Historische Dimensionen Europäischer Integration | 37

Christian Franke | Matthias Röhr [Eds.]

Small Business Computers made in Europe (1960s–1980s)

Between Booking Machines and the PC

Nomos

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Prof. Dr. Guido Thiemeyer

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Introduction

Christian Franke/Matthias Röhr

> "We are saying goodbye to medium data technology and discarding terminological and historical ballast." (Computerwoche, 10.2.1978)[1]

The European and, above all, German manufacturers of decentralized office computers decided to abandon the term "medium data technology" for their devices in 1977. Instead, they focused on the term "decentralized data processing", mainly to get rid of a label that had lost its function in the technological transformation of the 1970s. This term had lost its explanatory function in the now differentiated electronic data processing markets. The dull term "medium data technology" was banished to the history books because it was associated with a historical stage of technical development that was perceived as nothing more than ballast and was no longer honoured by customers.

The term and the associated devices originated in the development departments of European office machine manufacturers in the 1960s, when they began to integrate new technologies, such as transistors and magnetic memories, into their mechanical and, in some cases, already electronic, accounting machines. The result was a new class of device that still followed the tradition of mechanical office machines but also had functions similar to electronic computers. In other words, it was somewhere in between, in the "middle", so to speak, and was aimed at medium-sized companies. We use the direct translation of the German term "*Mittlere Datentechnik*" (medium data technology) in this volume to emphasize that we are dealing here with a specific class of devices and a particular development context from office and booking machines. This is to be distinguished from the term "mid-range computing", which originates from the context of US computer production.

1 "Wir nehmen Abschied von der Mittleren Datentechnik und werfen begrifflichen und historischen Ballast ab." Abschied von der Mittleren Datentechnik, in: Computerwoche from 10 February 1978. All original German quotations were translated into English by the authors.

European manufacturers of such devices were keen to establish themselves as a central component of the data processing industry from the mid-1970s in view of the growing importance of computers in the workplace and the seemingly unstoppable expansion of markets. However, very few realized at the time that manufacturers were already fighting a battle of retreat, both on national and international markets. With the advent of the personal computer (PC) in the 1980s, at the latest, it was clear that European manufacturers, with their desk-sized office computers, no longer had a future. The term "medium data technology" finally disappeared from active use and was relegated to the dustbin of computer history.

Historical research has so far only addressed the phenomenon of "medium data technology" to a limited extent. This is all the more remarkable given that the increasing spread and use of computers in offices has been a key development in industrialized countries since the second half of the 20th century. The various subdisciplines of historical studies have also hardly dealt with the development and significance of "medium data technology" for the progress of the techniques, practices and distribution of office computers in this product line.

This volume focuses, therefore, on the very piece of the "history of computing" puzzle that has, so far, only been a footnote in the "grand narrative" of computer history: medium data technology.

The history of medium data technology addresses some central gaps in the previous narratives of computer history. Firstly, it is a genuinely European phenomenon. While extensive research and overviews are available on US computer history,[2] its European counterpart has only been researched to a limited extent.[3] Little is known about European manufacturers, their devices and their customers,[4] especially when, as in this case, their development was largely independent of the USA. We know even less about their significance for utilization practices.

The second gap is its origin in the (European) office machine industry, which can be traced back to the 19th century.[5] The history of "medium

2 Haigh/Ceruzzi: A New History; Campbell-Kelly: From Airline Reservations; Campbell-Kelly/Aspray: Computer.

3 Schmitt et al.: Digitalgeschichte Deutschlands; Leimbach: Die Geschichte der Softwarebranche; Petzold: Moderne Rechenkünstler; Zellmer: Die Entstehung.

4 Jessen et al.: AEG-Telefunken TR 440; Hilger: European Enterprise; Hilger: Von der "Amerikanisierung".

5 Vahrenkamp: Informationsexplosion; Ramm-Ernst: Stahlgehirne; Dingwerth: Schreibmaschinen-Fabriken, Band 1.

data technology", its manufacturers and the practices of its use are, thus, part of a longer process of the technicalization of information processing, which did not just begin with the first electronic computers in the 1940s. In fact, medium data technology marks a "missing link" from older practices shaped by mechanical office machines to digital-electronic ones that are still effective today. Although the "history of information" has broadened its focus beyond a mere history of electronic computers and for some years been dealing with the (US-American) practices and technologies of information processing before the computer age,[6] studies linking the two have, to date, been rare. After all, the PC did not develop out of nowhere into a central tool of corporate management, and the computerization of offices did not only begin with its advent in the 1980s.

A third gap lies in the disappearance of medium data technology and its producers. Its closure promises new insights into the transformation of the data processing sector from the end of the 1980s onwards. The emergence of the PC not only had an impact on the (former) medium data technology sector, but, instead, its disappearance can be understood as an (early) part of a fundamental crisis in the global data processing industry, which also threw giants such as IBM and DEC off-course at the beginning of the 1990s.[7] At this point, the almost 30-year growth cycle of the data processing industry appeared to be over, before the industry reinvented itself in the mid-1990s, driven by the new significance of computer networks.

Finally, the focus on medium data technology adds to the "history of computing" a development strand that can be seen as failed or finished, or which, apart from a brief boom phase, cannot be integrated into one of the usual success stories of technologies. As history is usually told ex post (by the "winners"), developments that were relevant at the time but overshadowed by later phenomena are often forgotten. One such phenomenon is medium data technology. It shaped the notion of office computers in the late 1960s and 1970s, before this term was reinterpreted from the 1980s onwards due to the success of the PC. The few studies that have dealt

6 Yates: Structuring; Agar: The Government Machine; Yates: Business Use; Cortada: Before the Computer; Yates: Control; Beniger: The Control Revolution.

7 Cortada: IBM; Schein: DEC; Carroll: Big Blues.

directly with medium data technology to date have done so primarily from a business history perspective[8] or are reports by contemporary witnesses.[9]

This volume brings together various perspectives on the phenomenon of medium data technology. On the one hand, these are classic questions of economic history, in which companies are at the centre; in addition, the supporting technologies and their transformation are also included in the analysis from the perspective of a more broadly understood history of infrastructure and technology. In addition, from the perspective of a classical political history, the reactions and dealings of political actors at various levels, from Europe to the nation-state, with medium data technology will also be analysed.

The various contributions look at different aspects of the development of medium data technology in two sections. The first section takes an overarching perspective and deals with the rise and fall of this European class of equipment and its producers. Matthias Röhr starts in an overview chapter by analysing the West German office machine industry and its transformation to electronic data processing in the 1960s, the brief boom phase and the slow decline of the industry until the 1980s. He argues that, with the advent of medium data technology, office machines became computers, even before "the computer" itself, in the form of the PC, became a universal office machine in the 1980s. Christian Franke addresses the IT policy of the European Community in his contribution, which responded to the difficult competitive situation of European computer manufacturers by, among other things, designing the European research funding programme Esprit.

The various contributions in the second section highlight individual companies and developments. Christian Berg and Armin Müller take a look in their contributions at two central West German producers of medium data technology: Nixdorf and Kienzle, from a business history perspective. Matthias Röhr sheds light on the brief excursion into the world of medium data technology by the long-established musical instrument manufacturer Hohner, and Christian Franke uses the example of the former Siemag and Philips plant in Siegen-Eiserfeld to look at the impact medium data technology had on their locations. In the final article, Michael Homberg zooms in on another competitive aspect of medium data technology: A lot

8 Henrich-Franke: Innovationsmotor Medientechnik; Berg: Nixdorf; Müller: Kienzle.
9 Hanewinkel: Computerrevolution; Heinrich: Geschichte der Wirtschaftsinformatik; Müller: Glanz.

of companies were faced with the question of whether they would be better off using the services of an external data centre instead of buying a medium data technology computer.

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An overview on Small Business Computer made in Europe

A short and long history of medium data technology

Matthias Röhr

1. Introduction

Medium data technology is hardly ever mentioned in the popular narratives of computerization. This is primarily because of their focus on the US-American development of "the computer", from the first experimental devices for scientific computing at the end of the 1940s, via the microcomputers improvised by hobbyists in the 1970s, to the universal information machine of the 21st century. At best, parallel developments, especially those that took place outside the US, play an exotic role in this narrative.

However, the kind of medium data technology, or, "*mittlere Datentechnik*" in German, which is the focus of this article, was one such parallel development. Its origins can be traced back to the mechanical typewriters, calculators and accounting machines of the 19th century. In the 1960s, the manufacturers of such office machines began to use electronics and transform these devices into versatile computers. Thus, medium data technology tells the story of how office machines became computers, before "the computer", in the form of the PC, conquered the offices in the 1980s and became a universally applicable office machine.

At the time, medium data technology was already regarded as a particularly European, especially West German, phenomenon. This can be attributed mainly to the fact that the smaller European office machine manufacturers were only able to turn to electronics after the Second World War subsequent to a reorganization and reconstruction phase. At this time, they found a market for large computers that was already dominated by IBM. As a result, they developed their office machines further, placing them, in terms of price and performance, between mechanical accounting machines and mainframe computers. This offering met a strong demand, mainly from medium-sized companies that were struggling to meet their growing administrative needs with traditional office machines but were too small to buy a mainframe computer of their own.

That this phenomenon was centred in West Germany can already be seen from the name that emerged during the second half of the 1960s for

the new class of office machines: "*Mittlere Datentechnik*". This term was coined intentionally by West German manufacturers of these machines, who had come together in the "*Arbeitskreis Mittlere Datentechnik*" (AMD; "Working Group for Medium data technology"), aiming to collectively convince potential customers of the benefits of their new, electronic and increasingly intelligent office machines. Since the activities of this organization were concentrated in West Germany, and the manufacturers also used other terms, there was no coining of a comparable term in other languages to the same extent.

This confronts us with the dilemma of translation, particularly in this English-language publication. Even at the time, the German term, in all its dimensions of meaning, was considered difficult to translate.[1] The translation of "*mittlere Datentechnik*" with the term "mid-range computing" was and still is widespread. However, this term was similarly used to describe the "minicomputers" that also appeared in the 1960s, such as the famous PDPs from the Digital Equipment Company (DEC).[2] Other contemporary terms for devices of medium data technology, such as "small business computer" or "small computer", however, have been linked to the triumph of microcomputers since the 1980s. Even the term "*Magnetkartencomputer*" ("visible record computer" or "magnetic ledger card computer") used then derived from the central storage medium in the early years, the ledger card equipped with a magnetic strip, is only suitable as a collective term to a limited extent: The term became obsolete when the first "office computers" with hard drives and screens came onto the market. Considering this diversity of terms, this article takes a pragmatic approach to the use of terms, reflecting the variety that can be found in sources.

But what constitutes the core of "medium data technology" which is the focus of this article? Since the working group also had to explain this regularly, we can refer to two contemporary attempts to define it at this point.

1 The German magazine Computerwoche, for example, wrote in 1978: "The word '*Mittlere Datentechnik*' is difficult to translate into English, the native language of EDP [electronic data processing], in its domestic meaning (plus multiple meanings and connotations)." (original: "Das Wort 'Mittlere Datentechnik' kann man in seiner inländischen Bedeutung (plus Mehrdeutung und Hintersinn) schwerlich ins Englische, in die Muttersprache der EDV, übersetzen.") Ist der MDT-Begriff benutzernützlich?, in: Computerwoche from 13 January 1978. All original German quotations were translated into English by the author.

2 Bell: Rise and Fall of Minicomputers.

> "'Medium data technology' refers to [...] electronic data processing systems, which combine numerous characteristics of data processing systems from classic office machine technology and from computer technology, thus, forming a group that is related to both but nevertheless individual and new in its conception."[3]

> "The essential difference is that these data processing systems are extraordinarily dimensioned for the workstation. [...] [T]he entire internal capacities, the programme, and data memories, but especially the data input and output units, the peripheral units, are tailored to a different size of operation, to the workplace. They are essentially dimensioned in such a way that all analysis options associated with data acquisition can be carried out directly and summarized in a single operating cycle."[4]

What these two quotes make clear is that the origins of this new class of device are rooted in the tradition of the mechanical office machines, such as typewriters and calculators. Thanks to the development of electronics, above all transistors, these office machines could be equipped with a whole range of new features. In addition to extra computing and memory functions, this also included the ability to process the data entered autonomously, without having to rely on other devices.

Just as a typewriter was used primarily in the administration of companies and administrative bodies and designed for use by a single person, the early, formative models of medium data technology, such as the Kienzle

3 "Als »Mittlere Datentechnik« werden [...] elektronische Datenverarbeitungsanlagen bezeichnet, die zahlreiche Eigenschaften von Datenverarbeitungsanlagen der klassischen Büromaschinentechnik und der Computertechnik zu einer zwischen diesen stehenden, beiden verwandten, in ihrer Konzeption aber dennoch individuellen und neuartigen Gruppe vereinen." Heinrich, Lutz J.: Mittlere Datentechnik — Gegenstand und Instrument von Unternehmer-Entscheidungen, p. 7 in: Mittlere Datentechnik: wirtschaftliche Datenverarbeitung. II. Informationstagung über Wirtschaftliche Datentechnik in Deidesheim/Weinstraße 1970, p. 7–20.

4 "Der wesentliche Unterschied ist es, daß diese Datenverarbeitungsanlagen außerordentlich arbeitsplatzdimensioniert sind. [...] [D]ie gesamten internen Kapazitäten, die Programm- und Datenspeicher, insbesondere aber die Daten-Ein- und Ausgabeeinheiten, die peripheren Randeinheiten sind auf eine andere Betriebsgröße, auf den Arbeitsplatz zugeschnitten. Sie werden im wesentlichen so dimensioniert, daß unmittelbar alle mit der Datenerfassung zusammenhängenden Auswertungsmöglichkeiten durchgeführt und in einen einzigen Arbeitsgang zusammengefaßt werden können." Rausch, Helmut: Einführende Worte, p. 5–6, in: Mittlere Datentechnik: wirtschaftliche Datenverarbeitung. II. Informationstagung über Wirtschaftliche Datentechnik in Deidesheim/Weinstraße 1970, p. 5–7.

6000 or Nixdorf's 820, were desk-sized devices that could be used by a single person. This allowed administrative tasks, such as holding a business account, to be carried out without the need for further equipment. Thus, medium data technology made it possible to enter the world of automatic data processing without having to reorganize any operational processes.

However, most observers of the data processing market at the time took little notice of this new class of devices and the success of their manufacturers. Instead, the perception of the West German data processing market was characterized after the second half of the 1960s by the fear of the "computer gap" and the debate about the "American challenge" in the technology sector in general. The dominance of IBM, which had a market share of up to 70 per cent in the 1960s and 1970s in the West German and global data processing sector,[5] was considered particularly problematic. Following 1967, politicians, therefore, attempted to improve the competitiveness of national manufacturers with various support instruments and programmes. But it was not until the mid-1970s, with the third round of the central funding programme, that manufacturers of medium-sized data technology also became the focus of this initiative.

By this time, however, the market for medium data technology and the future prospects of its manufacturers had already become much darker. This was mainly because computers became more diverse over the course of the 1970s. Manufacturers such as IBM and DEC then covered a broader price and performance spectrum. Consequently, the niche that had until then protected the West German manufacturers from international competition became increasingly smaller. The fact that the concept of "medium data technology" and, with it, its manufacturers gradually lost importance from the mid-1970s onwards and became part of a broader, general data processing market can also be described terminologically: The working group that originally coined the term changed its name to the "*Arbeitskreis dezentrale Datentechnik*" ("Working Group Decentralized Data Technology") in 1977, to clarify the positioning of its members.

The fact that today we do not imagine desk-sized office computers when we think of decentralized data technology is mainly because the manufacturers were pushed to the sidelines by a new development in data processing a few years later: With the success of microcomputers, especially the "personal computer" (PC), the market for office computers underwent a fundamental change in the 1980s. The customized solutions of hard- and

5 Rösner: Wettbewerbsverhältnisse, p. 61.

software for each individual customer of medium data technology were replaced by a new mass market for office computers and software, which now came mainly from Asia and the USA. West German manufacturers were no longer able to keep up with the massive price drop that came with it. At the beginning of the 1990s, after a series of crises and takeovers, the history of medium data technology and its manufacturers came to an end.

For a long time, research on the history of technology and economics took little notice of medium data technology. One reason for this was that, already at the time, large computers overshadowed its development. The struggle for a competitive, national manufacturer of mainframes in Europe between the 1960s and 1980s stood at the centre of the (political) debate about computers. Secondly, the history of computerization is often told as an American victory story "from behind", starting with the first mainframes, through homemade microcomputers and the IBM PC, up to the breakthrough of the Internet in the 1990s.[6] Similarly, the history of office machines before the PC has received little attention so far,[7] and is typically written by collectors based on artefacts.[8] However, several studies have already been published on some manufacturers that integrate medium data technology into a corporate history[9] or approach it biographically,[10] sometimes even autobiographically.[11]

This article does not focus on any individual company, person or device. On the contrary, the aim is to analyse the phenomenon of "medium data technology" as widely as possible and place it in its technological, economic and political context. In terms of perspective, the article combines technological and economic developments with the reactions of the companies involved and the political level. The aim is to identify often overlooked "long lines" of the European data processing industries and to include medium data technology in these lines.

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6 Haigh/Ceruzzi: A New History; Ceruzzi/Aspray: The Internet and American Business; Campbell-Kelly/Aspray: Computer.

7 Cortada: Before the Computer; Petzold: Moderne Rechenkünstler; Knie: "Generierung".

8 Bruderer: Milestones in Analog and Digital Computing, Vol. 1, Vol. 2; Dingwerth: Schreibmaschinen-Fabriken, Vol. 1; Dingwerth: Schreibmaschinen-Fabriken, Vol. 2

9 Müller: Kienzle; Müller: Mittlere Datentechnik; Müller: Kienzle versus Nixdorf; Henrich-Franke: Innovationsmotor Medientechnik; Berghoff: Zwischen Kleinstadt und Weltmarkt.

10 Berg: Nixdorf.

11 Müller: Glanz.

For this purpose, in a total of four chapters, we will, firstly, (1) address the technologization of the office up to the 1960s, from whose tradition (2) medium data technology emerged in the 1960s. (3) Although the 1970s are often regarded as the most successful decade for medium data technology, the challenges were already apparent at that time. Finally, the following chapter (4) focuses on the final decline of medium data technology and its manufacturers in the 1980s.

2. Historical background

The initial success of medium data technology can also be explained by the fact that it was part of a longer tradition of tools and techniques that were developed to manage complex organizations, such as companies and states. It specifically combined tools for writing, computing and archiving.

Such tools and techniques date back to the beginnings of mankind. The first prototypes of mechanical calculating machines were developed in the early modern era.[12] However, it was only in the final third of the 19th century, in the age of industrialization, that a commercial market for office machines emerged, centred around the USA and Western Europe. On the one hand, this was due to the increasing demand of the economy. The advancing industrialization in these regions was accompanied by an increasing need for administrative operations within both companies and governments. On the other hand, running growing companies required new methods of controlling and accounting, which were based on collecting, transferring and analysing information,[13] and governments also demanded more and more information from businesses. This requirement met with improved engineering methods and increasingly sophisticated fine mechanics. It was now possible to manufacture complex instruments with hundreds of different parts at high quality and in large quantities.[14]

A key development of this era was the advent of typewriters. The devices made writing faster, at least for trained personnel, and, thanks to the standardized typeface, texts could be captured more quickly. There were various designs on the market in the early years, but the basic technical

12 Bruderer: Milestones, Vol 1, Vol. 2.
13 Beniger: The Control Revolution; Yates: Control through Communication; Yates: Business Use.
14 Cortada: All the Facts.

concept harmonized around the turn of the century. During this period, typewriters, with their typical noise, became commonplace in offices across Europe and the US. The growing demand for the devices attracted several German companies to start mass-producing typewriters, such as the bicycle manufacturer Wanderer or Adlerwerke in Frankfurt am Main.[15]

Alongside writing, computing was an essential activity in offices. There was also a continuously growing need for automation here, driven by new or expanded regulations and management practices. However, the construction of mechanical calculating machines was a lot more complex compared to typewriters. The former only became more widespread after the typewriter, and until the advent of electronics, calculators were pricier and less common than typewriters. As the various basic arithmetic operations could be realized with varying degrees of complexity by mechanical means, two categories of calculating machine emerged, which only lost importance with the advent of electronics in the early days of medium data technology. Addition machines, which were simpler and cheaper, could only add and subtract. However, this covered a large part of the accounting requirements. A lot of adding machines had printing mechanisms to allow the checking of the calculations afterwards. By contrast, it was more difficult to realize multiplication or even division with mechanical mechanisms, meaning that calculating machines that could perform all four basic arithmetic operations, so-called "four-species machines", were more complex and significantly more expensive.

After the First World War, offices were discovered as a place with unexploited productivity reserves, and from this time onwards we can speak of a distinct office machinery industry.[16] A prominent German foundation of this time was Taylorix. Named after Frederick Winslow Taylor, whose methods already symbolized a methodical and small-scale optimization process, the company quickly became known for its accounting system, initially based on forms and carbon copies. However, Taylorix also began to sell the novel accounting machines, the direct predecessors of medium data technology, from the 1930s onwards.

Booking machines were the result of combining adding machines with typewriters and able to write directly on large-format accounting forms. This meant that a booking and the result of the calculation could be recorded on the accounting sheet in a single step. This saved time; however, it was

15 Knie: "Generierung".
16 Cortada: All the Facts, p. 91–93.

just as important that the manual transfer of results, a frequent source of error, was avoided. The booking machines were complemented by devices that could also multiply. Such invoicing machines (*Fakturiermaschinen*) could also be used to create invoices or payslips in which quantities or working hours were multiplied by an amount or interest calculated.

From the very beginning, the manufacturers of office machines relied on an elaborate sales and service network. One reason for this was that typewriters and, even more, calculators were expensive, and many potential customers had to be convinced of their value initially. Furthermore, the machines had to be serviced regularly, and operating them required training and often the modification of business processes, for example, to utilize the full potential of a booking machine. As a result, the market became segmented. Many manufacturers did not supply their machines or parts of them directly to customers, instead they supplied them to service companies which then customized the machines, produced training and system materials, and sold the machines under their own names. This form of vertical market division characterized the office machine industry from its beginnings until the advent of the computer.

An example of such a service company is, once again, Taylorix, which did not produce their own equipment, but sold many devices from different manufacturers under their name. One advantage of this structure was that it allowed the company to focus more on the needs of its customers, instead of having to sell devices at all costs. Taylorix, for example, decided in the 1960s, in addition to selling office machines, to purchase mainframe computers and set up data centres. This enabled them to offer their customers additional services, such as off-site data processing.

During the Second World War, the development and production of office machines in both the USA and Europe was subordinated to the armaments industry and heavily regulated.[17] The market structures of the pre-war period were revitalized in the USA after the war, however, there was a fundamental restructuring in Western Europe and especially in Germany. This was not only due to the large-scale destruction of production facilities. The more significant fact was that the former centre of the German office machine industry, mainly the region around Chemnitz and Erfurt, was in the Soviet-occupied zone. Among other things, the fear of confiscation caused key figures of the office machine industry to flee to the West, where

17 Ibid., p. 189–205.

they then set up new production sites. Whereas Wanderer and Olympia built new production sites in Munich and Wilhelmshaven,[18] the mechanical engineering company Siemag[19] and the precision engineering company Kienzle[20] managed to set up a new foothold by producing typewriters and booking machines with the help of refugees. This restructuring was made easier by the massive demand for typewriters and calculating machines, which started in the immediate post-war period and continued during the post-war economic boom.

Technologically, the Second World War had brought progress in electronics and electronic computers. Alongside the first experimental computers, such as the ENIAC, the age of the commercial computing began with the UNIVAC. Its development was started by a newly founded company, the Eckert-Mauchly Computer Corporation. In 1950, Remington Rand, the American office machine manufacturer responsible for the breakthrough of the typewriter in the 1870s, took over the company and added electronic computers to its portfolio.[21]

Even so, the markets for office machines and computers remained separate until the 1960s. This was not only because the first computers were primarily considered to be instruments for scientific computing or as "giant brains".[22] As early as 1954, the major American corporation General Electric also used a UNIVAC for payroll accounting, an activity that could also be carried out with mechanical invoicing machines.[23] Instead, the enormous costs of the first computers made their use only profitable for large companies with exceptionally high volumes of accounting. In this area, computers, therefore, initially only competed with punch card machines.

This category of data processing machines had been developed at the end of the 19th century to speed up the analysis of large datasets, such as a census. Therefore, the first systems could only sort and count cards. IBM and Powers, the two manufacturers of these systems, began to expand their customer base after the 1920s by adding more functions, such as printing and calculating. In doing so, they were meeting the growing needs of corporations with high accounting requirements, such as insurance

18 Eiben: Industriestädte.
19 Henrich-Franke: Innovationsmotor.
20 Müller: Kienzle, p. 65–80.
21 Norberg: Computers and Commerce.
22 Berkeley: Giant Brains.
23 Haigh/Ceruzzi: A New History, p. 22–28.

companies, which were among the first users of punched cards for bookkeeping.[24] However, using punched card machines for bookkeeping was much more complex than using booking machines. The entire accounting process had to be adapted to the technology. Transactions had to initially be transferred to punched cards before they could be processed by the punched card system, which usually consisted of multiple devices. Therefore, their use for bookkeeping for smaller companies was neither profitable nor practical, especially since booking and invoicing machines were easier to integrate into existing accounting processes.

In the 1950s, when companies such as IBM or Siemens began producing computers, their main advantage over the existing punched card systems was their significantly higher processing speed. However, speed alone was less relevant in accounting, so that the existing manufacturers of office machines did not initially see a threat to their business in the first computers.

However, a technological shift began to take place in the industry during this time. Many functions of office machines could be solved much more easily using electronics than mechanical methods.

3. From office machines to computers: the advent of medium data technology

It can be argued that medium data technology was a particularly West German phenomenon because West Germany's office machine industry discovered computers later than producers from countries such as Great Britain or the USA. This was primarily due to the situation in the immediate post-war period. As has already been mentioned, central companies, such as Wanderer and Olympia, were busy setting up their new structures in West Germany. Instead of investing their scarce capital in a new technology with an uncertain future, these companies focused initially on the established technology of the mechanical typewriter, for which there was a secure demand in the post-war period.[25]

This was different in the USA. In addition to the office machine manufacturer Remington Rand with the UNIVAC, the early computer market was characterized mainly by IBM. Backed by large orders for the new technology by the US government, the company decided in 1952 to offer its customers electronic computers. Due to the success of the computer

24 Heide: Punched-card Systems; Vahrenkamp: Informationsexplosion.
25 Zellmer: Entstehung der deutschen Computerindustrie, p. 178–183.

IBM 650, introduced in 1953, IBM established itself as a central player on the global computer market and was able to strengthen its dominance in the following years.[26] In the 1950s, there were also domestic office machine manufacturers in France and the UK – Bull and the British Tabulating Machine Company,[27] respectively – which started producing and selling computers.

By contrast, it was not the manufacturers of office machines that began producing computers in the Federal Republic of Germany in the 1950s, but the two major corporations of the electrical industry, Siemens and AEG (or, to be more precise, its subsidiary Telefunken). These companies had good business connections primarily with state institutions and other large corporations, which enabled them to find capital and initial customers for their computers. However, they lacked established sales channels to other and smaller companies. Competing directly with IBM and its strong sales structures, the two companies could only gain small market shares in the field of business computing. For a long time, another disadvantage was the lack of their own peripheral devices. Operating a Siemens computer often required an additional business relationship with IBM, as only this company could provide equipment such as punch card readers or printers.[28]

Following an initial phase of reconstruction, the West German office machine manufacturers began to expand their product portfolio in some areas with electronic devices in the 1950s. Triumph and Adler, which were merged in 1957 by the radio and television manufacturer Max Grundig, and Olympia, a subsidiary of the large electrical group AEG, placed electric typewriters on the market during this period.[29] Siemag, a newcomer to the office machine market, opted for an electronic calculating unit connected to a typewriter when it launched its automatic booking and invoicing machines (Saldoquick and Multiquick) in 1953. However, in line with the practices of the industry, Siemag did not develop the electronics itself and initially did not produce them either. Instead, it outsourced this to another computer manufacturer of the early Federal Republic of Germany, Zuse KG,[30] which meant that Siemag decided not to build up in-house expertise. A similar approach was taken by the Cologne-based office machine manu-

26 Cortada: IBM, p. 149–202; Usselman: IBM and Its Imitators.
27 Campbell-Kelly: ICL.
28 Petzold: Rechnende Maschinen, p. 456–459.
29 Lämmel: Triumph-Adler.
30 Henrich-Franke: Innovationsmotor, p. 101–102; Zuse: Computer, p. 127.

facturer Exacta, which was acquired by its competitor Wanderer in 1963. Instead of developing the electronics for a new version of their booking machine "6000" on their own, they contracted Heinz Nixdorf and his Labor für Impulstechnik with the task.[31]

While the electronics of the booking machine "6000" already trended towards medium data technology, its technological origins were particularly associated with a new storage medium, the magnetic ledger card (*Magnetkonto* or *Magnetkontokarte*). This was a combination of a paper format, the account card, which had been used for a long time in bookkeeping and the management of accounts using booking machines, and a machine-readable magnetic strip attached to it.[32] Data corresponding to the account could be stored on this strip, primarily the account number, the last balance and the last used line of the card. When a magnetic ledger card was inserted into a booking machine, the magnetic strip was read, the balance was automatically transferred, and the system jumped to the next empty line so that new transactions could be entered directly. When the card was ejected from the machine, new values were saved. This combination of a traditional, human-readable document with a machine-readable storage not only speeded up work and reduced the risk of errors, but also fulfilled legal documentation requirements. Subsequently, the magnetic ledger card was also used as a convenient storage medium for programmes. One of the first automatic accounting machines to use magnetic ledger cards was the Class 2000 booking machine, introduced by Kienzle in 1963.[33]

However, the breakthrough of the magnetic ledger card came thanks to a development by Otto Müller, who was a key figure in the early years of medium data technology. Müller had his first experience with computers at Telefunken in the 1950s, and it was here that he developed the concept for a small office computer. As he did not receive any support at Telefunken for such a computer, in 1963, Müller went to the USA and joined IBM. Just one year later, Heinz Nixdorf headhunted him, and he returned to West Germany.[34] Müller developed the electronics for an all-electric booking machine for Nixdorf's Labor für Impulstechnik that worked with magnetic ledger cards and was programmable. These electronics and the correspond-

31 Berg: Nixdorf, p. 76–77. On Nixdorf, also see the article by Christian Berg in this volume.

32 For Gerd Dirks and Siemag's role in the development of magnetic storage technology, see Henrich-Franke: Innovationsmotor.

