   EQU      *

```

Test program DIVTST to exploit P800 CPU hardware bugs

While the divisions in DIVTST look complicated in decimal form, their binary (hex) representations are very simple. In fact, they are among the simplest for exploiting the bugs. The correct results and the bugs intended to be exploited can be found in the following table. T1–T3 are the correction problems as discussed above, while OVF is an overflow condition (CR = 3) and thus, those latter calculations are expected to be correct.

DECIMAL CALCULATIONS (SIMPLE IN HEX)						CONDITION
-1073741822	/	+32767	=	-32768, REM -32766	(T3)	
-1073741823	/	-32768	=	+32767, REM -32767	(T2)	
-1073709056	/	+32767	=	-32768, REM 0	(T1A & T3)	
-1073676289	/	-32767	=	+32767, REM 0	(T1B)	
-1073676289	/	+32767	=	-32767, REM 0	(T1A)	
+1073741822	/	+32767	=	+32768, REM +32766	(OVF)	
-1073676289	/	0	=	-INF, REM NAN	(OVF)	
0	/	0	=	+INF, REM NAN	(OVF)	
0	/	-32768	=	0, REM 0		

DATA	N_HI	N_LO	DENO	Q	R	CR
DATA	/8000,	/0002,	/7FFF,	/8000,	/8002,	0
DATA	/8000,	/0001,	/8000,	/7FFF,	/8001,	0
DATA	/8001,	/0000,	/7FFF,	/8000,	/0000,	0
DATA	/8001,	/7FFF,	/8001,	/7FFF,	/0000,	0
DATA	/8001,	/7FFF,	/7FFF,	/8001,	/0000,	0
DATA	/7FFF,	/7FFF,	/7FFF,	/0000,	/7FFF,	3
DATA	/8001,	/7FFF,	/0000,	/7FFF,	/8001,	3
DATA	/0000,	/0000,	/0000,	/0000,	/0000,	3
DATA	/0000,	/0000,	/8000,	/0000,	/0000,	0

Table of conditions exploited and correct results

Finally, there is a better way to record the program status word (PSW) including the condition register if it would be of interest to see its full content. However, it is not expected to find any bugs there, which is why it was deemed sufficient to record the OVF condition.

- * ALTERNATIVE WAY OF FETCHING ENTIRE PROGRAM STATUS WORD
- * THE ONLY WAY TO ACCESS THE PSW IS VIA A STACK PUSH
- * DECLARE A STACK AREA AND ASSIGN IT TO THE A6 REGISTER
- * CALL WITH CF A6,GETPSW

```

GETPSW EQU *
LD* A5,A6-2 \ GET PSW FROM STACK
STR A5,A4+CREG \ STORE ENTIRE PSW
RTN A6
    
```

Recording of the complete condition register

There is another way out of this algorithm dilemma, and that was the path taken by Intel when designing the first of its x86 microprocessors, the 8086. They had observed the various problems that manufacturers of minicomputers experienced through the first half of the 1970s. Thus, when they in 1977 were about to design their division instruction on the rather small chip area that they had available, they went for the simplest of solutions. They implemented division only for positive numerators and denominators by negating numbers that were negative before the microcode loop and keeping track of the signs in order to be able to restore them at the end. The same signs on the numerator and denominator yield a positive quotient, otherwise negative. The sign of the remainder follows the numerator (dividend). Thus, in total 0–3 sign flips were needed using the standard two-complement operation that was already on board. And none for the predominant case of a positive numerator and likewise denominator. The only extra check was to keep track of the most negative integer since it has no two-complement. And by avoiding that special case, all the troubles above were circumvented. Why did not more minicomputer CPU designers back in the day choose this simple yet elegant solution? Probably because of a misled ambition to handle all integers, even the most negative one. But the price paid for such an ambition was indeed high, both in terms of processing and bugs introduced.⁴⁰

C.2 DEC PDP-11

Philips CTI insisted on keeping these microcode bugs for at least two CPU generations. Why? The reason was that you know what you have but not what you might get. At least one of these bugs was known by many users, and their software code therefore circumvented it if necessary. In order to keep compatibility and, foremost, not introduce new bugs, the microcode bugs (known and unknown) were kept, at least for the first two generations. A

⁴⁰ As a side note, even though we are discussing integer division, similar problems can be seen in floating point (non-integer) division since – while the exponent part of a floating-point algorithm is only subtraction – the mantissa part performs a very similar division as integers do. When Intel decided to abandon its traditional floating point division algorithm it had until then had for all x86 coprocessors (8087 to 80487) for the 8086 to 80486 microprocessors for the so-called SRT algorithm in 1992 for speed reasons and fully integrate it into the main microprocessor chip, it ended in the first full recall ever of a computer chip: the Pentium processor and its infamous FDIV bug.

Partly based on lookup tables, the SRT algorithm is clever in that it can handle (guess) more than one bit at a time, but needless to say requires correct tables. Intel mistakenly left out a table section of five entries when producing the chip, which were instead filled with zeroes leading to miscalculations. Thus, this time it was Intel that bit the dust and it did cost them around USD 500 million in the end. Quite an expensive aftermath for simply forgetting to enter five ‘+2’ into table entries that remained at ‘0’ since they were untouched.

company that took another approach was Digital Equipment (DEC). In almost parallel development paths, they converted their PDP-11 architecture to a set of LSI chips in 1975 called LSI-11 (Philips P851 SPALU/PLANET was the parallel in 1976) and then to one single chip called J-11 in 1979 (Philips SPC 16/10 was the parallel the same year). Having a bug-correction strategy opposite to Philips', DEC tried to fix all known bugs prior to etching the processors onto LSI silicon, but that resulted in a number of new bugs being introduced instead. As an illustration, this is an excerpt from the bug chart of the PDP-11 family that leads to different behaviours depending on the model number, some even marked "unpredictable". The full chart has 56 entries; our snapshot serves to illustrate the scattering of the 'X' markings indicating different behaviours among the various processor versions.

ITEM	23/24	44	04	LSI-11	15/20	35/40	45	70	60	J-11	T-11
34. Opcodes 75040 thru 75777 trap to 10 as reserved instructions. If KEV-11 option is present, opcodes 75040 thru 75577 can be used as escapes to user microcode. If no user microcode exists, a trap to 10 occurs.	X	X	X	X	X	X	X	X	X	X	X
35. Opcodes 170000 thru 177777 trap to 10 as reserved instructions. Opcodes 170000 thru 177777 are implemented as floating point instructions. Opcodes 170000 thru 177777 can be used as escapes to user microcode. If no user microcode exists, a trap to 10 occurs.	X	X	X	X	X	X	X	X	X	X	X
36. CLR and SXT do just a DATO sequence for the last bus cycle. CLR and SXT do DATIP-DATO sequence for the last bus cycle.	X	X	X	X	X	X	X	X	X	X	2
37. MEM MGT maintenance mode MMRO bit 8 is implemented. MEM MGT maintenance mode MMRO bit 8 is not implemented.	X	X				X	X	X	X	X	

¹ Unpredictable
² CLR and SXT do DATI-DATO

Differences in PDP-11 processor versions, i.e. the hardware bug list

For the DEC J-11 single chip (it was in reality a 2-3 chip set, same as for the Philips SPC 16/10-12), there were even bugs discovered so late that they had to override and reuse two bug table positions (53, 54) in the bug list and replace them with the newly found bugs 55 and 56 documented by a typewriter and the 'X's entered using a pen. Recall that typesetting in these times was made by publishers, not on personal computers, so these were really late

calls. Philips' (CTI and Signetics) more conservative approach paid off comparatively well in this case, with better hardware compatibility and no new bugs introduced.

ITEM	23/24	44	04	LSI-11	15/20	35/40	45	70	60	J-11	T-11
50. MMR3<3>-CSM enable- implemented. MMR3<3> not implemented.		X								X	
	X					X	X	X	X		X
51. MMR2 tracks instruction fetches and interrupt vectors. MMR2 tracks only instruction fetches.							X	X			
	X	X				X			X	X	NA
52. MFPx %6, MTPx when PS<13:12>= 10 gives unpredictable results. MTPx %6, MTPx %6 when PS<13:12>= 10 uses user stack pointer.	X	X				X	X	X	X		
										X	NA
55. The ASH instruction with a source operand of octal 37 (shift left 31 decimal times) will cause the register to be shifted right instead of left.										X	
56. The ASHC instruction with an octal value of 37 (shift left 31 decimal times) in source operand bits 5:0 and bits 15:6 of the operand being non zero, will cause the register to be shifted right instead of left.										X	

Some more differences between PDP-11 processor versions, especially the J-11 bugs

C.3 Set System Mode

The following architecture bug was a convenient way of circumventing the operating system protection of the CPUs in the P800 series (the budget model P852 had no such protection).

Many instructions that were reserved for the operating system – everything from I/O and interrupt handling to manipulating the memory map – were protected by the system mode/user mode distinction in which the core parts of the operating system would run in system mode, thus having access to all instructions, while both user processes and some aspects of device drivers, despite the latter being a part of the operating system, had to use a restricted set of instructions that were harmless in the sense that they could not compromise the integrity of the operating system or its resources. Whether the CPU was in system or user mode was indicated by a bit (flag) in the PSW (program status word) which also

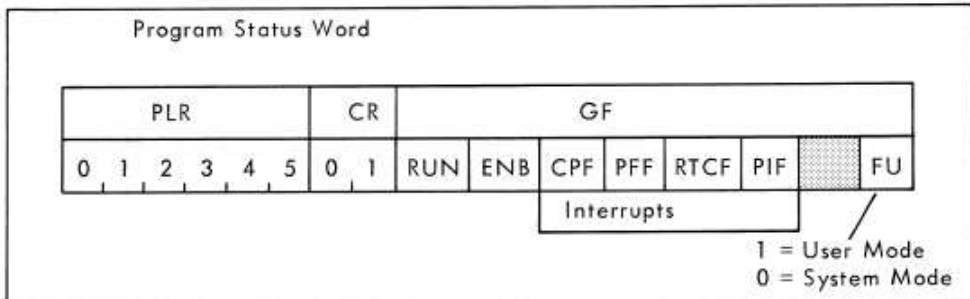
contained information on the processor priority level the program was running at, the condition register and some other hardware-related information.

