Aspects of the History of Computing in Modern Greece

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This article aims to shed light on notable aspects of the history of computing in Greece, starting from 1920. We cover six areas, including the early days of computing in the country, the transition to the Internet era, the formation of a computer-related educational infrastructure, the evolution of data networks, and the growth of the software and hardware industry. In each area we highlight findings that involve the important role of women in this technological evolution, how the risks taken by particular individuals pushed the boundaries of the field, the slow pace of the universities at the early stages, and the key part of multinational technology companies and state-controlled banks. Apart from numerous reports and publications, our sources also include interviews with individuals who played a major part in the development of computing in Greece.

This article aims to overview the history of computing in modern Greece from 1920 until today. Our account is based on both primary and secondary sources, including gray literature as well as interviews with and presentations by people who played key roles in computing in Greece. Figure 1 presents the timeline of some important events in the history of computing in Greece, as derived from our research.
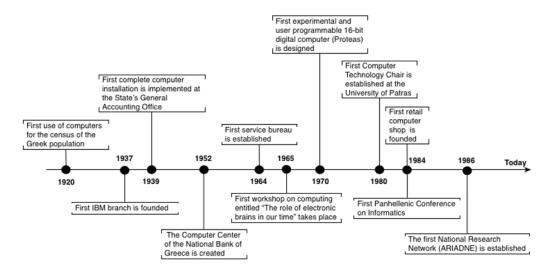
Figure 1. A timeline of significant events related to computing in Greece (not to scale).

The history of computing in modern Greece is often overshadowed by an interest in the Antikythera Mechanism, an artifact from the Hellenistic period. This is generally assumed to be an ancient analog computer,[1,2] which presaged important concepts of contemporary computer science.[3] Historians and philosophers of science have recently linked it to attempts at confirming philosophical arguments about astronomy through demonstration.[4] On the other hand, historians of technology have questioned the appropriateness of calling the mechanism an 'analog' computer, thereby projecting a demarcation of the modern period (the analog-digital demarcation of the post-1940s) into the period of the Antiquity.[5]

THE FIRST COMPUTERS AND THE ROLE OF IBM

Computing in modern Greece dates back to 1920, when it was used for the census of the Greek population. The Greek government, with the consent of the Statistics Council, bought five key punches[6] and a card sorter from the Powers Accounting and Tabulating Corporation of New York, through the Milano based company Società Italiana Machine Classificatrici e Addizionatrici. The key punches were used to transfer data from vouchers to punched card, which were then sorted and tallied. The average speed of the sorting machine was 15,000 punched cards per hour. To motivate civil servants to use such technologies, a corresponding certification was conferred by the government.[7]

IBM played an important role in Greece with its long term presence starting in 1937, when the first IBM branch was founded as an agency.[8,9] Greece, together with Hungary[10] and France,[11] was one of the first European countries where IBM supplied its hardware. IBM was also known for providing equipment to the Third Reich, through its German subsidiary Dehomag that had the monopoly of the German market before and during World War II.[12,13] In August 1939, IBM installed its first complete computer system at the State's General Accounting Office. This system was used to calculate public sector pensions.[9] Operations continued throughout the German occupation until 1944 when the departing German troops seized all types of accounting machines, leaving only typewriters behind.[8] With the liberation of Athens, the Greek IBM branch closed and thereafter, from 1946, Greece was engulfed in the maelstrom of a destructive civil war.[8]

The catastrophic consequences of the war compounded the need to take full advantage of technological opportunities in the country's reconstruction.[8] As the end of the civil war approached in 1949, and while the Marshall plan[8] was at the peak of its implementation, Greek banks were at the focal point of the American consultants who were trying to bring Greek companies up to US

standards.[8] At the general council held at the National Bank of Greece (NBG—not to be confused with the Bank of Greece, which is the country's central bank) on March 12th 1949, the governor of the general council, G. Pesmatzoglou, announced his plans to visit America. There, he met with the president of IBM, T. J. Watson, with whom he discussed the computerization of Greek banks and enterprises. After the end of the civil war, on November 1949, four IBM employees visited Greece, aiming to reopen the IBM branch. The head of the mission, L. Brunat, met with G. Pesmatzoglou, to discuss the prospect of the bank's computerization. Despite the mutual willingness to cooperate, NBG's requirements exceeded the means and technological abilities of IBM at that time.[8] The first post-war client of IBM in Greece was to be the Social Insurance Institution (IKA)[8,9] followed by the port of Piraeus.[8] During that time IBM gained experience by modifying its systems to meet the needs of its Greek clients.[8]

