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From “Difficult to Find” to “Picking from the Flood”: A Turning Point to the Turning of the Times

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Abstract: The article exposes the evolution of scholarly information availability and processing in Czechoslovak/Czech information centres and libraries over the past five decades, linked to developments in information and communication technologies, as seen by an active participant. It also reflects the author’s perspective on the peculiarities of the Czech higher education system and the role of key figures in librarianship history.

Keywords: Scholarly information availability; scholarly information processing; information and communication technology; role of personalities

Vom „Schwer zu finden“ zum „Picken aus der Flut“. Ein Wendepunkt zur Zeitenwende

Zusammenfassung: Der Artikel stellt aus der Sicht eines aktiv Beteiligten die Entwicklung der Zugänglichkeit und der Bearbeitung wissenschaftlicher Information in den tschechoslowakischen/tschechischen Informationszentren und Bibliotheken im Zusammenhang mit den Entwicklungen der Informations- und Kommunikationstechniken während der letzten fünf Jahrzehnte dar. Der Autor reflektiert auch die Besonderheiten des tschechischen Hochschulsystems und die Rolle von Schlüsselfiguren der Bibliotheksentwicklung.

Schlüsselwörter: Zugänglichkeit wissenschaftlicher Information; Bearbeitung wissenschaftlicher Information; Informations- und Kommunikationstechnik; Rolle von Persönlichkeiten

1 Disclaimer

At the outset of this article, I should like to clarify that this is not an academic article with a proper citation and annotation apparatus, but a very personal view of the transformation, of the changes in scholarly communication and librarianship over the last 50 years caused by the incredible development of information and then communication technologies, not only in the world, but also in Czechoslovakia and subsequently in the Czech Republic.

Why do I think I have some competence to speak and write about these technological changes? Because, I have been there from the beginning! My educational background is a master’s in computer science, graduating from the Czech Technical University in 1965 with specific interests such as information systems and mathematical linguistics. I got into an environment with some influence of communication technologies on scientific communications and eventually on libraries as a programmer sometime in the mid-1970s. I guess that was formative for me, because then I stayed in the field, whether it was scientific information or the tools for storing and providing such information, that is, libraries, to this day. So, I have been able to follow the development of information tools and technologies for processing research information and for librarianship in its full breadth and from different angles for more than five decades, the last 27 years in my position as Director of the National Library of Technology.

2 The Early Practical Use of Computers for Bibliographic Information

I graduated in 1965 *cum laude* in computer engineering from the Faculty of Electrical Engineering of the Czech Technical University. In January 1966, along with two colleagues from the Faculty, I started working as a technician on URAL-II, the second (vacuum tube) generation Soviet computer, which was almost a museum piece at that time, but which

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was intensively controlling the movement of the common fleet of freight cars of the railways of the CMEA countries.[1] It was programmed only in machine code and, of course, in absolute addresses, which is an unimaginable job nowadays: all the documentation was in Russian on hard-to-read copies. As young enthusiastic engineers, we jointly created a so-called debugging programme to facilitate the work of programmers, which we called in Russian "Prokrutka", but it probably did not see much use, because in August or September that year we all started our one-year military service. I managed successfully to combine this partly with my canoeing and partly with my skiing career; when I returned, the Ural had reached the end of its life. To our joy, a very modern third (transistor) generation English Electric Leo Marconi computer took its place. This was a huge cultural shift, since you could interact with the computer in a programming language, it could even calculate in British pounds, shillings, and pence, but there was not much work for a technician, so my colleagues and I took up systems programming in our spare time to help the computer operators.

Even this work eventually ceased to satisfy me, so I successfully sought a position at the Research Institute of Mathematical Machines[2]. At the end of August 1968, I was to join a department of research on machine translation and information systems, but 21 August 1968[3] found me in Rome, and although I decided to return to Prague, the return to a country occupied by Russian troops was painful. The position at the Research Institute of Mathematical Machines was great, plenty of time for study, I got my hands on Gerard Salton's pioneering work *Automatic Information Organization and Retrieval*, published in January 1968. There was also time to attend a postgraduate course in Mathematical Linguistics with Professor Sgall[4], and so on. However, any practical programming attempts were extremely frustrating because the only existing EPOS computer was overloaded with higher priority tasks.