Since different functions and different subroutines ran under different conditions, the PSW was pushed onto the stack at every function call (CF instruction) and at every hardware interrupt, and consequently restored on return from the function or interrupt (RTN instruction). Since the stack was just a part of memory, it could be manipulated by program code and thus, the PSW could be edited by software if so desired. The designers of the P800 architecture naturally realised this and made sure that a process running in user mode could not modify almost anything of the PSW upon executing an RTN instruction. From the hardware description, we can see this as the $\overline{A15}$ case where only the two bits in the condition register (CR) are restored from the stack and the rest are ignored.

The PSW is a 16-bit status word comprising the priority level register (PLR), condition register (CR), and general flip-flops (GF). The complete PSW is saved in the stack, via the A-bus, during the following :

- Interrupt routine
- Trap routine
- Page Fault
- Call Function (CFR)
- Halt (HLT)
- Inhibit Interrupt (INH)
- Reset Internal Interrupt (RIT)
- Enable Interrupt (ENB)
- Link to Monitor (LKM)
- Set Mode (SMD)

During a Return (OPC14) instruction in System Mode ($A15$), the PLR, the CR, and the ENB and FU-bits of GF are restored from the stack to the PSW; the other bits of GF are not changed by the Return. During a Return instruction in User Mode ($\overline{A15}$), only CR is restored from the stack.



Thus, running in user mode and executing an RTN instruction would not change the FU bit that determined whether the processor was in system or user mode. Loophole plugged. Well, not entirely. One of the authors discovered and exploited (only for benign purposes, of course) a loophole within the plugged prospective loophole. And this loophole-within-a-loophole was the real deal. It was never disclosed and, to the authors' knowledge, not used except in systems designed by us.

The trick was to find a way to temporarily be in system mode. This way, a return using a modified FU bit on the stack would actually be honoured by the processor. The trick consisted of creating a new, non-existing instruction. The authors chose the illegal opcode /4001 (hex) and named it SSM = set system mode, a mnemonic that would have sent a shiver down every hardware architect's spine. When the processor encountered this instruction, an illegal instruction trap interrupt occurred. Since all interrupts were serviced in system mode, the code that received this illegal instruction needed only to modify the FU bit on the stack and immediately return in order for a user process to have switched to system mode and gained access to all instructions of the processor, including the protected ones. This was done for convenience, efficiency and financial reasons since finding a solution to a customer project issue without having to modify the operating system was a substantial time and money saver. The code that did this was surprisingly simple. All instructions of this routine were allowed since it did itself operate in system mode due to the processor's architectural design. There was no mechanism to stop it, and it was only four lines of code (plus a test that it was /4001 that caused the trap).

```
SSM      EQU      *
          LD*     A1,A15-2      \ GET PSW FROM SYSTEM STACK
          ANKL    A1,/FFFE     \ RESET FU BIT TO 0 = SYSTEM MODE
          STR     A1,A15-2     \ RESTORE ENTIRE PSW
          RTN     A15         \ CONTINUE AS USER IN SYSTEM MODE
```

The code could easily be patched into the illegal instruction trap handler. The only caveat was that this "instruction" changed the A1 register, a small side effect that the programmers could easily live with, given the power of the trick. It was of course used with great care and only in well-motivated and well-documented situations since it in essence influenced the integrity of the operating system. Thus, it was never released to customers and only used internally in Philips PTS customer projects. The trick does not work on the earliest P800 CPUs (P855/P860) since they had no illegal instruction trap, instead treating an illegal instruction as an LKM (link-to-monitor) operating system call, but those processors were never utilised by PEAB-T/PTS anyway.

D. Microcode Disassembly

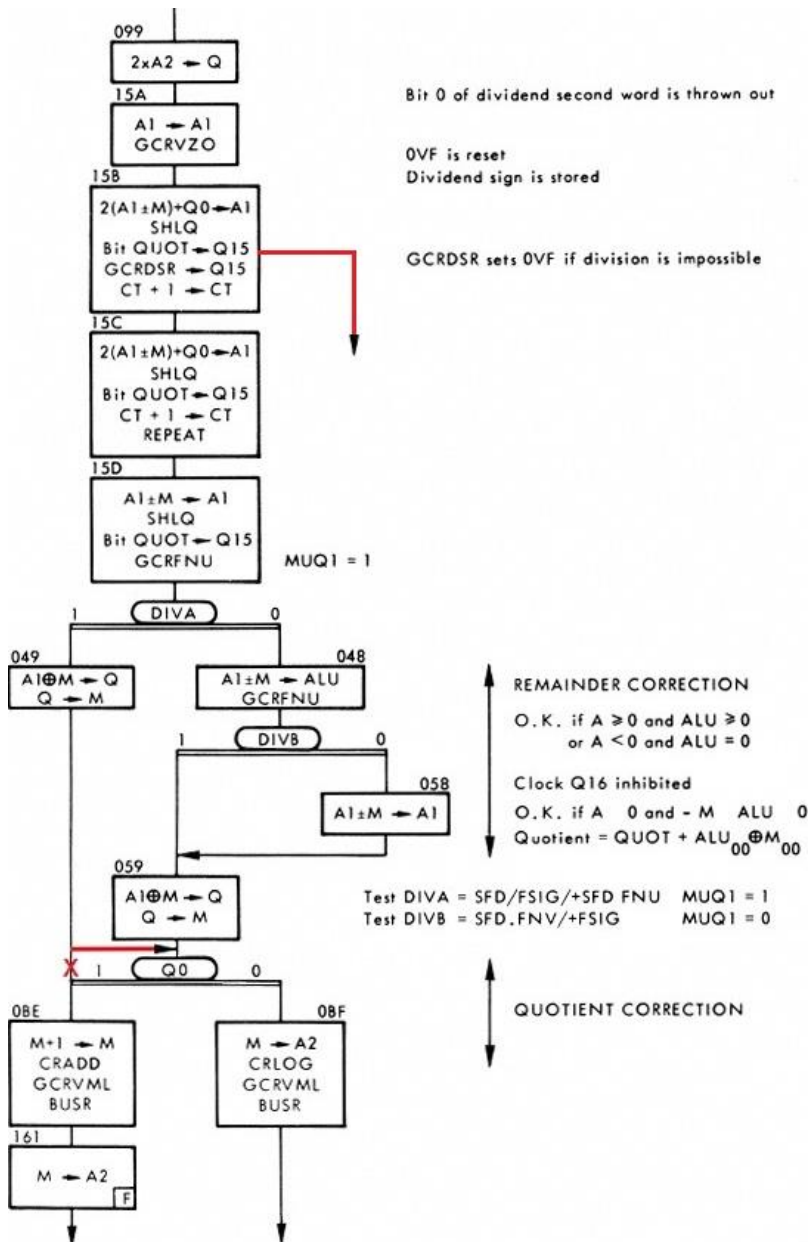
To create an emulator for the P800 processor family, the authors had to disassemble and dissect the microcode. The code is published on the internet nowadays, so it is mostly a matter of time to spend – the information is available. The authors have no special access to internal Philips hardware documentation, so this can be done by anyone interested. The format for the microcode is a 48-bit word with the following subfields. We refer to the P800 hardware service manual, which can be found by searching the internet, for details on the fields.

Table 2-2 Microinstruction Command Bits

	Field	Bit	CPU section controlled by the command field
Next Word Control	μSNA 0-1	0-1	Select Source of Next Address
	μNA 0-8N	2-10	Next Address, Explicit
Data Path Control	μA 0-4	11-15	A Bus Selector
	μADL 0-4	16-20	ALU, D, L Command Decoder
	μC 0-1	21-22	C Multiplexer
	μMLOAD MSEL	23-24	M Register
	μQ 0-1	25-26	Q Register
	μS 0-1	27-28	S Register
	μP 0-1	29-30	P Register
	μCT	31	CT Counter: loops, shifts
	μSEQ 0-1	35-36	Sequensor (CPU clock), Bus Controller
	μTMRN, BIOL, WRITE, BUSR	32-34 37	Bus Controller
	μGP 0-4	38-42	GENERAL FIELD SELECTION
	μCR 0-2	43-45	Condition Register
	(not used)	46-47	

P800 microcode fields

There are 384 words in the microcode ROM, of which 28 are for test programs and the rest are for the instruction set. No word is unoccupied. To emulate the processor, turn to the microcode flowcharts of each instruction. We have previously shown the DV instruction and repeat it here for reference.



DV microcode flowchart (opcode type OPC 9, repeated from page 305)

10. CTP1: 5-bit CT++

12. REPEAT:

Effect: $2(A1 \pm M) + Q0 \rightarrow A1$

15D|ROM FLAG./1B6.AWA1,DIVALU,,,SLQ,,,,,GCRFNU,D DIV 16TH PASS

1. FLAG: selection next address (p.62) Addr. /1B6 = flag 110 \rightarrow DIV (p.55+56)

2. /1B6: next address in 1-comp (p.62): /048 (DIVA=0) or /049 (DIVA=1)

3. AWA1: write A1 (p.62)

4. DIVALU: $A \pm B$

7. SLQ: here sets $\mu Q1=1$ (p.63), $\mu Q1=1 \rightarrow$ DIVA (p.56) [& shift left Q (p.84)]

14. GCRFNU: store OALU in FNU (p.61)

Effect: $A1 \pm M \rightarrow A1$

Path DIVA = 1

049|ROM FLAG./140.ARA1,AXB,CALU.MYQ,QYC,,,,,,D DIV TEST QUOT.

1. FLAG: selection next address (p.62). Addr. /140 = flag 000 \rightarrow Q00N (p.55, but Q00 p.107)

2. /140: next address in 1-comp (p.62): /0BE (Q00N=0) or /0BF (Q00N=1)

3. ARA1: read A1 (p.62)

4. AXB: $A \text{ XOR } B$ (p.81)

5. CALU: Selector for C register: ALU (p.84)

6. MYQ: $Q \rightarrow M$ (p.83)

7. QYC: Parallel load Q from C (p.84)

Effect: $A1 \text{ XOR } M \rightarrow Q$; $Q \rightarrow M$

Jump to /0BE or /0BF

Path DIVA = 0

048|ROM FLAG./1A6.ARA1,DIVALU,,,,,,GCRFNU,D DIV TEST COR.REM.

