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# NEUCC

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**Abstract.** NEUCC (Northern Europe University Computing Center) was a computing center established at the Technical University of Denmark in 1965 with equipment donated by IBM. The paper describes the negotiations before establishing the center, the installation and the first years of operation. The center became important for the introduction of computers in the Nordic countries, and very many got their first introduction to computing by visiting and using the center.

## 1 The IBM 7090 Computer

In April 1952 IBM announced the IBM 701 computer as the first commercially available scientific computer. A market of five computers was expected, actually about 20 were sold. Later models were the IBM 704 and IBM 709 and (in 1959) the IBM 7090. The IBM 7090 was a transistorized version of the IBM 709, (originally known as the IBM 709-T). The price was half of the price for the IBM 709, and the performance roughly six times that of the IBM 709. The purchase price for a typical IBM 7090 complete system was around 20 Million DKK, an awful lot of money at that time.

The specifications can be found in the references, but they tell very little to a modern reader. The smallest personal computer or smartphone of today is much more powerful than the IBM 7090. Typically the IBM 7090 did not have hard disks, all data storage and the operating system was on magnetic tape. Significant features were the data channels, separate computer units handling all data input and output under the control of an effective operating system. The computer was able to handle compute heavy batch jobs very efficiently. Further developments of the IBM 7090 were the faster models IBM 7094 and IBM 7094 II. In 1963 IBM announced downscaled cheaper versions, the IBM 7040 and IBM 7044.

The compiler for the Fortran language was developed by John Backus for the IBM 704 computer and became very important for the introduction of the IBM 704 computer and the following models. Fortran is very closely related to the machine code for these computers. The importance of this is that while programs can be written in a notation related to standard mathematical formulas, the resulting machine code for this type of computers is highly efficient. It therefore became possible for many researchers and students to write their own programs for the computers. The

usage grew very much, and early in the 1960s probably about 200 IBM 7090 computers were installed and heavily used in North American universities, research institutions and military establishments.

From about 1967 the IBM 7090 family were being replaced by larger models of the new IBM system/360, and other manufacturers' computers came into the market. Sometime early in the 1980's the last IBM 7090 was shut down for the last time.

## 2 The Project

In the early 1960s IBM 7090 computers were used at universities and research institutions in the USA, but only very few were installed outside USA. A plan was consequently established at IBM in New York to donate ten 7090 computers to universities outside USA, five in Europe and five in other countries. Four of the European computers were going to the major countries, Germany, UK, France and Italy, and the fifth to a smaller country.

IBM Denmark was interested and wanted to install one of the IBM 7090s at Danmarks tekniske Højskole, DTH. It was rejected in New York, this was not a well known school (a "High-school?"). Then Copenhagen University was suggested but that university was not interested – no need for a computer. So next IBM in New York suggested Uppsala University.

In the plan the local company, in this case IBM Sweden, had to purchase the equipment from the factory, and the price was unknown. It might be new equipment, or older, refurbished and much cheaper. IBM Sweden asked for a budget release as a condition, that was rejected and the bidding came back to Denmark, to DTH.

Therefore, late in 1963 serious negotiation started. At that time a plan existed to support Regnecentralen, the Danish Computing Center. Regnecentralen had, as a government supported institution, built the vintage computer DASK, and had constructed and sold a number of the more modern GIER computers. So Regnecentralen was to establish a large development office at the DTH campus with two GIER computers, and spare computer time could be used by the University. The dilemma was obvious: to support a budding Danish industry, or to give a major boost to use of computers in education and research by a donation from a large American company.

There was another problem. The Danish government had rented another large IBM computer, an IBM 7070, for use in census and the source-taxing system. The programs were delayed, and the 7070 computer had lots of spare capacity which could be used by the universities. But the 7070 was unsuited for scientific use, and that plan was dropped.

Now followed a time with hectic negotiations. A central person was the CEO of IBM Denmark, Mr. Viggo Troels-Smith. At one point he asked me whether the project would improve our chances for more university contracts, but I had to tell him that there would be a very negative sentiment in some places, and that the donation for sure would have a negative impact. Mr. Troels-Smith just remarked: "OK, we do it anyway". In fact, it was much later decided that other university contracts should be signed, and were signed, with different manufacturers.