33 Müller: Kienzle, p. 82–83. On Kienzle, see also the article by Müller in this volume.

34 For Müller's biography, see the autobiography of his wife: Müller: Glanz.

ing booking machine were not initially marketed by Nixdorf itself, but by Wanderer as "Logatronic" and the Swiss-based supplier of accounting systems RUF under the name "Praetor". Only after the takeover of Wanderer by Heinz Nixdorf in 1968 was the device marketed under the name Nixdorf 820, which laid the foundation for the commercial success of Nixdorf AG.

The class of medium data technology devices was taking shape by the mid-1960s. Other West German office machine manufacturers also brought comparable models onto the market. The Bielefeld-based company Anker, known mainly for its mechanical cash registers, introduced the programmable magnetic ledger card computer ADS 900 in 1965.[35] Two years later, Kienzle presented a comparable device, the Class 6000. However, a third-party microchip from the American microelectronics company Texas Instruments was at the centre of this device.[36]

Siemag also switched its product portfolio entirely to electronics in the 1960s. The production of mechanical typewriters was relocated to Portugal in 1963, and from 1965 on, a whole series of fully electronic booking machines were produced in Eiserfelde. The top model was the "Data 5000" magnetic ledger card computer. However, the necessary investments, including the reorganization of production and restructuring of sales, had challenged the original manufacturer of rolling mills, Siemag. As a result, the management entered into a cooperation agreement for its office machine division with the Dutch electronics giant Philips. The latter finally took control of Siemag's office equipment division and renamed it Philips Electrologica in 1969.[37]

Other manufacturers also realized that the emergence of this new class of devices could be made easier through new forms of cooperation. Therefore, Wanderer, Siemag, Kienzle and Anker founded the AMD in the mid-1960s, whose primary goal was public relations. The organization coined the term "*Mittlere Datentechnik*" (medium data technology), primarily for marketing purposes. The term was intended to refer to the fact that the new class of fully electronic office machines could be categorized "in the middle" between the simpler, still mechanical booking machines and powerful mainframe computers. The term was also intended to address small and medium-sized companies as potential customers for these machines.

35 Mittelstands-Elektronen. EDV-Anlagen unter 10000,- DM Monatsmiete, in: bit-Berichte, Informationen, Tatsachen über moderne Unternehmens- und Verwaltungspraxis, April 1967.

36 Müller: Kienzle, p. 95–96.

37 Henrich-Franke: Innovationsmotor, p. 110–115.

As a generic term, however, the definition of "*Mittelere Datentechnik*" (the AMD always capitalized it) remained vague. The question of how this term should be defined was a constant topic of discussion at AMD events and in the tech press until the mid-1970s.[38] The discussion was complicated by the fact that manufacturers and the trade press also used other terms in parallel, such as "direct data processing", "keyboard-orientated computers" or "computers for small and medium-sized enterprises".

Apart from debates about terminology, the AMD's work consisted primarily of cross-manufacturer seminars and publications, which were organized by its office, the "*Informationsstelle für Datenverarbeitung*". Another part of the manufacturers' co-ordinated public relations campaign was the donation of a chair at the University of Karlsruhe for "Organization Theory and Data Processing (Medium data technology)" in 1970, which was initially filled by the business graduate Lutz Jürgen Heinrich. Heinrich was a speaker at AMD events and the author of a key textbook on the subject, first published in 1968, which appeared in three editions up to 1974.[39]

The second half of the 1960s can generally be regarded as the take-off phase of medium data technology. On the one hand, this was reflected in growing sales figures and turnover by the manufacturers. A particular boost to sales in West Germany was the introduction of value added tax on 1 January 1968, which, as a pass-through expense, significantly increased the booking requirements of almost all companies. Considering the full employment at the time, the urge to automate was, consequently, high. In addition, the zeitgeist of the late 1960s, the technology-friendliness and planning euphoria, also favoured sales. This was because the medium data technology not only accelerated bookkeeping, but it also made it easier to compile statistics and capture benchmark data, which, in turn, made it possible to track the development of a department or an entire company in almost real time.

By electrifying the mechanical booking machine and simultaneously making it more intelligent, the West German office machine industry opened up an area of the data processing market in which there was

38 Rotger H. Greve: Was ist Mittlere Datentechnik?, in: eR – Elektronische Rechenanlagen 18 (1976), 2, p. 57–60.

39 Heinrich: Mittlere Datentechnik. Datenverarbeitung; Heinrich: Mittlere Datentechnik. Hardware; Heinrich/Krieger: Systemplanung. Henrich himself moved to the University of Linz in 1970 and can be considered one of the founders of the discipline of business informatics in German-speaking countries. In 2011, he examined the early history of this discipline: Heinrich: Geschichte der Wirtschaftsinformatik.

little non-German competition. In particular, American companies that dominated the West German market for mainframe computers during this period, most notably IBM, had no comparable devices in their portfolio at the time. This can be partially explained by structural differences in the domestic markets. Compared to German or European companies, American companies were larger on average, which meant that the American market favoured larger computers that were also considered to be more cost-efficient. In addition, the structures of the American telecommunications market were unique.[40] Because there was no state-run telecommunications monopoly, and AT&T, as the largest network operator, was forced to grant other companies access to their network, there was a commercial market for remote access to computers from the second half of the 1960s onwards.[41] This was a cost-effective form of data processing, especially for medium-sized and small companies, that often made the purchase of a company-owned computer unnecessary.

The sales success of medium data technology in West Germany led other manufacturers to enter this market at the end of the 1960s. These included other traditional manufacturers of office machines, such as the Nuremberg-based company Triumph-Adler. After Max Grundig had sold most of the company to the American electronics group Litton in 1969, the company initially launched the TA-10 accounting computer, which resembled a typewriter in shape and size and was advertised as a "people's computer" (*Volkscomputer*) that found its market primarily among tax consultants, a growing profession at this time.[42]

The company contracted Otto Müller, who had left Nixdorf in 1969, for the development of a larger class of devices, the TA-1000 magnetic card computer, which was launched in 1972. Müller and his wife founded their own company, "Computertechnik Müller" (CTM), in 1972 and launched an office computer of their own, the CTM 70. Although CTM was able to establish itself as a manufacturer of office computers, Diehl, a defence manufacturer, acquired a majority stake in the company as early as 1974.[43]

Even outsiders of the industry tried to establish themselves on the market for office computers in the late 1960s, including the musical instrument

40 Röhr: Der lange Weg, p. 79–99.
41 Campbell-Kelly/Carcia-Swartz: Economic Perspectives.
42 Lämmel: Triumph-Adler, p. 68.
43 Müller: Glanz, p. 136–204; Schöllgen: Diehl, p. 207–209.

manufacturer Hohner, although it had to sell its data processing division to the market leader Nixdorf by 1976.[44]

Even though medium data technology was, at its core, a West German phenomenon, there were also manufacturers from other European countries. One of these was the Dutch Philips Group, whose activities in this market, however, dated back to the takeover of Siemag's office equipment division. In addition to this, it was primarily the Italian company Olivetti that was able to establish itself on the market for fully electronic accounting computers. In the post-war period, the traditional manufacturer of typewriters had already developed and produced mainframe computers. However, Olivetti had to sell this division to the American giant General Electric in 1964, and focused on the production of typewriters and calculators. Therefore, the programmable, fully electronic desktop calculator "Programma 101", introduced in 1965, was not marketed as a computer but as an office machine. Once the success of medium data technology was foreseeable, Olivetti combined the desktop calculator with a typewriter and broadened its range of applications. At the beginning of the 1970s, Olivetti's portfolio was finally extended upwards with the "Audit 5" and "Audit 7" accounting computers.[45]

4. The end of the niche – The 1970s

Around the same time as medium data technology emerged, there was a broader social debate about the phenomenon of electronic computers for the first time in Western Europe. This was primarily because computers had developed rapidly in their first twenty years, and it was now clear, at least to experts, that this technology would soon spread across all sections of society and become a new fundamental resource of national economies. However, the steady and accelerating progress also meant that the mastery of this technology in a sustainable and economically viable way was a challenge which could not be taken for granted, even for highly industrialized countries.

44 Berghoff: Zwischen Kleinstadt und Weltmarkt; Hans Otto Eglau, Computer vom "Bläslemacher", in: Die ZEIT 32 from 11 August 1972.

45 On the history of Olivetti, see so far only: Castagnoli: Across Borders; Secrest: The Mysterious Affair.

Therefore, the perception of computers in Europe since the 1960s had been associated primarily with the fear of being technologically left behind, especially by the USA. Buzzwords such as "gaps in technology"[46] or "the American challenge"[47] were, thus, used in the 1960s to discuss the technological strength of the USA in key sectors, such as aviation, aerospace and data processing. In order to secure their prosperity, it seemed necessary to narrow the technological lead of the USA in these sectors, thus, from the second half of the 1960s, Western European governments began to support their data processing industries as well as aviation and aerospace[48] with various instruments. While the "Plan Calcul" was announced in France and a new company, the "Compagnie Internationale Pour L'informatique" (CII), was founded,[49] and the British computer industry was merged to form the company "International Computers Limited",[50] the West German government launched a funding programme for the data processing industry in 1967.

The main goal of the government's funding efforts was to make the West German computer industry more competitive and reduce IBM's market share in mainframe computers. The office machine industry, which had just made the technological leap from mechanical to electronic data processing in the 1960s and found a profitable niche with office computers, was initially not recognized politically, and was, therefore, not explicitly considered in the first funding programme.

Most of the financial aid was, therefore, directed towards mainframe computer development at Siemens and AEG-Telefunken. Siemens was able to gain a market share in the second half of the 1960s thanks to the licensed adaptation of the "Spectra 70" computer, an IBM-compatible computer developed by the American company RCA, which was sold as the Siemens 4004. However, AEG-Telefunken had problems finding customers for its high-performance computer "TR 440", whose development was funded mainly by the state.[51] In 1971, as AEG-Telefunken considered leaving the computer market, the West German government intervened. But their plan to merge the computer divisions of Siemens and AEG-Telefunken into

46 OECD: Gaps in Technology.
47 Servan-Schreiber: Le défi américain.
48 Ahrens: Strukturpolitik und Subventionen.
49 Mounier-Kuhn: French Computer Manufacturers; Flamm: Creating the Computer.
50 Campbell-Kelly: ICL.
51 Jessen et al.: AEG-Telefunken TR 440.

a "computer union" (*Großrechnerunuion*) failed due to resistance from Siemens, who saw no added value in this merger.

However, instead of Siemens, Nixdorf offered to cooperate with AEG-Telefunken. Telefunken Computer, a joint venture, should utilize Nixdorf's sales structures to sell the mainframe computer. But the biggest risk was taken by AEG-Telefunken, which had to cover any losses of the joint venture for the first two years.[52] However, the synergy effects between the sale of office computers and the sale of high-performance computers were low, therefore, Nixdorf ended the cooperation with AEG-Telefunken in 1974, just before it also had to share the losses.[53]

As this episode clearly shows, among the producers of medium data technology, it was primarily Nixdorf whose ambitions stretched beyond the narrow market for office computers. This is underlined by another development of the early 1970s, Nixdorf's participation in Datel GmbH.

Regarding Datel, the West German telecommunications monopolist Bundespost wanted to participate in the time-sharing market in 1969. To do so, the Bundespost founded a subsidiary together with the two West German manufacturers of mainframe computers, AEG-Telefunken and Siemens, with the aim of providing computing power via the telephone network. As this company's customer base also included small and medium-sized companies, typical purchasers of mid-range computers, Heinz Nixdorf considered the endeavour a threat to his business. Therefore, he managed to get Nixdorf AG and the AEG subsidiary Olympia to also become shareholders of Datel. But Nixdorf withdrew from this company as early as November 1973, after Datel had generated almost no income up to that point but had accumulated high debts due to ambitious growth targets.[54] At the end of 1974, the other shareholders also withdrew from the timeshare market and sold the company.[55]

Despite the failure, the attempt to establish a strong, West German provider of timesharing showed that the continuous change in computer technology represented a general challenge for medium data technology. Due to the rise of timesharing, some customers of medium data technology

52 Heinz Nixdorfs zweiter Senkrechtstart? Gründung der Telefunken Computer GmbH – Kristallisationspunkt: TR 440, in: adl-nachrichten 71.

53 Berg: Nixdorf, p. 122–130.

54 Maurer, Gerhard: Angst vor IBM und Mut zum neuen System, in: Computerwoche from 13 November 1974.

55 Röhr: Der lange Weg, p. 193–197.

were confronted with whether it was economically viable for them to have a computer of their own or use the services of a specialized data centre.[56]

Nixdorf, which was the market leader in West Germany in the 1970s, responded to the challenge of remote data processing and the changes in data processing with an expansion of its product portfolio. In addition to office computers, the company also offered cash registers and terminals, which were licensed from the American manufacturer Entrex and distributed as the Nixdorf 620 data capture system. Entrex became a subsidiary of Nixdorf in 1977.

A further development, a terminal (Datatel 8811) labelled by Nixdorf as a data telephone, led to a conflict between Nixdorf and the Bundespost that lasted for years. At first glance, this was only about the control of the built-in modem for data transmission.[57] However, underlying this was a fundamental conflict of the 1970s, in which the question was negotiated how to isolate the monopoly-based telecommunications sector from a competitive data processing market. In the USA, this question had led to several so-called "computer decisions" by the Federal Communications Commission since the 1960s, but was only finally resolved with a fundamental restructuring of the telecommunications sector.[58]

Kienzle, at the time the second-largest West German manufacturer of small computers after Nixdorf, also expanded its portfolio in the 1970s. Alongside terminals ("System 3000"), the "EFAS 2000 electronic accounting and invoicing system" was intended to expand the market for office computers at the lower end and win over customers who had formerly worked with mechanical accounting machines. Again, Kienzle did not develop its own electronics but, instead, used a microchip purchased from Intel.[59]

Philips, which had established itself as the number three on the West German office computer market as the successor to Siemag, faced turbulent times in the first half of the 1970s. This was due mainly to its integration into the Unidata group. The latter represented the politically moderated attempt to meet the "American challenge" in data processing by merging several computer manufacturers on a European level. Given that IBM's dominance in Western Europe had increased in the second half of the

56 On this topic, also see the article by Michael Homberg in this volume.
57 Henrich-Franke: EC Competition Law.
58 Röhr: Der lange Weg, p. 79–99.
59 Müller: Kienzle, p. 103–106.

1960s, despite government support for national manufacturers, the French and West German governments especially pushed for a trans-European merger. By the beginning of 1972, the negotiations had been finalized, and three "national champions", CII from France, Philips from the Netherlands and the West German company Siemens, announced a strategic partnership, along with a joint market presence under the name "Unidata". The core of the cooperation was a co-ordinated development programme for a new computer family that should be compatible with IBM's newly announced System/370.[60]

Philips was responsible for developing and producing the low-end version of the system family in this consortium. Therefore, with the "Unidata 300", a keyboard-orientated computer was created at the former Siemag plant in Eiserfelde, which was intended to function as an entry-level model.[61] However, the marketing of this model under the Unidata brand was short-lived, as the European joint venture was terminated at the end of 1975. The background to the failure was primarily the merger of the French group CII with Bull, a subsidiary of the American Honeywell Group. According to the other partners, this neutralized the idea behind Unidata as the core of a genuine European computer industry. The decision was also influenced by the fact that cooperation between the three companies was very difficult. The corporate cultures were too different, and both Philips and Siemens felt that their French counterparts had unfairly taken advantage of them when it came to allocating tasks, since the most powerful computers were to be developed by CII.

The integration of Philips, a manufacturer of medium data technology, into Unidata indicates that categories and classes of computing equipment began to change in the 1970s. While the West German office machine industry, with its magnetic ledger card computers, had still found a clear performance gap to mainframe computers in the 1960s, the range of computers and, in particular, software was now more differentiated. This was primarily due to American manufacturers, such as DEC and Hewlett Packard, who, from the mid-1960s, were also able to open a new market for relatively inexpensive, highly flexible computers, their so-called "minicomputers".[62]

60 Hilger: The European Enterprise; Griset: Informatique, politique industrielle, Europe.
61 Auerbach: Guide to Small Business Computers, p. 277–278.
62 Haigh/Ceruzzi: A New History, p. 93–96.

In the 1970s, these producers of minicomputers also pushed into the market for business computing beyond large companies.

Another challenge for the West German manufacturers was that, with the success of medium data technology, American manufacturers with significantly more capital were also moving into the market. Burroughs, for example, at the time the number two after IBM on the American market, also launched a keyboard-orientated computer specifically for accounting purposes in 1970, the L series, which competed directly with the devices of the West German manufacturers.[63] However, IBM's efforts were considered a greater threat. In response to the success of the minicomputers, IBM had initially introduced the System/3 in 1969, which was significantly more powerful than the default medium data technology device, but also targeted the market of small to medium-sized companies with no computer experience. With the introduction of the System/32, a keyboard-orientated computer, at the beginning of 1975, IBM finally pushed fully into the market of medium data technology. The IBM System/32 computer, with its prominently placed keyboard and printer, already visually looked like other medium data technology devices.[64]

By contrast, in the first half of the 1970s, the business of West German manufacturers of office computers was still largely based on magnetic ledger card computers. Even though the magnetic card as a combined display and data storage device had proved to be extremely useful in the transition from mechanical accounting machines to electronic office computers, this technology was not flexible enough to meet the challenge of minicomputers. Therefore, when it came to data storage, some existing models were upgraded with magnetic tape drives, often in the form of cassette drives. Then, from the mid-1970s, floppy drives made it easier to access data.

At the upper end of the medium data technology, magnetic discs became the successor technology to magnetic ledger cards. This technology, an early form of today's hard discs, made it possible that the respective account card no longer had to be inserted for posting. Entries could now simply be entered one after the other, allowing the individual accounts to be printed out separately later. Moreover, the manufacturers increasingly used

63 Auerbach: Guide to Small Business Computers. p. 24–30.
64 Ibid, p. 113–132.

cathode-ray tube monitors as a display medium.[65] Whereas the interaction with the devices had previously been based on the practices of mechanical accounting machines, which were largely account- and line-based, interactive dialogue systems now simplified the operation of the devices. This technological change also made it possible for terminals to be connected to the devices, allowing several users to work with the computer simultaneously. Thus, office computers increasingly became like minicomputers or even mainframes.

Increasing international competition and the need to continually improve their devices posed a major challenge for most West German manufacturers, as they were relatively undercapitalized, at least compared to American manufacturers. The technological change in the field of electronics also led the West German manufacturers to become increasingly dependent on American technology. This was primarily because of the rapid development of microelectronics; it was no longer viable to build the central processing electronics for an office computer themselves. But, in terms of capital and research, the individual manufacturers were too weak to set up their own microelectronics divisions, and there were also no competitive chip producers at a national or European level. Instead, they were forced to hand over this central element of the devices, and, more importantly, its added value, and had to buy chips from American companies, such as Intel or Texas Instruments.

A further challenge was the significant rise in software development costs in the 1970s, which, due to increasing international competition, could not be passed on to the prices of the devices. This was partly due to the ever-increasing range of functions, which caused the complexity of the software to increase disproportionately, as different industries required slightly different programmes. However, medium data technology was not alone regarding the phenomenon of the growing complexity of software projects. The term "software crisis" was already being used at the time.[66]

Even the distribution of the devices became more and more expensive, as accessible markets had become increasingly saturated together with the darkening economic situation in the 1970s. From the mid-1970s onwards, there was no longer a niche that protected the West German office machine

65 Schramm, H. F. W.: Vom Magnetkonto zur Magnetplatte. Speicher für MDT, in: Computerwoche from 27 March 1975.

66 On the software crisis and possible solutions, see Hashagen/Keil-Slawik/Norberg: Software Issues.

industry, like in the 1960s when it entered the world of electronic data processing.

Around the mid-1970s, the AMD was also forced to adapt to the new market reality. In 1977, the association abandoned the term "medium data technology" and renamed itself the "Working Group Decentralized Data Processing". On the one hand, this was to put an end to the fruitless discussion about what constituted the "medium" in medium data technology. The former price and performance gap in the "middle" between mainframe computers and mechanical office machines had now become a regular and competitive part of the broader IT market. On the other hand, the new name referred to a new trend in IT. "Distributed data processing" was considered to be the future of data processing at the end of the 1970s. The term particularly reflected the fact that even in the world of large computers, computing power had now moved closer to the workplace, since there were now numerous "intelligent terminals" on the market, which had limited data processing capacities of their own. Thus, with the new name, the members of the working group wanted to emphasize that they and their devices were now integrated into a broader data processing market, seeing themselves as pioneers of computing power at the workplace.

In this situation in the mid-1970s, West German politicians also became more involved with West German manufacturers of small computers. This was primarily because a further extension of the data processing programme was pending, still aiming for an independent and competitive data processing industry. Whereas the first term of the programme, starting in 1967, focused on mainframe computer development at Siemens and AEG-Telefunken, by 1970, the emphasis had shifted to the establishment of an infrastructure for training and research, such as computer science departments at universities. In the third term of the programme now beginning, however, the application of computers in business and administration should also be promoted, in addition to a prospective expansion to Europe. The Federal Ministry of Research and Technology (BMFT) was in charge of the conceptualization.

However, the files of the ministry reveal a fundamental scepticism about the structures of the existing West German market for small computers. The ministry considered most manufacturers to be too small to be able to survive in the long term. Until then, the strategy of the German government had consisted primarily in fostering the formation of a central, European data processing group that would cover the entire computer market. In 1974 and 1975, when the third term was being conceptualized,

this strategy also seemed to work out with Unidata. To complement this, the ministry also favoured a second, European group, at least for a time, which was to merge with Unidata in the medium term. Its core was to be formed by Nixdorf and the British computer group "International Computers Limited".

However, following the breakdown of Unidata in the course of 1975, the ministry initially favoured a different, national strategy. The West German market would be cleaned up and concentrated, with the medium-term aim of a merger of Siemens and Nixdorf, creating a central West German computer manufacturer. However, Heinz Nixdorf's personality, which was considered individualistic, was seen by the Ministry as a problem for this project. The other manufacturers were not considered worthy of preservation by the Ministry of Technology in their current form:

> "In this concept, there is no longer any room for Philips Electrologica alongside Siemens/Nixdorf, nor for Triumph-Adler or other manufacturers of small universal computers. Philips and Triumph-Adler are companies with a foreign majority, which are of secondary importance in the event of a national structural reorganization. In any case, the remaining German small computer manufacturers only have a chance against IBM by specializing and cooperating with the Siemens/Nixdorf Group, where they can mutually benefit from the combination of customized solutions at the workplace and industry-neutral IT systems without having to develop them themselves."[67]

An impression of West German manufacturers and their tense relationship with the political arena is also provided by a hearing before the Bundestag Committee on Research and Technology on 14 May 1975. During the questioning of the managing directors of the eight most important West

67 "Für Philips Electrologica ist in diesem Konzept kein Platz mehr an der Seite von Siemens/Nixdorf, ebensowenig für Triumph-Adler oder andere Hersteller von kleinen Universalrechnern. Bei Philips und Triumph-Adler handelt es sich um Firmen mit ausländischer Mehrheitsbeteiligung, die im Fall einer nationalen Strukturbereinigung von sekundärer Bedeutung sind. Die verbleibenden deutschen Kleinrechnerhersteller haben in Konkurrenz zu IBM ohnehin nur die Chance der Spezialisierung und können durch Kooperation mit der Gruppe Siemens/Nixdorf zu beiderseitigem Vorteil die Verbindung von Speziallösung am Arbeitsplatz zum branchenneutralen DV-System nutzen, ohne es selbst entwickeln zu müssen." Möglichkeiten der Strukturierung des DV-Marktes, in: Bundesministerium für Forschung und Technologie: 3. DV-Programm, Bundesarchiv Koblenz, B196/41492.

German small computer manufacturers, Olympia, Hohner, Anker, Kienzle, Philips, Triumph-Adler, Nixdorf and Diehl (CTM), the members of the committee asked primarily about co-operations and possible mergers within the industry. In their responses, however, the smaller manufacturers were reserved on these topics, even though they acknowledged the fundamental need for cooperation.[68]

From the Ministry's perspective, the results of the hearing were sobering:

> "It became apparent that the majority of small computer manufacturers assume that they will continue to receive state subsidies and are unwilling to give up their pronounced individualism. Although the threat posed by IBM's perfect marketing is recognized, the hopelessness of the situation with unchanged behaviour in the market is not. […] The weak impression left by the so-called experts will make it easy for the BMFT to argue in favour of highly selective funding before the FT Committee."[69]

After all, the federal government decided not to promote the manufacturers of small computers on a broad basis in the third data processing programme. The main reason for this is likely to have been that the ministry felt that these manufacturers were too small to survive as independent manufacturers in the medium term. Instead, the German government aimed for a market consolidation and concentration process that would result in the formation of a "national champion", which would essentially consist of Siemens and Nixdorf. For smaller manufacturers, such as Kienzle, however, the responsible ministerial consultant saw an opportunity in this structure by discontinuing the production of hardware in favour of Siemens/Nixdorf and using their market experience for industry-specific system and software solutions based on purchased hardware.

The internal goal of the government to consolidate the market seemed to be gathering pace in the mid-1970s. Due to the weak economy, the

68 Stenographisches Protokoll über die öffentliche Informationssitzung des Ausschusses für Forschung und Technologie am 14. Mai 1975, in: ibid.

69 "Es zeigte sich, daß die Mehrzahl der Kleinrechner-Hersteller von einer andauernden staatlichen Subvention ausgeht und nicht zur Aufgabe des ausgeprägten Individualistentums bereit ist. Es wird zwar die Bedrohung vor allem durch das perfekte Marketing von IBM erkannt, nicht jedoch die Hoffnungslosigkeit der Lage bei unverändertem Verhalten im Markt. […] Der schwache Eindruck, den die sog. Sachverständigen hinterließen, wird es dem BMFT leicht machen, eine stark selektive Förderung vor dem FT-Ausschuß zu vertreten." Möglichkeiten der Strukturierung des DV-Marktes, in: ibid.

market for medium data technology grew more slowly, and, as a result, two manufacturers were forced to give up. The smallest manufacturer, the family-owned company and long-established producer of musical instruments, Hohner, was forced by its creditors to leave the computer market. In 1976, they handed over that part of their company and their customer contacts to the market leader Nixdorf.[70]

Furthermore, the tradition-rich Bielefeld-based manufacturer of mechanical cash registers, Anker, had to file for bankruptcy in 1976, after having repeatedly sought support from the government and turned down takeover offers from Nixdorf. More than almost any other company, Anker was confronted with the challenge of managing the transition from the labour-intensive production of mechanical cash register systems to electronic systems. The company had been given a total of DM 11 million by the German government to assist its entry into electronics and medium data technology. However, the management decided not to cut its workforce and was no longer able to utilize its capacity in mechanical production. At the beginning of 1976, Anker, therefore, was forced to declare bankruptcy and ceased to be a manufacturer of medium data technology.[71]

However, in the second half of the 1970s, the business of the remaining West German manufacturers of small computers seemed to stabilize again, even if there were no major commercial successes.

5. Break-up in the 1980s

The market for office computers underwent fundamental changes in the 1980s. This was due, above all, to the triumph of microcomputers, particularly the PC, which was introduced by IBM in 1981 and until today defines the class of office computers.

70 Berghoff: Zwischen Kleinstadt und Weltmarkt, p. 605–609. Also see the article on Hohner in this volume.

71 Bundesministerium für Forschung und Technologie: Informationen zur Fa. Anker Werke AG, Bielefeld, Bundesarchiv Koblenz B196/43712; Bößenecker, Hermann: Mit Bonn gegen IBM. Die Bundesregierung will die deutsche Computer-Industrie weiter fördern. Wer soll die Millionen bekommen?, in: Die ZEIT 27/1975 from 27 June 1975; Maurer, Gerhard: Anker gibt auf und macht weiter, in: Computerwoche from 30 April 1976.