1. FLAG: selection next address (p.62). Addr. /1A6 = Flag 110 \rightarrow DIV (p.55+56)

2. /1A6: next address in 1-comp (p.62): /058 (DIVB=0) or /059 (DIVB=1)

3. ARA1: read A1 (p.62)

- 4. DIVALU: $A \pm B$ (p.82)
- 7. 0 resets $\mu Q0$ and $\mu Q1$. $\mu Q1=0 \rightarrow$ DIVB (p.56)
- 14. GCRFNU: store 0ALU in FNU (p.61)

Effect: $A1 \pm M \rightarrow$ ALU

Path DIVB = 0

058 | ROM ,/1A6.AWA1.DIVALU,,,,,,0 DIV CORR.REM.

- 2. /1A6: next address in 1-comp (p.62): /059
- 3. AWA1: write A1 (p.62)
- 4. DIVALU: $A \pm B$ (p.82)

Effect: $A1 \pm M \rightarrow$ A1

Path DIVB = 0 (cont'd) or 1

059 | ROM FLAG,/140.ARA1.AXB.CALU.MYQ.QYC,,,,,,0 DIV TEST QUOT.

- 1. FLAG: selection next address (p.62). Addr. /140 = Flag 000 \rightarrow Q00N (p.55)
- 2. /140: next address in 1-comp (p.62): /0BE (Q00N=0) or /0BF (Q00N=1)
- 3. ARA1: read A1 (p.62)
- 4. AXB: $A \text{ XOR } B$ (p.81)
- 5. CALU: Selector for C register: ALU (p.84)
- 6. MYQ: $Q \rightarrow M$ (p.83)
- 7. QYC: Parallel load Q from C (p.84)

Effect: $A1 \text{ XOR } M \rightarrow Q$; $Q \rightarrow M$

Path Q0 = 1

0BE | ROM ,/09E.AZ.APLB1.CALU.MYC,,,,,,BUSR.GCRVML.CRADD DIV COR.QUOT

- 2. /09E: next address in 1-comp (p.62): /161
- 3. AZ: zero \rightarrow A
- 4. APLB1: $A + B + 1$, with carry (p.81)
- 5. CALU: Selector for C register: ALU (p.84)
- 6. MYC: $C \rightarrow M$ (p.83)
- 13. BUSR:
- 14. GCRVML: set CR=3 if OFL (p.61)
- 15. CRADD: set CR=0..3 (p.90)

Effect: $M + 1 \rightarrow$ M

161 | FTA AWA2.ALUB.0

DIV ST CORTD QUOT

2. FTA /1FF: next address in 1-comp (p.62): /000
3. AWA2: write A2 (p.62)
4. ALUB: B

Effect: M → A2

Path Q0 = 0

0BF | ROM ./1E9.AWA2.ALUB.....BUSR.GCRVML.CRLOG

DIV QUOT OK

1. FTA /1FF: next address in 1-comp (p.62): /000 NOT TRUE! /1E9 → /016 = Fetch
2. AWA2: write A2 (p.62)
3. ALUB: B (p.81)
13. BUSR:
14. GCRVML: set CR=3 if OFL (p.61)
15. CRLOG: set CR=0..2 (p.90)

Effect: M → A2

Finally, to understand how the path selections in the flowchart occur (if-then-else), we consider the DIV flag which can operate in two modes (DIVA and DIVB).

2.35 Flag DIV enables the remainder correction according to test DIVA or DIVB, selected by $\mu Q1$. Test DIVA ($\mu Q1$) is true if the remainder sign is opposite to the dividend sign. Test DIVB ($\mu Q1N$) is true if both the remainder and dividend are <0 , but the absolute remainder value is greater than the absolute divisor value. The select inputs and data inputs of a 74151A multiplexer chip are used together to generate the FLAGDIV signal when either test is true.

- DIVA: $\mu Q1$ FSIGDIV FSIG (input 14)
FSIGDIV FNU (input 16,17)
- DIVB: $\mu Q1$ FSIGDIV FSIG FNUN (input 13)

The DIV flag with its two modes (last line should say $\mu Q1N$, not $\mu Q1$)

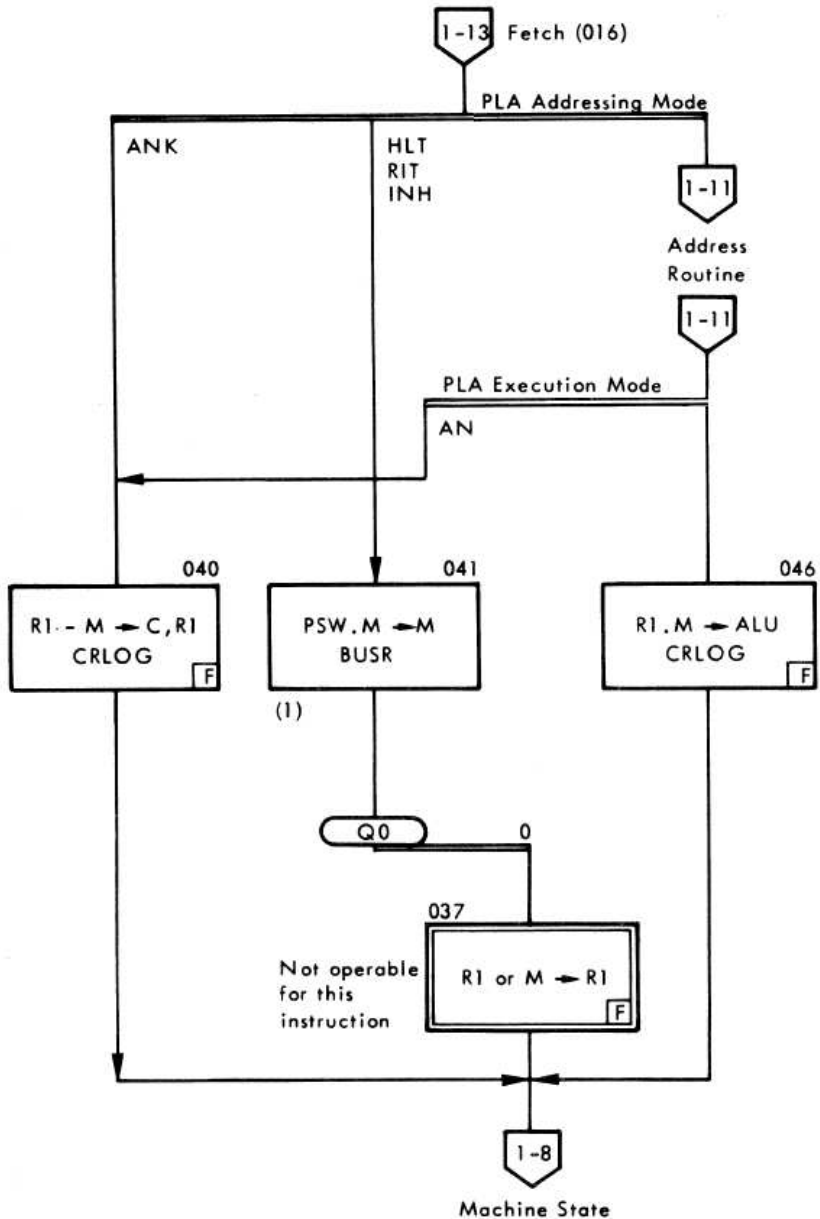
In the description of the DIV flag, there are some things to notice. Recall that of the three remainder situations to correct, T1–T3, the processor only attempts to correct T1. The DIVA test opens the remainder correction path, but the conditions are more suitable for a D1 al-

gorithm.⁴¹ This hints at CTI having changed the algorithm family midway through the development. A correctly implemented D2 algorithm only needs to check the FSIG signal (the sign of the dividend) since T1 and T2 corrections are only necessary for negative dividends. (T3 needs no correction at all for D2 if the condition register for the two-complement is handled correctly). Next, DIVB checks $|\text{remainder}| > |\text{divisor}|$. This is obviously a misprint; it has to be $|\text{remainder}| \geq |\text{divisor}|$ for the algorithm to function. But the ‘ \geq ’ condition is only necessary if the microcode runs a D1 algorithm since it can overshoot/undershoot by more than the amount $|\text{remainder}|$. A D2 algorithm, which behaves more properly, will only overshoot with exactly $|\text{remainder}|$ and thus a ‘=’ test would have been the choice. That is another clue that the hardware was initially designed for a D1 algorithm, and when its not-so-good properties were discovered during microcoding and testing, it was probably too late to change the hardware circuit board.

However, the documentation is a bit sloppy, so the authors are not aware of in detail what the DV instruction does when it encounters boundary conditions. The test program in Appendix C will, if ever run, be the ultimate decider for each processor in the P800 family that has DV instructions.

As a side note, we end this appendix with a computer folklore adage: “Those who once really knew a specific computer architecture will remember the instruction code for the HALT instruction to their dying day.” HALT symbolises the end, and in the P800/PTS 6000 assembler, which mainly used three-letter mnemonics for instructions, the HLT instruction was */207F* (hex). Referring to the microcode flowchart on the next page, it can be seen that the HLT instruction shared flow with the INH (inhibit interrupt) and RIT (reset interrupt) instructions. That was reasonable since they were similar. But to the left in the flowchart is the ANK instruction, which was a logical AND between a register (only A1–A7 allowed) and a short positive constant in the range [0, 255]. At first sight, that might not seem reasonable. However, in the P800 architecture, special instructions were piggybacked on unoccupied parts of other instructions to keep the instruction space as compact as possible, thus allowing for extensions to the instruction set. The instruction code for ANK was */2rkk*, where *r* was the register in the range [1, 7] and *kk* was the short positive constant [*/00, /FF*]. For ANK, it did not make sense to allow *r* = 0 since A0 was the program counter and a bitmask operation on it was nonsensical (and besides, it could still be done with the longer ANKL instruction). This way, the codes */20xx* became available for other instructions.

⁴¹ See Appendix C for a discussion on the D1 and D2 families of division microcode algorithms.



Microcode flowchart for the HLT instruction

E. AI Chatbot

As a contemporary bonus, let us hear what an “AI” chatbot like ChatGPT 4 has to say about PDS history. Those chatbots became very popular during the spring of 2023 and were thought to revolutionise writing in general. Thus, let us try ChatGPT out. This is a word-by-word verbatim account of the questions asked and the bot’s replies. ChatGPT likes to divide its answers into many very small paragraphs, much like short news texts on the web. Questions are in italics, authors’ comments are in blue, and chatbot responses are in plaintext. This chapter in the book will undoubtedly age the worst by far, but view it as a snapshot of the general state-of-the-art in “AI/ML/neural nets/deep learning/large language models” in the spring of 2023.