In April 1964 IBM announced the new line of computers system/360. We made a

special presentation for the Dean and leading professors at the DTH, but recommended that we stuck with the 7090 plan to avoid a yearlong delay. This advice was followed, and it proved to be a very good decision.

The IBM donation was accepted, The use of the computer was free, but the university had to pay for maintenance. IBM would pay the same amount back to a foundation for support of education. The final agreement was signed late in 1964, and the installation project could begin. The center was named NEUCC, Northern Europe University Computing Center. It should be open for universities in the Nordic countries and the Netherlands. The user group became mainly the Danish universities and there were very few, if any, Dutch users.

### **3 The Installation**

After the contract was signed a very hectic time followed. Fortunately nobody told us that we faced an impossible task.

At the DTH the building had to be finished. The computer was to be installed in building 305, which in late 1964 was just a concrete skeleton. On the DTH map it was named Regnecentralen. The building project got a very high priority, and details were planned, such as power supply, raised floor (or rather lowered floor, so that the floor of the computer-room was in level with the adjacent rooms), cooling equipment and a frequency converter to supply a machine designed for 60 Hz power. The frequency converter became a special project. The originally suggested American machine was a very big, very expensive machine, so we ordered a local and much cheaper converter from Thrige in Odense – a decision that proved to be nearly fatal. We had to order the computer boxes and the cables, also a major project. We ordered a complete 1401 computer as a satellite machine, and a lot of punched card equipment as eight card punch machines, a fast sorting machine and other equipment. We had to use a lot of persuasion to shorten delivery times to reach our self imposed deadline of August 1<sup>st</sup>, 1965.

In December 1964 IBM sent me on a three week study trip to USA, to visit the IBM research center in Yorktown Heights, university computing centers at UCLA and Stanford and IBM factories. The trip was headed by Jack Blackburn, a senior IBM'er with a vast experience in large computers. Jack was assigned project manager for the donation project, but unfortunately he was suddenly reassigned during this trip and no successor assigned, so after that the project was run without a manager, just with the responsibility of the local companies as IBM Denmark.

We ordered a lot of software on magnetic tape, and as soon as an office was finished in building 305 I moved there to supervise the project.

In May of 1965, the 1401 arrived. Building 305 was still a noisy and dirty building site, so the 1401 was installed temporarily in building 325, cooled by opening the windows, and used for early experiments with Fortran, and for testing of the support input/output routines – punched card to tape and tape to printer. I had no problems with the 1401, it was fully supported by the IBM office.

In June I went to Imperial College in London to get a working copy of the operating system on two magnetic tapes. The donated IBM 7090 at Imperial College was in full operation at that time.

Early in July the 7090 cabinets arrived. Most of the cabinets were of new

manufacture, others were refurbished, so at that time we knew what the expense would be for IBM Denmark. It was not small.

Late in July we were ready to power up the machine. It was a disaster. We found out that the computer used a huge initial power surge, far above the capacity of the Thrige machine. An engineer from the contractor and I went for a dinner at the Fortunen restaurant to celebrate the failure, and during the dinner we constructed a power relay system for start-up by using pens and napkins supplied by the restaurant, and we also redesigned the drive system. I asked the engineer to order the not very cheap relays first thing in the morning, they solved the problem, and the converter was in use until the 7094 finally was shut down at New Year 1972. Fortunately I was relieved by IBM so I did not have to pay the relays out of my own pocket. Anyway, it was still a major saving compared to the original proposed equipment. The cooling equipment was not finished, so we tried to cool by using large fans and use the outside air. Not entirely successful, but we could keep the computer running for shorter periods for testing.