The story of the microcomputer and the IBM PC has been told many times.[72] At the beginning of the 1970s, microelectronics had progressed so far that the central processing unit of a computer could be integrated into a single microchip. This offered the opportunity for some American electronics hobbyists to build their own computer. Starting in 1975, the first assembly kits for microcomputers (Altair 8800) became available, and in 1977, with the Apple II and the TRS-80, the era of the commercially available home computer began. The home computer also became increasingly relevant for the (American) business world with the innovative class of programmes for spreadsheets, which first conquered the American market in 1979 under the name "Visicalc".[73] In 1981, with its PC, the computer giant IBM presented its version of microcomputers for offices. The design of the IBM PC, which was assembled using standard components, led to more and more "clones" of the IBM PC by companies such as Compaq and Dell conquering the market during the 1980s. As a result, the PC developed into the central technological platform for office computers.

The rise of the PC was also linked to the fact that the software of small computers was now becoming increasingly separate from the hardware. It was common for manufacturers of medium data technology to provide customers with the software they needed, but a manufacturer-independent market for application and office software emerged in the 1980s. Although programmes such as Lotus 1–2–3 or Quicken were designed primarily for private users, to some extent, they also met the needs of smaller companies. The separation of hardware and software and the establishment of Microsoft DOS as the standard operating system of the IBM PC and its clones made it easy to create customized software solutions. Instead of buying a medium data technology computer, small and medium-sized companies could now purchase PCs and commission an external programmer or service company to develop the software they required.

The emergence of microcomputers and their broad social adaptation in the 1980s also meant that computers became a topic whose long-term, economic and social relevance was now also obvious to the public and subject of a wider social debate. While data processing had still been considered an expert topic a few years earlier, computers seemed to be everywhere in the 1980s.

72 Freiberger/Swaine: Fire in the Valley; Haigh: The IBM PC; Haigh/Ceruzzi: A New History, p. 207–242.

73 Nooney: The Apple II Age, p. 71–106.

However, the West German manufacturers of office computers were unable to benefit from the new significance of computing and the boom in microcomputers. They only realized the relevance of the microcomputer and the PC, which posed a central threat to their business model, at a late stage. Instead, they stuck to established strategies and tried to build on previous successes without reacting to developments in other countries. This had already been recognized as problematic at the beginning of the 1980s. An Enqueue Commission set up by the Bundestag on the subject of "New Information and Communication Technologies" stated that German manufacturers were clearly lacking in innovation:

> "The main competitors, the USA and Japan, recognized the opportunities offered by these technologies earlier. While German manufacturers concentrated on the established markets for too long, these two countries have driven forward the development of new ICT technologies and now have a head start of around a few years and in some cases overwhelming market shares [...]. The competitive situation of German manufacturers is currently only characterized as good in communications technology [...]."[74]

Considering the changes in the data processing market as a whole, the West German manufacturers' reluctance to innovate was especially problematic. The market was characterized from the late 1970s onwards by the fact that what was once referred to as medium data technology and constituted the entrepreneurial core of the manufacturers was absorbed into the general data processing market and, therefore, lost its contours. This meant that manufacturers of minicomputers and increasingly also PC manufacturers or producers of software were increasingly focusing on small and medium-sized companies. A niche into which West German manufacturers could retreat finally no longer existed.

74 "Vor allem die Hauptkonkurrenten USA und Japan haben die Chancen dieser Technologien früher erkannt. Während die deutschen Hersteller sich zu lange auf die etablierten Märkte konzentrierten, haben diese beiden Länder die Entwicklung der neuen IuK-Technologien vorangetrieben und verfügen nun über einen Zeitvorsprung von etwa einigen Jahren sowie über z. T. erdrückende Marktanteile [...]. Die Wettbewerbssituation der deutschen Hersteller wird derzeit nur noch in der Nachrichtentechnik [...] als gut bezeichnet." Zwischenbericht der Enquete-Kommission "Neue Informations- und Kommunikationstechniken" (March 1983), Bundestagsdrucksache 9/2442.

The way in which the German data processing industry was dealt politically in the 1980s was characterized by the search for new structures and funding instruments. This was mainly because the support provided in the twelve years between 1967 and 1979 had not led to the results intended. There was still no data processing industry in the Federal Republic of Germany that was able to compete on its merits. However, it was politically unfeasible to put the subsidization on a permanent basis.

An important development in the 1980s was the growing influence of the European Community in the field of data processing. There had been calls to create a common European market for data processing involving European manufacturers in response to the "American challenge" since the 1960s. Even if the European idea initially faded into the background after the failure of Unidata, the European Commission launched a new initiative from the end of the 1970s to strengthen data processing, which now primarily involved a stronger European influence on research funding.[75]

Furthermore, since the end of the 1970s, policymakers had increasingly turned to supply side approaches and, therefore, favoured instruments of indirect support.[76] This coincided with the fact that the fundamental relevance of the telecommunications sector and its structures for the data processing industry had become increasingly clear in the 1970s. This was driven by the rapid development in the USA. Here, the liberalization of the telecommunications sector, particularly the end of the monopoly on terminal equipment, led to the emergence of new markets, for example, around "intelligent terminal equipment".

Nixdorf had especially recognized the problems of the telecommunications monopoly and the potential of new types of terminal equipment in West Germany and had regularly raised this issue on the political agenda with reference to developments in the USA. The company, for example, wrote a document entitled "The legal and economic situation of telecommunications in the Federal Republic of Germany and its consequences" in early 1977 and sent it to various ministries and members of the Bundestag. In this document, Nixdorf primarily criticized the strong position of the Bundespost in the West German terminal equipment market and called for an end to the terminal equipment monopoly and for a standardized

75 On this subject, see the article by Christian Franke in this volume.
76 Ahrens: Strukturpolitik und Subventionen.

interface between the telephone network and terminal equipment similar to the American model.[77]

Nixdorf's criticism found support within the government, especially in the Ministry of Economics led by the liberal Free Democratic Party. The ministry had also concluded that a modernization of the telecommunications sector could have an enormous growth potential for the demand for data processing technology, from which the West German industry, with its strength in telecommunications technology and decentralized solutions in data processing, might particularly benefit.[78] An early result of this new approach came at the end of 1978, when the Bundespost, after a long conflict with the Ministry of Economics, had to give up its monopoly on terminal equipment when it came to the newly launched telefax service and open up this market to private manufacturers.

These ideas were also the driving force behind the attempt to internationally standardize data processing and especially the transmission of data with the OSI (open systems interconnection) protocols.[79] The central project associated with this in the Federal Republic of Germany was the digitization of the telephone network, known by the abbreviation ISDN. However, the digital telecommunications network, which was intended to combine the stabilization of the telecommunications monopoly on the network level with competition for end devices and services, turned out to be a project that, at best, could only improve the market conditions for small computer manufacturers of West Germany over the long term.[80] As early as the beginning of the 1980s, it was foreseeable that the new network would only be available towards the end of the decade. As other projects, such as the planned new mass medium of videotex,[81] were also delayed at the beginning of the 1980s, instruments had to be found that could take effect more quickly.

When Helmut Kohl, an advocate of a more liberal economic policy, came to power in the autumn of 1982, this did not mean a fundamental change in the state's funding policy.[82] Nevertheless, the new government attempted

77 Bundesministerium für Wirtschaft: Allgemeine technische und volkswirtschaftliche Fragen der EDV- und Elektroindustrie, Vol. 16, Bundesarchiv Koblenz, B102/196033.
78 Bundesministerium für Wirtschaft: Allgemeine technische und volkswirtschaftliche Fragen der EDV- und Elektroindustrie, Vol. 17, Bundesarchiv Koblenz, B102/196034.
79 Russell: OSI.
80 Röhr: Der lange Weg, p. 225–233.
81 Röhr/Schönrich: Weder Rundfunk noch Presse.
82 Ahrens: Strukturpolitik und Subventionen, p. 206–223.

to improve its relationship with the data processing industry and made a symbolic new beginning. In April 1983, at the invitation of the Federal Ministry of Science and Technology, representatives of the West German data processing industry and the ministry came together for a two-day "Seminar on Strategies for the German Data Processing Industry", held at the idyllically situated Winterscheider Mühle near Bonn. The audience was high-ranking; from the industry side came the leading figures of the companies invited, and the newly appointed Minister of Research, Heinz Riesenhuber, also attended the seminar for some time.[83]

At the seminar, in which the Ministry limited itself to the role of moderator, the participants discussed what they saw as the strengths and weaknesses of the West German IT industry. As a strength, the managers primarily identified the fact that the German IT industry offered its customers larger, self-contained solutions and kept its products available for several years, whereas American manufacturers require their customers to fulfil more tasks themselves. However, the weakness of the West German computer industry was their lack of focus on the global market and often the needs of their customers. Their wishes, for example, for "desktop computers" ("*Tischcomputer*"), as microcomputers were labelled there, were regularly not taken seriously. Instead, the manufacturers typically tried to force their way onto the market using their existing and established solutions.

Despite this admission of their weaknesses, the solutions proposed by the industry remained surprisingly conventional. In a memorandum written after the seminar that represented the joint view of the manufacturers, most of their demands were well-known. Once again, they hoped to reduce production costs and increase production volumes through more cooperation, hoping that this would make the production of peripheral devices in West

83 The participants from the industry side at the Winterscheid seminar were: Karl Heinz Beckurts (Siemens), Peter Dietz (Dietz), Georg Färber (PCS GmbH), Hartmut Fetzer (Nixdorf), Hans Gissel (AEG-Telefunken), Gerhard Goos (Universität Karlsruhe), Gunther Groh (Philips Data Systems), Martin Hebel (Triumph-Adler), Eike Jessen (Universität Hamburg), Eberhard Kiefer (CTM), Rolf-Dieter Leister (independent consultant, formerly IBM), Klaus Luft (Nixdorf), Klaus Mentzel (Triumph-Adler), Friedrich A. Meyer (ADV/ORGA), Dr. Klaus Neugebauer (Softlab), Hans Gerd Pärli (mbp Gmbh), Werner Poschenrieder (Siemens), Tom Sommerlatte (Arthur D. Little), Hermann W. Stähler (VDMA), Norbert Szyperski (GMD), Francesco Tatò (Kienzle) and Karl Friedrich Triebold (Krupp Atlas-Elektronik). Memorandum der informationstechnischen Wirtschaft an die Bundesregierung. Situation und Zukunft der Informationstechnik in der Bundesrepublik Deutschland, Band 1, Bundesarchiv Koblenz, B196/73993.

Germany profitable again. Furthermore, the manufacturers demanded that politicians should strengthen their "domestic market", for example, through favouring them by public contracts, which should have a component of structural policy. Additionally, they called for the continuation of direct project funding.[84]

The Research Ministry had been invited to the seminar because the new government was working on a novel concept for its funding policy in the field of data processing, in which the memorandum from industry was to be incorporated. The "Concept of the Federal Government for the Promotion of the Development of Microelectronics, Information and Communication Technologies", which the government presented at the beginning of 1984, was, therefore, strongly influenced by the ideas of industry. The Federal Government promised not only to "improve the basic conditions of the market", but also to reform the public procurement system and the continued provision of subsidies to the industry.[85]

However, even political support and the new subsidy programme, which ran from 1984 to 1988, were unable to improve the situation of West German computer manufacturers fundamentally. The changes that occurred on the global computer markets during the 1980s were too far-reaching.

This was mainly due to the PC, which transformed the data processing business in the 1980s, accelerating the growth of the markets, and was developed into a mass market within a few years. The quantities that manufacturers such as Compaq, Dell and Fujitsu were able to sell worldwide after just a few years were unreachable for the West German manufacturers. The quick technological progress, the intense pressure of competition and the emerging economies of scale resulted in a price war, in which the West German manufacturers with their small quantities and customized variants could not participate.

Nixdorf, the largest manufacturer of small computers in West Germany, responded to this challenge by expanding its product portfolio. Starting in 1980, the Paderborn-based company attempted to re-enter the market for mainframe computers after its joint venture with AEG-Telefunken failed in 1974. The 8890 was an IBM 370-compatible mainframe system from Nixdorf. However, once again, this was not an in-house development;

84 Ibid

85 Bundesregierung: Konzeption der Bundesregierung zur Förderung der Entwicklung der Mikroelektronik, der Informations- und Kommunikationstechniken (April 1984), Bundestagsdrucksache 10/1281.

Nixdorf merely took over the distribution of the computers developed and produced by the Israeli manufacturer Elbit.

The German government especially viewed Nixdorf's risk-averse strategy of only developing a small amount of technology and devices itself and, instead, purchasing them from other manufacturers with a certain degree of scepticism. The company would live "from hand to mouth" in this way. An internal memo from the Federal Ministry of Research and Technology from 1981 states the following:

> "The company [Nixdorf] can only be compared to a limited extent with other DP manufacturers with a greater depth of development, which are also not limited to a narrow section of the DP product spectrum. It has more the character of a trading company than conventional computer manufacturer (IBM, UNIVAC, Siemens, etc.)."[86]

Despite this scepticism by the Ministry of Research, Nixdorf, at least in the first half of the 1980s, appeared to be a successful company that even took the bold step of going public in 1984.

By contrast, the other remaining West German manufacturers of small computers had been facing a permanent crisis since the late 1970s and were looking unsuccessfully for new niches. Triumph-Adler, for example, was trying to capitalize on its strength in the global market for typewriters and became increasingly active in the field of text computers.

This new class of devices, which emerged in the mid-1970s, essentially combined a screen-based small computer with storage options, often in the form of floppy discs, and a printer or electric typewriter. This made it easier to write and particularly edit texts at a later date; it also allowed additional functions, such as serial letters. Although it may seem, in retrospect, that dedicated text computers suffered badly from competition from PCs in the 1980s, these devices were still successful in the field of professional word processing. This was because word processing with microcomputers was complicated at the beginning. The programmes lacked functions that were necessary for commercial users. Secondly, there were only a few high-quality printers for microcomputers in the 1980s, and they were also costly.

86 "Die Firma [Nixdorf] ist mit anderen DV-Herstellern mit größerer Entwicklungstiefe, die sich außerdem nicht auf einen schmalen Ausschnitt des DV-Produktspektrums beschränken, nur bedingt vergleichbar. Sie hat in stärkerem Maße den Charakter eines Handelshauses als herkömmliche DV-Hersteller (IBM, UNIVAC, Siemens usw.)." Bundesministerium für Forschung und Technologie. Besuch M bei der Nixdorf Computer AG [1981], Bundesarchiv Koblenz, B196/74118.

However, the West German market for text systems was also characterized by a highly competitive pressure, because Philipps (P5020), Nixdorf (8840) and the American Wang Group also sold corresponding devices in addition to Triumph-Adler.

However, Triumph-Adler was able to achieve a notable success because, unlike the other manufacturers, it also focused on microcomputers at an early stage. Starting in 1980, the Nuremberg-based company marketed microcomputers under the name "alphatronic", attempting to build on its earlier successes with the TA-10, the "people's computer". This step was also facilitated by a change in ownership. In 1979, the American conglomerate Litton had sold its subsidiary to the German Volkswagen group, which was, considering the slow growth of the automobile market, looking for new, promising business areas. Consequently, Volkswagen had initially negotiated its entry into Nixdorf. However, at the end of 1978, when this failed,[87] Volkswagen purchased Triumph-Adler instead.

During the 1970s, under the previous owner Litton, Triumph-Adler had to transfer most of its profits to the parent company (Litton) and, therefore, had only been able to invest a little, so that Volkswagen had to provide considerable resources to modernize the company. According to press reports, Volkswagen had invested at least DM 2 billion into the Nuremberg-based company up to 1986. However, even these modernization efforts and the reduction of jobs were unable to return the company to profitability. As a result, in the spring of 1986, the car manufacturer sold Triumph-Adler to the Italian computer and typewriter manufacturer Olivetti.[88]

Kienzle has also experienced some challenging times since the end of the 1970s. This was partly since the company had started the development of modern systems late and, furthermore, the process was delayed. After the presentation of the new, dialogue-oriented "ABC computer" (System 9055) at the beginning of 1980 failed to generate the orders hoped for, Kienzle was forced to look for a strong financial partner. The family business found this in Mannesmann, a former steel group that was now a conglomerate, which initially acquired a majority stake in 1981 and, in the following year, the entire company. Under the management and with the capital of Mannesmann,

87 Berg: Nixdorf, p. 139–147.

88 TA-Büromaschinen bald unter Olivetti-Flagge, in: Computerwoche from 25 April 1986; "Die Realität ist schockierend". SPIEGEL-Interview mit Triumph-Adler-Chef Francesco Tatò über die Sanierungspläne von Olivetti, in: SPIEGEL 15 (1987), p. 93–39.

as well as the managing director Francesco Tatò, who had come from Olivetti and later also took over the management of Triumph-Adler, more than 1,000 jobs were cut, and the group returned to profitability. From 1985, the company finally traded under the name Mannesmann Kienzle.[89]

Diehl, which until then had also developed its own computer systems alongside its subsidiary CTM, sold its unsuccessful text computer division to Triumph-Adler in 1979. At CTM itself, the founders Otto and Ilse Müller were forced to leave the management at the end of 1980. In 1984, Diehl finally sold CTM to the telecommunications equipment supplier SEL.[90]

In the second half of the 1980s, the sector finally realized that the West German manufacturers were unable to survive on their own. This even affected Nixdorf, which experienced a fundamental crisis in the years following the death of its founder Heinz Nixdorf, who unexpectedly passed away in spring 1986 at the first independent data processing trade fair, Cebit. Although business was already weakening, the new head of Nixdorf, Klaus Luft, stuck to the expansion course and recruited sales staff in large numbers.[91] After it became apparent that the company would make a loss of DM 1 billion in 1989, the banks pushed for a takeover by Siemens. At the beginning of 1990, Siemens took over the majority of Nixdorf and merged the company with its data division, which was also in crisis, to form the new company "Siemens Nixdorf Informationssysteme".[92]

Thus, there was now the "national champion" in which 15 years earlier, after the failure of a European computer alliance with Unidata, the BMFT already saw the best option for the German data processing industry. However, under the new market conditions, even the "national champion" Siemens Nixdorf Informationssysteme was unable to survive in the long term. Despite massive personnel cuts and successes in the PC business, from the mid-1990s onwards, the Siemens Executive Board no longer believed in the success of its computer division over the long term. After talks with Acer about the sale of the PC division failed in 1998, Siemens entered a joint venture with the Japanese manufacturer Fujitsu. Therefore, from 1999, Siemens Nixdorf Informationssysteme sold their computers under the name Fujitsu Siemens Computers GmbH together with Fujitsu, which also made them the market leader in Europe for a short time. Nevertheless,

89 Müller: Mittlere Datentechnik.
90 Müller: Glanz, p. 223–255.
91 Nixdorf: Ohne Partner chancenlos, in: Spiegel 52 (1989), p. 84–87.
92 Berg: Nixdorf, p. 166–185.

Siemens withdrew from the joint venture in 2009, thus, ending the manufacture of computers altogether. However, it is thanks to the European Union Commission that the name Nixdorf continues to exist today, at least as part of a name. In 1999, as a condition for the joint venture with Fujitsu, the Commission demanded that Siemens Nixdorf outsource its ATM division. This initially traded under the name "Wincor-Nixdorf", and, since the takeover of Diebold in 2016, finally as "Diebold-Nixdorf".

Next to Siemens, the American company DEC tried to secure the remnants of what had once made up the corporate core of medium data technology in West Germany. DEC, which in the 1960s had established minicomputers as an independent device class, had, since then, risen to become the number two on the global computer market after IBM. In the 1980s, their VAX computers were widely used primarily in the field of scientific and technical computing and were popular at universities.[93] At the end of the 1980s, DEC also wanted to expand its market position in business with other companies and, therefore, took over Mannesmann-Kienzle in 1990.[94] Shortly afterwards, it also acquired the computer division of Philips, but without its PC segment.[95] In 1992, DEC also acquired a strategic stake in Olivetti, which had meanwhile acquired Triumph-Adler, and signed a cooperation agreement with the Italian company.

However, just like IBM, DEC found itself in an existential crisis in the 1990s and had to report losses of billions. Most of the European subsidiaries and production facilities were ultimately liquidated in the attempt to reorganize the company.[96] Finally, in 1998, the American PC manufacturer Compaq took over the remains of the company.

6. Conclusion

The history of medium data technology and the companies associated with it began with a seized opportunity. In the early 1960s, companies in the area of office machines, including Kienzle, Nixdorf and Siemag, realized the

93 Goodwin: Digital Equipment Corporation.
94 Müller: Mittlere Datentechnik, p. 104–106.
95 Digital startet Offensive – Marktführerschaft in Europa im Visier. Kienzle und Philips sollen jetzt für DEC den Mittelstand erobern, in: Computerwoche from 22 November 1991.
96 For the final demise of Kienzle as a DEC subsidiary, see Müller: Mittlere Datentechnik, p. 104–406.

potential of electronics for their industry. Using electronics to add logical functions to their accounting machines, they invented a new class of office machine. In doing so, these companies followed the development paths of the office machine industry, dating back to the late 19th century, and were initially not orientated towards the still young phenomenon of electronic computers. This evolution of the classic office machines met a growing demand from numerous small and medium-sized companies for a faster and more information-rich bookkeeping system, a demand that was boosted by new government requirements. The new devices were affordable, whereas electronic computers were still too expensive for these companies. With their devices, the manufacturers were, thus, able to position themselves in the "middle" or in the gap between mainframes and calculating machines in terms of price and performance.

In the second half of the 1960s, once the success of this new class of devices became apparent, other companies began to participate in this growing market. Among them were established manufacturers of office machines, such as Triumph-Adler, start-ups, such as CTM, and companies from entirely different sectors, such as the musical instrument manufacturer Hohner. The boom of medium data technology continued until the mid-1970s.

The further history of medium data technology can be characterized by the fact that the companies involved did not take advantage of the opportunities that arose from their successful start. What proved to be particularly fatal was that the capital and growth generated by the manufacturers in the heyday of medium data technology was not used to build up adequate development capacities. When international computer manufacturers, such as IBM and DEC, discovered the market of office computers for themselves, it became increasingly difficult for West German manufacturers to keep up with the technological competition. Most of the latter manufacturers remained too small and quickly became technologically dependent on American microelectronics and lost out economically.

This was partly because the pace of innovation within the computer industry was much faster than in the office machine sector. Until then, calculators and accounting machines had been sold almost unchanged for years or sometimes even decades. Thus, the industry's entrepreneurial focus had traditionally been on sales and production, not development. By contrast, the much younger computer industry was characterized by a continuous and often disruptive innovation process. In the early stages of microelectronics, around the early 1970s, for example, companies came

into the market in rapid sequence, offering new products that were often cheaper than their predecessors.

By comparison, development tasks in the office machine industry were often outsourced or existing solutions were purchased. This is illustrated by the example of Triumph-Adler, who contracted Otto Müller as an external developer for the development of their TA-1000 magnetic card computer. Instead of using this project to build up expertise within his own company, Müller founded a competing company of his own immediately afterwards. Even the successes of the market leader Nixdorf were largely based on this structure. In the 1950s and 1960s, Nixdorf's "Labor für Impulstechnik" was able to grow as an external development office. After the purchase of Wanderer, Nixdorf itself relied on a strong sales organization and products developed externally.

The lack of development depth and the growing dependence of West German manufacturers on American technology was regularly criticized by the Federal Ministry of Research and Technology. It was the declared goal of the West German government to establish a sustainable, independent computer industry, to which end development projects were subsidized. Therefore, West German manufacturers of small computers only benefited to a limited extent from the federal government's subsidies.

Due to the fragmented market structure and the limited depth of development, the German government had doubts about the long-term success of the smaller companies. After the failure of Unidata in the mid-1970s, it aimed to consolidate the market. However, it was not until 1990, under entirely different market conditions, that the formulated goal of that time, namely, a merger of Siemens and Nixdorf to form a West German "national champion", was realized.

As a result of increasing competition, most manufacturers found themselves in a permanent crisis from the second half of the 1970s onwards. Whereas Anker and Hohner had already given up by this time, other companies, such as Kienzle or Triumph-Adler, were able to survive until the end of the 1980s, both supported by money from outside the industry.

The spread of the PC in the 1980s led to a fundamental change in what had once been the core business of medium data technology: providing small and medium-sized companies with computers. These companies were too small to participate successfully in the new mass market for PCs, resulting in this market being dominated by American and East Asian companies. However, the transformation of the business of office computers by the PC represents a yet another missed opportunity for the manufactur-

ers of medium data technology. The separation of hardware and software associated with the PC offered them the chance to leave the hardware production behind and reinvent themselves as software-based service companies. Instead, the surviving medium-sized data technology companies finally became victims of the general crisis of the data processing market at the beginning of the 1990s.

In summary, the history of medium data technology can be told in two ways: a short version and a long version. As a short version, it was the only briefly successful attempt by some West German office machine manufacturers to participate in the computer market and lasted from around the mid-1960s until the 1980s. In its longer version, however, it can also be included in the more than 100-year history of office machines and the mechanization of the office. In this perspective, medium data technology, as described in this article, represents the evolution of office machines into computers, even before the computer itself, in the form of the PC, became a universal office machine.

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A new approach to a European information technology policy: the European strategic programme for research and development in information technology (Esprit)

Christian Franke

1. Introduction

> "There is simply no alternative to cooperation between previous rivals and between industry itself and the academic world."

The London Times commented with these words on 19 December 1983 on the renewed postponement of a decision by the Council of the European Community (EC) to finally adopt the EC Commission's (hereafter: Commission) newly conceived strategy in the field of information technology (IT) policy: the Esprit programme. The commentary referred to the failure of Unidata in 1975, which showed once again how unsuited cross-border joint ventures in the European IT sector were to successfully counter competition from the USA and Japan, which dominated global IT markets. The governments of France, Germany and the UK attempted to do this with national funding programs, which were primarily intended to stimulate research and development.[1] However, their focus was on the national industry (the national champions) for larger computer systems, whose technological backlog – in contrast to the smaller office computers – was becoming increasingly obvious.

The EC, which endeavoured to play an independent role in industrial policy in the second half of the 1970s, also attempted to provide impetus. These efforts culminated in new policy approaches in the 1980s. The IT policy played a pioneering role in this, with Esprit being the first major funding programme for research and development. Although Esprit was rather modest in comparison to the financial volume of the IT funding programmes in the large member states, it should prove to be a blueprint for the future funding of research and development in the EC. It achieved a long-term significance that no national funding programme could match.

1 See Röhr in this volume.

Although Esprit, similar to all national programmes, failed to achieve its actual objectives, it, nevertheless, had a lasting impact on EC research and development funding.

The new approach to European IT policy, which took concrete form with Esprit in 1984, will be analysed in this article. The following questions are raised: What did the Commission's new strategy look like after the failure of Unidata in 1975? What role has industry played in the remodelling of IT policy? How should European IT policy and funding be integrated into existing national programmes? How has the Esprit programme developed in the first few years? The following questions need to be asked regarding the manufacturers of smaller office computers: What was the significance of the European funding programmes and collaborations for small office computers? What role did they play in the conception of Esprit?

The article closes a research gap by answering these questions. Esprit has already been dealt with in a number of works, but mostly from a very specific perspective. Studies on the development of EC industrial policy or early IT policy[2] tend to mention Esprit in a rather generalized way. This also applies to works on the history of the Commission from the perspective of its actors.[3] Overviews of the history of technology touch on the topic,[4] but they neglect the interdependence of technological development with the institutional development of the EC. The fact that Esprit is also about the EC deepening its interest in the area of industrial policy and, thus, about competences and responsibilities is usually ignored. Contemporary works that deal with Esprit[5] offer important insights, but there is a lack of non-public ministerial decision-making processes within the member states. The joint ventures of European IT companies in the 1960s and 1970s have been researched in much greater detail,[6] although these projects, such as Unidata, were only partly initiated by the EC.[7] Archive-based studies that examine the origins of the Esprit programme and place it in the history of data technology 'made in Europe' are a desideratum.

In terms of content, a number of limitations need to be made. Firstly, the article will have to be about the entire European IT policy. It is neither

2 Van Laer: Liberalization or Europeanization.
3 Van Laer: Forschung.
4 Fickers/Griset: Communicating Europe.
5 Sandholtz: High Tech Europe.
6 Henrich-Franke, Innovationsmotor Medientechnik.
7 Hilger: Von der Amerikanisierung; Kranakis: Politics, Business; Van Laer: Developing an EC Computer Policy.

possible nor appropriate to focus solely on the policy for smaller office computers. On the contrary, many manufacturers of small and medium-sized data processing systems, who have played a decisive role in shaping the European path of data technology, could only be reached with difficulty by a policy of support for research and development at national and international level. This was also due to the fact that the new approach of European IT policy focused strongly on the production and development of microelectronics. Secondly, it should be borne in mind that the EC's IT policy cannot really be considered in isolation from other policy areas, such as industry or telecommunications. On the one hand, the IT sector was seen as a key technology for the industrial development of the 21st century. On the other hand, computers and telecommunications slowly merged during this period. As a result, there were repeated conflicts between the telecom and IT industries over the scope of end device monopolies.[8] Despite the interdependencies between IT and telecommunications, which increased in the course of the expansion of digital data networks, telecommunications can only be mentioned here indirectly. Thirdly, the debates on the EC's IT policy and Esprit should not be seen in isolation from the Commission's two endeavours to strengthen the competitiveness of European industry and improve its own position in the EC's institutional structure.

In terms of time, the years between the failure of Unidata in 1975 and the adoption of the second phase of the Esprit programme in 1988 will be considered. This period is appropriate for several reasons: Firstly, it is a period in which Europe was characterized by a profound crisis of economic structural upheaval, in which old industries were dying off, especially in the coal and steel industry, and fundamentally new growth engines and growth conditions had to be found.[9] European companies and governments were confronted with tough competition on the global markets for future technologies, in which they were increasingly falling behind their competitors from the USA and Japan.[10] Secondly, this is the period in which even the European producers of smaller office computers and their markets collapsed after initially good sales figures. Within a few years, the entire development of this industry had collapsed.