Q1: Tell me about the success of Philips Data Systems in the 1970s.

A1: In the 1970s, Philips Data Systems (PDS) experienced a period of success and growth as it made significant contributions to the computer industry. PDS, a division of the Dutch electronics company Philips, focused on developing computer systems, software, and related services during that time.

One of the notable successes of PDS in the 1970s was the introduction of the PDP-11 minicomputer series. PDP-11, originally developed by the American company Digital Equipment Corporation (DEC), was licensed to PDS for distribution in Europe. The PDP-11 series gained popularity and became one of the most widely used minicomputers in Europe, providing a powerful and versatile computing platform for various applications.

PDS leveraged the success of the PDP-11 series to establish a strong presence in the European computer market. The company’s focus on delivering reliable and innovative computer systems resonated with businesses and organizations in sectors such as finance, industry, and government.

Furthermore, PDS expanded its product portfolio beyond the PDP-11 series and introduced other successful computer systems during the 1970s. One such example was the P1000 series, which targeted the business computing market. The P1000 series offered a range of models with different processing power and capabilities, catering to diverse customer needs.

PDS also invested in research and development, collaborating with universities and other industry partners to advance computer technology. This commitment to innovation resulted in the development of cutting-edge software and hardware solutions.

Additionally, PDS established a strong network of sales and service centers, ensuring efficient distribution and support for its products. The company's comprehensive customer service approach and commitment to after-sales support helped build customer loyalty and enhance its reputation in the market.

Overall, during the 1970s, Philips Data Systems experienced success by capitalizing on the popularity of the PDP-11 series and expanding its product offerings. The company's commitment to innovation, reliable systems, and customer support played a crucial role in establishing PDS as a significant player in the European computer industry during that era.

ChatGPT 4 has obviously recorded some connection between Philips and DEC. But that connection was only established in 1991 when DEC acquired Philips' computer businesses. In the 1960s, 1970s and 1980s, Philips PDS cooperated with other American computer companies like IBM, Honeywell and Motorola, but never with DEC. The answer is simply totally untrue.

Q2: *Tell me about the decline of Philips Data Systems in the 1980s.*

A2: Philips Data Systems (PDS) was a division of the Dutch electronics company Philips that operated in the 1980s. PDS focused on manufacturing and selling computer systems, software, and related services. While PDS had a promising start and developed several innovative products, it faced significant challenges and eventually met its demise.

PDS was established in 1980 as a result of Philips' acquisition of the American computer company, Computer Memories Inc. The acquisition aimed to strengthen Philips' presence in the computer industry, and PDS was tasked with developing and marketing computer systems and software for various sectors.

PDS introduced a range of products, including the P2000 and P3000 series of personal computers. The P2000 series gained popularity in Europe, particularly in the home computer market, where it competed with other popular platforms of the time, such as the Commodore 64 and the ZX Spectrum. The P3000 series targeted the business and professional market, offering more advanced features and capabilities.

Despite some initial success, PDS faced challenges that led to its demise in the 1980s. One significant factor was intense competition from established players in the computer industry, such as IBM and Apple, as well as emerging companies like Commodore and Atari. These competitors offered more advanced and cost-effective products, which made it difficult for PDS to gain a substantial market share.

Additionally, PDS struggled with internal management issues, including slow decision-making processes and a lack of clear strategic direction. These factors hindered the company's ability to adapt to rapidly evolving market demands and capitalize on emerging opportunities.

As a result, Philips made the decision to exit the computer industry in the mid-1980s. In 1986, Philips sold its computer division, including PDS, to the French company, Digital Equipment Corporation (DEC). DEC rebranded the acquired division as Philips Computer Systems (PCS). However, even under DEC's ownership, the division continued to face challenges, and its operations were eventually scaled down.

In the early 1990s, DEC made the decision to discontinue the PCS brand, effectively marking the end of Philips' involvement in the computer industry. DEC itself faced difficulties in the following years and was eventually acquired by Compaq in 1998.

The demise of Philips Data Systems in the 1980s can be attributed to factors such as intense competition, the inability to adapt to market changes, and internal management issues. While PDS made notable contributions to the computer industry during its existence, it ultimately could not sustain a competitive position and was eventually sold off as part of Philips' strategic realignment.

These were indeed leading questions, albeit still with mostly nonsense as replies. The chatbot seems to guess that higher numbers are more advanced, so the P2000 (a low-level PC series) was above the P1000 (which existed 10–15 years prior). And then that P3000 was way above this, etc. It also mixes small consumer play toys like Commodore 64 and Sinclair Spectrum into the discussion. And it discusses some made-up acronyms like “PCS” – utter nonsense.

Next, what if we swap the decades, asking for validation of untrue scenarios?

Q3: *Tell me about the success of Philips Data Systems in the 1980s.*

A3: In the 1980s, Philips Data Systems (PDS) faced challenges that led to its eventual demise rather than significant success. While PDS had a promising start and introduced innovative products, it struggled to compete with established players in the computer industry and faced internal management issues.

PDS made efforts to expand its product offerings during the 1980s. It introduced the P2000 series of personal computers, which gained popularity in the European home computer mar-

ket. The P2000 series offered features like expandable memory, built-in programming languages, and graphics capabilities. However, despite its initial success, it faced intense competition from other popular platforms like the Commodore 64 and the ZX Spectrum.

In the business and professional market, PDS launched the P3000 series, which offered more advanced features and capabilities. The P3000 series aimed to compete with established computer systems like IBM PCs. However, PDS struggled to gain a significant market share due to fierce competition from industry giants and emerging companies.

Internal management issues also plagued PDS during this period. Slow decision-making processes, lack of clear strategic direction, and difficulty adapting to market changes hindered the company's ability to capitalize on emerging opportunities. These issues contributed to its decline in the 1980s.

As a result, Philips made the decision to exit the computer industry in the mid-1980s. In 1986, Philips sold its computer division, including PDS, to Digital Equipment Corporation (DEC). DEC rebranded the acquired division as Philips Computer Systems (PCS). However, even under DEC's ownership, PCS continued to face challenges, and its operations were eventually scaled down.

Overall, while PDS introduced innovative products and achieved some initial success in the 1980s, it faced intense competition, struggled with internal management issues, and ultimately failed to sustain a strong market position. The challenges it encountered led to its demise and Philips' exit from the computer industry.

[Like a skilled con artist, ChatGPT obviously keeps close track of what it just responded. This happened next.](#)

Q4: *Tell me about the decline of Philips Data Systems in the 1970s.*

A4: I apologize for the confusion in my previous response. Philips Data Systems (PDS) did not meet its demise in the 1970s. In fact, the 1970s were a period of success and growth for PDS as it made significant contributions to the computer industry.

During the 1970s, PDS established itself as a major player in the European computer market. The company had a strong focus on developing and distributing computer systems, software, and related services. One of the key factors contributing to PDS's success during this period was its partnership with Digital Equipment Corporation (DEC).

DEC, an American computer company, licensed its highly popular PDP-11 minicomputer series to PDS for distribution in Europe. The PDP-11 became a widely used and influential

minicomputer platform in the region. PDS played a significant role in marketing, distributing, and supporting the PDP-11 systems, which helped the company gain a strong market presence.

PDS leveraged the success of the PDP-11 series to expand its product portfolio and offer a wide range of computer systems to different sectors. The company developed its own line of computer systems, such as the P1000 series, targeting the business computing market. These systems provided reliable and powerful computing solutions, attracting customers across various industries.

PDS also invested in research and development, collaborating with universities and other industry partners to advance computer technology. The company focused on developing innovative software and hardware solutions to meet the evolving needs of its customers.

Additionally, PDS established a robust sales and service network, ensuring efficient distribution and support for its products. The company's commitment to customer service and after-sales support further solidified its reputation in the market.

It's important to note that while PDS experienced success in the 1970s, the challenges it faced emerged in the subsequent decade, leading to its eventual demise in the 1980s.

The bot reiterates almost the same facts, but now delivered more negatively. It is evident that ChatGPT is only a language model with zero fact-checking of what it produces. And indeed, how could it, given the way it is constructed?

Q5: *Tell me about the origin of Philips Data Systems.*

A5: The origin of Philips Data Systems (PDS) can be traced back to the acquisition of a US company called Computer Memories Inc. (CMI) by the Dutch electronics company Philips in 1980. Philips, a renowned manufacturer of consumer electronics and electrical equipment, recognized the growing importance of the computer industry and sought to establish a foothold in that sector.

Computer Memories Inc., founded in 1968, specialized in memory systems for mainframe computers. The company developed expertise in computer systems and software, which made it an attractive acquisition target for Philips. The acquisition of CMI provided Philips with an established presence in the computer industry and laid the foundation for the creation of PDS.

Following the acquisition, Philips integrated CMI into its organization and formed Philips Data Systems as a separate division within the company. The new division, PDS, focused

on the development, manufacturing, and distribution of computer systems, software, and related services.

The acquisition of CMI and the establishment of PDS allowed Philips to leverage the existing technology and expertise of CMI while capitalizing on the growing demand for computer systems and services. By entering the computer industry, Philips aimed to expand its product portfolio and diversify its business operations beyond its traditional areas of consumer electronics and electrical equipment.

Under the umbrella of PDS, Philips developed and marketed a range of computer systems and software, including the popular P2000 and P3000 series of personal computers. These products targeted both the home computer market and the business and professional market, respectively.

While PDS faced challenges and eventually met its demise in the 1980s, the origin of the division can be traced back to the strategic acquisition of Computer Memories Inc. by Philips, which allowed the company to enter the computer industry and establish itself as a player in that sector.

Q6: *Tell me about the merger of Philips Data Systems with Philips Telecommunication Systems and subsequent reorganisations.*

A6: I apologize for the incorrect information in my previous response. To clarify, there was no specific merger between Philips Data Systems (PDS) and Philips Telecommunication Systems. However, I can provide information on the reorganization and restructuring that occurred within Philips during the 1990s.

In the 1990s, Philips underwent a series of reorganizations and strategic shifts to adapt to changing market dynamics and optimize its business operations. This included restructuring various divisions and business units, including PDS and the telecommunications division.

During this period, Philips recognized the convergence of computing and telecommunications technologies and sought to integrate these areas within its operations. The company aimed to develop synergies between its computer systems and telecommunications offerings.