Thus, I could not resist a new offer for a position as a system programmer for the then state-of-the-art IBM 360 model 30 computer in a large construction company. This was another technological and cultural leap, and we particularly appreciated the excellent documentation and the outstanding courses, partly at training centres in Vienna and London. The role of the systems group, apart from the ongoing care of the operating system, was mainly to standardise rules for the use of limited resources and to create support procedures for application programmers. In order to make frequently used procedures run quickly and efficiently utilize the limited resources of the computer (128 kB of internal memory and three disks of 7.25 MB each!), I had to learn to write in Assembler/360 – a language very close to machine code, but with an excellent Macro language extension.

3 The First Contact with Industrial Scale Information Processing

My expanded knowledge was needed by my fellow students, who were developing a system for processing bibliographic information called Unified Software System (USS) at COSTEI[5] as part of a national task to support computerized information processing. To their horror, a few weeks before the eagerly awaited launch of the processing Chemical Abstracts Service (CAS) in May 1974 (at the Chemical Industry Technical and Economic Research Institute), they discovered that the expensive purchased records of articles in chemical journals had a slightly different structure than the entire prepared and verified USS system had anticipated.

On a tight deadline, I wrote the Compressor program in Assembler, which processed tens of thousands of records for decades from then until the end of CAS processing for the Czech chemical research and industry. Thus, I became a member of the team that successfully provided an information service to hundreds of institutions in the Czechoslo-

1 The Council for Mutual Economic Assistance (CMEA) – dubbed Comecon – was a Soviet-controlled organisation which, in theory, was intended to exploit the advantages – natural, raw material, technological, expert and otherwise – of the individual participating countries to their mutual benefit in a planned socialist economy. In reality, it primarily served the limping Soviet economy.

2 "Mathematical machines" was the Czech official name for computers at this time.

3 On 21 August 1968, the armies of the Soviet Union, the German Democratic Republic, Poland, Bulgaria, and Hungary ended the so-called "Prague Spring" – a vain attempt to establish a more tolerable form of Soviet Communism – and returned Czechoslovakia to the Soviet Union's strict control for the next 20 years.

4 Professor Peter Sgall (27 May 1926–28 May 2019) was a Czech linguist. In the early 1960s, Sgall became acquainted with Chomskyan generative grammar. He immediately understood the importance of an explicit description of language; however, he was aware that the generative approach lacks due regard to the functions of language. Based on tenets of Prague Linguistic Circle, Sgall formulated and developed an original framework of generative description of language, the so-called Functional Generative Description (FGD).
More at https://en.wikipedia.org/wiki/Petr_Sgall and https://people.umass.edu/partee/RIP_Petr_Sgall.html and https://ufal.mff.cuni.cz/petr-sgall.

5 The Central Office for Scientific, Technical and Economic Information (COSTEI) was the de facto think-tank of the Communist regime, which was to mediate nationally and internationally the exchange of the most advanced information.

vak academic and industrial research sphere in COSTEI's Central Technical Base on what world professional literature published on several thousand topics. This was a great service, but it had one fundamental drawback: the researchers received references to the latest articles relevant to their research, but they had to acquire the journals or conference proceedings themselves, which was very difficult, if not impossible, in the 1970s and 1980s; COSTEI's support did not extend that far.

Around the basic search program, we created a puzzle of other programs based on the L-format[6] for sharing bibliographic data, which was our enhancement of the CAS Standard Distribution Format, based on similar principles to the US Library of Congress MARC – ISO 2709 format, but making the maximum use of the byte structure of IBM/360 series computers. This allowed for very efficient batch processing of (for the time) large volumes of data in the order of tens or even hundreds of Megabytes.[7] Colleagues in the applications department were then able, using a kit of several USS programs, to analyse document and patent data in depth and to track development teams and their focus in institutions of interest: what is now called data mining in Competitive (or Business) Intelligence. After Chemical Abstracts, we added other "magnetic tape services", as the periodically sent sets of bibliographic records for articles or patents in various fields were then called. These were mainly the technical "databases" INSPEC, INIS, Compendex, but also Pollution Abstracts, Excerpta Medica, Derwent patent records and many others. All of them were converted to our L-format for further processing – the INIS, INSPEC and Compendex databases were distributed in different ISO 2709 clones, so one general conversion program was sufficient, while the others required special "tailor-made" convertors. After conversion however, all further processing was just a repetition of the same procedure. In the second half of the 1970s, our USS processed about 3 000 "profiles", i. e., queries according to the wishes of individuals or institutes, carefully fine-tuned by colleagues in the service department. In terms of processing scale, we compared well with Europe. The COSTEI Central Technical Base was a great school of teamwork, mutual learning, and knowledge expansion, holding internal seminars, from which I still draw today.