8 Henrich-Franke: EC Competition Law.
9 Warlouzet: Governing Europe.
10 Hilger: The European Enterprise.

This article is primarily based on an analysis of the records of the Federal Archives in Koblenz and the relevant literature. It, therefore, focuses on decision-making processes and negotiation strategies within Germany and the companies based there.

2. Unidata: A turning point in the EC's IT policy

The break-up of the large-scale joint venture 'Unidata' marked a turning point in the attempts to make the European IT industry competitive with American producers. Unidata was a failed attempt at cross-border cooperation aimed at bringing together the entire range of European IT equipment under one roof in order to face competition on global markets with a complete product offering. However, the companies only participated superficially and just agreed on common operational business objectives in individual segments. There was no consistent pooling of resources, particularly in research and development.[11] Of course, this did not mean that cross-border cooperation in Europe was doomed to failure. There was successful cooperation between companies or even amicable takeovers. Philips, a major Dutch corporation, produced smaller office computers in Germany after taking over Siemag.[12] In some segments, the Dutch conglomerate even left its research and development centres in Germany, for example, in Hamburg or Siegen.

The basic problem of cooperation was the national interest of governments or corporate egoisms, which often stood in the way of European projects. In addition, the governments of the larger EC member states launched their own programmes to promote research and development. As these programmes were also intended to strengthen national companies in intra-European competition, they stood in the way of cooperation within the EC.[13]

11 Kranakis: Politics, Business; Hilger: Von der Amerikanisierung.
12 Henrich-Franke: Innovationsmotor Medientechnik.
13 Warlouzet: Governing Europe, p. 121ff.

3. A new approach to a common IT policy

a) Considering a new approach: the Commission's IT task force

Parallel to Unidata, the Commission proposed a new strategy in IT policy, which was adopted by the Council of the EC (hereafter: Council) in a resolution on 15 July 1974. The latter set the goal of establishing an independent European data processing industry by 1980, *inter alia*, by co-ordinating national measures. However, the Commission's first programmatic initiatives, including the proposal to initiate a community programme to promote research and development in the IT industry, were rejected by the Council in 1976. The member states had their own support programmes with which they wanted to support their national industries in the face of tough international competition – including with European competitors. A European programme with common goals ran counter to this.[14] For the time being, the Council only approved smaller project studies on IT applications in the areas of legal documentation or medicine (in July 1976) or smaller research projects on the use of IT in administration, for example, at the Commission itself (in September 1977).[15]

The second half of the 1970s was also a time when industrial policy issues were discussed that "jeopardized European industries [...] in order to facilitate positive structural change".[16] Of course, this implied the conviction that a formative structural policy was the prerequisite for an effective competition policy. During this period, which was also controversial in terms of regulatory policy, few in the EC questioned competition policy as the centrepiece of industrial policy. Nevertheless, many contemporaries – such as *The Times* – emphasized that there were sectors in which an active European structural policy would be beneficial, as "science-based industries" could not develop in Europe *because* "national markets are too small".[17] To make matters worse, the old industries were still too important due to their high number of employees to simply let them die. The Commission was extremely cautious in this respect in 1977/78. It found it

14 Sandholtz: High Tech Europe.
15 Preparatory notes for the meeting between the ministers and Davignon on 15 May 1979, Bundesarchiv Koblenz, B102/197906.
16 Statement of the 'European Centre of Public Enterprises' on the implementation of a European industrial policy, 9 January 1978, Bundesarchiv Koblenz, B102/197905.
17 *The Times*, 28 January 1978, Bundesarchiv Koblenz, B102/197905.

difficult to designate individual industrial sectors as sectors of the future and, thus, deny others eligibility for support. The EC's industrial policy was also in a transitional phase in which the outcome of the economic crisis was completely unclear.[18] Increasing global competitiveness in the areas of data processing, telecommunications, the aircraft industry or energy and combating high unemployment in the conurbations of the old industries were two sides of the same coin. However, as the Commission had no competence for social policy (and only a marginal one for structural policy), it placed its political focus on generating growth and discussing future growth sectors. In line with its basic liberal orientation, the Commission saw its main task as creating growth-promoting conditions, while the main responsibility should remain with the companies, which would ultimately reap the profits and create jobs. The Commission also, simultaneously, warned that "structural policy should not be overestimated".[19]

The Commission focused from the outset on the IT sector, which it regarded as one of the most important future technologies. A first 'Multiannual programme in the field of data processing (1979–1983)', conceived by the Commission as a larger funding programme, was reduced by the Council to less than a quarter of its originally proposed volume and a few contents (standardization, public procurement, funding measures for software). The governments, especially in Germany, the United Kingdom and France, preferred their national funding programmes. The federal government in Germany, for example, completely reorganized its funding programmes after the expiry of the 3rd data processing programme and only gave the EC a supplementary role.[20] However, this was not just about favouring national companies but also about questions of power and competence. The national ministries viewed the EC's intervention in their previous area of responsibility with considerable scepticism and rejection.[21] Industry, instead, which had certainly recognized that the national framework was too small to survive in international competition, complained that it had been neither sufficiently involved in the design of the funding programmes

18 Döring-Manteuffel/Raphael: Nach dem Boom; Raphael: Jenseits von Kohle und Stahl.

19 Note from the Federal Ministry of the Interior dated 16 June 1978, Bundesarchiv Koblenz, B102/197906.

20 Internal report of the German Ministry of Economic Affairs on the EC industrial policy, 16 June 1978, Bundesarchiv Koblenz, B102/197906.

21 Interministerial correspondence in the run-up to Davignon's visit to Bonn, 15 May 1979, B102/197906.

nor able to influence the positions of the national governments on the proposed EC funding programmes.

A significant turning point for the EC's IT policy was the appointment of Étienne Davignon as EC Commissioner for 'internal market, the customs union and industrial affairs' in 1977. Davignon took up the issue of the European IT sector with great commitment, as he saw it as a key driver of future European economic development.[22] As early as 1978, the Commission set up a working group 'Forecasting and Assessment in the field of Science and Technology' (FAST).[23] The aim of the experimental project was to identify ways of improving cooperation within the IT industry in Europe and sound out the long-term direction of joint research and development projects. The target was, as Roland Hüber, the main person responsible for IT in the FAST Group, put it: "to create the conditions for European collaboration in the long lead".[24] The Commission's new approach in the field of data processing was embedded in comprehensive efforts by the EC to examine the long-term strategic challenges for European industry in other areas, such as biotechnology. The fact that the European IT industry was structurally lagging behind in research and development, which threatened to have negative consequences for its long-term competitiveness, prompted the FAST Group to focus on research and development.

In 1980, the Commission initiated the 'Joint European Planning Exercise in Information Technology', which can be interpreted as a preliminary stage of Esprit. It became increasingly obvious in the discussions there that the European states alone were unable to invest enough in research and development compared to the large budgets of the funding programmes in the USA and Japan. Europeans were operating too many parallel funding instruments in order to close the technological gap and restore competitiveness. An important turning point in that context was the announcement of the Japanese Fifth Generation Computer project. Even the German government, which was sceptical about the EC's efforts, recognized the importance of the FAST Group for the development of a common IT policy a few years later, because "the very existence of FAST has triggered and

22 Interview with Étienne Davignon by Arthe van Laer, 14 September 2010. (retrieved from: https://archives.eui.eu/en/oral_history/INT133, 14 December 2023)
23 FAST, Die Zukunft Europas, p. 6–68.
24 FAST, Die Zukunft Europas, p. 8.

accelerated certain activities in the Commission's services, e.g. in the field of information technologies".[25]

Parallel to FAST, Commissioner Davignon set up an 'Information Technology Task Force', which proposed a co-ordinated IT strategy for the EC, member state governments and industry, the so-called 'telematics strategy', in September 1979. According to this strategy, the governments had to be convinced that joint funding of research and development would generate concrete added value, after they had previously preferred to distribute funding to their national industry instead of initiating a joint project. This was by no means easy, as the resistance of national governments to an EC funding policy was strong. In Germany, for example, in the run-up to a visit by EC Commissioner Davignon in May 1979, the Ministries of Economics and Research agreed that "the Commission should not be encouraged to draw up funding programmes in the field of data processing".[26] The Commission saw a key to convincing the governments in a clear vote by the industry for a European programme from which it expected real added value and for which it was also prepared to contribute its own funds. It was, therefore, necessary to work together with industry to localize content that appeared so relevant that companies would be prepared to contribute funds themselves, instead of primarily hoping to receive additional funding.[27]

The strategy, therefore, aimed to get industry interested in an EC funding policy in order to win over governments in favour of a common IT policy in the area of research and development. In doing so, the Commission was guided by the long-term programmes for research and development of the governments in the USA and Japan, both of which were leaders on the world markets for IT. Ultimately, however, it was also about 'competition', which was the EC's guiding regulatory ideal. The aim was to promote competition internally, i.e. on the European markets, and, at the same time, to strengthen external competitiveness. In line with liberal ideas of order, the primary responsibility had to lie with the companies.[28] The Commission did not make any strategic considerations regarding the merger of

25 Assessment of the FAST programme by the German government, June 1983, Bundesarchiv Koblenz, B136/23986.

26 Internal correspondence; Bundesarchiv Koblenz, B102/197906.

27 Interview with Étienne Davignon by Arthe van Laer, 14 September 2010. (retrieved from: https://archives.eui.eu/en/oral_history/INT133, 14 December 2023)

28 Report on a meeting between EC Commissioner Davignon and the German Minister for Economic Affairs Lambsdorff, 15 May 1979, Bundesarchiv Koblenz, B102/197906.

companies, in contrast to what the German government intended (and had tried to achieve with its support programmes).

The Commission (Davignon) initiated a 'round table' with representatives of European industry to further advance the European 'telematics strategy'. It launched the round table with representatives from twelve member state companies (France: Bull, CGE, Thomson; Germany: AEG, Siemens, Nixdorf; Great Britain: GEC, ICL, Plessey; Italy: Olivetti, STET; and the Netherlands: Philips) in summer 1981. The Commission primarily drew on the expertise of producers of large computers and traditional producers in the telecommunications sector (e.g. Siemens, Philips, IBM). It hoped that such an approach would have a multiplier effect.[29] Although there were also producers of smaller office computers, such as Nixdorf or Philips, their focus was not on this product segment. Companies supported Davignon's initiative from the beginning because they assumed that "unless together we can carry out a sufficiently large industrial program, the greater part, if not the whole of the existing IT industry could disappear within a few years".[30] The company representatives not only took the topics discussed back to their companies in order to harmonize them with existing corporate strategies, but also acted as a link to national governments. The roundtable was complemented by larger workshops at the Commission in Brussels, where contact was made with universities and research organizations. Small and medium-sized enterprises, which were particularly important in the field of medium-sized data technology and office computers, were only involved in the consultations after a considerable delay, i.e. actually only in the course of 1982, when the Esprit programme was actually already a done deal. Davignon further upgraded the 'Information Technology and Telecommunication Task Force' in 1983 and gave it the temporary status of 'department'.[31] Involving the industry from the very beginning of Esprit was a fundamental difference compared with all other initiatives created by the Commission previously.[32]

In view of the ever-worsening competitive situation of European industry, the realization prevailed that cross-border cooperation was the only remaining alternative to maintain Europe as an innovation and production location with its own computer industry in the long term. Earlier rivalries

29 Sandholtz: High Tech Europe.
30 Letter to Davignon quoted in Guzetti: A Brief History, p. 77.
31 Koutrakou: Technological Collaboration, p. 30.
32 Guzetti: A Brief History, p. 76.

between companies and universities/research institutions had to be overcome.[33]

Regarding the IT sector, microelectronics (to the detriment of the data processing industry) played a pioneering role for the entire industrial policy of the EC. More than any other, it was seen as a 'leading sector' that would also have an impact on other branches of industry, because IT would both fundamentally change production and penetrate deeply into other areas of society. Remarkably, the Commission's General Report on the activities of the Community in 1982 spoke for the first time of 'new technologies'.[34] In this context, it was not insignificant that the Commission had been called upon by its Council in May 1980 to reform the EC budget, which was to mean, above all, a reduction in the high expenditure on the agricultural sector. From this, the Commission derived the right to launch new ideas, including the conception of a subsidy policy to improve the European economic structure.[35]

The discussions about a European IT policy, especially concerning funding, always took place against the backdrop of greatly accelerated technological change, in which European companies lost out to the competition from the USA and Japan in terms of innovative strength.[36] At the same time, the development of decentralized data processing (instead of mainframes and centralized processing, such as with Datel), the increases in performance in the computer industry and the synergies from developments in the telecommunications sector, including data transmission via digitalized data networks, have completely changed the industry. This also meant that existing structures, such as national telecommunications monopolies, including in the areas of terminal equipment and data transmission, were fundamentally questioned. The demands for the liberalization of terminal equipment markets and the privatization of telecommunications monopolies also opened up scope for the computer industry to exert influence on political decision-makers, particularly on the issue of decentralized data processing.

The market for computers and data processing technologies must be differentiated and considered as part of the large microelectronics sector,

33 Interview with Étienne Davignon by Arthe van Laer, 14 September 2010. (retrieved from: https://archives.eui.eu/en/oral_history/INT133, 14 December 2023)
34 Annual report of the EC Commission on the activities of the EC, 1982.
35 Van Laer: Forschung, p. 287ff.
36 Sandholtz: High Tech Europe.

in which the backwardness of European manufacturers in the field of microchips was perceived as particularly threatening.[37] Although these were rather low-priced products that did not represent a significant financial factor in the economic calculations of European device manufacturers, they were, nevertheless, decisive for the future development of the computer industry. While European manufacturers increasingly lost ground, particularly in the area of larger computer systems, manufacturers of smaller and medium-sized devices continued to be successful (despite all the demarcation problems caused by the increasingly flexible use of peripheral devices) and were able to report positive business figures. It is precisely in these application areas that European manufacturers do not seem to be generally lagging behind.

b) Esprit I

The years 1980 to 1982 can be regarded as key years for the introduction of an EC IT policy, the core element of which was to be the promotion of research and development within the framework of Esprit. The Commission and the European Parliament worked intensively on joint programmes. The Commission presented a community strategy for industrial innovation on 20 October 1981, which was followed on 1 January 1982 by a regulation on joint actions in the field of microelectronics. In May 1982, the Commission finally launched its official proposal for the Esprit programme and, only a few months later, in August 1982, outlined its idea of what a pilot phase of the programme could look like.[38] During this phase, the Commission also discussed the programme with small and medium-sized enterprises from the IT sector, which resulted in the Commission proposing that they, as well as universities and research institutes, could apply for 70 % of the project funds in exceptional cases. The Commission, thus, attempted to compensate for their limited financial resources by reducing the contribution required by these developers to 30 %. It was also significant that the European Parliament, which, after all, had to approve the EC budget,

37 European Commission, Proposal for a European Scientific and Technical Strategy Framework Program 1984–1987, COM(82)865.

38 Internal report of the German government on the European research policy (political analysis), 28 December 1982, Bundesarchiv Koblenz, B136/23986.

presented a resolution on the market situation in the electronics sector on 18 June 1982, which emphatically supported the Commission in its plans.[39]

In November 1982, the fundamental decision was made in favour of Esprit as the Community's first substantial technology programme to promote the competitiveness of industry in the EC. The experimental character of the programme was emphasized, which was also reflected in a rather broad-based funding concept consisting of five core areas, which had been developed in close cooperation with industry:[40]

- Microelectronics
- Software technologies
- Advanced data processing
- Office systems
- Factory automation

A first step should be taken towards a long-term strategy to maintain an adequate market share in the field of microelectronics and information technologies. The aim was to avoid dependence on imports of basic technology.[41] However, the funding was not allowed to influence competition within the EC, so that only research and development in a 'precompetitive' phase could be funded. It was mainly about basic research, which is why there were only limited opportunities for small and medium-sized companies to participate. They purchased these components, especially microelectronics, rather than producing them themselves. Collaboration within the research projects funded should be characterized by three principles: resource sharing, risk sharing and result sharing. The Commission sought to put cross-border cooperation within the EC on a new basis to pool European resources better than the joint ventures of the 1970s.[42]

Once the basic decision in favour of the Esprit programme had been made, the lines of conflict from the Commission's earlier efforts to establish an EC IT policy resurfaced when it came to the overall financial volume of the programme, ensuring the participation of national representatives in

39 Report by the German government on the Esprit programme, January 1990, Bundesarchiv Koblenz, B196/151525.

40 ESPRIT in der Haushaltssackgasse, Vereinigte Wirtschaftsdienste, 14 December 1983, Bundesarchiv Koblenz, B102/301516.

41 Internal report of the German government on the European research policy (political analysis), 28 December 1982, Bundesarchiv Koblenz, B136/23986.

42 Report by the German government on the Esprit programme, January 1990, Bundesarchiv Koblenz, B196/151525.

decision-making on larger projects and the final decision-making power in the event of conflicts, especially after the Commission had presented its ideas on the details for the first phase of the Esprit programme in June 1983.[43]

These conflicts broke out again mainly because Esprit had a pioneering role, and the content and administrative design of the programme could quickly become a blueprint for the EC's entire future industrial policy research and development funding. For this reason, the German Ministry of Economics also urged that national governments in the Council or Esprit's intended board of directors should approve with a positive qualified majority for all larger projects with a volume of over 5 million ECU. According to the Ministry of Economics, which had massive influence on the German negotiations, the financial volume should also be limited to 400 million ECU instead of the 750 million preferred by the Commission. The larger EC member states particularly did not want to provide the Commission with too many powers and resources in order to protect themselves from any undesirable long-term consequences of industrial policy. The German Ministry of Economics even warned the Minister of Research, Riesenhuber, of "effects on other policy areas that should not be underestimated".[44] It continued to prioritize national programmes in the IT sector because it was convinced that the federal government's own three funding programmes that had been launched in the 1970s had been successful. The Ministry of Economics assumed, with extreme confidence, that poor business decisions were responsible for the ongoing backwardness of the German computer industry, for which the state could not compensate.[45] With its stance, the Ministry of Economics also divided the new German government led by the Christian-Democratic chancellor Helmut Kohl, as the Foreign Office (for diplomatic reasons) and the Research Ministry underlined the need for 'joint action' by the EC.[46]

Research Minister Riesenhuber took a significant step towards the realization of Esprit when he opposed the vote of the Ministry of Economics

43 Report on the Council of Research Ministers, 5 November 1983, Bundesarchiv Koblenz, B102/301516.

44 Letter from Department E in the Federal Ministry of Economics to Research Minister Riesenhuber, 19 December 1983, Bundesarchiv Koblenz, B102/301517.

45 Ahrens: Strukturpolitik und Subventionen.

46 Protest note by the Ministry of Economic Affairs' Secretary of State, Schlecht, to the Research Ministry's Secretary of State, Haunschild, 16 December 1983, Bundesarchiv Koblenz, B102/301517.

and its national industrial policy focus at the meeting of the EC Council of Research Ministers on 13 December 1983.[47] This gave the Commission the final right to decide on the approval of larger project applications in the Esprit programme, which strengthened the European character of the programme enormously. However, the Council was unable to adopt the Esprit programme at its meeting in December 1983 because it failed to decouple the agreement on Esprit's financial volume from the general agreement on the restructuring of the EC budget. Neither the British nor the German government wanted to agree to a pioneering project such as Esprit as long as the basic budget architecture of the EC had not been finally negotiated. Since the British government vehemently refused to co-finance the constantly increasing agricultural subsidies and, therefore, demanded a reduction in its own contribution to the EC, no final decision could be made about the financial volume of Esprit and its launch.[48] The German newspaper *Die Welt* even had a headline: "Europe is in danger of becoming a 'microelectronic colony'".[49]

The pressure to act was so great in the winter of 1983/84 that all controversial points were finally clarified in February 1984 and the Esprit programme was approved by the Council. The EC Commissioner Davignon had previously warned, once again, that the industry would have to look for non-European partners if no decision was made for intra-European cooperation. The European Parliament even called for a much more extensive redistribution from national to European funding programmes in the "sense of land consolidation".[50]

The Council finally approved the financing of Esprit in February 1984, with 750 million ECU coming from EC funds, while the same amount had to come from industry. A total of 441 project consortia ultimately applied to the official call for proposals in March 1984, of which 90 were selected. Esprit's financial volume overall was comparatively small. The German IT industry in 1986, for example, spent around 12.5 billion DM on research and development, funding from the federal government was 3.5 billion DM and funding from Esprit funds (in the Federal Republic) was 0.35 billion

47 Letter from the Department for European Affairs at the Ministry of Economic Affairs to the Research Minister, Riesenhuber, 19 December 1983, Bundesarchiv Koblenz, B102/301517.

48 Brunn: Europäische Einigung.

49 *Die Welt*, 19 December 1983, p. 7.

50 Resolution of the European Parliament on the problems and prospects of a European research policy, Bundesarchiv Koblenz, B136/23986.

DM.[51] In the mid-1980s, it was national governments and companies who decided on the main content of research and development in the IT sector, while Esprit was more of an additional element. The Commission had to present a work programme annually, drafted in collaboration with a management committee made up of two representatives from each Member State, a consultative committee, composed of experts in the sector and the Executive Committee created by the twelve companies from the roundtable.

The successful initiation of the Esprit programme should, nevertheless, give the EC an enormous boost in the research and development policy in the technology sector.[52] Under the slogan 'Towards a technological community', the Council approved a further increase in community funding to promote cooperation between industry and universities, such as innovative companies in spring 1985. On the way to the desired European technology community, Esprit acted as an initial spark for similar programmes with which the Commission wanted to strengthen the competitiveness of community industries and stimulate cooperation and exchange in science and technology. Technologies such as smaller office computers and their manufacturers were hardly included in the Commission's funding programme. Instead, the EC targeted highly innovative technologies and basic IT research, which were explicitly not (yet) relevant to the market and competition.

c) Esprit II

The Esprit programme was considered to be of great political importance, therefore, the commission carried out an evaluation of the programme early on, in the spring of 1985, by a small group of experts, which was chaired by the previous head of the research department at Philips, Eduard Pannenborg. This took place against the background of dramatically changing conditions on the IT markets. On the one hand, the market shares of European producers had fallen significantly for all types of computers and their technical components, even for small business computers (see other articles). On the other hand, it became apparent that spending on research and development would increase significantly in the second half of the

51 Preparatory documents for the council meeting on 8 April 1986, Bundesarchiv Koblenz, B196/76925.

52 ESPRIT, The first phase: progress and results, (COM(86)687).

1980s. The Commission assumed an increase from ECU 35 billion in 1985 to ECU 90 billion in 1990.[53] It warned urgently that competitors from the USA and Japan would be able to counter this growing cost pressure even more effectively in the near future due to the strong government demand in those countries and their extensive funding programmes for research and development.

In terms of content, the assessment of the Esprit programme by both the expert commission and the member states was quite ambivalent, but fundamentally positive. Everyone involved particularly praised Esprit's potential to create a culture of cross-border collaboration that went beyond joint ventures. Everyone involved shared the conviction that Europe-wide co-ordination and alignment of actors towards common goals must be strengthened. According to the unanimous verdict, Esprit ensured new practices in the evaluation of joint research programmes, the development of new research strategies and, thus, the establishment of a European research area. In addition, Esprit was creating uniform European norms and standards that were previously missing. The German Research Minister Riesenhuber, therefore, even described Esprit as the "flagship of EC research policy".[54]

Some criticisms and suggestions for the further development of Esprit were formulated:

(a) The very broad content concept of the programme (too many small projects) would provide too little impetus for economic exploitation and the rapid increase in competitiveness on international markets. Companies such as Siemens, therefore, warned of a lack of strategic support. Against the background of falling market shares and rising cost structures, quite a few actors, including the Federal Ministry of Research, called for a stronger market-driven strategy that should pay more attention to potential industrial applications and economic effects without abandoning the fundamental focus on precompetitive research. Ultimately, it concerned directly visible effects on the markets. Such demands were incompatible with the Commission's basic liberal ideals. As a 'guardian of competition', she shied away from providing financial stimulus that would directly benefit individual companies and give them economic advantages over European competitors.[55]

53 Communication from the EC Commission to the EC Council, 21 May 1986 (Com(86)269), Bundesarchiv Koblenz, B196/76925.

54 Riesenhuber von Esprit begeistert, in: *Handelsblatt*, 29 September 1987, p. 1.

55 Bussière: Industrial Policy, p. 305ff.

The Commission also called for greater co-ordination of the EC funding programmes that were currently being set up with the existing national programmes. As far as the EC programmes were concerned, the Commission proposed that Esprit should continue to represent basic IT research, while other programmes, such as RACE (Research in Advanced Communication in Europe, a programme for the development of a broadband communications network in Europe) or DELTA (Dedicated Road Infrastructure for Vehicle Safety in Europe), should be added to this and address specific application-oriented goals. The member states that did not yet have a significant IT industry and/or funding instruments also wanted the broad funding strategy to be continued. The more the funding policy was oriented towards strategic market needs, the less their industry could successfully compete for European funding.[56]

(b) In addition to the more needs-oriented funding policy, companies and individual national ministries, especially from member states with established IT industries, suggested greater consideration of ambitious projects with high innovation potential.

(c) Weaknesses in the administration, project requirements and application procedures were also highlighted. The complex application procedures with the low funding rates of less than 20 % were rather discouraging, particularly for companies in difficult market situations, as was the case for the majority of the European IT industry. It was also criticized that only structurally equivalent partners would join to form project teams because, in principle, all project partners benefited equally from the results of the project work.

(d) Clear criticism was directed at the lack of opportunities for participation by small and medium-sized enterprises, for example, in the area of smaller office computers, in the first phase of the Esprit programme. What is particularly important here is that, although these companies were very successful on the markets, they did not have the capacity for precompetitive research. Applied research played a much larger role for them. In addition, potential partners in other EC countries were often neither known nor trusted. Therefore – according to criticism from business – national ministries were responsible for setting up advisory centres for companies (and

56 Ministerial assessment report on Esprit, 24 January 1986, Bundesarchiv Koblenz, B196/76925.

universities) to provide assistance with the application procedures.[57] The German government set up an 'International Liaison Bureau'.[58]

The evaluation of the Esprit programme demonstrated that the first phase of Esprit was a trial phase, in which European research funding had to find its way, especially in a dynamic field such as IT. The problem, however, was that developments on the international IT markets did not actually allow for a trial phase. The Federal Research Ministry also judged that "cross-border industrial cooperation has been promoted [...] and companies and markets have therefore become more European". They assessed the overall "indirect effect of Esprit as positive", but also pointed out that "on the other hand [...] the direct effect [...] must be viewed soberly".[59]

During the preparation of the second phase, despite all positive assessments, Esprit ran into conflicts about the general expansion of the EC's research and development programme and the deepening of cooperation in advance of the internal market project. It was the three 'large' member states – Germany, France and Great Britain – which themselves had a complex set of policy instruments for promoting research and development, that spoke out against a major expansion of the EC's research framework programme.[60] Once again, a lot of time passed during which there was uncertainty about the continued existence of Esprit. This coincided in 1985–1987 with a phase in which the entire European computer industry, including manufacturers of small and medium-sized computer systems, lost competitiveness compared to non-European producers. It took until July 1987 – after the elections in Great Britain – for the Council to take a decision on the research framework programme. This was accompanied by significant cuts at Esprit of a total volume of 1.6 billion ECU compared to the Commission's proposal of 2.2 billion ECU. Although this was a reduction compared to the Commission's proposals, it was more than double the volume of Esprit I. These figures also show that the programme met with broad approval.[61]

In terms of content, the course was set in autumn 1987, which the Council of Research Ministers finally approved on 11 April 1988. Given the

57 Circular letter of the Ministry for Research and Technology, 18 August 1987, Bundesarchiv Koblenz, B196/76925.
58 Federal Government Report, January 1990, Bundesarchiv Koblenz, B196/151525.
59 Internal note of the German Ministry for Research and Technology, July 1986, Bundesarchiv Koblenz, B196/76926.
60 Warlouzet: Governing Europe, p. 180ff.
61 Sandholtz: High Tech Europe, p. 195ff.

different ideas of the Commission, member states and industry, this seemed to be more of a continuous transition from Esprit I to Esprit II, which did not show any radical substantive or conceptual breaks. The much-discussed stronger strategic (application-oriented) orientation of funding particularly occurred rather gradually, as member states with a less competitive (or non-existent) industry had little interest in it.[62] The EC, thus, remained true to its regulatory policy guidelines that no funding should be provided that could lead to distortions of competition. Instead, it allowed funding of 100 % of costs of universities and research centres. The focus of the content was also only slightly changed. The original five focal points were reduced to four:

– Information processing systems
– Office and business systems
– Computer integrated manufacturing
– Microelectronics

With Esprit II, considerations began, particularly in the three large member states, to align national funding programmes more closely with European priorities. This led to the German federal government completely withdrawing from funding agency systems.

4. Conclusion

The EC took a first step towards developing sustainable funding programmes for the research and development of future technologies with the implementation and development of the Esprit programme. The EC, thus, moved into an area of industrial policy that had previously been the sole domain of national governments. However, the new approach to a European IT policy that was pursued with the Esprit programmes was not able to significantly improve the competitiveness of European computer technology producers in the 1980s. On the contrary, both the mainframe segment and the medium and smaller computer systems constantly lost market share.

