An overview on Small Business Computer made in Europe

A short and long history of medium data technology

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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.

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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