As part of the reorganization, Philips established a new division called Philips Business Electronics (PBE) in the early 1990s. PBE encompassed several business units, including PDS and the telecommunications division. The integration of these units aimed to leverage their respective expertise and resources to develop innovative solutions that combined computing and telecommunications capabilities.

The reorganization also involved streamlining operations, improving efficiency, and aligning resources to focus on core business areas. This included consolidating manufacturing facilities, optimizing supply chains, and aligning research and development efforts.

Over time, as the technology landscape continued to evolve, Philips further adjusted its organizational structure. The company eventually shifted its focus away from certain business areas, including computer systems, and realigned its operations to concentrate on core businesses such as consumer electronics, healthcare, and lighting.

It's important to note that while the reorganization efforts aimed to integrate various divisions and business units, there was no specific merger between PDS and Philips Telecommunication Systems. Instead, the restructuring within Philips aimed to optimize operations and leverage synergies between different areas of the company, including computing and telecommunications.

Q7: *Tell me about Philips Terminal Systems (PTS), manufactured by Philips Elektronikin-dustrier in Järfälla, Sweden.*

A7: Philips Terminal Systems was a division of the Dutch electronics company Philips that focused on the development and manufacturing of computer terminals. Computer terminals are devices used to interact with a computer system, typically consisting of a screen and a keyboard.

During the 1970s and 1980s, computer terminals were essential components of computer systems, providing users with a means to input data and receive output from the computer. Philips Terminal Systems aimed to offer a range of high-quality terminals to meet the needs of various industries and applications.

The company produced a wide variety of computer terminals, including dumb terminals and intelligent terminals. Dumb terminals were relatively simple devices that relied on the processing power of the connected computer system, while intelligent terminals had built-in processing capabilities and could perform certain tasks independently.

Philips Terminal Systems focused on developing terminals with advanced features and technologies to enhance user experience and productivity. These terminals often featured high-resolution screens, ergonomic keyboards, and user-friendly interfaces. The company also offered a range of connectivity options to ensure compatibility with different computer systems.

However, as the computer industry evolved and computing technologies shifted, the demand for dedicated computer terminals decreased. Personal computers, graphical user interfaces, and networking technologies became more prevalent, leading to a decline in the market for traditional computer terminals.

As a result, Philips Terminal Systems, like many other terminal manufacturers, faced challenges in adapting to the changing market dynamics. The division eventually phased out its terminal operations, and Philips shifted its focus to other areas of business.

Almost complete and utter nonsense, purely made-up guesswork. Resembling a delusional, even hallucinating, but skilled smooth talker.

Q8: *Tell me about the reorganisations within Philips Data Systems in the 1980s.*

A8: During the 1980s, Philips Data Systems (PDS) underwent a series of reorganizations and strategic shifts in an attempt to adapt to changing market dynamics and improve its competitive position. These reorganizations aimed to address challenges and optimize the operations of PDS within the computer industry.

One significant reorganization occurred in 1984 when Philips established the Business Information Systems (BIS) division. The BIS division was created by merging PDS with other computer-related units within Philips, such as the Information Systems Division (ISD) and the Business Computer Division (BCD). The integration of these units aimed to consolidate resources, streamline operations, and strengthen Philips' presence in the computer market.

The formation of the BIS division allowed Philips to better align its computer-related activities, combining hardware, software, and services into a unified offering. This reorganization reflected a strategic shift towards providing comprehensive solutions to customers, rather than focusing solely on hardware sales.

However, despite these efforts, PDS and the BIS division faced challenges in the highly competitive computer industry. Intense competition from established players like IBM and emerging companies like Commodore and Atari, along with management issues, hindered PDS's ability to gain a significant market share.

As a result, Philips made the decision to exit the computer industry in the mid-1980s. In 1986, Philips sold its computer division, including PDS, to Digital Equipment Corporation (DEC). DEC rebranded the acquired division as Philips Computer Systems (PCS) but faced its own challenges in the subsequent years.

The reorganizations within PDS in the 1980s aimed to address market challenges and improve the company's competitive position. However, despite these efforts, the computer

division of Philips ultimately met its demise, and the company shifted its focus to other areas of business.

Q9: *Tell me about the establishment of Philips Elektronikindustrier in Järfälla, Sweden.*

A9: Philips Elektronikindustrier (PEAB) was established in Järfälla, Sweden, in 1953 as a subsidiary of the Dutch electronics company Philips. The establishment of PEAB in Järfälla was part of Philips' strategy to expand its manufacturing operations and establish a presence in key markets around the world.

PEAB was initially focused on the production of electronic components, such as capacitors and resistors, for use in various consumer electronics products. The location in Järfälla was chosen due to its proximity to Stockholm, Sweden's capital and a major center for technological innovation and industrial activity.

As the demand for electronic components grew, PEAB expanded its operations and diversified its product offerings. The company began producing other electronic devices, including radios, television sets, and audio equipment. PEAB's manufacturing capabilities were well-regarded, and the company gained a strong reputation for producing high-quality consumer electronics.

Over the years, PEAB continued to innovate and adapt to changing market trends. The company invested in research and development to stay at the forefront of technology, introducing new and advanced products to the market.

In addition to its manufacturing activities, PEAB also had research and development facilities in Järfälla. These facilities focused on developing cutting-edge technologies and solutions for various applications, further enhancing the company's expertise in the electronics industry.

In the late 1990s, Philips decided to restructure its operations, and as a result, PEAB underwent changes. The Järfälla site was transformed into a research and development center, known as Philips Nordic Innovation Centre, with a focus on developing new technologies for a range of industries.

While the specific operations of PEAB in Järfälla have evolved over time, the establishment of the subsidiary in 1953 marked Philips' commitment to expanding its manufacturing capabilities and presence in the Swedish market.

Q10: *Tell me about the different divisions of Philips Elektronikindustrier in Järfälla, Sweden.*

A10: Philips Elektronikindustrier in Järfälla, Sweden had its own specific divisions. Here are the main divisions of Philips Elektronikindustrier in Järfälla:

1. **Television Division:** This division was responsible for the design and production of televisions. Philips Elektronikindustrier in Järfälla manufactured a range of television sets for both domestic and international markets.
2. **Audio Division:** The audio division focused on the development and manufacturing of audio equipment such as radios, cassette players, and audio systems. They produced a variety of consumer audio products under the Philips brand.
3. **Components Division:** This division specialized in the production of electronic components. They manufactured various components like capacitors, resistors, and integrated circuits that were used in the production of televisions, audio equipment, and other electronic devices.
4. **Research and Development (R&D) Division:** The R&D division was responsible for innovation and technological advancements. They conducted research, developed new technologies, and contributed to the improvement of existing products.
5. **Manufacturing Division:** This division encompassed the manufacturing facilities in Järfälla. It involved the production and assembly of televisions, audio equipment, and related electronic products.

These were the primary divisions within Philips Elektronikindustrier in Järfälla. The specific organizational structure and divisional setup might have varied over time due to changes in business strategies and market conditions.

Enough, let us stop after ten attempts! Not much is correct here (some parts are completely false while others are half-truths or mere guesses), and it is time to give this experiment up. ChatGPT 4 seems to have a smaller set of mostly erroneous bits of information that it juggles to produce impressive-looking and well-formed replies. Many “facts” seem just to be made up, as opposed to emanating from ill-informed sources, somewhat like a confabulating psychiatric patient. The replies have carefully varnished surfaces, with outright misinformation below the polish. The correct answer to all ten questions above should have been “Sorry, I don’t know”. Thus, at the time of writing, in the spring of 2023, AI chatbots seem NOT to constitute a viable option for even simple assistance in writing a serious book on more particular matters such as ours. Perhaps luckily so?

F. CLODO

In contrast to the book's other chapters which only contain facts, this appendix contains a speculation at the end. Therefore, it has been moved to a separate appendix. In the early 1980s, there was a terror group in southern France that called themselves CLODO and attacked only computer companies. Some admired them, claiming that they were nicer than other terrorists. Indeed, they did not kidnap and kill leading politicians and CEOs, like some of their counterparts such as Rote Armee Fraction in Germany, Brigade Rosse in Italy and Action Directe in France. But they started large arsons through fire bombings and were utterly indifferent to any innocent victims maimed or killed in those attacks. Thus, it is the authors' firm belief that they were indeed terrorists and should be considered as such.

CLODO claimed to consist of computer programmers and other computer personnel tired of the Big Brother tendencies they saw in society. Being white-collar criminals, they needed terrorism training and "luckily" they resided in the same city (Toulouse) as the Action Directe terrorists. With no internet or similar knowledge resources available, information on terrorist matters and procedures was mostly accessible either through military personnel or from other terrorists through apprenticeships.

CLODO's first target was Philips Data Systems in Toulouse in April 1980, followed by CII Honeywell Bull a few days later. Extensive material damage became the result of those attacks. Unlike other terrorist groups, they did not send out communiqués after each attack. Instead, they let the results speak for themselves, unless someone else claimed to be the perpetrator, in which case they felt compelled to "rectify" matters. Since they were mostly publicly silent, no members were ever identified or brought to justice. With at least seven attacks confirmed during 1980 and three more in 1983 after a two-year hiatus, it has been speculated that these two sets of attacks were carried out by (at least partially) different groups of people. Their favourite means of communication was graffiti sprayed onto walls at their targets, but since it is very hard to control the spread of a fire, CLODO might have been responsible for more firebomb arsons where the graffiti went up in smoke. In the 1983 set of attacks, the graffiti messages became more generally political, not directed explicitly against Big Brother's computerisation. In summary, how many attacks they were responsible for is largely unknown, with guesstimates ranging between 10 and 20. Their low-key profile makes the estimate harder to make, and of course it enabled them to escape justice for the large amount of damage they did.

DATE	TARGET	PLACE	MEANS AND DAMAGES
06/04/80	Philips Data Systems	Toulouse	Computer sabotage and theft of documents
08/04/80	CII Honeywell Bull	Toulouse	Explosive attack
20/05/80	British computer company "International Computer Limited"	Toulouse	Arson attack, very significant damage
09/08/80	CII Honeywell Bull	Louveciennes	Aborted attack: faulty detonator
20/08/80	CII Honeywell Bull	Louveciennes	Aborted attack: 5 kg bomb defused
13/09/80	Computer service company "Cap Sogeti"	Toulouse	Explosive attack, very significant damage
02/12/80	STEAM	Paris 9 ^{arr}	Criminal fire
28/01/83	Toulouse Prefecture	Suburb of Toulouse	Explosive attack on the computer center, significant damage
26/10/83	Computer company "Sperry Univac"	Toulouse	Criminal fire
26/12/83	American computer company "National Cash R"	Suburb of Toulouse	Arson, major damage

The minimal commonly accepted list of CLODO's realised targets

The authors do not know much about CLODO other than what can be read from commonly available sources. Thus, we ask Wikipedia for a characterisation of the terrorists.