In 1952, the NBG established an accounting center with IBM's equipment and technical support. Its official operation started in November 1954. One of the reasons that IBM was preferred over other suppliers was its support for two-pass verification. The bank's records also highlight the fact that IBM, instead of selling equipment, offered it through leasing and profited from the sale of punched cards. The launch of the accounting center coincided with the merger between the NBG and the Bank of Athens, thus diverting management attention from the integration of new computer technology. Nevertheless, the system demonstrated the bank's operational capacity and was promoted as a keystone of the organizational streamlining of the Greek business world.[8]

From its early stages, the NBG accounting center revealed prospects that employees and management could not fully appreciate. It served the monitoring of the accounting processes for the large stores in the area of Athens, and facilitated the resolution of payroll problems. To address the lack of experience among bank employees, IBM ran a support and programming office inside the accounting center for two years. Emphasis was given to the training of plugboard programming with wires. By the end of 1950, the autonomy of the first developers was achieved. At that time, one could see the developers wandering through the accounting center with wires and plugs protruding from their pockets. This department paved the way for high-level programming languages. By 1955, the banking processes integrated in the accounting center covered only a small part of all the total, showcasing the bad relationship between management and technology, an international phenomenon that will largely characterize the reality of Greek banking until the end of the 1980s.[8,14] A. Kyrtsis describes the accounting center's harsh working conditions, such that its employees monikered it "Dachau" in reference to the eponymous Nazi concentration camp.[8]

Female employees were preferred for staffing computing centers, based on the belief that they were more patient and disciplined, had more legible handwriting, and tolerated tight management. Punching was an arduous process requiring patience, endurance, and precision. Preference for female employees in banking technology lasted as long as the systems depended on punching machines. Thus, women participated in Greek computing, but were confined to specific roles. Throughout the mainframe era in the 1960s, women in banking would be employed mainly in data-entry positions, while men would be designing computer configurations or would be employed as analysts. This was reflected in a salary gap with men receiving much higher salaries than women.[8] A similar salary gap reappeared in the post-1980s, as shown by M. Stratigaki.[15,16] Gender stereotypes in computing continued throughout the 1980s and 1990s, with new forms of expression. The status quo was showcased clearly in the Greek advertisements where men had a leading role, using a phone or holding a mouse, while women were just typing characters on a keyboard.[15,16,17]

Meanwhile, IBM continued to play an important role in the computerization of Greece. In December 1956, the powerful IBM 604 was presented in Greece as a showpiece of the Office Machinery Exhibition, which was part of the first Panhellenic Accounting Conference of Greece, held at the building of the Athens School of Commercial Studies (known today as the Athens University of Economics and Business).[9] In 1957, the NBG was the first company in Greece to obtain the IBM 604,[8] followed by the Railway Company and the Seamen's Pension Fund.[9]

In 1958, the rapidly growing NBG and the proliferation of its deposits led to the acquisition of new computing equipment to be used for purposes such as statistical reporting. The IBM 650 computer was delivered to NBG in the second half of 1959[18] — quite late compared to other European countries (e.g. it reached France in 1956[19] and Canada in 1958[20]). By the late 1960s all branches were connected with the accounting center. By 1968, NBG was still using plugboard-

programmed sorters in its accounting center. The punched sheet and plugboard programming were the basis of NBG's technological culture for many years and were used until the middle 1970s.[8] Throughout the 1960s technological evolution expanded to the rest of the Greek banking sector, including the Commercial Bank of Greece and the Ionian Bank.[18]