We had to hire operators and a secretary, and order supplies: punch cards, magnetic tapes, printer paper, furniture etc., and I worked as manager and signed all expenses on behalf of the University. I was moved, by the University, to the manager's office when that was finished. The first users came sneaking in during the last days of July, and by August 1<sup>st</sup> we were in full operation. The complete IBM staff was two part time students and myself, and two engineers for installing and maintaining the hardware. We had to get everything working, learn to operate both computers, card punches, card reader and printer, we had to be familiar with the operating system, write the accounting routines and assist the operators and the ever increasing number of users, so I purchased two folding beds and installed them in a storeroom, so we could get a couple of hours sleep every night.

#### **4 Start of Operation**

The center was off to a flying start. Within days we had hundreds of users, and we had to teach operators and get the operation procedures in place. Very soon some rather big jobs showed up, many from researchers' international contacts, so closing time in the evening soon became flexible. Accounting was working from day one, and we made daily and monthly detailed statistics and graphs of the usage. Of course the procedures were complicated, users had to punch cards with their programs and data and instructions to the operating system, cards were collected and processed, magnetic tapes switched between the computers and the final results printed. We had to write programs to identify the outputs. We also had a system for small Fortran programs where punch cards with program statements could be marked with conductive graphite marks for automatic conversion to input to the computer. Users had to be helped and the operators had to be trained. But there was a lot of enthusiasm and we had really very few serious problems. The hardware, the programs and the operating system just worked.

We had to arrange Fortran courses, and I wrote in my spare time a small Fortran textbook for the elementary courses. I worked as manager and with education and user support during the day and as a system programmer during second, and

sometimes third shift, with invaluable assistance from the hired students.

Very many projects, both in education and research, were based on programs developed by the users. The most common programming language of course was Fortran, but other languages were frequently tried, e.g. Algol, Cobol and Lisp. From the beginning researchers from the universities received a large number of programs from abroad, and the use of these programs were often base for large research projects.

One major problem was hiring of a center manager. There were very few applicants, such a position did not exist. But eventually the University hired Hans Jørgen Helms, a mathematician working at NATO's scientific office. Helms had a large network and it was a very fortunate choice. He knew nothing of managing a large computing center – nobody did – so we started a crash course in computing and arranged an extensive study trip to major computing centers in USA. Helms was installed in my former small office, and after the training period we swapped offices without much ceremony. More staff was hired and trained.

We were now ready for the official inauguration in October 1965 where K. B. Andersen, the Minister of Education, cut the red tape and declared the center open.

Helms did much for attracting visitors from abroad, and they gave us much inspiration. He arranged summer schools, as the Summer School of Programming Languages in August of 1967. He succeeded in attracting programming language developers from all over the world, representing many developing languages. Of much interest was the new Algol version Algol 68. Kenneth Iverson demonstrated the newly developed interactive version of his APL, "A Programming Language". We had to get a connection using a typewriter terminal to a computer with the right equipment, and a connection was established to the system/360 computer at Bergen University for testing and for use in the lecture hall.

The APL story is a story of its own, to be told at another time. But the terminal connection was also a demonstration of the developing use of computers. The era of batch computing was to be followed by a time of interaction with the computers.

The usage exploded. Users came from Danish universities, and courier services were established from the Niels Bohr Institute and Aarhus University. There were also users from other Nordic countries, mainly Finland.

In 1966 Hans Ole Aagaard was hired. He was a brilliant technician, and he did a very good job in maintaining the system programs and streamlining the operation.

## **5 IBM 7094**

The usage grew very rapidly, and already early 1967 it was obvious that the 7090 did no longer have sufficient capacity. The computer was running around the clock. At that time the international part of the project was dead, so I convinced the IBM Denmark management that we had to increase the capacity. I got approval to extend the capacity by rebuilding the 7090 to the faster 7094 model.

Some cabinets were replaced, and others rebuilt. We had two engineers coming

from the IBM factory in Poughkeepsie, USA, to rewire the data-channels. The circuitry at that time was made by wire-wrapping, connecting wires were simply wrapped around contact pins using special tools. During four days the two engineers changed 16.000 connections in the machines. After the change the machines did not work, but it was just three faulty connections that had to be replaced.