In the late 1970s, a novelty began to appear abroad: database centres, where it was possible to search for information remotely via telephone lines when the researcher needed it. This had a catch though in the then divided world: the somewhat paranoid research or rather research policy leadership here was concerned that the enemy on the other side of the Iron Curtain might deduce from the researchers' queries what research was being conducted in the then Czechoslovak Socialist Republic. Connection to the West (e. g., to Lockheed Dialog and the like) was possible only through the International Institute for Applied Systems Analysis located in Laxenburg in admittedly neutral Austria, but still under the close supervision of Soviet experts in the 1970s. Even this was not enough, it was necessary to install a modern small computer from Digital Equipment Corporation, the PDP-11, on the communication line to monitor the traffic. Instead of the dreamed of large IBM computer we were preparing for (even in ICSTI,[8] where we had the opportunity to try its Russian clone), a modern computer was installed in the COSTEI, but it was a Siemens one with a completely differently conceived system. Moreover, with it came a team and a new director vetted by the State Security and co-operation with them was not going well.

4 Note about the System of Higher Education and Research in Czechoslovakia

Here it is important to clarify a few – for a citizen of the free world – little understood peculiarities.

1. In Czechoslovakia, similar to many countries that became part of the Soviet empire, a system of higher education and research was established where the role of universities was mainly to prepare professional cadres, as "spare parts" for industry and the general functioning of society, rather than universally educated – and therefore more generally exploitable – professionals. In contrast, scientific research was organised in highly specialised research institutes, partly affiliated to the national academies of sciences or to the relevant sectoral ministries. This significant difference compared to the standard Western system, where research is an integral part of the educational system and takes place in universities, especially in strong universities that have the ambition to do research, introduced a misbalance in Communist regimes between the process of education and the process of research. Research was to be concentrated in the Academy of

6 Bloch et al. (1977).

7 We once transported about 50 reels of magnetic tapes from our partner Slovak Technical Library in a Škoda 1000 MB – and that was about the data capacity of our load.

8 The International Centre for Scientific and Technical Information (ICSTI) was the headquarters in Moscow, monitoring and to some extent coordinating the national information centres of the Socialist countries.

Sciences while the schools and universities were to be devoted mainly to teaching. The complete subordination of both research and education to the only correct philosophy and scientific theory, i. e., Marx-Leninist led to a profound decline in general education. The humanities and social sciences were reduced to the violent – sometimes even comical to the external-unencumbered observer – demonstration of the "lawful" derivation of anything from precisely the "only correct" scientific position.

2. The Communist Party and the government in Czechoslovakia were effectively the same, although they were formally separated for appearances. They eventually recognized that without technical advancement, their system would eventually collapse—a fate ultimately sealed by the concentrated efforts of Reagan's and Thatcher's policies. As a result, they heavily promoted technical skills at the expense of general education. Likewise, it promoted selected fields, among them the chemical industry, even at the level of quality information support. That is why the Chemical Industry Technical and Economic Research Institute could afford to buy expensive "Chemical Abstracts" and the State Technical Library, part of COSTEI, was the only library in Czechoslovakia with a fairly good comprehensive collection of foreign specialized journals.
3. In free societies, libraries are almost sacred institutions guaranteeing free access to knowledge for everyone, whether public or academic. In Communist countries, access to even ordinary everyday information, including fiction, film, and theatre, was severely restricted and strictly controlled according to Orwell's rule[9] "Who controls the past controls the future. Who controls the present controls the past". It is clear from this that libraries were potentially dangerous to the regime and were treated accordingly. Public libraries became a mouthpiece for the truths promoted by the regime. This was equally true of university libraries, which became mere textbook lending libraries, receiving scant resources to replenish their literature. If there were any foreign textbooks available, they were Russian, and there were also Chinese reprints of publications from developed countries, regardless of copyright, but these were all very difficult to obtain. For students, teachers and researchers in technical fields, the State Technical Library was an extremely important, in fact unique, opportunity to access foreign journals.