A computer center in the National Statistical Service of Greece began operating in 1950 with Remington Rand machines for the mechanical processing of statistics censuses and surveys.[8] In 1962, the computer center was supplemented with other IBM machines, and in 1963 it acquired the IBM 1401.[18,9] Subsequent processing tasks included the 1961 population census data with the IBM 1401 computer[8,9] which involved 8 million cards, and the agriculture and livestock inventory of 1961, which involved the statistical analysis of 1.2 million agricultural holdings.[8] Apart from the purely statistical operations, the computer center implemented tasks for the Ministry of Finance, such as the settlement of income tax returns,[8,9] which was first performed with the IBM 1401.[9] It also processed higher education candidate scores for the Ministry of Education. The projects of the National Statistical Service of Greece operated in accordance with international standards, and the data collected was used by international organizations such as the United Nations and the European Economic Community.[8]

The commercial partnerships of IBM spread to the rest of the private and public sectors. The Olympic Airways and the Hellenic Shipyards, two of the biggest Greek companies were among the first to install the IBM 1401. By 1966, an IBM 360 Model 20 was installed in the two largest retailers in Athens: MINION and Lampropoulou Bros, while another one was already operating in the General Accounting Office. IBM 1440 computers were installed at the Agricultural Bank of Greece, the Drapetsona Fertilizer Factory, and the cotton industry Piraiki-Patraiki S.A.[18] Among those who acquired computers at that time was also the Bank of Greece.[9] In July 1962, an IBM 1620 was installed in the National Technical University of Athens and immediately began operating in order to cover urgent research needs.[18] The IBM 1620 was also installed at the Faculty of Physics and Mathematics of the Aristotle University of Thessaloniki in 1964.[18,9] The introduction of computers in academia trailed that of neighbouring countries; for example, in Italy, the Polytechnic University of Milano acquired a CRC 102-A computer in 1954.[21]

IBM also installed a computer in its customer service office, which by 1966, was serving up to 22 companies. Applications included the issuing of 500,000 electricity bills per month, the maintenance of records and payrolls for the Public Power Corporation S.A., the inventory of agricultural holdings in the Municipality of Peloponnese for the Ministry of Agriculture, and an Athens traffic study for the Ministry of Transport.[18]

The first Greek workshop on computers was held in Athens on May 6 and 7, 1965. It was organized by the Lambrakis Press Group with the scientific collaboration of IBM. Its title was the now quaint-sounding "The role of electronic brains in our time."[18,9] Over 150 representatives of ministries, public services, banking institutions, large enterprises, and other interested parties attended this two-day seminar. The workshop's proceedings show that Greek academic institutions mainly performed numerical analysis tasks, while most of the businesses and companies focused on data processing.[18]

In 1970, researchers of the oldest and largest National Center of Scientific Research Demokritos designed and created Proteas, Greece's first user-programmable 16-bit electronic computer.[22] Again, computing research trailed that of other countries where corresponding developments occurred in Romania[11] and Czechoslovakia[23] in the late 50s and in Italy and Hungary[10] in the early 60s.[24]

Over the 1969–1971 period, computerization across the country still covered 20% of its potential.[9] In years to come the use of computers would slowly reach higher levels. In 1972, the Ministry of Finance, which for years had a remarkable record on computerization, launched the Univac 9400 computer system in order to cover the needs of the General Directorate of Taxation. By December 1978, computers were operating in the majority of the ministries, in several Higher Education Institutions, Demokritos Center, and in the banking sector.[9]

Other organizations that further utilized computer systems were the National Observatory of Athens, the Hellenic Broadcasting Corporation, the Evangelismos Hospital, the KAT General

Hospital, the Athens-Piraeus Electric Railways, and the Workers' Housing Organization. In addition, computers spread through the business world to over 200 companies including the Hellenic Steel industry, the Hellenic Sugar Industry, the Hellenic Aerospace Industry, the Refineries of Aspropyrgos, the Neorion Shipyards of Syros, the Poultry and Eggs Cooperative of Epirus, Steel and Chemical Industry of Northern Greece, and a number of textile mills, shipping, and insurance companies. From 1978 to1979, it was estimated that the Public Sector hosted computing equipment worth almost 500 thousand drachmas (about $21,000 at PPP, or $78,000 in today's prices).[9]