Although Esprit was unable to achieve its actual goal of making EC IT producers competitive in the short term, it, nevertheless, plays a pioneering role in European research funding policy. Esprit turned out to be a

62 Mitzner: European Research Policy, p. 321ff.

significant door-opener for the independent funding of research and development by the EC. The efforts of the actors involved to ensure the future competitiveness of European IT producers played a key role in the further development of European industrial and research funding policy. Esprit resulted in a more open atmosphere among companies, which discovered that cooperation and competition were equally important. Its "success" was also an important piece of the puzzle on the way to a comprehensive framework programme for research funding. However, the coming into being of the Esprit programme demonstrates that common EC strategies could often only be implemented at a slow pace and against sometimes bitter national and corporate reservations. That Esprit was unable to help save European manufacturers of smaller office computers from technological backwardness in the first half of the 1980s is probably due to these long periods of time. What was much more important, however, was that Esprit was not suitable for producers of smaller office computer systems in its first phase because it focused on research and development in a precompetitive environment. These producers, which had usually emerged from manufacturing medium data computers, had hardly carried out any basic research. Instead, they bought microelectronics and focused more on the application of technology (customer and service orientation), especially in software. The few European producers of such systems that had successfully managed to assert themselves on the markets until the mid-1980s were hardly addressed by Esprit. Especially the small and medium-sized enterprises among them found it difficult to overcome the high administrative hurdles (e.g. searching for foreign project partners, formulating research proposals). When the second Esprit programme finally opened up better application opportunities for producers of smaller office computers after 1988, they were either already insolvent or about to be bought up by non-European competitors.

It is difficult to assess what successes Esprit actually achieved or whether it even contributed to the competitiveness of European IT manufacturers. However, it is undisputed that Esprit contributed to a Europeanization of the IT industry and a new 'culture' of intra-European cooperation between companies and/or research institutions, which subsequently became noticeable beyond funding programmes. Joint Esprit projects led to the creation of personal networks or corporate collaborations, such as the

establishment of a joint research laboratory between Siemens, Bull and ICL, which emerged directly from an Esprit research project.[63]

Finally, Esprit also played a central role in the fundamental debate in the late 1970s and early 1980s about deepening and expanding the EC. Regarding the structural crises of the economy at that time, many political protagonists viewed a deeper integration of Europe, including a comprehensive industrial, technological and research policy as well as greater decision-making powers of Commission, as a necessary step to raise European competitiveness in a globalizing world. The threat to European industry, which was perceived as particularly intense in a future sector such as IT, practically forced cooperation – according to the protagonists of European integration.

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63 Sandholtz: High Tech Europe, p. 207–208.

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Individual Companies and Developments

Nixdorf – pioneer of decentralized data processing

Christian Berg

1. Introduction

Nixdorf Computer AG (NCAG) – founded in 1952 as the Labor für Impulstechnik (Laboratory for Impulse Technology, LfI) – was part of a piece of post-war German economic history. At the dawn of the German computer industry, Heinz Nixdorf, born in Paderborn, Germany, in 1925, took the opportunity to open new markets in a novel industry.

He entered the then still new field of electronics unburdened by the electromechanical tradition of established office machine manufacturers. Nixdorf recognized the immense market potential for smaller commercial computing systems below the market-dominating mainframes early on. Together with a few other companies, such as Kienzle[1] and Siemag/Philips[2], he created computers for the commercial-administrative sector in the mid-1960s, which, in terms of price and performance, could also be used by small and medium-sized businesses. Mid-range computing was born.

Nixdorf, in accordance with his user-focused objectives, also provided demand-oriented software and information technology (IT) training for his customers in addition to the hardware. This "all-round service" gave NCAG a competitive edge and great business success, especially among medium-sized companies without their own IT department.

Computers at that time developed over a few years into multi-user systems with their own networks or networking with mainframes, and NCAG was able to maintain their initial lead. By the end of the 1970s, Nixdorf was Germany's market leader for mid-range computing and rose to become Europe's fourth largest computer company.[3]

1 For Kienzle, see also the article by Armin Müller in this volume.
2 Henrich-Franke: Innovationsmotor Medientechnik.
3 See also Berg: Heinz Nixdorf.

2. Starting with the Nixdorf 820

In the 1960s and early 1970s, "the basis [...] of [the company's] success"[4] was the so-called Nixdorf 820 computer. The company had already started the first developments in 1963, while it was still manufacturing under the name LfI, as a supplier for office machine manufacturers, such as Wanderer and Ruf. This computer was presented to the public for the first time at the Hannover Trade Fair in 1965 under the name Wanderer Logatronic and Ruf Praetor. The press was impressed by this innovative "small computer"[5] and stated, among other things, that "the applications for this accounting machine [...] extend far beyond those of conventional bookkeeping machines".[6]

The Nixdorf computer was one of the "boldest and most trend-setting designs",[7] especially since the overall concept envisaged using as few mechanical parts as possible from the traditional office machine industry. Thus, a IBM ball head typewriter was used as the input and output unit, replacing "expensive and heavy carriages or [...] high-speed printers".[8] The computer was also designed according to a modular principle. All models were built around the central processing unit, which, in turn, consisted of a combination of the following functional units: computer, input and output unit, micro and macro programme, and magnetic core memory: "The System 820 [...] follows a very wide-ranging modular concept. The electronic calculation part can be expanded within a wide range. Programming is mainly 'wired' on interchangeable plug-in units. However, the magnetic core memories also allow 'living' program storage. The peripheral units were also a modular system based on the IBM ball head typewriter."[9] This modular design and the strict separation between mechanical and electronic components also facilitated maintenance and repair work, so that faults could be quickly located using test programmes and the faulty component could be replaced accordingly.[10]

4 Nixdorf, Heinz: Vom Bumm [sic! This should be Bull, author's note] Gamma zum Rechner 8818, in: Die Welt, 2 April 1986.
5 Bürotechnik und Automation [BTA] 5 (1965), p. 240.
6 Büromarkt 11 (1965), BK 242 Rechnende Schreibbuchungsmaschinen, p. 40.
7 Bongartz, Karl Heinz: Hannover Messe 1967, BK 24 Buchungs- und Fakturiermaschinen, Buchungsmittel, in: Büromarkt 12 (1967), p. 10.
8 Nixdorf: Bumm.
9 Büromarkt 12 (1968), Nixdorf, p. 31.
10 Hanewinkel: Computerevolution, p. 81.

The Nixdorf computer was less susceptible to faults, as competitor Kienzle also admitted: "With regard to the invoicing machines, it should be mentioned that the 'Prätor' for Ruf and the identical 'Logatronic' for Wanderer were a great success under Nixdorf's personal influence and went into production so carefully that no complaints have been reported."[11]

The concept of the System 820 was also considered trendsetting, since, for the first time, "two previously different working principles [were] combined in the field of data processing. On the one hand, it [was] an EDP [electronic data processing] system with regard to its functional operation and internal efficiency, which [made it] quite comparable to the systems that had existed on the market up to that point. On the other hand, the System 820 [offered] the possibility of direct data entry via keyboard. It is precisely this possibility of direct data input and processing that allows users to retain the working principles that they are familiar with from, for example, invoicing and accounting machines."[12] In other words, when using the new computer, customers did not have to familiarize themselves with fundamentally new work processes, but could retain the work steps they had learned and practiced.

After the Nixdorf computer had caused quite a stir at the Hannover Trade Fair in previous years, it was Heinz Nixdorf himself who first attracted the attention of a wider public in 1968: "For every professional, Hannover offers plenty to talk about every year in addition to the exhibition itself." There were usually rumours and discussions about technical and factual matters, however, this time a person was in the foreground: "Heinz Nixdorf, a man who until now had kept himself modestly in the background as a supplier of office machines, announced at a press conference that he was taking over Wanderer-Werke AG, Büromaschinenwerk, Cologne. The de facto takeover by a sole proprietor is already a rarity in a phase of market concentration, the handing over of an DM 18 million cheque with personal cover no less."[13]

The overall focus of the Wanderer-Werke had remained electro-mechanical bookkeeping machines, so that the management had manoeuvred the company into the technological sidelines within a few years, although the company had a pioneering model in its product portfolio from 1965

11 Ernst: Die Entwicklung, p. 82. The work remained unpublished but is available in the HNF archives, see HNF 3-Sg/0183, Bringer's estate.

12 BTA 5 (1968), S. Nixdorf System, p. 248.

13 Hofmann, Klaus P., Messe Hannover 1968, in: BTA 5 (1968), p. 226.

onwards in the form of the Logatronic computer. They remained in the familiar patterns and structures for too long and were not able to change track. The company ran into financial difficulties in 1967 when it finally tried to set up its own electronics production and, at the same time, hired new employees for development, production and sales, as well as purchasing semifinished products and other materials for production on a large scale.

Wanderer's main shareholder, Dresdner Bank, had, therefore, already been negotiating behind the scenes with Nixdorf about the sale of Wanderer-Werke since July 1967. Nixdorf was interested neither in the expertise in producing office machines nor in the office machine factory in Cologne itself, but in the sales department. The latter comprised 45 general agencies in Germany, another 30 agencies in other countries, as well as subsidiaries in Italy, France and Spain.

Nixdorf had been interested in establishing its own distribution organization since 1964, when the French company Bull, which had, at that time, bought about 90 per cent of Nixdorf's products, stopped doing business with Nixdorf altogether, due to the entry of General Electric. "This transaction deprived us of our distribution base from one day to the next. […] The realization that without our own distribution department we would be 'nothing' in the computer industry mobilized all forces to form a sales organization. But it took six years to achieve this. […]. The final step had been the acquisition of Wanderer-Werke, which led to the old company being renamed Nixdorf Computer AG."[14] The purchase made the laborious and lengthy process of developing a distribution structure of its own obsolete, and the trade press said: "With the Wanderer distribution organization, Nixdorf now has more or less the strongest distribution organization of more demanding and efficient professionals which represents the old Saxon-Thuringian heritage of brands in the areas of computing and accounting."[15]

As a result of the acquisition of the Wanderer shares in April 1968, Nixdorf was the *de facto* owner of two companies: the Cologne-based office machine factory, including distribution, and the LfI in Paderborn. Nixdorf Computer AG, formerly Wanderer-Werke AG, acquired LfI on 23 April 1969, with retroactive effect from 1 October 1968. The annual report states:

14 Nixdorf: Bumm.
15 Basten, Peter: Wanderer zu Nixdorf, in: Büromarkt 10 (1968), p. 22.

"From October 1968, our business will be determined by the production and distribution of electronic computers. Thus, at the same time, the continuation of the Paderborn company's business has become the main object of our business operations."[16]

Founded in 1952 as a one-man operation in post-war Germany, within about 15 years the computer firm developed into a company with almost 2,000 employees and a turnover of more than DM 100 million in 1968. Nixdorf ventured directly onto the market in its role as a competent supplier with the 820 magnetic accounting computer, which dominated the market as early as 1967/68.[17]

3. The next generation: magnetic disk storage

There was another giant leap in storage technology in the 1960s, but the 820 was technically unable to cope with it. In the same way as the punch card had previously been replaced as a storage medium by magnetic tape and magnetic account cards, account cards were subsequently replaced by magnetic disk storage. The NCAG also had to cope with this memory change in order not to lose its technological position in the computer industry. However, the development of a new system range with magnetic disk storage, which later became the 88 system, had not yet been completed, and the turnover and sales figures of the 820 stagnated from 1972. A new revenue stream was needed for the company, and, to this end Nixdorf purchased expertise in the USA. The data collection system from the US company Entrex[18] was already established on the market and Nixdorf introduced this system in Germany as the 620 range in 1973. This system secured the company's turnover, especially in 1975, as incoming orders at that time showed "a clear shift in emphasis from 820 products to the 88 series disk

16 Nixdorf Computer AG, Annual Report 1968, p. 5.

17 BTA 5 (1968), Kleincomputer für direkte Datenverarbeitung, p. 263.

18 The cooperation resulted in Entrex merging with the US subsidiary Nixdorf Computer, Chicago in 1977. Nixdorf Computer, Chicago had started business on 1 January 1973 and emerged from the computer division of Victor Comptometer Corporation. In May 1977, Nixdorf Computer, Chicago took over Entrex, including its 60 offices in the USA and Canada, and around 600 employees. As a result, Nixdorf's US headquarters were moved from Chicago to Burlington.

systems",[19] but this changeover process from the 820 magnetic accounting computer to the new 8870 magnetic disk system required a start-up phase.

Utilizing the 620 system, Nixdorf not only secured the company during the upheaval phase of the storage changeover, but also, at the same time, was the market leader in the data entry segment for the next ten years both in Germany and the USA.[20] The competitors either offered data input systems without a screen, such as NCR or Kienzle, or the data had to be initially temporarily stored on floppy disks or magnetic tapes, as with IBM or Kienzle, and could only then be saved on magnetic disks. By contrast, the 620 system was not only technically competitive, as it was equipped with a screen and the data was saved directly on magnetic disks, but was also designed for high market penetration in terms of price.

4. From a niche to mass markets

Parallel to the challenging storage changeover, the market niche of offering computer solutions for small businesses directly at the workplace at a reasonable price/performance ratio had become a mass market. A few years earlier, only a few companies manufactured mid-range computers, for example, Wanderer/Nixdorf, Kienzle, Ruf-Buchhaltung, Philips, Olympia and Anker, but new companies had entered the market since the late 1960s. These included the musical instrument manufacturer Hohner[21] from Trossingen in Swabia, the US sewing machine manufacturer Singer with its Singer Business Machines Division and the German subsidiary Singer Computer GmbH in Nuremberg, and Computertechnik Müller (CTM) from Konstanz in Germany. The founder of CTM was Otto Müller, who had previously been instrumental in the development of the 820 at Nixdorf and, together with his wife Ilse, had taken the step of becoming self-employed after Nixdorf and other companies, such as Triumph-Alder Büromaschinen-Vertriebsgesellschaft, had refused to implement his new computer concept.[22]

19 HNF 3-Sg/0142, therein: Report of the Executive Board, third quarter 1975.
20 A good overview of the functional principles, characteristics, mode of operation and possible applications, as well as the state of the art in data acquisition is provided by Schleuder: Periphere Geräte.
21 Berghoff: Zwischen Kleinstadt und Weltmarkt, pp. 605–609.
22 Müller: Glanz und Elend, pp 153 – 261.

It was not only spin-offs and start-ups that entered this market from 1974 onwards. The established manufacturers of large computers, mainly from the USA, also offered mid-range computing systems. The German journal *Zeitschrift für Bürobedarf* noted: "The almost tumultuous reception that the cost-conscious user, plagued by accounting problems, has given mid-range computers in recent years is obviously something that the leading suppliers of large-scale EDP systems also want to profit from."[23]

Accordingly, these manufacturers advertised their products at the 1974 Hannover Trade Fair with slogans such as "Computer power at the workplace" (IBM), "The computer at the workplace – a utopia yesterday, reality today" (UNIVAC) and "Easy to use" (Honeywell Bull).

A general tendency towards smaller and decentralized computer systems was evident at this Hannover Trade Fair. On the one hand, the classic mid-range computer manufacturers, such as Nixdorf and Kienzle, offered further developments, so that magnetic disk storage technology and screens enabled new application possibilities and, thus, for the first time, the performance of a computer was brought to the workplace. On the other hand, the minicomputers of mostly US companies had become so inexpensive that they broke into the mid-range computer sector. In addition, peripheral devices, such as monitors, floppy disks and magnetic disks, were often originally present in the computers and did not have to be adapted first, as was the case with the original mid-range computers.

Users could not do much with low-cost computer power in everyday office life. They were used to receiving solutions tailored to their accounting problems from providers. However, the major IT manufacturers were only able to supply these software solutions on a rather modest scale in 1974. The German mid-range computer manufacturers, such as Nixdorf or Kienzle, on the other hand, were different. It was precisely in this segment that their strengths and advantages over IBM lay. Although the mid-range computers were less powerful than their US counterparts, these companies had years of experience in developing computer solutions for the everyday office life of small to medium-sized enterprises.

Being able to offer these solutions in everyday office life meant having solutions in the software sector at the ready. Here, NCAG was the trendsetter in the mid-range computer industry: "In its endeavour to offer comput-

23 Schulte, Otto: Computer für Anwender, in: Burghagens Zeitschrift für Bürobedarf (BZB) – Sachmagazin 6 (1974), pp. 10–12.

ers, operating systems, application programmes as well as after-sales service as a single unit within the scope of its services, Nixdorf has gone one step further. A software system developed on an international basis was presented in Hannover that opens up new perspectives for data processing in small and medium-sized enterprises. […] This programme contains all essential operations related to order processing, invoicing, materials management, payroll accounting, financial accounting, company accounting, production control and purchasing."[24]

It was also NCAG that clearly dominated the mid-range computer market in West Germany in the 1970s, ahead of Kienzle.

Provider	Total number of units of all deliveries	Share in per cent
Nixdorf	14,000	25.1
Kienzle	8,600	15.4
Philips	7,300	13.1
Triumph-Adler	6,800	12.2
Ruf	4,500	8.1
Akkord	2,400	4.3
NCR	2,200	3.9
Olivetti	1,900	3.4
Singer	1,700	3.1
Hohner	1,200	2.2
Burroughs	800	1.4
Other	4,350	7.8
Total	55,750	100

Graph 1: Installed inventory and manufacturer shares (start of 1974) of medium data systems in the Federal Republic of Germany[25]

24 Bürotechnik und Automation (BTA) 6 (1974), Nixdorf, pp. 714–716.

25 Table taken from Rösner: Wettbewerbsverhältnisse, p. 64. The fact that some of the Ruf systems were produced by Nixdorf must be taken into account.

The growing mid-range computer market provided sufficient leeway for the economic growth of almost all companies operating in the sector for some time. But equity investments, takeovers, mergers and corporate bankruptcies were to determine the scene over the next few years.

Some examples of the latter are as follows. The firm CTM became a Diehl Group company in January 1975.[26] At the turn of 1975/76, the Singer Company announced that it was dissolving the Singer Business Machines Division and getting out of the computer business. In April 1976, the British computer group ICL took over the Singer Business Machines Division shares.[27] Finally, Nixdorf bought Hohner's IT business on 1 January 1977. But that was only the prelude to a whole series of company acquisitions and shareholdings: "The list of the deceased and apparent dead is long: Alphadelta, Beaugrand Datentechnik, Bross Datensysteme, CMC, Compucorp, Compudata, Contidata, DDC Computer, Datasaab, Dietz Computer, ERA General Automation, Feiner Reichenelectronic, Hermes Precisa, Herzke KG, Hohner GDC, IG Industria Computer, Inforex, Interscan, ISE Sammentinger Electronic, Krantz Computer, Logabox, Mail, Montedison, Ruf, Schrem, Tealtronic and Wagner. Still alive as mid-market comforters – although they haven't exactly covered themselves in mid-range computing glory in recent years: Burroughs, CTM, Datapoint, Honeywell Bull, IBL, Kienzle, MAI, MDS, NCR, Philips, Sperry, Taylorix and Triumph-Adler."[28]

The negative list does not include Nixdorf. This raises the question of what the difference was between Nixdorf and the other manufacturers. Dieter Eckbauer, the long-standing editor-in-chief of Computerwoche, had the following opinion on this: "The success of Nixdorf Computer AG […] is clearly based on selling reliability through all-round support, everything to do with organization – no black boxes. […] Nixdorf knows how to deal with the owners and managers of small and medium-sized enterprises."[29] Accordingly, Nixdorf sold not only computing power in the form of a black box but also solutions for everyday office life, specially tailored to the needs of its customers. A pronounced customer orientation and industry focus on distribution were part of this.

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26 Computerwoche 1 (1975), Diehl kauft CTM.

27 Computerwoche 1 (1976), Zurück zur Nähmaschine: Auch Singer wirft das Handtuch; Computerwoche 20 (1976), International Computer Limited: Singer-Produktion läuft weiter.

28 Eckbauer, Dieter: IBM: Sturm und Drang im MDT-Wasserglas, in: Computerwoche 49 (1985).

29 Ibid.

5. Nixdorf's response to the new challenges

NCAG's reorganization transformed it from a company with a focus on development into one which was sales-oriented. This is also reflected in the number of employees. While NCAG's development department increased by about 82 per cent from 1974 (695 employees) to 1986 (1,266 employees), the sales staff increased by 178 per cent (2,396 employees in 1974 to 6,655 in 1986). The expansion of the sales network was a consequence of the Board of Directors' strategy of taking the lucrative business into its own hands and forcing factory representatives and other customers of Nixdorf products out of the market. This strategy proved to be successful even in the economically difficult years from 1973 to 1976, as an increase in sales was generated by the company's own sales organizations, while, at the same time, long-standing cooperation agreements in sales, including with Ruf Buchhaltung, were terminated. One thing was certain for the Nixdorf board of directors: "The concept of accelerated expansion of our own domestic and foreign distribution organizations in recent years has, thus, proven its worth, even in a difficult economic period."[30]

The well-developed sales companies, which enabled a strong customer focus, brought NCAG profitable business in the 1970s and 1980s. The company's continued success was also based on the technical development of new systems, such as the 8870 computer system, which proved to be a bestseller for NCAG: "Heinz Nixdorf and his Nixdorf Computer AG have always been regarded as fast starters in the industry – and with a reputation for finishing what they started: a turnover of more than DM 600 million for 1975, a full order book and a 'popular range' are the keys to success. After a boom with the 620 data collection system, the Paderborn-based company now launched a second big seller: the 8870 magnetic disk system."[31] As a successor model to the 820, the 8870 magnetic disk system was aimed at the Nixdorf domain of mid-range computing, in other words, it was "designed for the SME market for which a magnetic accounting computer

30 HNF 3-Sg/0142, therein: Report of the Executive Board, first quarter 1976, p. 2. After Ruf Buchhaltung ceased to be Nixdorf's distribution partner, the company got into financial difficulties and was finally taken over in 1980 by the Swiss company Hermes Precisa International, which, in turn, sold its shareholding in 1983. Computerwochte 7 (1980), Ruf als MDT unter Hermes' Fittichen. Also see Computerwoche 9 (1983), Hermes Precisa kappt deutschen DV-Vertrieb.

31 BZB 2 (1976), Nixdorf erweitert Produktfamilie 8870, p. 62.

organization had become too small, but for which a larger system was not yet an option".[32]

In fact, within a year, the 88 product family systems had become the mainstays of NCAG' s sales and in the first quarter of 1976, "already accounted for more than 40 % of the total incoming orders of the domestic sales organization. […] This positive trend makes it clear that the new products have asserted themselves in the market even in the face of tougher competition".[33]

Nixdorf's competitors, such as Wang Laboratories, saw the strength of the Paderborn-based company in its tailor-made offers for everything to do with EDP: "That's why Nixdorf is so successful in Germany: users feel they have all-round support, they don't need to worry about what the hardware can do. They are offered a complete application solution."[34] Nixdorf offered corresponding user programmes for a fee, which included system maintenance. Programmes for data entry and programme packages for the commercial sector, stock level monitoring and ordering, as well as product requirement determination, bookkeeping and payroll fulfilled the customers' requirements.[35]

The market for office computers,[36] such as systems ranging in price from DM 25,000 to 250,000 from the mid-1970s, was generally a market with high growth potential.[37] It was precisely this potential that Nixdorf exploited with the 88 product family. The company was the undisputed leader in Germany in 1977 with 19,090 installations, followed by Kienzle with 6,500 and Philips with 6,000 customer-installed office computer systems. These were followed by Triumph-Adler (3,900 installed systems), Olivetti (2,800),

32 BZB 2 (1975), Das Nixdorf-System 8870 bietet eine problemlose EDV-Anwendung, pp. 10–12.

33 HNF 3-Sg/0142, therein: Report of the Executive Board, first quarter 1976.

34 This is what John F. Cunningham, Senior Vice President Sales of Wang Laboratories, said in 1978 in an interview with Computerwoche. Eckbauer, Dieter/Elmauer, Elmar: "In fünf Jahren größer als Nixdorf", in: Computerwoche 23 (1978).

35 BZB 2 (1975), Nixdorf System, p. 12.

36 In addition to the price segment, there were other criteria that defined an office computer: "Office computers are fully-fledged, screen-oriented EDP systems that, in addition to internal memories, have direct access to external mass storage (e.g. on magnetic disk) and can be used as single-user or multi-user systems. […] Today [1980] the term 'office computer' is understood as a collective term for small computer, minicomputer, mid-range computing system, small computer and others." Pleil: Bürocomputer in der Praxis, p. 5.

37 Computerwoche 43 (1977), Diebold prognostiziert Bürocomputer-Boom.

Ruf (2,700), Hohner (2,200), IBM (1,600, excluding System /32), Taylorix (1,300), CTM (1,020) and, with 830 systems each, NCR and Dietz.[38]

As has been mentioned earlier, IBM and other major IT manufacturers pushed into this industry with all their might because of the success of the mid-range computing manufacturers. Around the same time as the market launch of the Nixdorf 8870 in 1975, IBM presented a new computer system called /32. Although the Americans were late in adapting to the "user needs of the market", according to the trade press, "IBM's success with the /32 system should be assured: In the USA [...] 2,000 units were sold in the first three months after the announcement there".[39] This predicted success was not long in coming. IBM was only in eighth place in Germany in 1977, with 1,600 /32 systems, but was "at the same time, the leader when it comes to the most installed machine in the first half of 1977: the system was installed 450 times. [...] Nixdorf added 205 machines to the 8870 disk system. Kienzle brought a good 200 of the 6000/6100 systems into the field".[40]

IBM, thus, also prepared to take the market-leading position in the field of decentralized data processing, this term replaced the description 'mid-range computing' at the end of the 1970s. The /32 system was followed in 1977 by the /34 system, which was also aimed at the "Nixdorf domain"[41] and, similar to the 8870, was designed as a single or multi-user computer. IBM took its cue from Nixdorf not only in the computer structure but also in the pricing for the /34, and the saying "It was always a bit more expensive to choose IBM" no longer applied: "Nixdorf's price for an 8870/1 stand-alone system: DM 99,500. The comparable IBM 34: DM 98,610."[42]

In addition to IBM and the other large computer manufacturers, mini-computer manufacturers such as Digital Equipment Corporation and Hewlett-Packard entered the field of commercial data processing from the mid-1970s onwards. Although these manufacturers only offered customers the hardware and not a complete package (hardware, software and maintenance) like Nixdorf or Kienzle, these computers cost only about half the price. Since customers in the commercial sector could do little or nothing with the hardware alone, these manufacturers advised that they involve

38 Computerwoche 45 (1977), IBM hält Platz acht im Bürocomputer-Markt.
39 Computerwoche 16 (1975), IBM steigt mit System /32 in den MDT-Ring.
40 Computerwoche 45 (1977), IBM.
41 Computerwoche 17 (1977), System /34: Späte Reaktion auf dem Markt.
42 Computerwoche 18 (1977), IBMs System 34 wird einen Preisverfall erzwingen.

a software company to carry out the programme installations desired. Alternatively, the software companies went directly to the mini-computer manufacturers, bought the hardware there and offered it on the market with user-specific software. All in all, an approach such as this meant a cost advantage over the complete solution offered by IBM, Nixdorf or Kienzle.[43]

Barely two years after the market launch of the 8870, competitive pressure in the mid-range computing and decentralized data processing sector had increased further. In order to remain competitive in the market, the development of a new operating system was imperative for Nixdorf. This was released for distribution under the name Comet in 1978.[44] Comet was a piece of industry-independent software that could be adapted to the individual needs of the customer. The software was advantageous for technical customer service because a special system structure meant that there was no need for time-consuming programming and it was possible to respond quickly to customer requests.[45] With Comet, NCAG once again emphasized customer focus and "this orientation towards a system and software provider created a competitive advantage for Nixdorf which, as market observers attest, made customers overlook even temporary weaknesses in the hardware and whose durability is also reflected in the fact that the software existed longer than Nixdorf itself."[46]

Accordingly, in the long term, Comet strengthened Nixdorf's position in the overall business of decentralized data processing. However, it can only be concluded to a limited extent that this software was what made Nixdorf a system provider in the first place, because NCAG had already gone down this path before and, as described, had different programme packages on offer. Comet was, therefore, rather the consistent pursuit of the strategy of offering hardware and software from a single source, which, in turn, corresponded to the customer's wish to have only one contact person for the seemingly unfathomable EDP.

The 8870 office computer system clearly became the company's main revenue generator in the 1970s and 1980s. Together with Comet software, Nixdorf remained the industry leader in decentralized data processing in Germany. However, the rapid growth of the company was not solely

43 Heitz, Christoph: Wo liegt das Geschäft der Mini-Computer-Hersteller? in: Computerwoche 26 (1977).

44 HNF 3-Sg/0142, therein: Minutes of the meeting of the Supervisory Board of Nixdorf Computer Aktiengesellschaft, 20 November 1978.

45 Leimbach: Die Geschichte der Softwarebranche, pp. 200–201.

46 Ibid., p. 201.

driven by office computer systems. Nixdorf was able to achieve high sales growth rates of 15 to 20 per cent annually, especially with computers and solutions for the retail sector (cash register systems/point of sale systems), banks (bank automation/automatic teller machines) and communications technology (data telephones).

6. An abrupt end

The Nixdorf company was at its zenith in the mid-1980s. At this time, the press reports about the entrepreneur Nixdorf seem like court reporting. The headlines "He 'came, saw and conquered'",[47] "The gnarled patriarch of electronics"[48] or the "Economic miracle in Westphalia" are representative examples. But the golden age of Nixdorf Computer AG came to an abrupt end with the death of the company's founder in 1986.