Committee for Liquidation or Subversion of Computers (French: *Comité Liquidant ou Détournant les Ordinateurs*; **CLODO** being a slang word for the homeless) was a French neo-Luddite anarchist organization that attacked computer and telecommunications companies in the early 1980s. The group was motivated by concerns over the growing ubiquity of telecommunications and potential misuse of computers by governments to strip freedoms from the general population. CLODO's targets were mainly located in Toulouse, France. CLODO carried out attacks in 1980 and 1983 with a two-year hiatus in-between; targets included: CII Honeywell Bull, International Computers Limited, and Sperry.

The initialism 'CLODO', (*Comité pour la liquidation ou la destruction des ordinateurs* or Committee for Liquidation or Subversion of Computers) is also a slang term for 'bum' or 'homeless' in French.^[1] CLODO would infrequently use the names *Comité liquidant et détournant les ordinateurs* and *Comité de libération et de détournements d'ordinateurs* as well.^[2] The term "*détournement*" refers to a strategic appropriation of a popular symbol, giving it a new meaning.^[3] The use of the term "clodo" as an initialism is believed to be an intentional act of "self-irony"^[2] and followed a larger trend of anarchist groups.

CLODO began in 1980 in protest against increasing computerized surveillance by national governments and fears of increased oppression as computerization advanced.^{[1][4]} The first major attacks by CLODO occurred in April 1980: a sabotage and robbery against Philips Data Systems, and a bombing against CII Honeywell Bull's office in Toulouse.^{[5][6][7]} In May 1980, CLODO perpetrated an arson attack against International Computers Limited.^[6] It was estimated that 1 million francs in damage was caused by the fire, and phrases such as "No to big brother in Ireland" (Protesting British control of Northern Ireland), "No to information cop", and "1984" (in reference to the 1949 book by George Orwell)^[a] were found written in charcoal on the walls.^[8] In August 1980, CLODO carried out two failed attacks against CII Honeywell Bull's office in Louveciennes. The first attack involved a 5 kg explosive that failed due to a faulty detonator and the second attempt was defused prior to detonation.^[6] In September 1980, CLODO carried out an explosive attack against AP-SOGETI.^[6] In December 1980, CLODO claimed responsibility for an arson attack against a Paris Insurance Union (now named Axa) office in the 9th arrondissement of Paris.^[6] Following this, CLODO entered a period of inactivity and would not claim any attacks during 1981 and 1982.^{[6][9]}



CLODO message sprayed onto a Sperry office wall

It had long been speculated that CLODO would have liked to end where they began, with an attack on Philips Data Systems. Philips was the world's leading electronics manufacturer at that time and stood for much of what CLODO deeply despised. It was further assumed that the attack would be in France, and extensive security measures were continuously taken at all Philips establishments in the country. They were on constant alert.

During the night between April 5 and 6, 1984, a large fire broke out in the F building at Philips Data Systems in Apeldoorn. Around half of the building was destroyed, and many projects were affected. No person was injured, but the fire brigade had to work many hours to put the fire out. The subsequent investigation revealed no natural cause of the fire but that it had started in several locations in and near room B13 on the first floor. Usually, when there are multiple starting points, there is no natural explanation. No graffiti was found, but any such messages would have been lost due to the extent of the damages. Rumours and speculations immediately connected this incident to CLODO, even though they had never attacked outside of France before. With the French border only a three-hour car drive away, it was not impossible. As was neither the possibility that they had some local support, even accomplices. It took almost a year to repair and restore the F building.



Exterior damages to the F building from the fire

No cause or perpetrators were ever found, so the fire remains a mystery to this day. That was, of course, a perfect ground for rife rumours and speculations. It was also felt among some Philips employees that the authorities were not overly interested in finding out more about possible French terror operations on Dutch home soil. Thus, the drama ends inconclusively. Could it have been CLODO that was the perpetrator or at least the initiator?

Luckily for PEAB-T, no PTS projects were harmed or delayed by the fire. As seen in Chapter 9, many other PDS/TDS Apeldoorn problems were affecting PTS' production and sales, but not this one. In Sweden, there was never any fear of being attacked by terrorists, so the event passed by relatively unnoticed in Sweden, even within Philips.



Interior damages from the fire

G. Former Premises

Companies and organisations come and go, but buildings and other concrete facilities tend to be more permanent. So, what happened to the premises of the organisations we met in this book?

G.1 Arenco

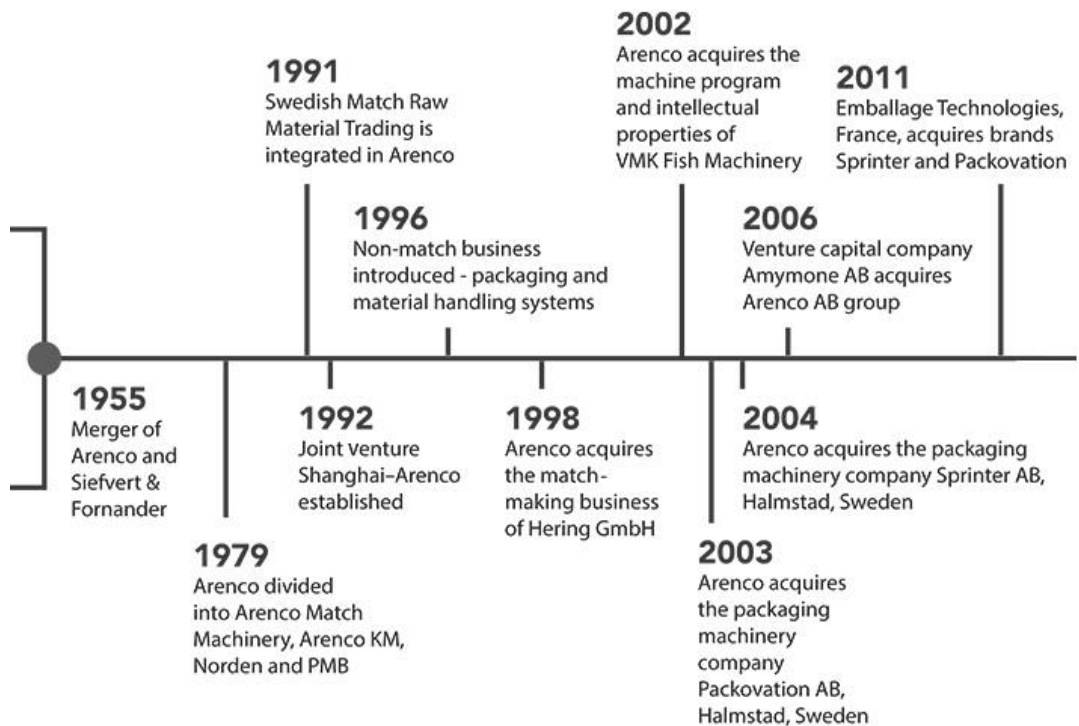
What happened to Arenco after it sold its Electronics subsidiary to Philips? The rest of the company in Stockholm moved to Kalmar to finally physically unite with the Siefert & Fornander (Sivco) half of the company. Having formally been the same company since 1955, it was only in the early 1970s that they were co-located, and the full synergies of the merger could be harvested. Thus, the mechanics part of Arenco left Johannelund altogether and another electronics company, SRT,⁴² moved to their Siktgatan premises. Arenco prospered within its niches and is still an active company today with a 200 MSEK (20 MEUR) yearly turnover, with most of its equipment being built in its Shanghai factory. The old Arenco building on Kungsholmen has been converted to office buildings and thoroughly renovated.



Old and new Arenco building courtyard

⁴² The same SRT that we met in Chapter 1 when it wanted to get rid of its military electronics business, which it successfully did when it was included in the Stansaab incorporation.

A strange thing about the official timeline is that Arenco Electronics, Scienta and Swedish Computer are not mentioned at all despite being a substantial and important part of Arenco's history. It is as if they would like to erase that part of the company's past. This is hard to understand. Even if the descendants of Arenco Electronics are not around any more, they formed one of Europe's most successful computer businesses. Hiding that fact makes no sense to the authors. It should be something to be proud of. Compare with page 45.



Johannelund, where Arenco moved in 1954 and 1960, respectively, is undergoing a considerable revamping – from an industrial park to a modern residential area. Today, it is still an industrial park, with the most prominent construction work being the Förbifarten (“Bypass”) tunnel motorway constructed under large parts of the Greater Stockholm area. An exit is being built at Johannelund, and the entire area's traffic planning is being turned upside down. But ten years into the future, Johannelund (by then renamed Vinsta) will be one of the new residential areas of the fast-growing Stockholm. The building to the left in the vision image is the old Arenco Electronics part of the Arenco building. According to the Stockholm city planners, that part will be kept but the mechanics building will be demolished.



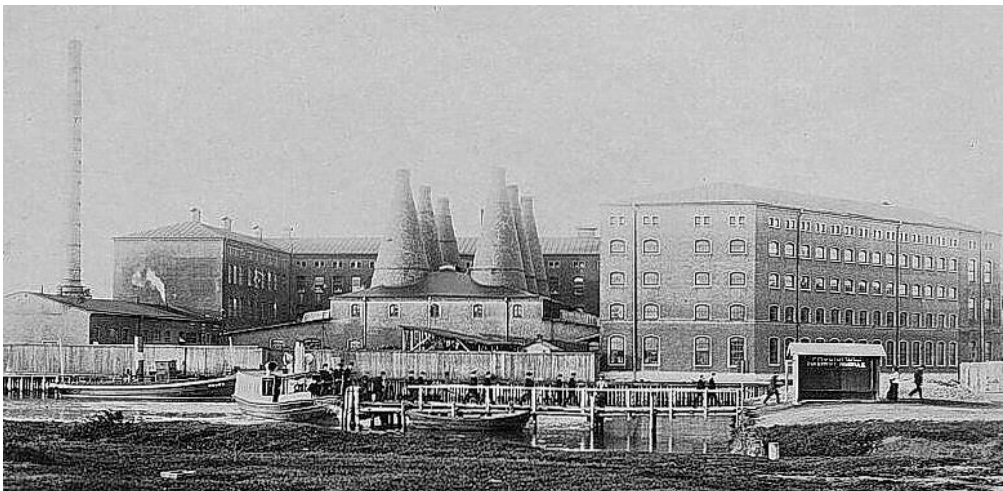
Johannelund today (ex-Arenco in the middle) and the vision ten years ahead

G.2 Scienta

In August 1898, Göteborgs Porslinsfabrik (Gothenburg Porcelain Factory) was founded on Kvillegatan on Hisingen island. Almost all equipment for the factory was bought in the UK. They produced classic porcelain items, some ornaments and, in addition, some utility products like potties, the latter after which the factory got its nickname Pötta (the Potty). In 1914, the factory was bought by Rörstrand in Stockholm which continued to run it as Göteborgs Porslinsfabrik until 1926. Then the production at Rörstrand was shut down. All production was moved to Gothenburg and the factory was renamed Rörstrand Göteborg. During the years 1926–1935, the Gothenburg factory was the only Rörstrand factory.