THE TRANSITION TO THE ELECTRONIC ERA

The late 1960s marked the transition to the electronic era. The first reference to online systems was found inBanking magazine in 1967.[8] The actual transformation of the NBG branches' network began in 1970, with the introduction of online and real time processes, while the wholesale adoption of online processes commenced in 1975. In 1970 the first remote data access system in Greece started operating at the office of the NBG's Governor. By the end of 1973 the bank was the first in Greece to implement online transactions.[8]

In 1977, NBG in cooperation with Société Générale founded Ethnodata. This company acquired an educational center that provided computer services as a service bureau and IT training of business executives for the NBG and other companies. The NBG was also the first organization in Greece to adopt IBM's MVS (Multiple Virtual Storage) system.[8]

At beginning of the 1970s the computer center of the NBG was said to be the most powerful in the Balkans. Nevertheless, a complete transition to an online system was delayed until the late 1980s, while over the same period, the Commercial Bank of Greece had also started establishing an online system. ATM machines started operating in Greek banks in 1979, and by the beginning of the 1990s they had become part of the online system.[8] Meanwhile, between 1978 and 1980 NBG became one of the first Greek Banks to be connected to the SWIFT network. By 1984, it still operated exclusively with mainframes with personal computers introduced to aid office automation by the mid 1990s. In 1995 the NBG was maintaining the largest network in Greece with 7500 terminals.[8]

KNOWLEDGE INFRASTRUCTURE AND EDUCATION

A serious issue that would impede the growth of informatics in Greece was the lack of properly trained and experienced IT personnel. This was due to the absence of academic departments granting corresponding higher education degrees.[25] Until 1978, training on computer systems was either done abroad[25] or was performed by the Hellenic Center of Productivity (ELKEPA),[9,26] the Demokritos Center, and private companies, such as Control Data.[9,27] ELKEPA set up diverse programming courses, where the staff of the Doxiadis Associates Computer Center would teach programming in languages such as Cobol and Fortran. The practical training of the students was done in the Computer Center's service bureau. The first alumni of this training catalyzed the growth of computer science in Greece.[26] However, the number of alumni was not sufficient, especially because many endedup as salespersons for multinational companies rather than software developers. The problem was exacerbated by multinationals, which offered product-oriented training rather than a broad curriculum to their mid-level computer personnel.[25]

Gradually, the computer science profession was promoted by the press as the job of the future, thus paving the way for further developments. Many private colleges started offering courses on Cobol and Fortran programming. In the mid-1970s, efforts began for the establishment of a professional association, which was formed in 1977 as the Greek Computer Society. In 1978, an educational program addressing school students was implemented by Citibank, aiming to unravel the mystery of computers and stress their contribution to the company's operations.[9]

During that time, Greece ranked very low by European standards in informatics higher education. The first attempts to establish self-contained university courses on computer science and informatics took place in the late 1970s and early 1980s.[25]The first courses, established at the

Schools of Mathematics and Physics of the Universities of Athens, Thessaloniki, Patras, Ioannina as well as the University of Thessaloniki Faculty of Engineering, taught systems analysis and programming. In 1980, the first informatics chair was established at the University of Patras[9,28,29] later to be followed by two similar chairs established at the National Technical University of Athens.[9] Similar courses were introduced in other countries a lot earlier (France in 1947,[19] Italy in 1954,[24] Chile in 1962,[30] Slovakia in 1962).[23] Gradually more programming and IT courses were offered in technology-oriented academic departments.[9] By 1985, degree courses in computer science and informatics were also available at the University of Crete. Courses in system analysis and operations research were also being introduced at the Athens University of Economics and Business and at the Athens Technological Education Institute.[25] Over the same period, the compulsory course Computers and Arithmetic Programming was introduced in the country's technical high schools.[9,27] In 1984, the Greek Computer Society organized the first Panhellenic Conference in Informatics.[27]

In 1986, a group of computer scientists led by Christos Koilias published the Greek five-volume Encyclopedia of Informatics and Computer Technology. It gained popularity in the Technological faculties of the country and introduced Information Technology and its vocabulary to many households.[31,32]

ACADEMIC AND RESEARCH DATA NETWORKS

In the early 1980s public research centers and universities started to receive financial support from numerous R&D programs of the EU as well as the Greek Community Support Framework. In addition, many research centers aimed to increase their funding by participating in industry projects. Thus, multiple data networks were developed and technology parks emerged.[33] By 1994, most universities and research centers, as well as some companies, were connected to the Internet.[33] Note that with the term "Internet," we refer to the global system of interconnected computer networks that use the Internet protocol suite.