9 Orwell (1949).

5 A Brief Interlude with a Taste of Change

Disillusioned by the developments mentioned earlier, and for personal reasons, I left COSTEI and went to the computing centre of Technomat, a nationwide colossal supplier and distributor of installation materials for water, gas, and electricity, from fittings to pumps, from light bulbs to giant transformers. I joined there as head of systems programmers. Although the computer was a Robotron product from the German Democratic Republic, it worked perfectly under IBM 360 operating systems. Terminal connections began to be used, which was a dramatic change from the punched card boxes that had been inherent for more than ten years as a recording medium for programs. We were able to organize our work well, and in my spare time I was able to do some interesting work with the Terminology Database (TDB) as a tool for generating multilingual dictionaries of technical terminology. The fundamental principle of professional terminology is to define a term in as unambiguous a way as possible – as a point in the semantic space defined as clearly as possible – so that the possibility of different interpretations in different languages is limited as much as possible. Hence, we concluded that a symmetrical tipping (i. e., from an English-Czech dictionary to create a Czech-English dictionary) was possible – unlike with the common language vocabularies with too fuzzy a semantic cloud of any term. For the implementation of the database and the subsequent printing process, we used the CDS/ISIS information system developed by Mr Giampaolo del Bigio at UNESCO for the International Labour Office (ILO) for IBM 360 mainframes. Later, at Technomat, I also experienced the advent of a new generation of microcomputers on Intel 8080 processors with CP/M operating system and tried to use them with a colleague to modernise the then completely archaic system of tracking the movement of goods between warehouses and suppliers. However, by the late 1980s in a Czechoslovak wholesaler, there was little interest in innovation.

6 The National Library of the Czech Republic

In 1988, I took up a position as a systems programmer at the National Library of the Czech Republic. The Library was set to receive a mainframe computer, an IBM clone manufactured in the USSR. At that time, the National Library's IT operations were limited to finance and staff management and

the production of the printed National Bibliography, which was the main focus for the IT department, alongside preparations for the mainframe. Fortunately, we managed to prevent the delivery of the mainframe before the fall of the Communist regime and to orient development towards the new technology: for experimental work we had three standalone Commodore PCs with MS-DOS operating systems, each with a 20 MB hard drive. On these, my librarian colleague Bohdana Stoklasová and I, as the main authors of the team, started preparing a project *maks* (modular automated library system) based on the excellent, flexible – and, most importantly, freely available – CDS/ISIS system for PCs.

Mr Giampaolo del Bigio, mentioned earlier, under the auspices of UNESCO, transformed the CDS/ISIS from the original mainframe version into the so-called mini-micro CDS/ISIS for PCs. This system was remarkably flexible, capable of working with records in a somewhat simplified ISO 2709 format, and it was possible to write a custom editor for data input and output formatting based on simplified Pascal. The database for storing data was very economical, yet very well indexed, with search time increasing only logarithmically with the number of records. Because of all these features, CDS/ISIS became an important tool for the introduction of automation in libraries, not only in post-Socialist countries but also in many other countries at the turn of the 1980s and, in fact, well into the new millennium; eventually a Windows and a networked version were developed.

Thus, with Bohdana Stoklasová and others, we defined the "Exchange Format," a reasonably simplified version of the MARC format, within a state research project *maks*. That was in November 1989,[10] when we were writing materials for the project defence late into the night, and, in between, we went to demonstrations against the regime.

We based the automation of the ISBN and several other processes in the National Library itself on *maks*, and besides that, it became the starting point for several hundred Czech libraries to begin automation and the precursor of today's library systems. The printed National Bibliography at that time was a complex process involving manual transcription onto magnetic tapes and subsequent typesetting on a mainframe computer outside the Library; all at high cost. It occurred to me that it would be easy to create input data from the National Bibliography records stored in CDS/ISIS for further processing with Donald Knuth's TeX typographic program. A colleague from Masaryk University wrote templates and macros for the printed National Bibliography ... and we reduced production costs by over 90 %.

All processes in the Library, especially catalogue creation, were extremely complex. As an example, each Czech book was catalogued three times: once for the aforementioned National Bibliography, once as legal deposit for the preservation collection and a third time for the lending collection – to ensure a copy was available soon after publication, as the legal deposit copy often arrived after considerable delay. In my spare time, I reused the tried-and-tested technology CDS/ISIS with LaTeX and helped to create and typeset the English-Czech and Czech-English, as well as German-Czech and Czech-German, explanatory dictionaries of computing terminology.