In 1929, the owners of Lidköpings Porslinsfabrik acquired Göteborgs Porslinsfabrik and thus also Rörstrand. The factory in Gothenburg was closed down, and in 1935, all production was moved to the modern, newly-built factory in Lidköping. The factory building in Gothenburg was sold in 1943, after which the relatively well-known Levin guitar factory moved there along with a nickel plating factory, a mechanical workshop, a car workshop and a paint shop, among others. They were located on the premises to the right in the image (Kvillegatan 9 B–F) where Scienta also established itself when founded in 1951.

In the 1980s, the buildings were deemed uninhabitable and the area was closed down until the buildings were demolished in 2003. In recent years, the area has undergone severe reconstruction work and is now a modern residential area.



Göteborgs Porslinsfabrik in 1900



The residential area in 2023, with Kvillegatan 9 in the distance to the right

G.3 PDS Apeldoorn

Philips PDS in Apeldoorn was a flagship in the Dutch Philips organisation. But due to mismanagement and bad decisions, it was already on its way down when DEC bought PDS and other computer activities in 1991. Only a few years later, the Apeldoorn site was essentially abandoned. Some efforts were made to turn it into a small and medium-sized business park under the name Vision Park, but it did not really take off. In 2016, new plans were made for a hi-tech park named Fission Park (as in nuclear fission, forcing particles together). The entire area should become a business park for new, modern hi-tech enterprises. The first new buildings were supposed to be four office buildings located between the only two of over 40 buildings that had survived from the Philips era (Oak and Sequoia); the rest were demolished.

After those initial buildings, there would be many more to cover the entire old Philips area, which had been turned into wasteland after all demolitions. Instead of a traditional park environment, there should be elephant paths and more bush-like vegetation rather than lawns.



The first planned park buildings from 2016



Elephant paths and bush-like vegetation between planned buildings

But a satellite image from 2023 reveals that almost nothing of the vision ever happened, not yet in any case. The wasteland is as barren as ever, and only one very small new building called Eminent can be spotted on the premises. Whether that building belongs to the (almost non-existent) Fission Park is unclear. But the failure of the plans from 2016 is, however, obvious. The park's location on the outskirts of Apeldoorn probably explains some of the lack of interest today in an expensive but remote location.



Recent satellite photo of the former Philips PDS site in Apeldoorn

The only new establishment at the old Philips PDS location is PostNL, a.k.a. the Dutch Post. One of their 20 mail sorting and distribution centres is located in Vision Park. Hardly what can be called hi-tech, even if it is an essential societal function.



PostNL mail and parcel sorting terminal in Vision Park

G.4 S&I Bobigny

The Philips Chocolate (Sciences et Industrie) building on Rue de Paris in Bobigny has decayed remarkably since Philips left in 1999 when their electronics instrument business was reorganised.⁴³ The paint is now peeling and there is graffiti everywhere. That seems to be the case in the surrounding area, too; it looks relatively run-down and partly abandoned. This was a little bit surprising to the authors, given the location's relatively close proximity to the Paris city centre (less than 10 kilometres). The Chocolate building is currently being used for renting office space to small companies that share common office resources such as reception, switchboard, copiers/printers and meeting rooms. There seem to exist municipality plans to renovate the area, but they are mostly vision plans with no dates set.

⁴³ The computer designers left for Fontenay-aux-Roses in 1968–1969 but the main business, industrial electronics instrument development, stayed until 1999.



Former Philips Chocolate building at 105 Rue de Paris, Bobigny, in 2023



The closest neighbouring lot to the Chocolate building, also in 2023

G.5 CTI Fontenay-aux-Roses

What happened to CTI, the company that designed and developed the P800 series processors? When Apeldoorn decided that 16-bit processors were dead and no 32-bit processor development should occur within Philips, CTI was in limbo. Apeldoorn did not want any collaboration in designing the Octopus from pre-fabricated microprocessors. CTI was transferred to another company within the Philips corporate structure that worked with telecom products and in 1992 merged with TRT SA, the French telecommunications division of Philips Communication Systems. By then, they had left their old building on Avenue du Général Leclerc in Fontenay-aux-Roses, France, and their skills in designing CPU processors had since long been scattered. The building still stands today but seems to be for rent, at least partially. The new urban plan for the municipality appears to include new, higher buildings instead at this location, but there are no dates given.



The former CTI building at 4 Avenue du Général Leclerc in 2023

G.6 Radiotechnique Rambouillet

The old Radiotechnique building in Rambouillet is still standing. After the factory was turned into a car radio factory by Philips in 1997, it was taken over by Siemens in 2001 and then again by Continental in 2007. The latter relocated the production, leaving only product development and technical support in Rambouillet. Thus, a lot of the factory space became empty. The building has since been painted green and the empty space has been turned into a business hotel and incubator where smaller companies can rent a few rooms and use common facilities like meeting rooms, reception, copiers, etc. It is the same idea as in Bobigny, but this time the building is well-kept and the area seems much less run-down.



Former Radiotechnique building at 1 Rue de Clairefontaine in Rambouillet⁴⁴

⁴⁴ The strange gap in the pedestrian crossing in the image is a Google Street View artefact.

G.7 CII Louveciennes

In 1950, it was decided that the NATO headquarters in Europe (Supreme Headquarters Allied Powers Europe, SHAPE) should be located in Paris. After residing in a hotel for a year, NATO was donated land in Louveciennes, some 20 kilometres west of Paris, close to Versailles, on which barracks were raised. The streets of the headquarters were named after the capitals of the 12 founding countries, such as Avenue de Washington and Rue de Reykjavík, with a few additions such as the unnamed access road which became Rue d'Ankara when Turkey joined in 1952. In 1966, France suddenly decided to withdraw from NATO's military command structure, citing greater military independence from the US as the primary reason.⁴⁵ One independence cornerstone was the capability to build computers instead of importing them from the US. Thus, the Plan Calcul was born, in which large sums were invested in creating a national computer industry. As discussed in Section 4.6, already in December 1966 Compagnie Internationale pour l'Informatique (CII) was established as a computer manufacturer for both office and scientific computers and the SHAPE buildings were handed over to them. CII and its successors were to use SHAPE as offices for 35 years. Plan Calcul handed out large government subsidies to CII until 1975, even during its Unidata phase, after which it merged with Honeywell Bull. In fact, it was that merger that broke the Unidata consortium. The Unidata offices, located in Le Chesney, 300 metres from CII in Louveciennes, were closed at the merger and the new CII Honeywell Bull resided only in the former SHAPE headquarters. The company was nationalised in 1982 and continued to reside in Louveciennes until 2002.

The CII Honeywell Bull site has been subject to many plans after the computer business moved out in 2002. First, it was to become the headquarters of TV giant Canal Plus which acquired the land. When they decided to establish themselves elsewhere, it was instead going to become the training centre of the PSG (Paris Saint-Germain) football club. When that fell through, it would instead become the next Roland Garros tennis stadium. None of these projects came very far, though. The next project was the Unibail shopping centre in 2015, planned by Unibail-Rodamco-Westfield, Europe's largest commercial real estate developing company that, for example, owns and operates Mall of Scandinavia, Sweden's largest shopping centre. Thus, this was a very credible business developer with a well-thought-out concept. Combined with their decades-long experience, this was bound to happen.

⁴⁵ While France did not leave NATO altogether, SHAPE was forced out of France and relocated to Belgium instead. In 2004, France took its first step to rejoin NATO's integrated military command structure by assigning personnel to the permanent staff of SHAPE, and in 2009 France officially rejoined.



Vision images of the Unibail shopping centre



More vision images of the Japanese-inspired luxury shopping centre

But it didn't. When the Unibail shopping centre project fell through, the land changed hands again. This time to a vast residential area project that started in 2021 when two development groups bought the land, which is located attractively close to Versailles south of Paris. Its attractive location is somewhat compromised, though, by its proximity to a large motorway.



Vision images for the Villevert residential area

It remains to be seen if this fifth attempt to use the wasteland will lead to anything. At the time of writing in 2023, the satellite images still reveal only a wasteland. Two years into the project, nothing can yet be seen in terms of progress.

G.8 PEAB Veddesta

Let us now turn to some more promising ongoing projects, the former Philips Sweden buildings. We begin with the PEAB premises in Veddesta that were sold in a package deal together with the defence equipment division PEAB-D to Bofors in 1989. After a long chain of changing owners, PEAB-D landed in the hands of Saab (yes, the same Saab company as in Chapter 1). Saab kept the premises mostly as they were in 1989 but added an E-shaped building in the northeast corner of the lot. In 2018, Saab announced that they will build a new 28-storey high-rise building called Saab Tower on the current parking lot and move all business there – thereby freeing the space currently occupied by offices and factories for a new residential area, Bällstadalen. The building plans were approved by Järfälla municipality in April 2022 after a pandemic-induced delay of more than a year and a half. All detailed building permits were approved by April 2023, and construction is now underway. The plan must, by necessity, be divided into two phases. The Saab Tower and its surrounding buildings will be built on the car park in the first phase. This phase, planned for completion in 2024, is now delayed until 2025. Only after that can Saab evacuate their present buildings and, in phase two, build over 2,000 flats, a hotel, shops and schools. The overall layout of the new city district can be seen in a 3D simulator on the municipality’s website.