FORTHnet

An important pioneering institution in the field was the Foundation for Research and Technology — Hellas (FORTH). FORTH was founded in steps between 1983 and 1987. It initially consisted of three independent research centers in Crete, Patras, and Thessaloniki. The Crete branch established in 1985 was one of the largest and most technologically ambitious network in Greece: FORTHnet.[34,33,35]

FORTHnet was a multi-protocol network, interconnecting LANs all over Greece and linking them to the Internet. The network mainly used digital and analog leased lines as well as privately owned fiber optic cabling providing a full-range of Internet services ranging from email to file transfer. Its international link was served by a 64 kbps leased line connected to Ebone, Paris. Analog and digital leased lines with bandwidth ranging from 128 kbps to 2 Mbps connected FORTH offices around the country as well as the University of Crete networks.[33]

In the late 1980s, FORTH's Crete branch contributed to the evolution of FORTHnet and Greek networks in general, by developing:[36]

- WAN links between departments of FORTH,
- The first serial line IP connection in Greece, linking FORTHnet with the University of Crete,
- X.25 and UUCP (Unix-to-Unix Copy) links between FORTHnet and corresponding nodes abroad, and
- Dial up connections to the FORTHnet Unix systems.

By 1994, FORTHnet was connected to the European Academic and Research Network (EARN). EARN was conceived and initiated by IBM in 1982 and served as a connection between universities and research institutions across Europe.[37] FORTHnet was later absorbed by the private sector and became a telecommunication service provider.

Furthermore, FORTH along with the Demokritos research center created a series of technology parks. In general, every research institution aiming to improve its contacts with industry aspired to create a technology park. The first was the Attica Technology Park, an incubator located in the Demokritos campus to encourage high tech companies to use Demokritos's services. The FORTH Technology Park in Patras, was the first to be planned in Greece in the mid 1980s, but its development was delayed due to the lack of support by the local authorities. The Thessaloniki and Crete Technology Parks, which were associated with the local FORTH branches, aimed mainly to host their own spin off activities.[33]

By 1994, Greece was ahead of other EU countries regarding technology parks, underlining a supply-led initiative. These four attempts to create science parks, however, showcased ambitions limited to building incubators in the same campus with research facilities. Also, even though the national administration was supportive, some regional administrations were unfriendly.[33]

Ariadne

In 1984, the Cooperation for Open Systems Interconnection Networking in Europe (COSINE) project was implemented in the context of the EUREKA program funded by the EU. One of the project's main aims was to establish a pan-European OSI standards-conforming infrastructure.[38] Subsequently, during 1986, the General Secretariat for Research and Technology with a team of Greek researchers, developed the first National Research and Academic Network, named Program ARIADNE and later known simply as Ariadne.[31]

Ariadne was open to all the Greek Academic Community members and to some industrial research and development companies. By 1992, the Ariadne Network offered services such as remote login via PAD or TELNET, E-Mail, file transfer via FTP and Kermit, and anonymous FTP connections to fetch RFCs and UNIX configuration files. Furthermore, Ariadne provided an information server named Pythia for browsing information and keywords about networks and related topics. Around 1993, most research institutes and universities were connected via a private backbone of more than 20 leased analog circuits (9.6 kbps).[39] Athens was at the center of the network, with the peripheries stretching to Thrace, Macedonia, Epirus, Peloponnese, and Crete. An alphabet soup of other networks such as the International Networks Internet, BITNET, EUnet and the CERN's DECnet, CLNS, and PILOT could also be accessed from Ariadne.[39,33]

The Ariadne and FORTHnet networks had more international linkages than regional ones. Until the early 1990s the industry was not utilizing them; the networks were mostly used by the academic community for multinational projects and training purposes.[33]