It was only with the Velvet Revolution in November 1989 that gradual changes became possible, mainly because the management began to take an interest in the functioning of the Library and supported the changes. In 1991, Professor Andrew Lass and I became co-founders of the CASLIN[11] (Czech and Slovak Library Information Network) project, which marked a significant step towards modern standard procedures in Czech and Slovak libraries. Supported by a grant of one million dollars from the A. W. Mellon Foundation, the project procured a joint library system for the four largest Czech and Slovak libraries (National Library in Prague, Moravian Library in Brno, Slovak National Library in Martin, and the University Library in Bratislava) in 1993. We chose the successful Aleph library system from the Israeli company Ex Libris through a rigorous selection process. Subsequently, we added more installations in the Library of the Czech Academy of Sciences, Masaryk University, and the Olomouc Research Library through further grants from the A. W. Mellon Foundation. Unfortunately, the CASLIN project was not able to fulfil the idea of a co-operative system with two mirrored centres in the national libraries of the Czech Republic and Slovakia, due to both technological obstacles (inadequate hardware and software quality and low communication network speed and reliability), but also – and rather because of – the lack of will for truly effective co-operation. Nevertheless, what remained fully accepted by the Czech librarian community were the global cataloguing standards, the Union Catalogue contributed to by almost all existing Czech libraries and the co-operatively enhanced Authority files system. Another extremely important legacy of the project is the annual CASLIN seminar. The seminar successfully attracted outstanding speakers such as Sarah Thomas, Cornell University Library,[12] Ole Husby, BIBSYS, Norway, Herbert van de Sompel, newly PhD from Ghent

10 On 17 November 1989, the Communist police brutally dispersed a peaceful student demonstration – thus giving rise to the so-called Velvet Revolution – the collapse of the Communist regime in Czechoslovakia.

11 More about the CASLIN project: Czech and Slovak Libraries: CASLIN: Quandt (2002) 195, Lass (1999), Svoboda (2000).

12 Speakers' affiliations are given at the time of their lectures for CASLIN.

University, Clifford Lynch, Executive Director of the Coalition for Networked Information (CNI), Lorcan Dempsey, Director of UKOLN, and others, which was significant for the then-developing Czech librarianship. Initially funded by a grant from the Pew Charitable Trust, after the grant was depleted in 1995, the major libraries of the Czech Republic and Slovakia have kept organizing it ever since.

From 1993 to 1999, I represented the National Library in the International Consortium of Aleph Users (ICAU), an important system user association, where we managed to formalize the collection and discussion of user requests with the system vendor, created the first ICAU web pages[13] (for ICAU 95 still B/W only[14]), and I chaired it from 1995 to 1998. Since 1992, I have also had the opportunity of participating almost annually in ELAG[15] seminars held in libraries in a number of European countries, and for several years, I have been a member of the programme committee and twice the organiser of an ELAG seminar. This experience provided me with a very good overview of the state of automation and co-operation among European libraries in this field. In addition, it gave me an insight into the architecture and operation of academic libraries in historic and state-of-the-art buildings as well – which, little did I know, would prove very useful later.

Before I conclude this section, I should like to highlight the remarkable technological advances that occurred within the mere nine years I spent working at the National Library. During this period, we made incredible strides in catching up with the West, reducing a gap of at least twenty years at an astonishing pace. When I arrived in 1988, just before the fall of Communism, Czechoslovakia had only recently started to use microcomputers equipped with the Intel 8080 processor and the CP/M operating system, or their Socialist clones. Shortly thereafter, the first IBM PCs began to appear. By mid-1988, the National Library possessed three Commodore PCs, each with a 20 MB hard disk and a 4.5-inch floppy drive.

By the time I left in 1997 the National Library had established a structured network, featuring a top-notch DEC Alpha 2100 server for the library system, another DEC Alpha 1200 for the Union Catalogue, an Ultra*Net CD-ROM server, and more than 70 networked IBM PC-compatible computers running MS Windows. This tremendous progress was made possible by the rapid adoption of personal computers, which became increasingly affordable, a trend predicted by Moore’s Law, which states that technological performance doubles every 18 months without an increase in cost. However, the most significant factor was the newly awakened interest and enthusiasm among people, spurred by the political changes of the time. But let’s take it step by step.