Similar to other manufacturers of mid-range data technology, Nixdorf had underestimated the technical development of the PC and, thus, initiated the downfall of his company.[49] He had failed to recognize the changing market conditions and held on to the outdated technology of the 8870 computer for too long instead of placing the PC at the centre of his office systems.

The breakthrough of the PC had undeniably influenced the negative economic development of NCAG after Nixdorf's death in the late 1980s. There is no doubt that Heinz Nixdorf had a wait-and-see attitude towards the PC. But NCAG's portfolio included IBM-compatible personal computers with the 8810 system family from 1983. From 1985 onwards, MS-DOS[50] was used as the operating system and in 1989, NCAG achieved a turnover of about

47 Markt & Technik. The Weekly Newspaper for Electronics and Information Technology 42 (1985), Er "kam, sah und siegte". "Corporate Identity" und Managementstrategie bei Nixdorf, pp. 36–39.

48 Grunenberg: Der knorrige Patriarch, pp. 211–221. Grunenberg's article on Nixdorf appeared in the weekly newspaper Die Zeit on 10 August 1984 and was published in the anthology mentioned here in 1993. A paperback edition appeared in 1995.

49 Nixdorf: Ohne Partner chancenlos, in: Der Spiegel 52/1989, S. 84–87.

50 See Computerwoche 44 (1985); Kooperation zwischen Nixdorf und Microsoft; Elektronische Rechenanlagen mit Computerpraxis (eR) 6 (1985), Zusammenarbeit zwischen Nixdorf und Microsoft, p. 356: "The focus of the cooperation is the use of operating systems and application solutions from Microsoft in the Nixdorf product family 8810. […] Microsoft has been installing 8870 systems since mid-1985. Scott Oki, vice president of international operations for Microsoft commented: 'We chose Nixdorf primarily because of the strengths of the Comet software.'"

DM 500 million with PCs. A change in the competitive situation in increasingly competitive international markets also played a decisive role. Similar to many other computer manufacturers, the Paderborn-based company was not making any profits from the sale of PCs, as fierce competition and price erosion had set in at the end of the 1980s in the industry, which was not accompanied by price reductions in the computer components purchased by PC manufacturers.

In retrospect, a market strategy oriented towards the PC, as so often rumoured, would not have been an alternative. Growth rates of 20 per cent were the rule in the PC industry around 1990, but all the computer companies involved, whether established for years, such as IBM, Sperry, Burroughs or Wang, or newcomers, such as Digital Research, Digital Equipment Corporation, Commodore and Compaq, found themselves in constant cut-throat competition, which was subsequently accompanied by concentration processes. If one assumes that NCAG should have concentrated more on the sale of PCs from 1983 onwards, it might have been possible to increase sales, but this would not necessarily have led to an increase in profits due to the fall in prices. Instead, it appears that only a radical reduction in personnel, standardized operating systems on all Nixdorf system families, more intensive marketing of the Comet software and a concentration on the areas of cash register, banking and communication systems, i.e. on products that could have been produced competitively in Germany at that time, might have enabled the entire Nixdorf company to survive in the 1990s.

On 1 October 1990, Nixdorf Computer AG was merged with the data and information technology division of Siemens AG. The resulting Siemens Nixdorf Informationssysteme AG, with about 52,000 employees and an annual turnover of about DM 11.5 billion, was the largest data processing company in Europe at the time, but only lasted in this form until 1999. Like so many companies, it became a victim of the concentration processes in the computer industry, so that it was split up into several successor companies. The best known were Fujitsu Siemens and Wincor Nixdorf, merged into Diebold Nixdorf in 2016.

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Innovations from the Black Forest: Kienzle and medium data technology

Armin Müller

1. Introduction

Kienzle Apparate GmbH was one of the leading manufacturers in West Germany, with a strong presence in other European and international markets, during the boom period of medium data technology in the 1970s. The company's roots lay in the precision engineering industry, which had formed a strong cluster region with the watch industry in south-west Germany for decades. Kienzle Apparate GmbH was founded as an independent company in 1929 in Villingen (Black Forest) as a developer and producer of measuring and control devices for the automotive industry.

Kienzle Apparate built up a second major division by entering the business machine industry in the 1950s and 60s, and recognized the new possibilities of electronic components at the right time. This led to the successful transformation of the company into one of the major German computer manufacturers in the segment of medium data technology. The following article describes this development up to the final demise of the Kienzle computer division in the 1990s.[1]

2. Roots and beginnings

The roots of Kienzle Apparate GmbH lie in the precision engineering and watchmaking industry of south-west Germany (Black Forest region). The Kienzle watch factories in the industrial town of Schwenningen had been established in the 19th century and were able to position themselves as an internationally recognized brand on the watch market until the years of

1 The business history of Kienzle Apparate GmbH was compiled as part of a research project at the University of Konstanz (Economic and Social History, Prof. Dr. Clemens Wischermann) and published as book: Müller: Kienzle.

crisis in the industry from the 1970s onwards.[2] However, the measuring and counting equipment business was spun off as an independent company, Kienzle Apparate, based in the neighbouring town of Villingen, during the Weimar Republic and went its own way from then on. The founder and driving force behind the company was the engineer Dr. Herbert Kienzle (1887–1954), who left his father's watch factory in 1929 and put all his energy into building up the new company.

Kienzle Apparate developed and produced equipment for the automotive industry, particularly for commercial vehicles. The company began by manufacturing and selling taximeters and equipment for recording operating data. The key innovation for the subsequent boom was the tachograph in the late 1920s, a calibratable device that could measure and record vehicle speed as well as driving and stopping times. The number of trucks in Germany increased after the Great Depression. The transition of Nazi Germany to a wartime economy provided the company with an ideal market environment. The Kienzle tachograph was a control instrument that gave haulage companies, car manufacturers and state institutions the opportunity to oblige their drivers to drive economically.

Kienzle Apparate was a typical German industrial company during the war years, whose production was of great importance to Nazi Germany and its war effort. Entrepreneurs and managers at Kienzle were closely associated with the Nazi regime. In addition to the tachograph business, the company became a supplier to the German aviation industry, particularly developing and producing regulators for aircraft engines.[3]

3. Entering the business machine industry

At the end of the war in 1945 and the beginning of the Allied occupation, Kienzle Apparate had to reorganize and overcome several years of crisis. The company's situation stabilized again with the formation of the Federal Republic of Germany and the normalization of the economy following monetary union and market liberalization, Business with equipment for the automotive sector was resumed and developed into an unprecedented volume of production and sales as a result of the general breakthrough of automobilization ("*Automobilisierung*") in Germany and throughout

2 Schmid: Lexikon Uhrenindustrie, p. 478f.
3 Müller: Kienzle, p. 42–58.

Europe. The main external driver was the legal requirement to install tachographs in commercial vehicles, first in Western Germany and later throughout the European Community.[4]

In the post-war years The company also succeeded in entering an entirely new field of business in the post-war years: the manufacture and sale of business machines. The technological skills acquired in precision engineering certainly helped, but other factors were crucial to success. Up to that point, significant parts of the German business machine industry had been concentrated in Saxony and Thuringia. However, the division of Germany and the resulting economic restructuring of the country meant that the industry had to be completely reorganized.[5] Saxony and Thuringia were part of the Soviet occupation zone, therefore, companies there were confronted with a policy of expropriation and socialization. Despite the major upheavals, the business machine industry continued to establish itself as an important and efficient sector in the GDR. However, there was also a considerable exodus of skilled workers and managers to the West, where the industry was rebuilt.

The flight of two people from the industrial centre of Chemnitz[6] (Saxonia) to the south-west of Germany was particularly significant for Kienzle Apparate. They were Lorenz Maier, until then a designer of business machines at Astra-Werke,[7] and Karl Hueg, sales manager at Wanderer Continental.[8] Maier had been in West Germany since 1945 and was looking for new customers for his designs for adding and booking machines. Contact was made with the management of Kienzle Apparate in Villingen in 1948. The company was still suffering from the general effects of the war, with orders from the defence industry having been lost and business in commercial vehicle equipment not yet resumed. The management was, therefore, looking for new product ideas. Maier and Kienzle came to an agreement, resulting in the first generation of Kienzle business machines.[9] At the same time, Hueg left Chemnitz and signed a contract as sales manager for the new Kienzle division. Maier's technological expertise and Hueg's marketing knowledge and contacts enabled Kienzle Apparate to successfully enter the West German business machine market. More skilled

4 Müller: Stiller Wächter.
5 Bauer: Büromaschinen-Industrie.
6 Jornitz/Naumann, p. 110–119; Schneider: Unternehmensstrategien, p. 160–187.
7 Reese: Lorenz Maier, p. 16–20.
8 Anonymous: Karl Hueg.
9 Polzin: Der Blick in die Vergangenheit, p. 8–11.

workers were added. It was no coincidence that Kienzle set up a subsidiary in Oberndorf am Neckar. Many employees were taken over from Mauser-Werke AG, a former producer of business machines and weapons, which was a victim of extensive expropriation and dismantling by the French occupying forces.

The 1950s and 60s were the heyday of mechanical business machines.[10] Kienzle developed, produced and marketed a modular system for adding and accounting machines.[11] The most important customers at that time were large administrative organizations, such as the German Post Office, many banks and administrations. The second division quickly established itself as an independent and equally essential part of Kienzle Apparate GmbH. Both divisions benefited from the general economic situation during the economic miracle, the very positive development of the automotive industry and the trend towards automation in administration. As early as 1952, the turnover and the number of employees exceeded the previous wartime peak and continued to grow steadily.

Therefore, Kienzle's entry into the business machine industry took place under favourable conditions due to the reorganization of the industry and the post-war boom years that followed. But it was also the result of proactive management preparing for a second line of business. These included the recruitment of experienced managers for the technical and commercial management of the new mainstay.

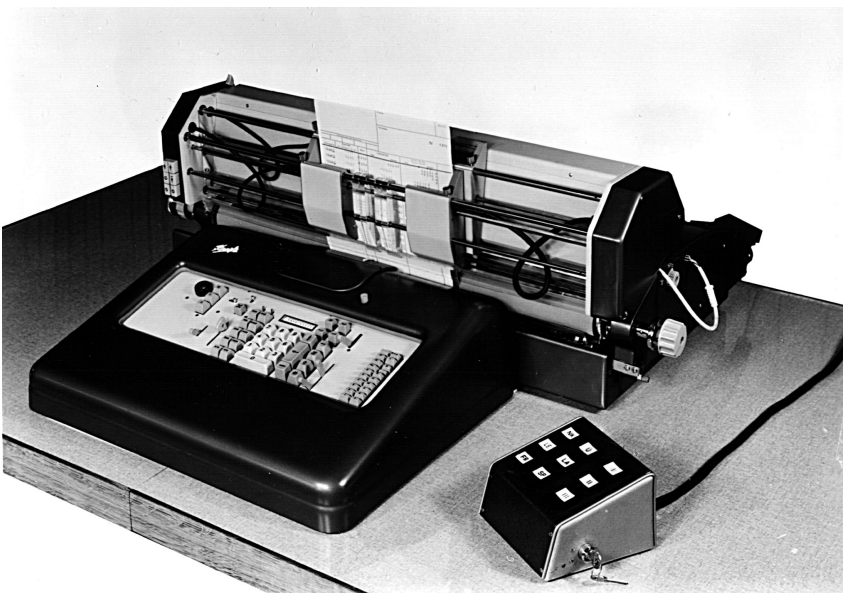
4. On the way to the first Kienzle computer

Kienzle Apparate GmbH established itself from the 1950s to the late 1960s as a major supplier of mechanical adding and accounting machines. Together with the existing automotive division, the company had grown to a size of over 3,000 employees. This period saw the transition to semi and fully electronic systems. Despite several crises and many operational problems, this far-reaching technological change was completed successfully.

Kienzle's first steps in the direction of electronics began in 1954, when Gerwalt Polzin, the commercial director at the time, brought back his first impressions of commercial applications for computers from a study trip to the USA. The company set up its own engineering office, firstly, in Berlin, and

10 Schierz: Die westdeutsche Büromaschinenindustrie, p. 105–126.
11 Hueg: Unser Büromaschinenprogramm, p. 6–7.

then moved to Munich. Around 20 employees carried out basic development work on electronic applications.[12] The initial results were electronic counting devices and an electronic printing unit. Important intermediate steps apart from the mechanical calculator were devices with an electronic "*Multiplikationskörper*" (Kienzle Class 300) and models with an electronic "*Saldovortrag*", i.e. a memory periphery (Kienzle Class 2000). These models were launched between 1959 and 1962. During these years, Kienzle also developed its own partially electronic invoicing machine (Kienzle Class FM 36).



Picture 1: The Kienzle Class 2000 was the first partially electronic accounting machine

In addition to its own developments, the company collaborated with other innovative companies, such as Standard Elektronik Lorenz in Stuttgart and the laboratory for pulse technology (Labor für Impulstechnik) of computer pioneer Heinz Nixdorf in Paderborn.[13]

12 Maier: Die Geschichte der Kienzle, p. 28; Ernst: Entwicklung der Fa. Kienzle Apparate, p. 9–10.

13 Berg in this volume.

This period of technological change at Kienzle lasted a full decade. It was accompanied by a generational change in key management positions and an adjustment of central company processes. At the personnel level, there was a conflict with the previous chief designer, Lorenz Maier, who was very sceptical of electronic innovations. A new technical manager for business machines was appointed in 1957. The company had two competing research and development departments for several years.[14]

In 1962, there was a serious development crisis at Kienzle Apparate, which led to the dismissal of a managing director and the previous technical managers. In addition, cooperation between the sales, customer service, design, production preparation and assembly departments were reorganized and medium-term product planning was put on a new footing. The creation of a new Development Committee ("*Entwicklungsausschuss B*"), which brought together engineering, development and sales on an equal footing, was essential. This brought together different perspectives and reconciled customer views with technical planning in the spirit of modern innovation management.[15] This was the most important measure within the company for the imminent introduction of their own fully electronic computer systems. In 1964, the Development Committee met for the first time and set the course for the construction of the first independent Kienzle computer system. The future Class 6000 was prepared based on fundamental decisions in the management and Supervisory Board of Kienzle, and a first prototype of the computer could be demonstrated towards the end of 1964.

Finally, between 1962 and 1964, Kienzle was able to undergo the necessary learning process for the new computer age and emerge from this internal crisis stronger as a company.

5. Close cooperation with Nixdorf

This internal process of change coincided with an important collaboration:[16] The first contact between Kienzle and Heinz Nixdorf took place at the Hannover Messe in 1963. Nixdorf was to become a key figure in the German computer industry. At the time, however, he was only the head of his laboratory for pulse technology in Paderborn, which employed no more than

14 Müller: Kienzle, p. 82.
15 Ackermann: Zehn Jahre EAB, p. 2–4; Müller: Innovation, p. 258–272.
16 Müller: Kienzle versus Nixdorf, p. 305–327.

100 people and worked mainly on development contracts for other companies in the business machine industry. There were several negotiations between Kienzle and Nixdorf from 1963 to 1965. At the level of technical cooperation, it was agreed that Nixdorf would supply the electronic memory system for the planned Kienzle Class 800 magnetic account computer. In this form, the cooperation was successful, despite delays and setbacks. The new Class 800 was launched in 1966. Visually, it was still modelled predominantly on the traditional mechanical and partially electronic Kienzle accounting machines. In essence, however, it was Kienzle's first freely programmable small computer with magnetic accounting technology.[17] Although similar systems from other manufacturers were being launched at the same time, Kienzle enjoyed high demand, selling around 1,500 units by 1969 and a total of 2,800 by the time the system was discontinued in 1972.[18]

However, the cooperation between Kienzle and Nixdorf was to fail on a commercial level. There were various attempts at a (partial) merger, but none of them came to fruition, mainly for two reasons. Firstly, the different business interests of Kienzle and Nixdorf were too far apart. Secondly, their corporate cultures were not compatible: Heinz Nixdorf was an ambitious founder and entrepreneur looking for the best future option for his comparatively small but innovative Labor für Impulstechnik. Kienzle Apparate was, by contrast, a more traditional, family-run company with two large divisions, one for automotive supplies and the other for business machines. Around 100 Nixdorf employees worked for Kienzle in 1963/64, which had around 3,500 employees of its own. Nevertheless, Nixdorf considered himself to be on an equal footing with the Kienzle management. He was perceived by the Kienzle management as unreliable and very changeable regarding his promises. Overall, the negotiations between Kienzle and Nixdorf were unsuccessful. Cooperation between the two companies was limited to individual projects. The crisis at Wanderer-Werke, the large Cologne-based manufacturer of business machines, which got into financial difficulties in 1968, was an opportunity for Heinz Nixdorf. In April 1968, Nixdorf bought the entire Wanderer company and merged it with his laboratory for pulse technology to form the new Nixdorf Computer AG.

The years between 1964 and 1968 were crucial for Kienzle concerning breaking into the markets for medium data technology.[19] Although the

17 Heinrich: Mittlere Datentechnik, p. 48–50.
18 Ernst: Entwicklung der Fa. Kienzle Apparate, p. 96.
19 Ackermann: Mittleren Datentechnik, p. 588–592.

company was somewhat overshadowed by Nixdorf, the new market leader in Germany, it was able to offer attractive solutions for small and medium-sized businesses introducing new all-electronic systems, such as the 800 and 6000 series. The new models made it easier for many customers of previously mechanical business machines to move into electronic data processing. Large numbers of units were quickly sold, especially of the magnetic ledger accounting machines. The customers were industrial and commercial companies, especially banks and financial institutions, which rationalized and automated their administrative and organizational processes with medium data systems. Comparatively, inexpensive computers from Nixdorf and Kienzle also enabled medium-sized companies to enter the world of electronic data processing.

Picture 2: With the Class 6000 magnetic accounting computer, Kienzle achieved a breakthrough in the market for smaller computer systems.

Kienzle entered the new market with great publicity at the Hanover Messe in 1968, where the Kienzle 6000 was presented to the professional world for the first time. Visually, the computer had a completely new design. Technologically, it combined a freely programmable central computer with a magnetic account processing system and various peripheral devices. The system became a cash cow for Kienzle in the years to come. By 1974, a total of around 55,000 medium data systems had been installed in West Germany. Of these, 25 per cent came from the market leader, Nixdorf, and as much as 15 per cent from Kienzle in second place,[20] mainly systems of the Kienzle 6000 class and the more advanced 6100 class.

6. In the boom and crisis years of medium data technology

The final breakthrough of the German computer industry led to golden years for Kienzle Apparate in the first half of the 1970s. In addition, the company's second line of business, automotive equipment (especially tachographs), was also booming because of the expansion of the single European market. By the middle of the decade, dark clouds of crisis were already gathering, caused by increasing international competition and the changing economic situation in Europe. In 1974, Kienzle experienced its first decline in sales and profits in the office machine and computer sector.

Despite the unfavourable conditions, Kienzle was able to launch a completely new model in 1975. The EFAS 2000 series was aimed at the lower end of the medium data technology market.[21] The strategy was to offer the machines as a replacement for the mechanical accounting machines that were now being phased out. The good performance figures and the positive response from the trade confirmed the company's strategy of filling the gap in the market between automatic accounting machines and small computers.

The high pressure of competition and innovation in the industry put a particular strain on medium-sized companies in Germany. Some competitors had to leave the computer business or went bankrupt. The general technological buzzword was the switch to modular computer systems. This term represented the increasing ability to communicate and combine with

20 Rösner, Wettbewerbsverhältnisse, p. 64.

21 EFAS stands for Electronic Billing and Invoicing System ("*Elektronisches Abrechnungs- und Fakturiersystem*").

other information and technology systems and the transition to systems with screens and magnetic disc storage. For Kienzle, this meant launching a complete successor system to the previous 6000 generation and incurring considerable development costs. The delayed entry into modular computer systems was also reflected in a declining market share in Germany. By the second half of the 1970s, Kienzle had slipped from 15 to less than 10 per cent in the medium-data technology segment, from second to fourth place. Nixdorf remained the market leader, but was now followed by Italian company Olivetti and Triumph-Adler.[22]

Kienzle's entry into the modular computer systems generation became successful with the new 9000 generation. The first model was the 9055 single-user system. However, its launch in 1980 flopped due to technical defects and a lack of compatibility with other systems. As a result, the company made a loss of DM 80 million in 1980/81, which could no longer be offset by the profits of the other division.

This pressure forced the former family business to sell the entire company to the industrial group Mannesmann AG in 1981/82.[23] Mannesmann was prepared to invest the necessary financial resources to accelerate the introduction of the 9000 family of systems. In addition, Mannesmann ordered a change of management and a restructuring programme with savings in development and sales.

The new subsidiary, Mannesmann Kienzle GmbH (the name was changed in 1984), succeeded in consolidating its market position in the computer sector. Kienzle continued to focus on target market strategies in sales. The most important customer groups continued to be banks, public administrations and medium-sized companies. A new segment was that of large customers, where important orders were won against competitors. In the low-cost computer systems segment (less than Mark 100,000 per system), Mannesmann Kienzle was able to maintain second place behind Olivetti, on a par with Nixdorf. In the medium data segment (up to Mark 250,000), Mannesmann Kienzle took third place behind IBM and Nixdorf.[24] These figures reflect the situation on the German market in the mid-1980s.

22 Müller: Kienzle, p. 108.
23 Ibid., p. 232–240.
24 Hillebrand: Schwarzwald-Klinik.

7. The end of the Kienzle computer business

The situation changed again in 1989/90 when the Mannesmann AG was awarded the contract to build the first German private mobile phone network, D2.[25] Priority was now on the telecommunications sector, whereas the computer business became uninteresting. Subsequently, the Mannesmann AG began looking for an investor for the Kienzle computer business.

This search ended in December 1990 when the Mannesmann management decided in favour of the US computer manufacturer DEC. The new company Digital-Kienzle GmbH & Co. KG was founded on 1 January 1991. The new company had a turnover of around one billion marks, 2,500 employees in the core company (formerly Mannesmann Kienzle) and a total of almost 4,000 employees including other Mannesmann companies and sales companies, which also became part of the new corporation. At a strategic level, the new partners hoped to achieve synergies in the German and European markets. DEC had previously concentrated on business with large customers in the manufacturing, scientific and research sectors, while Kienzle's computer business had traditionally focused on small to medium-sized enterprises, banks and public administrations.

However, there was no time to seriously explore the potential of this strategy. Instead, Digital-Kienzle fell victim to a serious crisis at its parent company, DEC. In the few years between 1991 and 1994, DEC's German operations went through one wave of restructuring after another. Only a rump business remained in Villingen. In-house hardware production was discontinued in 1994. A small successor company was run for a few years, mainly continuing the previous software business. The last light went out at the Kienzle computer factory in 2001 at the latest. This marked the end of a 50-year history of office machines and computers in Villingen.

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Hope and crisis: Hohner as a producer of small business computers

Matthias Röhr

1. Introduction

The West German company Hohner is an example of the hopes and expectations of a new beginning associated with the emergence of medium data technology in the 1960s. Entering this sector even seemed suitable as a second pillar for a non-industry company in the crisis. However, the history of Hohner also shows that, after just a few successful years, medium data technology and its manufacturers quickly found themselves in a crisis. Consequently, Hohner had to pull out of the market in 1976.

2. Origins of Hohner

Watchmaker Matthias Hohner began manufacturing harmonicas in the Swabian town of Trossingen in 1857. In the light of an increasing demand for the handy, inexpensive and popular musical instruments, particularly from the USA, his company was able to expand from the 1880s on. By 1885, he was producing one million harmonicas a year, and by 1900, well over three million, most of them for export. At the beginning of the 20th century, Hohner also began to sell accordions, another popular and mass-appeal musical instrument. His sons took over after the death of the company founder, and the company was transformed into a family-owned stock corporation in 1909 and continued to expand. At the end of the 1920s, Hohner was producing around 20 million harmonicas per year and had become Germany's largest producer of musical instruments. During the Nazi era, the company focused on the domestic market, and later manufactured munitions boxes and shell detonators for the Wehrmacht. After the war, Hohner tried to return to its previous successes with musical instruments.

However, lifestyles and consumer habits changed in the post-war period, to the disadvantage of the company. Popular music no longer had to be

homemade; instead, turntables and radios provided a more convenient way of enjoying everyday music. Harmonicas and accordions, once sold in large numbers to the masses, turned into musical instruments for a few talented entertainers. Hohner initially had no answer to this existential crisis. In the 1950s, the company began to diversify its range of musical instruments and started to produce flutes, saxophones and electronic pianos. As this did not provide a way out of the crisis, in the 1960s, Hohner decided to take on manufacturing jobs for other companies. This was a highly lucrative business during the years of full employment, and Hohner was able to utilize its large workforce and avoided lay-offs. As a result of this activity, the company acquired additional expertise in electronics production because Hohner manufactured taxi radios for Siemens and circuit boards for IBM.[1]

3. A producer of medium data technology

It was only after the death of Ernst Hohner in 1965, who was still part of the first generation after the company's founder, that the company tried to set up new structures, aiming to become less dependent on the musical instrument business or external production orders. This step was also a consequence of the brief recession of 1966/67, during which external manufacturing jobs suddenly fell away. At first glance, it seems surprising that Hohner decided to enter the medium data technology sector, searching for a secondary foothold. However, from Hohner's perspective in the mid-1960s, this was not so far-fetched. The company already possessed extensive experience in precision engineering and had gained a certain expertise in electronics through external manufacturing jobs. Given the technical fundamentals of the first office computers of this time, this seemed a sufficient foundation to join the growing data processing market as a newcomer. This decision was certainly also influenced by geographical proximity. Trossingen was only ten kilometres away from Villingen, the headquarters of Kienzle, one of the pioneers in the industry (see the article by Armin Müller in this volume).

In order to enter the data processing market, Hohner recruited senior engineers from Nixdorf and IBM, and they began developing computer models in 1967. The entry into the market was also supported by a partner-

1 For the history of Hohner up to the 1970s, see Berghoff: Zwischen Kleinstadt und Weltmarkt.

ship with the bookkeeping company RUF. The Swiss company, similar to its competitor Taylorix, had been developing a bookkeeping system based on forms and carbon paper since the 1920s. Later, it also supplied its customers with booking and billing machines, which it purchased from various manufacturers. In the mid-1960s, RUF began selling magnetic card computers, which were marketed under the name Praetor. While RUF purchased electronics for a Praetor model from Heinz Nixdorf and his "Labor für Impulstechnik" from 1965 onwards,[2] it also sold other models under the same name that were produced by Hohner, starting in the late 1960s.[3]

As a partner with market experience and an established sales structure, RUF certainly made it easier for Hohner to enter the data processing market, but Hohner had to establish itself as an autonomous computer manufacturer to avoid becoming dependent. Therefore, at the end of the 1960s, the company began to invest in setting up its own distribution network and training centre. It finally marketed its first models in 1970 under its own name via its subsidiary "Gesellschaft für Datensysteme und Computer".

Hohner finally launched several classes of instruments on the market between 1970 and 1972, covering different price and performance categories, from the Hohner-2000 to the Hohner-9000.[4] Thanks to its cooperation with RUF and the sales of its own sales department, the turnover of Hohner's computer division grew from DM 12.1 to 26.8 million between 1969 and 1973.[5] Even if these figures looked like a successful market entry at first glance and Hohner made profits in these years thanks to its computer division, these turnovers look problematic when looking at the market as a whole. During the period in which Hohner was able to double its income, industry leader Nixdorf was able to almost triple its turnover.[6] While Hohner was able to benefit from the boom of medium data technology and grow with the market, it was unable to generate independent growth beyond this. This meant that Hohner was heavily dependent on the development of the market.

Consequently, after its brief boom phase in the years from 1970 to 1973, the company, together with other medium data technology companies,

2 Berg: Heinz Nixdorf. Eine Biographie, p. 94-99.
3 Eglau: Computer vom "Bläslemacher", in: Die ZEIT 32, 11 August 1972.
4 Auerbach: Guide to small business computers, p. 2.
5 Berghoff: Zwischen Kleinstadt und Weltmarkt. p. 605.
6 Berg: Heinz Nixdorf. Eine Biographie, p. 114.

fell into a crisis from 1974 onwards. Even though the company attributed this to many companies' unwillingness to invest because of the economic turbulence of the mid-1970s, it became apparent during this period that Hohner had been too optimistic about its market opportunities. This was mainly because the conditions of the former office machine market were changing rapidly in the 1970s due to the advance of computers. Until the 1960s, office machines could be sold almost unchanged for several years or even decades, but the computer market had a faster pace of innovation. To keep up with the increasing international competition, high and especially continuous investments in the development of products were necessary. A smaller manufacturer such as Hohner, which could only sell limited quantities, could not afford this level of investment.

Therefore, in the mid-1970s, Hohner had to modernize its product portfolio in order to keep up with the new dialogue-oriented magnetic disk systems of its competitors. Despite building up sufficient in-house expertise, Hohner contracted the development work to the external engineering firm "DFE" near Karlsruhe, founded by a former Nixdorf developer, which was later successful with own products.[7] But the high development costs for the new Hohner computer "HC 1", which was first was presented in October 1975,[8] could no longer be recovered from sales of the older models, meaning that the computer division made losses.[9] Even unusual campaigns to increase sales, such as offers for short-term leasing of appliances at year-end, including the provision of trained staff via the employment office,[10] did little to help.