GRNET

Between 1992 and 1995, Greek researchers designed the transition of the Ariadne network from OSI to TCP/IP. Within this project, the first national network of Greek developers was also formed under the name of Greek Research &Technology Network (GRNET).[40] GRNET was established in 1995 as a research project of the General Secretariat for Research & Technology. The Greek Ministry of Development established an organization with the same name in 1998.[40,41,42]

In 1998, GRNET management, with the support of the government, initiated the establishment of links to the research and education communities of neighboring countries. This led to a series of important steps, the first of which was the connection of UNICOM-B (Universal Integrated Communication — Bulgaria) with GRNET on a 128 kbps circuit provided by the Hellenic Telecommunications Organization.[37] Later on, GRNET was connected to the GEANT Pan-European network, which in turn interconnects Europe's national research and education networking (NREN) organizations.[43]

GUnet (The Greek Universities Network)

A civil organization under that name was founded in September 2000. The main aims of GUnet include the development and support of the academic network of all Greek universities and the development of advanced network services and applications in the broad academic and research community.[44]

HARDWARE AND SOFTWARE INDUSTRY

The hardware and software computer industry in Greece was for many years import-led, and remains so in the hardware sector to this day.

Hardware

In 1960, the first company that developed activities focusing on mainframes in Greece was IBM. In 1963, Sperry Rand Corporation also appeared as a mainframe and service supplier. In 1986 the company changed its name to Unisys, after merging with Burroughs. Its representative in Greece was Doxiadis Associates.[8]

During the 1980s, the retail computer market boomed with the appearance of home and then personal computers. From the ZX-81 and Spectrum to the Amiga and TI-99/4A, the recreational use of computers was then the rule. For youngsters a computer often meant a game console. With the spread of home computers by Amstrad, BBC, Commodore, Sinclair, and Texas Instruments, and, later, personal computers by IBM, Compaq, Olivetti, Tulip, and Wang, hundreds of new businesses appeared, importing and assembling computers or producing software.[9]

At that time, the Greek hardware resale market was still small but profitable. Many significant multinational companies had entered the market including Honeywell-Bull, Univac, Control Data, Sperry, NCR, and Nixdorf. There were also independent businesses that supported banks and insurance companies.[9]

The entrepreneurial presence of informatics in Greece blossomed around 1980. C. Giannopoulos was one of the main initiators of the Greek informatics industry. After failing to establish a computer factory in Greece due to red tape, in 1984 he founded the Microbytes Computer Shop & Wang, the first computer shop in Greece. With a few machines as stock, including Spectrum and Commodore models, the shop made a turnover of 3.8 million drachmas ($12 million in today's prices) during the first month. The shop also included a service department that provided Greek character font support for computers and printers. Such initiatives stimulated the creation of the Greek Silicon Valley on Stournari Street in Athens, an area where multiple computer shops such as Plaisio and Micropolis, grew over the following years.[45,46,27] At that time, some Greek companies began producing small computer accessories, such as Aneroussis Control, a company that reached its peak with amusement equipment and games.[46]

Among the companies founded between 1985-1990, the most important ones were Ergodata, Intracom, and Gigatronics. Ergodata was established in the mid-80s as a subsidiary company of another bank (Trapeza Ergasias). Its activities focused on establishing a network for the distribution of computers, peripherals, and commercial software. Intracom, established in 1986, was a dominant company in the field of telecommunications and microelectronics.[27]

Concerning hardware production, the main attempt that took off was that of Gigatronics, a company that was founded in April 1980. Within the first year of its operation its sales reached 1 million drachmas ($3,256 in today's prices), and by the third year its sales reached 70 million drachmas ($228,000 in today's prices). In 1985, it employed more than 35 people. Gigatronics assembled several computer models, with Hermes being the first Greek computer produced by the industry in 1984.[25,27] Hermes was also used by organizations such as the Public Power Corporation and the Agricultural bank.[9]Gigatronics also designed and implemented its own software, such as the SUPER BASIC programming language.[25]

In 1985, the installed capacity of electronic data processing systems of Greece was estimated at US$ 120 million, of which 70% belonged to US companies or their subsidiaries, and 30% to European companies. Most systems were installed in the private sector, and these were mainly mini, micro, and medium size computers, whereas large installed systems prevailed in the public sector.[25]