With those three standalone Commodore PCs, we began developing the *maks* project. Soon thereafter, we built a local area network serviced by Novell NetWare, using Ethernet connections over coaxial cables, which allowed us to extend the network to at least part of the library. In the autumn, one segment of the network began to malfunction intermittently. Despite efforts throughout the winter, the issue could not be resolved, and with the arrival of spring, the problem disappeared, only to reappear at the onset of the following winter. Drilling into the walls of the Klementinum was prohibited, so the coaxial cables were run along the edges of the floor near the walls. At one point, the cable passed through a corner under the carpet, where a coat rack was positioned. In summer, the coat rack stood empty, but as winter coats and furs were hung on it, the weight pressed down on the coaxial cable, altering its impedance, and causing the network to fail. The following year, we replaced the wiring with twisted pair cables using RJ45 connectors, and the issue was permanently resolved.

In the autumn of 1991, we began preparing the CASLIN project. A joint statement by the directors outlined that it would be based on modern [library] standards such as MARC, ISBD, ISO/OSI, and ISO character sets, as well as technological advancements like UNIX, Ethernet, and network accessibility (at that time, the term “Internet” had not yet come into common usage), all of which were successfully implemented over the next few years. In the spring of 1993, we were negotiating with the company Ex Libris for the delivery of a library system still via fax, we did not have email yet. The supplier was to provide not only the library system but also the hardware on which it would run. Fortunately, they aligned with our request for cutting-edge technology by selecting a Digital Equipment Alpha UNIX server, which had its global debut in 1994.

In the summer of that year, we secured a connection to the Prague Academic Network (via a telephone line with a remarkable speed of 19.2 kbit/sec!), enabling us to use email, FTP, and Telnet. Sometime around 1994–1995, this was upgraded to a connection to the CESNET optical backbone in a tunnel conduit next to the Klementinum, directly linking to the centre in Dejvice. We also managed to arrange CESNET connectivity for all regional libraries through the universities in regional capitals.

13 https://old.stk.cz/icau/, visited on 2024.07.29.

14 https://old.stk.cz/icau/ICAU95.html, visited on 2024.07.29.

15 The European Libraries Automation Group (ELAG) was an informal society of systems librarians voluntarily sharing their knowledge and practices in the field of library systems, founded around 1984. It ran an annual ELAG seminar, hosted by a different library each year.

In the early 1990s, a cost-effective alternative to "magnetic tape services" also emerged: a number of providers, led by SilverPlatter, began offering abstract journals and other databases on a new medium, originally intended for audio use—CD-ROMs, which at the time had an impressive capacity of 600 MB. Soon after, CD-ROM towers or jukeboxes allowed network access to a multitude of databases. This phase lost its economic relevance when network access speeds increased towards the end of the 1990s.

By 1995, Aleph was accessible via Telnet, email had become an invaluable tool, by then available in nearly all universities, and we briefly used WAIS and Gopher. Around this time, Tim Berners-Lee's invention from CERN—the HTTP protocol and HTML markup language—began to gain wider adoption. We initially used the text-based browser Lynx, but it was soon replaced by the graphical browser Mosaic, which was quickly succeeded by the more elegant Netscape Navigator. The entire web was still small enough to be easily navigated using the Altavista search engine, as the web was poised to evolve into what we now understand as the "Ubiquitous Internet".

7 Thoughts on Innovation in Librarianship and Scholarly

7.1 Information Sharing

It is noteworthy that the most significant innovations in librarianship – specifically technical innovations that facilitate work and potentially increase the efficiency of library services – were introduced not by librarians (at least not those originally trained as such), but by individuals with backgrounds in the natural sciences or technical fields. Look: mathematician Shiyali Ramamrita Ranganathan, chemist Frederick G. Kilgour, structural linguist (and thus actually a mathematician) Eugene Garfield, and computer scientists such as Henriette Avram, Brewster Kahle, Clifford Lynch, Tim Berners-Lee, and Herbert Van de Sompel. Apart from the pre-computer Ranganathan and Kilgour, the significance of all the others lies in their keen awareness of the potential of information (and communication technologies) capable of enhancing the efficiency of library services and related activities. Clearly, these individuals were gifted and further they developed strong analytical skills, allowing them to view immediate tasks as specific instances of broader classes of solutions. This perspective ensured that the resulting products were conceptually robust and capable of enduring technological changes over time.

In 1968, the mother of MARC, Henriette Avram, designed a data structure and format for the Library of Congress's needs, especially the production of cataloguing cards that made maximum use of the computer technology available at the time (IBM 1400 and 7000 series). The format also facilitated the sharing of records – a crucial feature, as demonstrated by the involvement of Fred Kilgour, founder of OCLC, as a consultant. Its space-efficient design was particularly significant, even for an institution as large as the Library of Congress at the time. This development was a breakthrough moment that enabled effective library collaboration, eventually on a global scale, and one that influenced – or marked – the library world for many decades.