The overall situation of the company took a clear turn for the worse and insolvency was imminent. Largely under pressure from its creditors, Hohner began to withdraw from the computer market in the course of 1976. The West German market leader, Nixdorf AG, quickly came into play as a buyer. In the autumn of 1976, Nixdorf announced that it would initially take over 75 % of Hohner's computer division. Hohner's sales division would now sell Nixdorf's hard disk system 8870 instead of its own development

7 Kontinuierliches Wachstum beim MDT-Spezialisten DFE, in: Computerwoche, 22 April 1977.

8 Anwender zeigen wieder Kaufinteresse. Signalisierte die Orgatechnik den Konjunkturaufschwung?, in: Computerwoche, 31 October 1975.

9 Hohner: Verlust bei DV, in: Computerwoche, 27 August 1976.

10 Hohner Computer 2000M für 2 bis X Monate Kurz-Zeit-Miete. Anzeige in SPIEGEL 46 (1975), p. 228; Magnetkonten-Computer in Kurzzeit-Miete, in: Computerwoche, 21 November 1975.

"HC 1".[11] But it appears that Nixdorf's main objective in the takeover was probably neither the models nor the production capacities, nor even Hohner's sales channels, but primarily the expansion of Nixdorf's market share and Hohner's customer contacts. This enabled Nixdorf's additional growth opportunities by selling new devices in the medium data technology market, which is strongly defined by strong customer relationships.

4. Conclusion and end

When Hohner withdrew from the computer market in 1976, it became clear to many market observers that the boom phase of medium data technology was finally over. In the same year, Anker, a traditional manufacturer of cash registers and pioneer of medium data technology, also had to file for bankruptcy. The protected niche between the large mainframe computers and the smaller booking machines, which had made the emergence of medium data technology possible, no longer existed. Hohner was a company from outside the industry, and had taken the risk of entering a wholly new and promising market, driving forward the transformation of the office machine into a computer, but it underestimated the dynamics of this market and its underlying technology. Looking back, it seems as if Hohner's computer activities were doomed to failure from the outset. This misjudgement was widespread. After a brief period of success, none of the other West German producers of medium data technology managed to establish themselves as sustainable computer manufacturers. Similar to Hohner, they remained too small to build up sufficient development capacities or, like Nixdorf, focused more on a strong sales organization. However, this did not enable them to remain competitive as computer manufacturers in the long term. Once the PC became the central office machine in the 1980s, the remaining manufacturers were no longer able to keep up. To this extent, Hohner's short history as a computer manufacturer is an illustration of what happened to West German computer manufacturers.

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Eiserfeld: European production and development centre for European data technology

Christian Franke

1. Introduction

In contrast to many other 'mythical' places in the history of computers and data technology, the site of Eiserfeld does not appear in the standard works on computer history. Although the computer giant IBM made the rather small towns of Endicott and Armonk (in the state of New York) famous,[1] and its later competitor Apple did the same for the small town of Los Alto (in the state of California) or the German manufacturer Nixdorf for the tranquil town of Paderborn in East Westphalia (North Rhine-Westphalia),[2] Eiserfeld in South Westphalia (North Rhine-Westphalia) is hardly known. However, there are few places in Europe where the eventful history of data technology 'made in Europe' can be found in so many facets. Traces can be found at the Eiserfeld site from mechanical typewriters and early semi-electrical booking machines to the first ever fully electronic booking machine or the small computer division of the European joint venture 'Unidata', to the last great attempt by a European company to keep up with personal computer (PC) development – the Philips :Yes computer. It is remarkable that Eiserfeld is a neglected site of European data technologies and computers if we consider the multifaceted developments there.

This paper takes a closer look at the location of Eiserfeld in the development of data technology of European production. What is the significance of the production site and the companies producing there for the development of European data technology? How did location factors affect entrepreneurial activity? Why has the Eiserfeld production site hardly been mentioned in the history of computing?

1 Pugh: Building IBM.
2 Berg: Heinz Nixdorf

The majority of studies focus on the business history and individual European producers of data technology.[3] These works have always taken into account a production site's characteristics for the development and production of data technology. However, a location itself, with its specific factors, and their suitability at different phases in the history of computing, has seldom been zoomed in on.[4] In order to be able to do this for Eiserfeld, this article is based on the archives of and business history studies on Siemag and Philips (Philips Electrologica, Philips Data Systems and Philips Kommunikationstechnologien AG)[5] producing there, isolated interviews with contemporary witnesses and works on local (economic) history.

In the following, the basic location factors of Eiserfeld are outlined, then the development of the Eiserfeld production site is presented in six chronological chapters. Finally, the guiding questions of this paper are answered in a concluding chapter.

2. Production site characteristics at Eiserfeld, South Westphalia

The economic history of South Westphalia has been shaped by the mining industry and strong companies for mechanical engineering, especially plant and rolling mill construction, since the 19th century. These companies had mixed mining-industrial product portfolios up to the mid-20th century. Thereafter, the focus was increasingly on highly specialized products sold worldwide.[6]

The founding of the European Coal and Steel Community (ECSC) in 1952 was extraordinarily significant for the region and the Eiserfeld site due to the ECSC banning the railway's exceptional tariffs for the transport of iron ore, which had existed since the 1880s, from this region to the Ruhr area because of their competition-distorting effect.[7] From then on, the extraction of various ores was no longer lucrative. After a final ruling by the European Court of Justice, the last mine in the region, Pfannenberger Einigkeit in Eiserfeld, ceased operations in April 1962. This meant the end

3 Müller: Kienzle; Berghoff: Zwischen Kleinstadt und Weltmacht; Feldkamp/Dressler: 120 Jahre Wanderer.
4 Mahoney: Histories of Computing.
5 Henrich-Franke: Innovationsmotor; Stähler: Frühe Innovationen.
6 Hufnagel: Interesse und Verantwortung; Gösche: Insolvenzen und wirtschaftlicher Wandel.
7 Petzina: Eine Industrieregion, p. 66.

of an almost 2000-year mining history for Eiserfeld, which was followed only a few years later by the end of steel production in the Eiserfeld ironworks.[8] This marked the beginning of the search for new motors of industrial development. Data technology was to play an essential role in that context.

Concerning the classic production factors, the Eiserfeld site was characterized by a number of disadvantages regarding the production of data technology in the mid-20th century. Firstly, Eiserfeld, located in the peripheral mountain region of South Westphalia, had a poor transport infrastructure and high transport costs.[9] The region had neither navigable waterways nor an efficient railway system. Until it was connected to the motorway network in the 1970s, road freight transport was not an alternative either. Secondly, the region was comparatively scarcely populated. Eiserfeld itself had just 9,000 inhabitants in the second half of the 20th century; together with the neighbouring towns of Hüttental and Siegen (all three merged into to the town of Siegen in 1975), the population was close to 100,000. The labour supply was limited both in terms of numbers and specialized qualifications for data technology. The regional education system hardly trained for such expertise. Even the University of Siegen, which was founded in 1972, focused primarily on the heavy industrial plant construction. Thirdly, there was the difficult topographical situation in the narrow Siegtal valley, which made a large integrated plant scarcely possible. What was available, however, was entrepreneurial expertise in (inter-)national cooperation. The leading mechanical engineering companies in the region had opened up to world markets, especially North American companies, at a very early stage.[10]

3. Eiserfeld – a production site in transition

a) The beginnings of production in Eiserfeld

The Eiserfeld production site was established in the early 1920s by the Siegener Maschinenbau AG (Siemag) to produce precision mechanics, especially bicycles and chains, for regional markets. From the beginning,

8 Neutsch: Einmischen.
9 Franke: Zur regionalen Industrialisierung.
10 Henrich-Franke/Neutsch: Aus dem Siegerland in die Welt, p. 82–84.

however, precision mechanics was a secondary part of Siemag's product portfolio. The actual core business, the construction of rolling mills, which increasingly developed into the main pillar of the company, was not carried out at the Eiserfeld site. Regarding the rolling mills, the company had conquered world markets already in the interwar period and formed its own expertise in areas such as research and development around this product.[11] Siemag owed its entrepreneurial success to a strategic policy of cooperation and licensing as well as its own research and development. Before the Second World War, however, data processing, in the broadest sense, was neither part of the Eiserfeld site nor of Siemag.[12]

b) External expertise and the entry into data processing

External expertise was the entry into data processing and its subsequent technical development at Eiserfeld. After the Second World War, typewriters were manufactured for the first time alongside the production of steel chains, following a suggestion by refugees who had worked in the Saxon Wanderer-Werke on the production of office machines. In the shadow of the rapidly expanding typewriter business, the Siemag management in the first half of the 1950s pushed to extend the product range into the field of office communication to include accounting and invoicing machines, especially in view of fierce international competition in the mechanical typewriter segment. This should also meet the more sophisticated demand for data processing equipment. However, the necessary technical expertise was available neither among the staff at Eiserfeld nor at Siemag as a whole. The company, therefore, entered more sophisticated machine production without its own research and development. A balancing machine was connected to a Siemag typewriter, which was produced externally, as was the relay technology connecting them.[13]

11 Hufnagel: Interesse und Verantwortung.
12 Henrich-Franke/Neutsch: Aus dem Siegerland in die Welt, p. 85.
13 Henrich-Franke: Innovationsmotor, p. 100.

Picture 1: Typewriter production in Eiserfeld (1950) (Source: Archives of the SMS Group)

The early 1950s were characterized by a price war in the segment of semi-electronic accounting machines, which Siemag could not survive. The location conditions at Eiserfeld were simply not suitable for low-priced, mass production because of the high transport costs, lack of qualified personnel and lack of technical expertise. Data technology could only be successfully produced and sold if it was highly innovative. This, in turn, required technical research and development, which was not available. Consequently, Siemag entered a (patent) cooperation with leading companies in the industry in the mid-1950s, including Zuse KG in the field of electronic component production.[14]

Siemag took an important step for the further development of the Eiserfeld site when, on 1 July 1954, it concluded a general licence agreement with the Frankfurt-based engineer Gerhard Dirks, who had registered leading patents on data storage methods and storage devices.[15] In this agreement, Siemag received the exclusive first right of the commercial exploitation of

14 Hanewinkel: Computerevolution; Zuse: Der Computer.
15 Rimmer: Die Flucht.

the patents in the areas of typewriters and calculating machines, as well as calculating and non-calculating office machines, which also applied to new models to be developed. The management secured the company's entry into the field of electronic data processing. In return, Dirks' engineering office retained its independence, basic financial resources and became the actual research and development centre for production at the Eiserfeld site, albeit in distant Frankfurt.[16]

Research and development by Dirks' engineering firm, however, hardly paid off for Siemag. On the one hand, Dirks did not succeed in implementing his basic concept of decentralized data processing at small input terminals – the subsequent core concept of medium range computing[17] and, 20 years later, also the recipe for the PC's success. On the other hand, the technical advances of Dirk's company did not serve Siemag's market segment. Siemag was able to present the world's first fully electronic accounting machine, the Dataquick, at the technical fair in Hanover in 1959. But the Dataquick was simply too expensive for the market segment below mainframe computers that Siemag served at the time.

The basic problem for the future development of data technology at the Eiserfeld production site at the end of the 1950s was that technical development, production and sales were not co-ordinated and bundled. To specialize in production, develop innovative products and establish an effective sales and customer service network was a matter of survival for the Eiserfeld site. These challenges, however, had already subsequently been taken up by Siemag in the 1950s.[18]

c) Specialization and extension

Siemag intensified its efforts at the beginning of the 1960s, and rebuilt the Eiserfeld site having specialization and expansion in mind. To this end, a number of measures were taken. (1) Firstly, the product portfolio was reduced by ceasing the production of chains and mechanical booking machines. In 1963, the production of typewriters was transferred completely to Portugal. From then on, only fully electronic office computers and (for a transitional period of two years) electromechanical invoicing machines

16 Henrich-Franke: Patents and Licences, p. 76–77.
17 Heinrich: Mittlere Datentechnik.
18 Henrich-Franke: Innovationsmotor, p. 105.

were manufactured in Eiserfeld. The specialization of the Eiserfeld site also included the production of semifinished items, such as cable harnesses, in their own production facility in Hamm. Siemag wanted to make more effective use of the limited possibilities in Eiserfeld and, at the same time, become less dependent on suppliers. 2) The specialization in office computers went hand in hand with product diversification in this area, which was demanded by an expanding market. From 1965 onwards, Siemag produced a functional range of office computers in Eiserfeld in various sizes: the Data 1000, 2000 and 5000 were aimed at a heterogeneous clientele ranging from retail shops to commercial banks. (3) Siemag became independent in research and development. The company took a decisive step by setting up its own research and development centre in Eiserfeld, which was to further develop the fully electronic product range independently of external expertise. Subsequently, Siemag built up its own technical proficiency in the first half of the 1960s and specifically recruited engineering staff from outside the region. A truly independent technology development was established around the storage technology of magnetic ledgers for the first time. The research and development department was converted into a modern research centre, which has been based on the production site in Eiserfeld since 1968. A special focus was then placed on sales-oriented thinking and concrete application references, which is why the development centre did not see itself as a pure engineering laboratory but rather as a centre for combined hardware and software. In the tradition of Gerhard Dirks' concepts, decentralized data processing was the guiding principle of development activities.[19] (4) The technical development of the equipment and the ever-increasing importance of different software solutions resulted in the construction of a special training centre in 1965 for employees and customers using office computers. However, the training centre had to move to neighbouring Herdorf as rooms could be rented there at a reasonable price. It would have been too expensive to build from scratch on the narrow site in Eiserfeld.

In the mid-1960s, despite all the entrepreneurial efforts, it became apparent that the production and development of modern data technology at the Eiserfeld site had reached its limits. The magnetic card computers of the data series were at the forefront of the technical development of ultra-modern single-user machines and machine systems. The business

19 Henrich-Franke: Patents and Licences, p. 77–78.

challenges, however, were growing steadily, especially the cost pressure from distribution networks, research and development, training and ever shorter product cycles. At that time, large corporations, such as IBM, were able to offer their comparable products, such as the 'IBM 6400 Accounting Machine', at much more favourable conditions than the corresponding Siemag products.[20] The Eiserfeld site, with its 2000 employees, had reached the upper limit of its capacity to be able to survive alone in the long term on highly competitive national and international markets. Eiserfeld was simply too small, the product portfolio of the entire Siemag too heterogeneous and the capital base of the company too limited to master the rapid technical changes with their manifold entrepreneurial challenges. Recruiting staff also proved to be increasingly difficult. The more smaller business computers became a mass product, the more difficult it became to survive in the market as a medium-sized company. In addition, data technologies and computing were industries that required entrepreneurial expansion strategies that did not match the tradition and expertise of Siemag's management. Nevertheless, the location in Eiserfeld, with its newly established research and development centre, product concepts, increasingly differentiated sales network and specialized staff, was an attractive site for integration into a larger business complex with a compatible overall portfolio.[21]

d) Joint ventures and international cooperation as answers to the American challenge

In this critical situation, Siemag entered into a 'joint venture' with the Dutch Philips group, which ended in a unanimous takeover of the site within a few years. In the second half of the 1960s, Philips – the largest European electronics group at the time – tried to make massive inroads into the future industry of data processing and computing. This move was also prompted by the fact that their previous major customer, IBM, had switched to producing electronic components for computer production by itself. For Philips, the step into the production of office computers at Eiserfeld was, therefore, not only an investment in the future but also a step to safeguard its own production capacities. In 1968, Philips also ac-

20 Cortada: IBM
21 Stähler: Frühe Innovationen.

quired the Dutch computer manufacturer Electrologica,[22] partly to anticipate IBM's advance into the European market, and integrated it into its own, previously rather insignificant 'Philips Computer Industrie' in Apeldoorn: henceforth, under the name 'Philips Electrologica'. Remarkably, as early as 1964, Philips had enticed Dr. Munter, the head of the new development centre in Eiserfeld, away from Siemag.

The joint venture, which started in 1966, enabled Eiserfeld to overcome the existing production restrictions more easily in the group of the large corporation. The internationally widespread sales network and many semi-finished products, especially electronic components, which could be supplied much cheaper within the large Philips group were important aspects. At the same time, Eiserfeld was a prime site for Philips to expand its computer division. In this respect, it seemed only logical that the Philips board of directors, who were extremely positive about the development opportunities at Eiserfeld, planned to take over the production site as early as 1967. It enabled Philips to be able to "regroup the entire area of electronic data processing systems and office machines".[23] From then on, the computers manufactured at Eiserfeld, such as the extremely successful P250 and P350 models – the latter alone sold 25,000 units worldwide between 1969 and 1975 – bore the Philips label, although technically the Data series designed by the Eiserfeld development centre continued to be concealed behind the devices. Eiserfeld was organizationally integrated into Philips AG, however, for the time being, a high degree of continuity was maintained in terms of staff, products and work processes.

The binational joint venture from 1966 onwards had been a first step for Philips towards meeting the 'American challenge' represented by IBM. Just a few years later, at the beginning of the 1970s, Philips and other European companies in the data processing industry were again confronted with the question of having to join forces in a European 'joint venture'.[24] Governments across Europe made a plea for European cooperation. Previously, Siemens had lost the American technology supplier RCA, the French CII had problems with technical development and Philips was still busy developing its own strategy to become a major European producer of data

22 De Wit: The Construction.

23 Correspondence of Bernhard Weiss (Siemag) with P.H. le Clercq (Member of the management at N.V. Philips Gloeilampenfabrieken), in: Archives of the SMS Group Dahlbruch, S-Da 01 D2 33 2844.

24 Hilger: Von der Amerikanisierung.

processing equipment. All three companies cooperated in 1972/73 to form the European alliance 'Unidata'. Together, they were able to offer the whole range of data technologies as a European competitor to IBM.[25] Philips took over the small business computer division in Unidata, which meant that they joined Unidata essentially with the products of the Eiserfeld site. From then on, the P410, which was developed and manufactured at Eiserfeld, was sold as the Unidata 410. One of Unidata's design flaws, however, was that each of these partners only sought its own advantages. Philips did not bring any of the new developments conceived in Eiserfeld into the joint venture and, instead, hoped that it would be able to take advantage of the technical expertise of Unidata's partners, especially that of Siemens in the field of mainframe computers. It is, therefore, hardly surprising that Unidata, which was declared a 'European champion' by the European Community and celebrated as a prime example of a European industrial alliance, broke up again as early as 1974 due to national and corporate egoisms.[26] Unidata ultimately meant only a temporary relabelling of an established model from the portfolio of its office computers for the Eiserfeld site and the development and production there.

All in all, the Eiserfeld site emerged as a central building block of the Philips electronics group regarding the competition on the markets for data technologies and computers. Eiserfeld became an important driving force in the transformation of the Philips group into a provider of modern data technology because of its development centre and technical expertise.

e) Specialization and expansion within the Philips group

As a result of the Unidata intermezzo, Philips stopped producing mainframes. However, this did not change the fact that the incorporation of the Eiserfeld site into the Philips group was a smooth transition. Within the large corporation, Eiserfeld stood for the production and development of the smaller office computers and was, thus, able to continue the strategy of modularized and decentralized data processing still adopted in Siemag times under the new name Philips Data Systems.[27] As part of Philips, the new possibilities, such as the joint production of components, complement-

25 Hilger: The European Enterprise.
26 Kranakis: Politics, Business; Sandholtz: High Tech Europe.
27 Stähler: Frühe Innovationen.

ary research or professionalized international sales, became noticeable in the sales figures, which increased sharply. Even the production changed. Philips manufactured semifinished products (electronic and electrotechnical elements) at other company sites and primarily manufactured finished products in Eiserfeld.

The P300 series, which was designed in the Eiserfeld research and development centre and launched on the market in 1975, was quickly to become a bestseller. More than 10,000 units had already been sold to customers from 28 states in the first 2.5 years. More than 80 % of the production in Eiserfeld was exported, which also meant that Eiserfeld no longer served regional or national markets, as had been the case in Siemag times. Instead, Eiserfeld had turned into a production site for international markets. Business newspapers, such as Handelsblatt, were full of success stories about Eiserfeld in the years between 1975 and 1980. Philips Data Systems mastered this positive development. However, when the German government tried to financially support the manufacturers of data processing machines in the 1970s with its 'DV' programmes,[28] Eiserfeld was regarded as a Dutch producer and was received no support.

The strategy of decentralized and modularized devices had been continued with the P300 series, but, at the same time, new options for system integration and networking had been created. The series had a modular hardware design, so that magnetic account devices, display terminals, floppy disk drives, line printers, punch card punches and other peripherals could be flexibly combined. Various models of the series were equipped with components for the remote transmission of data, so that, with the appropriate network equipment, online connections could be established between decentralized company branches or with central data centres. Depending on the number of connected or networked devices, the integrated systems could no longer really be called 'small computers'. The P300 series developed in Eiserfeld also introduced new user software solutions. Software development was closely tied to the devices and their manufacturers can be seen in the name of the programming language 'PHOCAL' (Philips Office Computer Assembler Language). Software solutions were developed for the specific requirements of data processing in, for example, hotels, local authorities, clinics, industrial companies and construction companies. The good sales figures of the P300 series also prompted Philips to expand its customer network further.

28 Ahrens: Varieties of Subsidization.

Expanding production figures, ever-increasing research and development requirements, and a steadily rising need for training once again revealed the capacity limits of the Eiserfeld site. In the early 1970s, therefore, new facilities were built in the Weidenau district of Siegen, 5 km away, for the head office and the main headquarters of the customer service network, which was composed of 300 technicians in 70 support points and a sales network with 4 regional sales directorates and 30 sales offices only in Germany. In 1977, facilities in Weidenau were extended by a new training and information centre to train customers and employees in areas such as data systems, process computers, terminals and their application in business and administration. This was even more important as the competitive pressure on the market for office computers further increased in the second half of the 1970s and marketing became more and more important. During this phase, Philips Data Systems consistently relied on the concept of a 'full-service' sales organization that continued to aggressively promote and sell office computers as complete packages of hardware, software, technical support, consulting and customer training.[29]

At the same time, Eiserfeld was transformed into a pure centre of development and production. Once again, a new development centre for another 450 technicians and scientists from various disciplines was built at Eiserfeld, because the development of software was becoming increasingly important for successful sales. It required interdisciplinary research by computer scientists, engineers, business economists, organizational scientists and work psychologists. After all, 40 % of the Eiserfeld workforce was already employed in research and development at this time, making the site into an increasingly important centre of innovation for the office computer sector. Eiserfeld (including the new facilities in Weidenau) could now be expanded so consistently also for customer training, because South Westphalia was better connected to the European road network through the construction of the A45 and A4 motorways in the first half of the 1970s, which put the unfavourable site conditions into perspective somewhat. At the end of the 1970s, the development and production site in Eiserfeld was Philip's largest and most important in the Data Systems Division.[30]

29 Linssen: PDS – Philips Data Systems.
30 Ende/Wijnberg/Meijer: The Influence, p. 202.

Picture 2: The Eiserfeld production site (1974) (Source: Foto Loos, Siegen)

f) Competition with the PC and networking of devices

The decision of the group management to completely discontinue the production of mainframes was accompanied by a realignment of the internal company organization, which resulted in a greater centralization at Philips Data Systems. This particularly affected the rather autonomous location in Eiserfeld. Important decisions regarding production and development were no longer made there but at Philips headquarters in the Netherlands. The greater centralization continued in 1982 when Philips merged its office and telecommunications divisions – henceforth, Philips Communications Industry. Merging technologies made the Philips management even merge their divisions. This also meant that strategic and operational decisions were made in the Netherlands, where expertise tended to be in electrical engineering and telecommunications. This was considered more significant for the further development of the company compared to data technology.[31]

31 Dekker: Levenslang Philips.

Philips' computer division developed extremely positively in the second half of the 1970s and the early 1980s – the years 1984 and 1985 were even the most successful ever – although with clear differences between the individual departments. The production and development of small computers in Eiserfeld stood out particularly positively. Van de Ende/Wiganberg/Meijer[32] even conclude that of all the activities of the Philips Group in the field of data processing and computing, only the office computers developed and produced in Eiserfeld were a business success. Thus, the success with the P 300 series was continued with the successor models P 4000 and P 9000. The established concept of modularized and decentralized data processing equipment, which was developed in Eiserfeld, corresponded to the possibilities for decentralized office work created at the time by new digital data networks.

Nevertheless, the decline came quickly. Philips reacted less successfully to the PC, which entered the market in the first half of the 1980s, intensified competition enormously and spelled the end for many European producers of data technology. After 1986, Philips tried to counter the IBM PC with its flexible software applications with the Philips :Yes computer, which had not been developed in Eiserfeld after the restructuring of the Philips group. Eiserfeld was realigned with a focus on terminals and components, including printers, which were now manufactured in Eiserfeld. The :Yes computer, while faster than IBM's PC, was not compatible with the PC's software and, thus, much more limited in its application possibilities. While the PC software was flexible to use and adult education centres (*Volkshochschulen*) started to offer a wide range of software courses, Philips customers had to rely on the company's own software and training. Philips simply failed to move away from the concept of a 'full-service' sales organization offering office computers as complete packages of hardware, software, technical support, consultancy and customer training at this crucial stage in the development of data technologies. In addition, the PC was significantly cheaper than a comparable :Yes computer from Philips. As Philips slipped increasingly into the red in the second half of the 1980s, the entire computer division was sold to the American manufacturer DEC (Digital Equipment Corporation) in 1991.[33]

The site in Eiserfeld/Weidenau, which had lost its key position as Philip's research and development centre, was given up in the course of the sale

32 Ende/Wijnberg/Meijer: The Influence, p. 201.
33 Dekker: Levenslang Philips, p. 277ff.

of the computer division. Only some parts were able to survive under new brands, such as the printer division, which from then on served the market niche of continuous feed printers as a management buyout in the new company PSI (Printer Systems International).

4. Conclusion

First Siemag and then Philips manufactured data processing technologies at the production site in Eiserfeld for four decades, from the first mechanical typewriter to the :Yes computer, perhaps the last European competitor to the IBM PC. Location factors forced Siemag and Philips to be highly innovative and permanently adapt their corporate structures to changing markets and technologies. In these four decades, the Eiserfeld site periodically reached the limits its capacity, which initially led to its integration into the Philips group and then to the outsourcing of administration, service and training to Siegen-Weidenau. From the end of the 1960s, the comparatively small Eiserfeld site was only able to survive the fierce competition of a consolidating data industry as part of the Philips Group because it was able to concentrate on small office computers and purchase semifinished products cheaply from Philip's own production facilities.

After the takeover in 1969, Philips continued to run the Eiserfeld site in its substance and made the factory the entrepreneurial base for one of the strongest European competitors to US producers. The large corporation created the preconditions for a continuation of a gradual development and expansion of the site, where research, development and production were closely linked. Even in the 1990s, when many European manufacturers of medium-sized data technology had long since disappeared from the market, computers and their devices were still being manufactured in the same halls in which Siemag had produced the first mechanical typewriters in 1948. Remarkably, the Eiserfeld site (under both Siemag and Philips) was transformed from a pure production site in the 1950s, where neither research nor development was carried out, to a research and development centre for small office computers.

Eiserfeld must be regarded as a truly European location for the production of data processing technologies, because it was integrated into a transnational group, produced for international (especially European) markets and was even part of European cooperation projects, such as Unidata.

It is likely that Eiserfeld has received so little attention from historical research because there was no actual 'national champion' there. When national governments designed their support programmes for the data processing industry in the late 1960s and early 1970s, they addressed national manufacturers and – as in the case of the Federal Republic – not Dutch companies on German soil. The extent to which the 'national glasses' influenced the perception can be seen precisely in the historiography, which – with a few exceptions – tends to attribute Philips to the locations in Eindhoven and Apeldoorn in the Netherlands. (Historical) research on 'German' producers of data and computer technologies have neglected Philips and, instead, tended to focus on 'domestic' companies. such as Nixdorf (Paderborn), Kienzle (Villingen) and Hohner (Trossingen).

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In-House Computing? (De-)Centralizing data services in Germany, c. 1970

Michael Homberg

1. Computers in the Federal Republic of Germany around 1970

The widely popular electronic brains in the dawning computer age were large machines, usually surrounded by even larger computing centres. Thus, since the 1950s, centralized computing services, based on colossal data processing machines, had gained an overriding importance in business, administration and academia, as acquiring computers was energy-, manpower- and capital-intensive, and know-how was scarce. Smaller companies, therefore, shared computing time and used (mainframe) computers and consultancy services from IBM and other competitors extensively through the 1960s.[1] As in the United States, computer power via data networks developed into a dynamic business area throughout Europe and, thus, also in West Germany, while time-sharing became the order of the day, both in industry as well as in the banking and insurance sectors. However, data service centres were facing new challenges by the 1970s, as decentralized arrangements and consultancy agencies emerged. Since computer usage had become substantially cheaper, a new make-or-buy debate quickly flared up in Germany under the slogan: "EDP in-house or outsourced?"[2] Small computers and microcomputers with microchips and miniaturized hardware now conquered offices and factories, while computer networks simultaneously expanded, making long-distance data transmission and remote working arrangements possible.[3] Hence, in addition to setting up, maintaining and repairing computer systems, service

1 Leimbach: Geschichte der Softwarebranche; Gugerli: Welt; Dommann/Rickli/Stadler: Data Centers; Campbell-Kelly/Garcia-Swartz: Economic Perspectives; Hu: Prehistory; Yost: Making IT Work.