In 1988, Gigatronics designed and implemented the KAT computer. The novelty of KAT's operating system was that it employed components supporting two operating systems: MS DOS and Apple. However, the project gradually weakened and the effort foundered due to politics and internal strife among shareholders. In one of their interviews[47] Gigatronic partners discuss the many obstacles imposed by the Greek state, such as red tape, which hindered the company's licensing. Meanwhile, imported personal computers were gaining more ground along with the burst of telecommunication technologies.[9,27] The rise of the IBM-PC led to the local assembly of compatible computers under brand names such as Turbo-X (by the Plaisio stores) and Plato (by Pouliadis & Associates).

Greece's lag in computer hardware can be attributed to the fact that major advances in computer hardware took place in the United States. This gave an advantage to companies such as IBM and Univac compared with the corresponding European ones, especially after (and during) World War II.[48]This was one of the reasons why IBM hardware dominated the Greek market — see Subsection 2.1. Also, companies coming from the US supported their marketing strategies effectively. For instance, recall IBM's support to the inexperienced employees of NGB and its hardware donations to several European universities.[21]

Software

An important role in the development of the Greek software industry was played by Doxiadis Associates, a private firm of consulting engineers on city planning and architecture founded in 1951. Its specialized subsidiary Doxiadis Associates Computer Center (DACC), created in 1964, ran the largest computer center and the first service bureau in Greece.[26,49]

In 1967, the Detroit Edison company assigned the Great Lakes Megalopolis study to DACC.[26]This study aimed to forecast the residential evolution of a large Detroit area for the year 2000, so that the company could prepare the corresponding electrical infrastructure. The study had already begun in 1965, but in 1967 the area under study was expanded to 17 states and 720 counties. The manual handling of multiple parameters seemed prohibitive. The Technical University of Stuttgart offered the nightly use of Univac 1107 computer for a fee to DACC when it was not used for teaching.[26,49] After twenty nights of Algol programming[26,49] and the use of methods such as principal component analysis,[26] the DACC team came back to Athens to present its findings. The achievement underlined the added value of the use of computers in the eyes of many people and marked a milestone in the company's involvement in Greece's informatics.[26,49]

In 1969, C.A. Doxiadis (the owner of Doxiadis Associates) decided to install a Univac 1107 in Doxiadis Associates' premises at the cost of $500,000 ($3.3M in today's prices).[49] A computer center with air-conditioning and bulletproof windows was set up for the installation.[26] The fact that at that time only four similar computer systems existed in Europe and around ten more were operating in the US underlies the project's importance. The computer was presented through a series of events to opinion leaders including businessmen, journalists, and scientists and was made available for third party use.[26]

In 1967, Control Data Greece implemented software to manage the allocation of the high school graduating candidates to the country's universities. This was one of the first programs written in Greece in the Algol programming language.[26,49] In 1976, the DACC used a Univac 1100/10 computer system to implement the first real-time collection and transmission of election results. Its application on national and European elections in October 1981 was extremely successful and established computers in the public's mindset.[26]

In 1984, the DACC service bureau was detached from the company and became the basis of a new company: Delta Informatics. DACC continued its commercial activity, and in 2000 it was

renamed Unisystems, representing Sperry Univac in Greece. In 2004, when the American company First Data bought Delta Informatics, the company had as clients 34 banks worldwide.[8,26]

In the 20th century the lack of computing internationalization forced users around the world to deal with several region-specific software and hardware localization issues. Due to the small size of the Greek market, hardware and software manufacturers often failed to provide the requisite localization support. A prevalent problem was the correct input, display, collation, and printing of Greek characters, which ended up being represented in no fewer than 14 different encodings.[50] Consequently, Greek users often had to tinker to resolve such problems, thus developing a more active attitude towards their computers.[51,52] In contrast, US users influenced technology diffusion mainly through their purchases.[48]