There is a question as to whether it is fair to criticize the MARC format for not looking further into the future and not anticipating further uses of bibliographic data beyond print catalogue cards or computerized catalogues. Regardless, it was perhaps unfortunate for Henriette Avram (and for contemporary librarianship) that she did not meet the fathers of the Generalized Markup Language during the early days at the Library of Congress she spent analysing cataloguing records, which apparently prevented MARC from reaching the conceptual level of the GML proposal. GML, a precursor of SGML (of which HTML and XML are instances), was being developed at the same time by Charles **G**oldfarb, Edward **M**osher, and Raymond **L**orie at IBM to enable the long-term sharing of extensive machine-readable government, legal, and industrial (mainly IBM) documents. This meant that the documents must be readable and usable for decades (an extremely long time in IT) and the markup must allow them to be processed for different purposes, and by different computer systems or applications. These qualities, regrettably absent in MARC, brought headaches to all concerned on how to proceed with the hundreds of millions of varied MARC records worldwide.

The rigidity of the MARC record structure likely prevented Henriette Avram from envisioning something akin to what we now pursue under the name Bibframe. It is now clear that only by

- implementing a markup language for describing complete records, including all fields and their relationships,
- ensuring these definitions are readable by both humans and machines and allow for syntactic validation,
- rigorously standardizing fields, and
- separating content from form, semantic from formal markup

we can efficiently exploit the knowledge embedded in bibliographic records.

The second breakthrough for librarianship came when the Chancellors of Ohio’s Colleges formed the Ohio College Association and called on Fred Kilgour[16], originally a chemist, to design a co-operative computer network for Ohio’s libraries. In 1967, long before the advent of the Internet, the Ohio College Library Center, now OCLC, was founded. What we now call shared cataloguing – a concept still unfamiliar to many in the Czech Republic, where institutions often cling to their “unique specifications” – began to operate in Ohio after three years of work in 1971, over fifty years ago. Today, OCLC, with more than 57 000 member libraries, museums and archives, offers the human-searchable WorldCat Catalogue containing nearly 560 million bibliographic records (April 2024) referencing nearly 3.5 billion print or electronic items in 490 languages.

8 The National Library of Technology

In 1997, I was appointed Director of the State Technical Library (STK) after a competitive selection process. Like the National Library, STK employed the Aleph library system and at that time had just launched the pioneering “INVIK – Library on Your Desk” (INtegrated VIrtual Library) system for delivering copies of articles from print journals using web technologies. At that time there were no sections in the Czech copyright law dealing with the electronic form of a document, so with the help of lawyers we simulated as best we could the delivery of an e-copy to just one user. Each user received a “private” web page, accessible only by name and password, where the system hung a pdf of the ordered article. The system proved highly successful and in 2001, we transformed it into a co-operative Virtual Polytechnic Library (VPK) system with 45 participating institutions and utilised a meticulously maintained Union Catalogue of Periodicals from 50 organisations. The VPK became the de facto standard in the Czech Republic for electronic document delivery and continued to serve hundreds of users to this day. Only now, it is being replaced by the modern and better integrable system Získej (Get it!) developed by National Library of Technology (NTK).

8.1 Note about the Building for the National Library of Technology

Upon my appointment as Director of the STK, the Deputy Minister of Education remarked, “Mr Director, you may leave the routine management of the library to your deputy; your task is to oversee the construction of a new building for the STK!” Thus, from 1997 onwards, my team and I prepared the “Project for the Construction of the National Library of Technology as a Node of Information Infrastructure for Research and Development, Education and Public Information Services of the Czech Republic”. The project astutely anticipated the future network-based nature of information services and established key principles for the building’s design: openness, friendliness, accessibility, clarity, permeability, flexibility, low energy and operating costs, restrained use of cutting-edge technologies, and an interior design and art integral to the building itself. In addition, it contained a detailed building programme (at that time still including – but never built – smoking rooms) sufficient to define the intended architectural competition. Fortuitously, in 1998, a new law granted universities public legal status, as well as the associated land, buildings, and equipment. However, on the proposal of another deputy minister, it was STK which received a prime building lot in the centre of the Dejvice campus of technical universities for the construction of a new library.