2 Komor: EDV; MMA: EDV-Praxis, p. 197–137.

3 Neugebauer/Dehn/Thomae: Untersuchung; Neugebauer/Marock/Bujara: Markt für Software; Bundesministerium für Wirtschaft, BMWI-Dokumentationen: Informationstechnik.

companies installed computer networks and communication systems and designed customized programming solutions.

Politicians, entrepreneurs and publicists in West Germany closely observed the developments across the Atlantic, and soon, a larger political debate revolved around the question whether computers and computer-based data services should be centralized or decentralized. Here, state intervention had promoted a new technology policy for electronic data processing (EDP) since 1955. Nationwide EDP-subsidy programmes started in 1967[4] with an initial focus on industrial research and development and, most importantly, hardware production.[5] As the West German industrial landscape was characterized by the dominance of small and medium-sized enterprises, which – similar to the country's federalist structure[6] – shaped the process of digital transformation,[7] observers quickly predicted a growing need for on-demand access to data processing services via the telecommunications network.[8] Hence, in Germany, one of the world's top computer markets in the 1960s and early 1970s, and home to renowned hardware companies including Siemens, AEG and, in the mid-range computing sector, Nixdorf, Kienzle and Triumph-Adler[9], the implementation of nationwide computer services was a priority on the political agenda.

Using the West German case as an analytical lens to portray the complex liaisons between state and industry in 20th century computer policy, this article is devoted to the growing controversy over (de-)centralizing computer systems and computer expertise in the 1970s as a crucial, but largely overlooked milestone on the country's pathway into the digital age. Thus, it centres on the role which data centres, with large data processing machines and peripheral devices, on the one hand, and new decentralized

4 Homberg: Innovation; Bösch: Wege.

5 Sommerlatte et al.: Entwicklung, p. 80; cf. Leimbach: Geschichte der Softwarebranche, p. 182–187.

6 Thießen: Digitalgeschichte.

7 Petzold: Rechnende Maschinen, p. 428–432; Leimbach: Geschichte der Softwarebranche, p. 70.

8 Civilian computer usage served primarily to optimize and rationalize work processes. Accounting and bookkeeping, thus, powered German computer expansion. Digital technologies made a decisive contribution here to the expansion of the service society by radically changing logistics in mail-order businesses from the 1950s onwards, shaping systems for booking air and rail travel in the transportation and tourism sectors, and designing the processes in the banking sector with checking accounts and electronic payments. Cf. Bösch: Wege, p. 13; Heßler: Ersetzung; Müller: Job-Killer.

9 Jansen et al.: Untersuchung, p. 33f.; Diebold: Bedeutung, p. 203f.; Jacob/Jungemann: Statistischer Sammelband, p. 31–88, 181–188.

systems, based on small and mid-range computers, on the other, played in business and administration plans between the late 1960s and the early 1980s. Accordingly, the article exemplarily spots the political and economic power struggles over public-private partnerships when building computer service companies nationally.

2. Scaling Data Services: Governmental Policies and Corporate Interests in Digital Networks and Centralized Hardware Solutions

"Small computers or large data centres?"[10] This very question increasingly moved business leaders and governmental planning authorities in West Germany through the 1960s and 1970s. At first sight, however, there was little reason to question the crucial role of data centres in these days. The 1970s saw a veritable boom in computer (service) centres. Around 1970, there were more than 500 centres in West Germany; among them, 150 to 200 worked exclusively or partially for third parties.[11] Further attempts to centralize the EDP activities were mirrored in an EDP co-ordination and advisory office in public administration, set up by the German cabinet in March 1968 to establish a nationwide database network. Only a few weeks later, the *Gesellschaft für Mathematik und Datenverarbeitung* (Society for Mathematics and Data Processing) was inaugurated as a body to discuss and execute system planning and programming attempts,[12] while the *Co-operation Committee on Automated Data Processing* (KoopA ADV), formed

10 Schneider: Kleincomputer oder Rechenzentrum?.

11 The *Verband Deutscher Rechenzentren* gathered various service providers. See on this Lange-Hellwig: Rationalisierung, p. 34–52; VDRZ: Dienstleistungsunternehmen. On the data centre boom in the 1960s and 1970s, see Schneider: Kleincomputer, p. 87–95; Heinrich: Gemeinsame Computernutzung, p. 77–83; Hellfors: Zusammenarbeit, p. 5; Wirtschaftsforum. Rund 560 Rechenzentren in der Bundesrepublik, in: MM-Industrie-Journal, Vol. 78, No. 20 (1972), p. 400; Schwab: Zukunft, p. 132. Fischer/Frimmel: Gemeinschaftliche Datenverarbeitung, p. 9-11; Kloten: EDV-Markt, p. 130–136; Neugebauer/Dehn/Thomae: Untersuchung, p. 89–92. Another study names around 300 service computer centers: Seibt/Oehler: Erhebungen.

12 Deutscher Bundestag: Bericht der Bundesregierung über die Anwendung der elektronischen Datenverarbeitung in der Bundesverwaltung, 7 October 1968, Drucksache V/3355. URL: https://dserver.bundestag.de/btd/05/033/0503355.pdf (accessed: 7 September 2023), p. 1–7; cf. Frohman: Network Euphoria, p. 311–313.

on 10 February 1970, centrally organized and co-ordinated the collection of data holdings at the federal, state and local levels.[13]

The Federal Ministry of Posts and Telecommunications (Deutsche Bundespost, DBP), with its monopoly in telecommunications, was a key actor in shaping the digital change in Germany. The DBP was in a key position to regulate the national computer networks and, with that, the upcoming data centre landscape, as the ministry was able to control the tariffs for digital data traffic. However, despite such plans being initially on the table, there were legal reasons which thwarted a directly owned DBP timesharing service. According to the Federal Constitutional Court, the DBP was only granted an unchanged transmission of signals, whereas data processing services had to be delegated to a third party.

The Federal Minister of Posts and Telecommunications, Werner Dollinger, had become acquainted with a timesharing service operated by the local telecommunications administration NTT (Nippon Telegraph and Telephone Public Corporation, Tokyo), during a trip to Japan in the late 1960s. He also read reports on nationwide services in England and Sweden. Bearing in mind the accelerated digital change in the USA, he commissioned to establish a comparable service in Germany. His successor Georg Leber continued to pursue the dirigiste planning calculus from the 1970s onwards.[14]

The plan to create new, centralized EDP services was eventually embodied in the *Deutsche DATEL-Gesellschaft für Datenfernverarbeitung* (German DATEL Company for Remote Data Processing). This company had

13 Brinckmann/Kuhlmann: Computerbürokratie, p. 123–133; cf. generally Fleischhack: Welt, p. 38–65. In the process, states and municipalities decided on the legislative basis to synchronize data traffic through "information systems". As a result, a network of municipal data processing centres, so-called *Gebietsrechenzentren* (KGRZ), was established, which provided regional data services for the public sector. There were more than 100 municipal data centres by 1978. Cf. KGSt, Gutachten; KGSt, Berichte; ADV 1987. The expansion of digital networks depended largely on economic and political goals, but it was also shaped by regional disputes over competencies and local situational opportunities. Cf. Thießen: Digitalgeschichte, p. 64–68.

14 DBP, Dateldienste, 24 March 1967; Meeting with AEG-Telefunken and Siemens AG on 15 January 1969 on the promotion of EDP and data transmission by DBP; Memorandum ("Aktenvermerk"), 18 April 1969; Technical Report, T-No. 18, Data Communication System for Nation-Wide Banking Business, Synopsis, 30 April 1969, B 257/20248; Administrative Board, DBP, meeting minutes, 31 July 1970, p. 47–50, B 257/1753; on early press reports since 1968, see DATEL-Report, 28 June 1973, B 106/99520; Press Review, 20 July 1970 – Gründung DATEL, B 257/1753, Bundesarchiv Koblenz (BAK).

been established, in line with preliminary agreements, as a private-law subsidiary to the DBP on 1 June 1970. In addition to the DBP as the main shareholder (with 40 % of the company's shares), the consortium included the leading national computer manufacturers Siemens, Nixdorf and AEG-Telefunken along with Olympia (with 20 % each). As the existing computer service centres in Germany were mainly held by IBM and other US competitors, this endeavour aimed to strengthen the domestic computer companies in line with larger industrial subsidy policies. Suggestions to include US companies, such as IBM, UNIVAC and CDC, were, thus, quickly overruled. Overall, the DATEL should, hence, do nothing less than "supporting the national computer industry".[15] Facing the "American challenge",[16] the German national "champions" were gathered to bridge the "technological gap".[17]

DATEL immediately spurred a huge media attention – and incited mixed feelings – by marketing new plugged-in computer networks ("*Computer aus der Steckdose*"). During its early conceptual days, in the late 1960s, Dollinger had only contacted leading Siemens and AEG executives, echoing close political relationships with certain computer hardware suppliers. Thus, competitors – especially among mid-range computer companies – harshly criticized the approach, as they worried that such plans could end up in a state monopoly in computer services and privilege competitors one-sidedly. Due to ongoing protests, and along with suggestions in ministerial bureaucracy, the consortium was extended with Olympia and the Nixdorf Computer AG as shareholders.[18] The *Manager Magazin* in 1972/73

15 Note on the situation DBP/DATEL GmbH, 8 January 1970; Willy H. Schlieker to Minister Georg Leber, 23 March 1970, B 257/20248; Deutsche Bundespost gründet Deutsche DATEL GmbH, outline of the announcement, B 257/20248, BAK. The DBP, here, was said to "catalyze" EDP knowledge and experience within the consortium. On the political agenda, see explicitly: Meeting AEG-Telefunken/Siemens AG, 15 January 1969, B 257/20248, BAK.

16 Servan-Schreiber: Die amerikanische Herausforderung.

17 Homberg: Innovation. On IBM's dominance in West Germany, see Stoltenberg: Die amerikanische Herausforderung; Ibid: Bundesrepublik, p. 258. The plans to establish a European computer company – through a consortium led by Siemens, Philips and the French Compagnie Industrielle pour l'Informatique – as a "fortress" against the dominating US competitors were pursued in the same vein. On these plans, see Unidata (I), 1971–1973, File No. 21945; Unidata (II), 1972–1973, File No. 22839; Unidata MC, 1973–1977, File No. 22752; Siemens Corporate Archives, Munich/Berlin. See also generally Kranakis: Politics; Hilger: European Enterprise; Ahrens: Varieties of Subsidization?.

18 Scherer: Telekommunikationsrecht, p. 368–372.

now saw prosperous perspectives in centralizing digital expertise in Germany, despite the monopoly issues, and explicitly attacked disparate work processes and "inefficient" single-solutions shaping the country's economic culture.[19] As DATEL quickly incorporated several small companies, others, however, disapproved the company's "ever-growing" appetite, calling DATEL a "haphazardly purchased dump".[20]

DATEL had been established to expand "telecommunications routes" and build up a national computer centre network based on remote "time-sharing" capabilities.[21] Its declared goal was to make commercial IT applications and services, in cooperation with the German Computer Centre (Deutsches Rechenzentrum), affordable, particularly for small and medium-sized enterprises. Data transmission capacities were in high demand and – with DATEL – computers and terminals were connected to the various data networks in growing numbers, while remote data processing was envisioned to bridge the performance gap between mid-range and large-scale, mainframe computer technology.[22] Advertising centralized computer services, however, required more than digital networks only – and so DATEL's products and services expanded. In addition to leasing, maintaining and repairing hardware, such as computer terminals, the company

19 Computer aus der Steckdose. Monopol für Datel? in: Manager Magazin, Vol. 2, No. 6 (1972), pp. 70f.; Selbst programmieren kommt teuer zu stehen, in: Manager Magazin, Vol. 3, No. 8 (1973), p. 62–66, here p. 62. See also Deutsche Datel-Gesellschaft für Datenverarbeitung endgültig gegründet – Nixdorf und Olympia dateln mit, in: Bürotechnik + Automation, No. 8/1970, p. 508f.

20 Die DATEL-Gefahr bleibt: Sie wächst und wächst, in: Die Computer Zeitung, 17 April 1973, p. 6.

21 Datenverarbeitung. Computer von der Post, in: Die ZEIT, 22 May 1970, p. 30; cf. Kein Gegensatz zum eigenen Rechner. Industriemagazin-Gespräch mit Dr. Bernhard Friedmann, in: Industriemagazin, 2 June 1972, p. 38; Novotny, Mähner und Assozierte: Service Rechenzentrum der Deutschen DATEL, in: DLW-Nachrichten (1973), pp. 42f.; 100 Millionen Mark Verwirtschaftet. Das Debakel der Datel, in: Frankfurter Allgemeine Zeitung, 8 January 1975, p. 7; Röhr: Der lange Weg, p. 193–196.

22 The demand in data transmission capacities in Germany was highly distributed among the various networks. Companies were particularly keen on using data transmission via the telephone network and fixed lines, so-called "power lines" (*Stromwege*), while demand for data transmission via the Telex or Datex network remained low. The DBP had listed an increase in computers and terminals connected to its networks since the late 1960s, from 1,273 to 17,553 in 1973 and roughly 37,350 in 1975. Other services, such as the electronic data exchange system (EDS) by Siemens, remained in an experimental phase, while an Integrated Services Digital Network (ISDN) was only planned in the late 1970s and early 1980s. Cf. Röhr: Weg, p. 197–200; see also Tietz: Dateldienste.

launched consultancy services, coached clients in EDP usage, and eventually even commercialized standardized programmes and applications.[23]

The company grew quickly regarding its personnel and service branches. DATEL started with three employees in June 1970; by December, there were already more than thirty. A year later, over 300 people were working at the headquarters and its branches. In October 1972, the company then reached nearly 500 employees, and even surpassed this with approximately 550 in June 1973. By December 1973, DATEL ran ten data centres across the country, from Berlin to Essen and from Hamburg to Munich.[24]

All parties involved had high expectations: While the DBP aimed to develop a nationwide data network, the computer companies in the consortium hoped to scale products and services. This plan seemed to materialize for Siemens and AEG, as nearly all DATEL data (service) centres quickly acquired large main computers – mostly made in Germany (seven were made by Siemens, one by AEG and only one by UNIVAC). Furthermore, data devices, terminals and peripherals were anticipated to be sold to DATEL clients by the mid-range computing companies in the consortium. However, despite the fact that DATEL's representatives regularly participated in working groups on mid-range computing and EDP outsourcing (Arbeitskreis MDT und Datenverarbeitung außer Haus), for example, in the *Arbeitsgemeinschaft für Wirtschaftliche Verwaltung*, the consortium quickly deprioritized its small-scale customer services in order to pursue large-scale data network plans. As a result, after 12 months, Nixdorf's shareholders internally already reconsidered the company's participation in DATEL, particularly as leading executives neither expected a "return-on-investment" nor groundbreaking "innovations in the EDP sector" by the new service consortium. To make matters worse, the press quickly reported

23 On DATEL's goals, see Ziele und Aufgaben der Deutschen DATEL GmbH, 21 September 1969, B 257/1753; Bernhard Friedmann: Die deutsche DATEL Gesellschaft, Skizze, c. 1973; Brochure: Die Datel GmbH als EDV-Dienstleistungsunternehmen, c. 1973; DATEL-Report, 28 June 1973, B 106/99520; Chefbriefe/Mitteilungen der Geschäftsleitung, in: DATEL-Intern, No. 1, 25 October 1972, p. 3f., B 257/7166, BAK.

24 Die Datel GmbH als EDV-Dienstleistungsunternehmen, c. 1973; Ein wichtiger Tag, in: DATEL Report, 28 June 1973, p. 1, B 106/99520; Jahresbericht 1971, B 257/7165; Jahresbericht 1972; Entwicklung eines Rechnerverbundsystems durch die DATEL GmbH, B257/7166, BAK. On DATEL's growth, see Die DATEL-Gefahr bleibt: Sie wächst und wächst, in: Die Computer Zeitung, 17 April 1973, p. 6. The DATEL headquarters has been located in a newly erected skyscraper in Darmstadt, Neu Kranichstein, since May 1973.

sensitive discords among the shareholders. Nixdorf announced in November 1973 that it was leaving the consortium.[25]

The DATEL dream, thus, proved short-lived, as repeated disagreements over organizational, technological and strategic issues caused the alliance to break up within a few years. When Siemens and AEG finally announced their withdrawal and DATEL was sold to foreign competitors (Générale de Service lnformatique Europe, GSI, Brussels, and INDELEC, Schweizerische Gesellschaft für elektrische Industrie, Basel), the German Bundestag lamented in March 1975 over a potential foreign network monopoly.[26] The episode exemplarily revealed how regional and national subsidy policies as well as new, fragile economic alliances determined the expansion of digital networks, data centres and computer services in Germany.

3. *Centralize or Decentralize Computing? The 1970s as a Digital Transition Period*

In Germany, during the 1970s, large corporations with data centres and cross-sectional EDP departments experimented with new, decentralized ways to enter, process and store data, based on microelectronics, mid-range computers and, subsequently, microcomputers and personal computers.[27]

25 Wir und unsere Aufgaben, in: DATEL-Intern, No. 1, 25 October 1972, p. 7; Neues vom MDT+DVaH-Arbeitskreis des AWV, in: DATEL-Intern, No. 2, 6 November 1972, p. 4, B 257/7166; Supervisory Board Minutes, Meeting 21 June 1974, DATEL Hochhaus, p. 5f., B 257/7167; DATEL im Markt von morgen, in: DATEL-Report, 28 June 1973, n.p., B 106/99520, BAK. See also Deutsche Datel-Gesellschaft für Datenverarbeitung endgültig gegründet – Nixdorf und Olympia dateln mit, in: Bürotechnik + Automation, No. 8/1970, p. 508f.; Angst vor IBM und Mut zum neuen System. Interview mit Heinz Nixdorf, in: Computerwoche, 13 November 1974, p. 8; Steigt Nixdorf bei Datel aus?, in: Frankfurter Allgemeine Zeitung, 26 October 1974, p. 14; Die Datel kommt die Bundespost teuer zu stehen, in: Frankfurter Allgemeine Zeitung, 17 December 1974, p. 11; 100 Millionen Mark Verwirtschaftet. Das Debakel der Datel, in: Frankfurter Allgemeine Zeitung, 8 January 1975, p. 7.

26 Deutscher Bundestag. Stenographische Berichte, 7. Wahlperiode, 155. Sitzung, 13 March 1975, p. 10857. On DATEL history, see generally B 257/7164 – B 257/7168; B 257/20248 – B 257/20253, BAK. For a historical perspective on the German Computing Centre, see also: Deutsches Rechenzentrum (DRZ), N 24, Hessisches Staatsarchiv Darmstadt; DRZ, fonds 504, No. 6655 – No. 6667; fonds 507, No. 7641, Hessisches Hauptstaatsarchiv, Wiesbaden.

27 When the golden age of "mainframes" ended, mid-range computers in the 1970s and the rise of personal computers in the 1980s and 1990s opened up new user groups. On mid-range computing, see Heinz Sebinger: Mittlere Datentechnik – kein

Concurrently, computer centres operating on vendor-bound hardware services were shared by small and medium-sized enterprises – and sometimes, as in the case of the Volksbanken or DATEV, even in cooperative models.[28] Above all, however, small business computers provided new opportunities, especially for self-employed professionals and small and medium-sized enterprises. Lawyers, physicians or tax consultants discovered computers in these days as crucial tools to optimize and rationalize their daily administrative duties.[29] Computers were gradually adopted even in crafts businesses.[30] The usage, according to Lutz J. Heinrich, was widely spread.[31]

From this perspective, the 1970s can be seen as a digital transition period. To pin down the change in numbers: according to a contemporary survey, hardly any company with less than 50 employees in the late 1960s used (or planned to use) data centres in order to pursue publicly debated EDP outsourcing plans. For many businesses, it was simply too expensive to use digital computers, even via time-sharing. Here, conventional punched card and accounting machines remained unrivalled, especially as modern online data processing (as a means to centralize remote resources) was barely

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Gegensatz zur Buchführung außer Haus, in: Der Erfolg, No. 3 (1976), p. 12–16, Sonderdruck, DATEV Corporate Archives; Pleil: Büro- und Personalcomputer; cf. generally Müller: Mittlere Datentechnik; Müller: Kienzle. On personal computers, see Danyel: Zeitgeschichte; Ehrmanntraut: Computer; Sarasin: 1977.

28 Nähr: Schramberger Modell; Heinrich: Gemeinsame Computernutzung, p. 87–103; Thürbach: Automatisierte Datenverarbeitung, p. 370–413; Straube: Zwischenbetriebliche Kooperation, p. 151–157; DATEV: Die DATEV heute, Broschüre 1973, DATEV Corporate Archives; Dube: Computer. On private and state computer schools see, e.g., Berufe / Datenverarbeitung: Aufstieg zu Cobol, in: Der Spiegel, 8 February 1970, p. 78f. The DGB's Bundes-Fachschule was among the largest computer schools around 1970. Individual computer service bureaus also offered their services, such as the cooperatively organized DATEV Kolleg. DATEV (1970): Werbeschreiben Steuerberater, p. 1f., DATEV Corporate Archives.

29 Reichertz: Bedeutung; Wolff: Einsatz, p. 21–36, 139–160; Kilian: Juristische Entscheidung; Ulf Bauernfeind: Eigener Computer oder Datenverarbeitung außer Haus, in: Der Steuerberater, 20 December 1977, p. 285–290; Niebling/Kussel/Freis: Computer.

30 Bensberg: Elektronische Datenverarbeitung; Rogowski/Kohle: Datenverarbeitung; Nagel/Single: Handwerk, p. 51–57.

31 Heinrich: Mittlere Datentechnik, p. 240. In a commentary published in the German trade press magazine *Computerwoche*, Heinrich challenged the conventional semantics of "mid-range computing" as a complicated, technical term and emphatically proclaimed a new nomenclature: "user-oriented computer systems". As new competitors arose who marketed "workstations" and "distributed data processing", companies should be alerted to win new users. Cf. Abschied von der Mittleren Datentechnik, in: Computerwoche, 10 February 1978, p. 6.

on the horizon. This changed only slowly in the 1970s, when an accelerated trend to "decentralize" data processing via mid-range and minicomputers grew popular and "full-service EDP service companies" gained ground.[32] Thus, mid-range computers were used by small and medium-sized enterprises, and, increasingly, within large-scale corporations. According to Nixdorf, nearly 50 % of the company's business revenue in the early 1970s was generated by sales in this category. The consultancy and marketing research company *Diebold Deutschland* even stated in 1975 that there was a continuous trend towards the coexistence of "large and small computers", as every second mid-range computer was sold to large size companies.[33] Here, they were utilized as office terminals and components in the data centre architecture.

A representative sample survey among nearly 4,250 companies in West Germany, commissioned by the Federal Ministry of Research and Technology in 1980, analysed German EDP markets and customer structures in-depth. Only 22 % of the companies (with more than ten employees) used their own computer systems, another 40 % were indirectly supplied by company headquarters or commercial data centres.[34] A total of 27 % of all data centre clients were larger corporations with more than 500 employees, while roughly 50 % were registered as mid-sized companies (50 to 500 employees) and another 20 % as small companies. The users were mainly regionally active, private service, sector companies, closely located (< 50 kms) to the data centres.[35] This mixed picture remained paradigmatic in the 1970s and early 1980s. However, since the mid-1980s and especially during the 1990s, new, cheaper and smaller solutions slowly

32 Heinrich: Gemeinsame Computernutzung, p. 196–213; Diebold: Markt, p. 30, 45–50, 73–81; Heinrich et al.: Mittlere Datentechnik und Datenverarbeitung, p. 1–11, 64–67; Service-RZ – oder lieber etwas Eigenes?, in: Computerwoche, 27 June 1975, p. 5; Stahlknecht: Erfahrungen, p. 84–87; Rösner: Wettbewerbsverhältnisse, p. 32–37; cf. also generally Leimbach: Geschichte der Softwarebranche, p. 238–245.

33 Rösner: Wettbewerbsverhältnisse, p. 35f.

34 As hardware acquisition depended greatly on the company's size, small businesses (increasingly even companies with under 10 employees on which the study only provided estimates) especially used computer service bureaus. Around 60 % of private owners used a small EDP system (purchase price less than 100,000 DM), and only 3 % could afford a large system whose costs exceeded one million DM.

35 Neugebauer/Marock/Bujara: Markt, p. 12, 40–48, 54–58, 62–65, 80–82.

dampened all data centre euphoria[36] and equally caused a rapid decline in mid-range computing, as workstations and personal computers conquered the markets.

4. Conclusion

Revisiting structural developments in West Germany's computer industry in the 1970s, this article explored governmental plans and path decisions to centralize or decentralize computers in industry, commerce and administration – with a special emphasis on a passionate make-or-buy debate quickly popularized under the slogan "EDP in-house or outsourced?". The threshold to the 1970s proved to be a decisive period, as dirigiste attempts to build up "national champions" in the computer industry and services, driven by an ongoing planning euphoria, were undermined by an accelerating worldwide competition in information and communication technologies. The DATEL story, hence, exemplarily showed how and why the country's regional and national subsidy calculus promoting new, however, non-durable economic alliances shaped expanding digital networks, devices and services. Technologically, small computers increasingly challenged the idea to centralize computers in large data centres and computer expertise in cross-sectional EDP departments. Hence, as microelectronics developed, decentralized (corporate) consultancy services saw a new boom driven by the "unbundling" of hardware and programming services. In a larger perspective, national solutions and claims, however, were globally entangled. Thus, since the 1980s and 1990s, when digital experts and consultants were mobilized by an enhanced drive to outsource work processes all around the globe, a new move to centralize data work and data services in large computing hubs, server clusters and business process outsourcing centres was under way, as digital networks expanded and cloud solutions grew popular. Hence, analysing the attempts and approaches to (de-)centralize digital work processes, with all their material and know-how resources, through a global lens remains a promising endeavour to explore the digital age, its systems, actors and dynamics in knowledge exchange.

36 Röske: Umstellung; Neugebauer/Marock/Bujara: Markt, p. 57; Gerhard Karck: Der Zahn der Zeit nagt auch am RZ, in: Online, Vol. 23, No. 8 (1985), p. 76; Leimbach: Geschichte der Softwarebranche, p. 260–262; 382.

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Annex

All-Purpose Computers (Universal Computers, w/o Medium Data Computers) in the Federal Republic of Germany (valued stock, reporting date: 1 January), Market Shares in %											
Company	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
AEG-Telefunken	-	-	0.8	1.0	1.5	1.7	1.9	1.9	1.8	1.9	2.1
Bull (Bull/GE)	-	1.3	2.3	1.9	1.8	2.3	3.8	5.4	5.5	5.4	4.9
Burroughs	-	-	-	-	0.2	0.3	0.6	0.6	0.6	0.5	0.4
CDC	-	-	0.1	0.2	0.6	0.6	1.0	1.8	1.7	2.0	1.7
Honeywell	-	-	-	-	-	0.1	0.6	1.6	2.0	2.1	2.0
IBM	60.1	65.2	69.0	71.5	71.9	73.0	70.5	66.4	66.6	65.8	65.8
NCR	0.5	0.3	1.5	1.3	1.3	1.2	1.1	1.4	1.4	1.2	1.2
Philips	5.1	3.6	2.6	2.3	1.9	1.4	1.1	1.1	0.8	0.7	0.5
Siemens (since 1968: Siemens-Zuse)	11.5	12.2	9.1	7.4	5.9	5.0	5.5	6.0	8.1	12.2	13.4
Univac	15.0	10.6	8.7	8.3	9.8	9.3	8.9	8.9	7.6	7.0	7.2
Zuse	3.8	3.3	2.7	2.7	2.5	2.6	3.1	2.9	2.3	-	-
Others	4.0	3.4	3.2	3.4	2.6	2.5	1.9	2.0	1.6	1.2	0.8

Annex 1: German Computer Markets (1) | Rösner 1978, p. 60ff., based on Diebold Computer Register.

Company	All-Purpose Computers (w/o Mid-range Computers) in the FRG (valued stock, reporting date: 1 January 1975), Producer Shares in %
IBM	61.6
Siemens/ Unidata	17.6
Honeywell	7.0
Univac	5.3
Burroughs	1.1
ICL	1.1
NCR	1.0
Others	5.3

Company	Installation, Producer Shares, Mid-range Computers in the FRG (absolute numbers | %)
Nixdorf	14,000 (25.1)
Kienzle	8,600 (15.4)
Philips	7,300 (13.1)
Triumph-Adler	6,800 (12.2)
Ruf	4,500 (8.1.)
Akkord	2,400 (4.3)
NCR	2,200 (3.9.)
Olivetti	1,900 (3.4)
Singer	1,700 (3.1)
Hohner	1,200 (2.2)
Burroughs	800 (1.4)
Others	4,350 (7.8)
Total	55,750 (100)

Annex 2: German Computer Markets (II) | Rösner 1978, p. 62 and p.64, based on Diebold Germany Statistics (o/b/o Federal Ministry of Research and Technology – DP-Program) and own calculations.

Structural Data	*Large Mainframe Computer Systems [Großdatenanlagen]*	*Mid-range Computer Users [MDT-Anwender]*	*Data Center Users [RZ-Benutzer]*	*Share, Workplaces [Anteil an Arbeitsstätten insges.]*
Basis	487	469	185	
Employees				
under 100	6%	27%	32%	51%
100 up to 200	7%	24%	24%	26%
200 up to 500	22%	34%	26%	15%
500 up to 1.000	22%	8%	13%	5%
1.000 and more	43%	8%	5%	3%

Annex 3: Sample Survey: EDP-Users in the Federal Republic of Germany (FRG) (c. 1975) | Neugebauer et al. 1976, p. 43.

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