Another hitch was that we did not have sufficient floor space or cooling capacity in the machine room. One of the computer cabinets contained a large electric motor and generator to convert the 60 Hz power to 400 Hz power to the other parts of the computer. We decided to move this machine to an external underground room cooled only by using large fans. To do this we had to install some long cables, and I requested permission from the factory for the change and to deliver the cables. The order was delayed and delayed, pending technical assurance from the factory, and I asked several times for the confirmation. Finally I got a telegram promising a reply soon, and I just answered that it was too late. We had purchased cables locally and we had already moved the motor/generator, and the rebuilt computer was in full operation.

An additional 1401 computer was installed and soon we replaced the 1401s with a newer system/360 model 30. IBM Denmark donated a very special box to connect the two computers. It behaved as a magnetic tape unit to both systems, and Hans Ole Aagaard programmed the box so that the jobs were automatically transferred between the computers. To my knowledge this was the only successful use of such a box worldwide. We installed a card reader and a printer attached to the system/360 which the users could use, and the result was that for small jobs the users could often put their cards in the reader and walk to the printer and immediately collect the output. We had a priority system where the computer time had to be estimated by the user. For small jobs with high priority, like education examples, more than 100 jobs were handled per hour. A similar card reader and printer was installed at Øster Voldgade in Copenhagen and connected by cable to the system/360 computer..

## **6 System/360**

Even the 7094 did not have enough capacity, and it was obvious that we had a severe problem. The 7094 was outdated, and world-wide universities were rapidly changing to much more modern equipment. At the same time it was impossible for the University to get money for purchase of new equipment at the necessary scale, as the 7094 worked very well. There was a real risk that the center would be stuck for years with obsolete equipment. I therefore created a new plan. It was impossible to make a new donation, and even that would just give the same problem in a few years. I proposed that IBM Denmark for the first year would donate half of the rental price for modern equipment, and the donation should then be phased out over five years. The plan was approved by IBM Denmark and submitted to New York for approval.

Late in 1967 I got a late afternoon phone call from New York. A number of lawyers were sitting around a table with a "squeak box", and they started by declaring that we had to drop the plan for legal reasons. It was, they stated, in conflict with the

monopoly laws. I protested, and after almost an hour with heated arguments I succeeded in convincing the lawyers that I was right, they were wrong and the plan should be permitted.

The final obstacle was top management approval. Late March 1968 I flew to New York with persons from the IBM European headquarter in Paris. We worked for four days preparing flip charts to present the plan to the CEO of IBM World Trade in New York, Mr. Ted Groo. On Friday April 5 at 10.00 we met with Ted Groo. He opened the meeting by telling that Martin Luther King had been shot the day before, there was a fear of major unrest, the company was closing and all staff sent home. We got five minutes to present the plan, it was immediately approved, and I was told not to take a cab but walk quickly to the East Side Air Terminal and take the first bus to the airport and wait for my flight to Copenhagen.

Shortly after the agreement for the system/360 model 75 was signed by Helms and Troels-Smith. The relation between NEUCC and IBM was now an (almost) normal business relation, and the relations were at IBM to be handled by the sales office for government institutions. I left NEUCC and did not come back until after my retirement, then as a user. I never saw the new system/360 installation.

## **7 Postscript**

In April 2014 IBM held a reception to mark the “50 year anniversary of the mainframe”. At that occasion two of the three invited speakers remarked that their introduction to computers were at the NEUCC, well before the general availability of the first IBM system/360 computers. For these persons, as well as for many many others, the work and computer courses at NEUCC became the beginning of a computer career in business, education or science. The creation and start of NEUCC thus became important for the introduction of computer techniques in Denmark and to some extent in the other Nordic countries. The usage and impact on research and education far exceeded the expectations. Also the international aspect was from the beginning important, access to computers at NEUCC was vital for many international projects. So the original objective, to boost the introduction of computing in higher education, was fully achieved.

It is necessary to remember that the project was only successful because of the enthusiastic support from many persons: University teachers and administration, the NEUCC staff and management and technical specialists from IBM Denmark who supported the creation and start of the center – and of course the very many users. Without this wholehearted support the project would have been impossible. Together we built a solid base for the Universities' use of computers.



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