Home computing and technological knowledge were guided and shaped by two factors: computer magazines and small computer stores. From these services, users could find there information regarding the aforementioned problems[51,52] and guide their purchases. One notable achievement of computer stores was the development of Work Writer, a word processing application for IBM personal computers. Notably at the time, the program had a Greek user interface and user manual.[25] In parallel, computer magazines emerged in 1982, and by the end of the 1980s, twenty seven computer magazines were being published. Popular ones included the gamer-oriented Pixel (the highest-circulation Greek computer magazine of the 80s), Computers for All, and the more business-oriented RAM.[51,53,52]

The spread of home and personal computers was also aided by software piracy and the lax enforcement of intellectual property rights. Several local shops supplied personal computers accompanied with unlicensed software, while on the home computer front audio tapes containing software were often illegally copied with specialized tools. For example, the Pixel magazine would provide guidelines on how to copy software tapes and crack games.[52]

Concerning software exports, Greek companies were taking important steps during the 1970s. Gigatronics was trying to enter the US market while other companies, such as Computer Logic, ABC, and STEP, exported software to Eastern Europe and the Middle East. Notably, M-DATA had 33 customers in the Middle East market, while the SOFRAGEM and Computer Logic Greek software houses exported to the French market.[25]

Public Sector

In the early 1980s, the Greek public administration launched an initiative for the increased use of IT to support its services. Specifically, a Technology Directorate and an Office of Scientific Research and Technology started operating as parts of the Ministry of Coordination. Their objective was to monitor IT developments and incorporate them into their strategic planning. In 1983, under a socialist government, a committee was established at the Ministry of Finance to study the country's information technology development. It found that Greece needed a national informatics industry so as to be independent from foreign suppliers in the future. In addition, the committee formulated three strategic goals for the country: the organization of information technology government procurements, the development of a software industry, and the balance between IT imports and exports. Following this, four unsuccessful companies were established as the initial activity cores, by the names Athena, Prometheus, Hermes, and Hephaestus.[9]

Starting in the 80s and throughout the 90s, Greek public sector computing was characterized by an absence of coordination, limited absorption, duplication of effort, gaps, and societal fear of IT.[54] Greece was continuously ranking among the last-places in all the lists of information society indicators.[54] The uneasy relationship between IT and society was clearly highlighted in the case of TAXIS, the revenue collection e-services system. Its development was initiated in the early 1990s by the Greek Ministry of Finance, and supported by national and EU funds.[55,27] Most western countries had developed similar applications to streamline tax bureaucracies since the late 1970s. After several delays, TAXIS became operational in 2000. However, the released version was unstable, and many problems in its design and implementation arose in the following years.[14] In the following years, Greece continued to have issues regarding the automation of the public administration.[56]

CONCLUSION

Our findings reveal that there is no continuity in the development of computing in Greece. Instead, the evolution is punctuated with bursts of technological developments. Although rapid computerization was witnessed in the 1950s, many computing developments were significantly delayed. Possible reasons include the market's small size and insularity, the high cost of equipment relative to the GDP, red tape, complex localization requirements, and the lack of awareness regarding IT's benefits. Technological evolution typically started from the private, particularly the banking, sector, and spread with tentative steps across the public sector and higher education. IBM played an important role with a continuous presence in Greek technological developments. Local needs emphasized software development, leaving behind hardware production, which never flourished. Higher education in informatics remained undeveloped compared to the rest of Europe, until the mid 1990s. Many of computing's developments that took place in Greece during the 20th century were not initiatives of groups, organizations, or state institutions but thrusts of perspicacious individuals who took bold decisions and risks. In many cases they were confronted with daunting red-tape, inefficient state institutions, and societal pushback and fear of change.

Currently computing is playing a central role in the country's economy and education. The range of businesses involved in designing computer software and networking infrastructures has become broader and more outward looking. For instance, according to the Hellenic Association of Mobile Applications Companies, there are more than 80 high-tech companies whose activities include the development of mobile applications and the provision of services for telecommunication providers.[57] These companies provide employment to thousands of people. In addition, a vibrant ecosystem has been formed around the Greek microelectronics industry. Furthermore, the computer science departments of the various Greek universities appear in lists with the field's top departments.[58] Finally, the Hellenic IT Museum started its operations in 2008 through private initiative.[46]

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