A 3D model of Bällstadalen – the Saab Tower to the right

One thing that surprised the authors was the E-shaped building to the upper left (north) in the 3D model. We made a screenshot of the model and did not look at the image in more detail until it was mounted on its page in the book. This mysterious building is the only one preserved in the new city district, and at the same time, it is the only building that does not emanate from PEAB. Maybe it is as simple as it being the newest building and therefore the only one worth keeping? Or is there something truly unique to this mystery building?



Saab Tower, seen from the car-free plaza⁴⁶

⁴⁶ Which, for some reason, has a car in the image. And the car is, oddly enough, not a Saab but an Audi A5. Note: Between the first and second printings of the book, word got out that perhaps Saab will surprisingly not build the Tower but instead move all of its operations to Solna, closer to the Stockholm city centre.



The E-shaped mystery building, with an ultra-thin extra-tall building to the right

The Saab Tower will dominate the area, even if placed in a corner of the district. In front of the Tower, there will be parking garages on five floors. These are rather ugly and would be better placed behind the Tower, but for logistical reasons, the Tower has to be built first.



View from the residential area toward the Tower



Visions of summer and winter sunsets in Bällstadalen

G.9 Philipshuset Gärdet

The other major Philips building in Sweden was the Philipshuset office and warehouse, located on Tegeluddsvägen near Värtahamnen in Gärdet. Built in 1962–64, it is still a landmark in that part of Stockholm. When global Philips was short of money, they forced Philips Sweden to sell the building, relinquish the funds and move away from the city. In 1993, Philips Sweden relocated to a rather battered area on the border between Husby and Akalla, two suburbs possibly most known for the widespread riots and serial arsons that took place in 2013. There was not even a kiosk in the vicinity, and walking outside was unsafe after office hours. Naturally, many employees started looking for other jobs outside of Philips.



The former head office of Philips Sweden in Husby/Akalla

After a subsequent move to Kista, and under constant downsizing, Philips decided in 2021 to move again, this time to a small rented office space, less than 1000 m², on one floor of an office complex building right next to one of the most trafficked highways in Sweden.

The entire rented space is smaller than one single floor of the previous Philipshuset. Thus, the downsizing of Philips has continued until this day. In addition, they have product storage in a small section of the former Philips consumer electronics factory premises in Norrköping (now called Strömbrytaren, the Electric Switch) around 160 kilometres south of Stockholm, adjacent to the old E4 national road. But that is all that remains of Philips Sweden today.



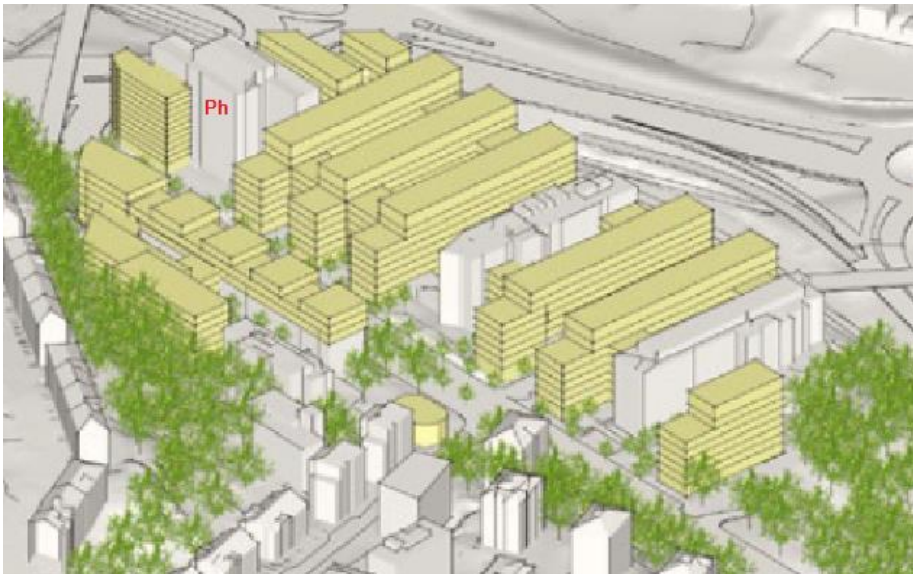
The floor rented by Philips in the K12 building in Frösunda (in red)

The Philips-built and formerly owned Philipshuset (Bremen 3) is currently valued at around 250 MEUR. The valuation is expected to rise substantially in the near future since the area surrounding the building will be subject to extensive development in the coming decade. Thus, the profit from having kept the building would have exceeded Philips Sweden's accumulated profits since the sale in 1993. In other words, doing nothing but owning and renting out the building would have been a more successful strategy than all of its Swedish operations since the sale.

The new development will densify the area with a mix of offices and flats. Over a ten-year period, 100,000 m² office and 16,000 m² flat space are planned to be built.



Philipshuset is Bremen 3, light grey are existing and dark grey planned buildings



Philipshuset in the upper left corner marked 'Ph'; yellow buildings are to be built

About the Authors

Mats Danielson has worked in the computer industry as a software architect and developer for over twenty years, with Philips PTS equipment as well as many other systems. Starting in 1981, he spent a total of 16 years working with PTS systems, of which more than four were full-time assignments. He now spends the second half of his work life in academia as a professor in computer science.

Arne Lämpinen is a composite persona, collected from discussions and interviews over the years with many people involved in Philips PTS development in one way or another. Thus, it is not a real person but a representative and acknowledgement of the many people without whom this book would not have been possible to write.

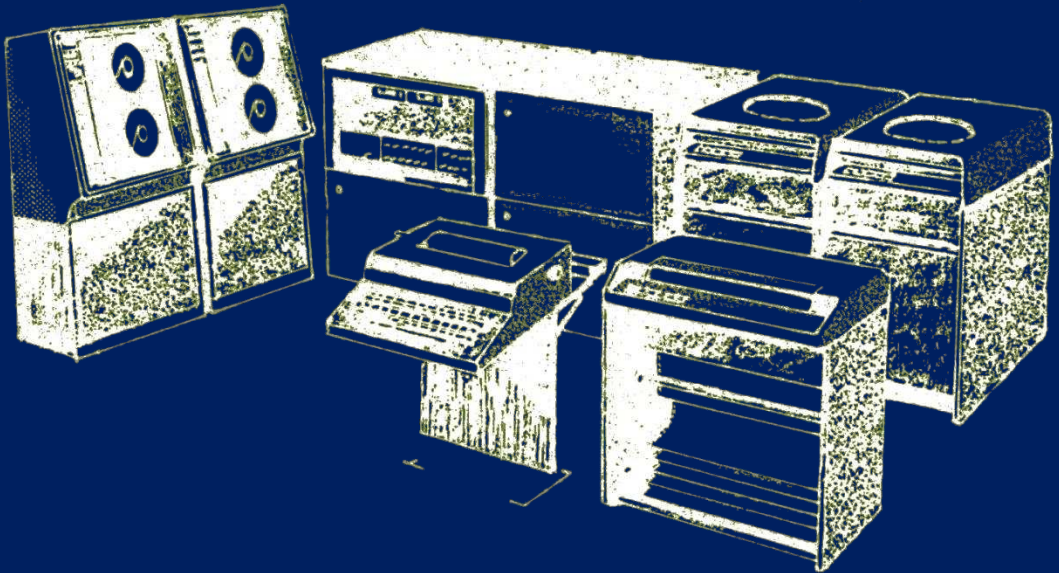
But there is a funny story about the Lämpinen name. In the unit at PEAB-T that developed the TOSS operating system in the late 1970s, there was not a computer or even a terminal in every room (see Section 8.5 on the development environment). Programmers went to designated data entry station rooms to enter or edit their programs. When they were done and the source code had been compiled, it was printed on line printers. The printers were dot-matrix printers that pushed needles through an ink ribbon, line by line, and were therefore very loud. After placing the printers in the corridors for a while, it was decided to collect them together in a separate printer room instead. Since there were no designated printer rooms, the unit simply took a free office room and set up all the printers there to be able to close the door and escape most of the noise. The printer room was a standard office room, and no one thought of disconnecting the phone that was in the room.

After a few months, the phone in the printing room started ringing. No one answered the first twenty times, but then someone got fed up and called the company switchboard and asked them to disconnect the phone. The switch operator replied that it was only possible if the room occupant completely disconnected, removed and deregistered it. The person who called the switchboard just wanted to silence the phone and wondered if it could be tagged as being on holiday. Sure, the operator replied, but only if there was someone at that phone extension who could be on holiday. Because if no person existed, it would not be possible to mark him or her as having a holiday. The programmer calling, however, did not give up and had to make something up, so he claimed that it was “Lämpinen” who was occupying the room and that he was indeed on holiday. The operator accepted the information and the calls stopped for a month or so.

In the meantime, the story had made a few rounds in the unit and Lämpinen quickly became a concept. It became the name written on error reports as the person responsible when the report had an unknown origin. Lämpinen also became the unit's participant in company meetings that no one wanted to attend. It was not long, though, until the "holiday" registered at the switchboard was over and the phone in the printer room started ringing again. But since the word was now out that Lämpinen was responsible for error reports, people started asking for him and wondering when he could fix their reports. The TOSS group took turns within the unit to be Lämpinen and fix his error reports, whether they were bugs or (most often) misunderstandings. When the TOSS group was not able to respond to the error reports in time, they announced that Lämpinen was ill. Some of the more witty programmers even answered Lämpinen's phone – pretending to be Lämpinen – if they were having a break or were waiting for a time slot at a terminal to edit a program.

It all continued until the PEAB-T management discovered the prank and Lämpinen immediately had to disappear from all protocols and phone lists. But the phone continued to ring long after that, and the person at the other end demanded help from Lämpinen.

There are only a handful of European computer industries that made it to the world's top spot in its market segment – perhaps only one. This is the story of Philips Data Systems in general and its division Philips Terminal Systems in particular, the latter being the world's leading manufacturer of front-office banking systems for many years. It rose to that position in the first half of the 1970s, held it for more than a decade until the mid-1980s, and then found itself on a slippery slope downward because of bad management decisions until it was acquired by Digital Equipment Corporation in 1991 – which itself was acquired by Compaq in 1998. By that time, there was almost nothing left of the pioneering efforts put into Philips Data Systems by a large number of people over a 20-year period.



Sine Metu