In 2000, the project received government approval, although without the necessary funding for construction. Fortunately, again with the ministerial support, we were able to complete quality documents and launch an architectural competition based on highly detailed yet open specifications. An outstanding jury selected a distinctive winning design from 44 competition entries in early 2001. The government did not approve funding for design and construction until 2004. Construction began in October 2006 and after 28 months, the building was completed on schedule and the new modern National Library of Technology building on the Dejvice Campus was ceremoniously opened on 09/09/09. As the first major public building in Prague for 80 years, it received numerous awards, among the most welcome “The best new building in a historical context” from the Prague Monument Care Club and “Building of the Year” from the Chamber of Architects. It has also become an instantly vibrant campus centre serving more than 800 000 visitors annually, except for the pandemic years.

In the late 1990s, the Ministry of Education recognised the increasing necessity and financial challenge of providing access to electronic information resources (EIR) for Czech research and education. It initially permitted applications

16 Fred Kilgour was an intelligence officer during the Second World War, later Deputy-Director of the Office of Intelligence Collection and Dissemination, and then Director of the Medical Library at Yale University.

for support of EIRs under a pilot programme for the development of infrastructure at universities. Following the success of two pioneers, the Ministry launched a programme specifically aimed at supporting the acquisition of EIRs for all research organisations. Thus, at the turn of the Millennium, still under the STK name, we negotiated the first nationwide licence for electronic journals from Springer, soon followed by large consortia for resources from Elsevier, J. Wiley, Academic Press, IOPP, Kluwer, and other publishers. Despite lingering resistance to anything "centralised", a vestige of Communist central planning, competition for funding was necessary, as the Ministry had no other vehicle to deliver financial resources to applicants. The initial programme attracted 62 consortia, with subsequent programmes reducing the number to 36 and then to 18, reflecting a Darwinian winnowing process. Between 2011 and 2014, initiated by the management of the University of Chemistry and Technology Prague (UCT Prague), NTK and the UCT underwent an integration process, followed by the Institute of Organic Chemistry and Biochemistry of the Czech Academy of Sciences. This integration significantly impacted NTK's operations, providing a demanding and concrete customer base that led to streamlining and simplifying several long-established, almost petrified practices.

The Ministry of Education, Youth and Sports finally responded to the long-standing effort to establish a national centre for electronic information resources and made it possible through the European Operational Programme Research, Development, Education (OP RDE). In 2016, along with Eva Dibuszová, Head of the Centre for Information Services at UCT, we launched the CzechELib project. This project greatly rationalised and clarified the provision of tens of thousands of electronic journals and other databases to over 130 universities, research institutes, major libraries, hospitals, and other research organisations. Initially met with scepticism – "we could do it better" and similar objections – the project eventually received positive feedback in Ernst & Young's final evaluation, with 90 % of participants expressing satisfaction with its transparency, simplified accounting workflow, clear rules, and even cost savings, which the project never promised. The OP RDE funds financed the establishment of the CzechELib National Centre and its staff and operational expenses together with a three-year "test" support for the purchase of EIRs.

The success of CzechELib led to the preparation, again with Eva Dibuszová, of the "National Centre for Information Support of Research, Development and Innovation (NCIS RDI)" project in 2021, aimed at supporting Open Science. This project fully funded from the Czech state budget for research support, ensured the continuation of CzechELib after the conclusion of OP RDE funding, with a focus on negotiating "transformative" agreements for open access to publications. It also expanded its scope to include the development of advanced academic and corporate services, the coordination of open science practices in the national research environment, and the establishment of a national document repository. As of today, the National Centre CzechELib meets 85–90 % of the Czech research community's needs for access to electronic journals and other databases. It has secured transformative agreements supporting open access publishing with the most of the top twenty publishers frequented by Czech authors, with negotiations ongoing with Elsevier, APS, IEEE, and the Nature portfolio still in negotiations.

Two years later, leveraging European funds, we launched another project, CARDS – Czech Academic and Research Discovery Services. Properly we should have named it CARDDS, as it aims to facilitate not only the discovery but also the delivery or sharing of expensive resources, whether print, digital, or electronic, and even datasets equipped with quality metadata for discoverability. The project has two main activities: the first is the acquisition of a single, centrally created and centrally populated "next generation platform" (PNG) for efficient management and sharing of various types of information resource types, including printed, electronic, and digitised documents and research data. This will, more than 50 years after OCLC, create the first centralised shared catalogue in the Czech Republic for 22 universities and research organisations, replacing the ageing Aleph and several other Czech-produced library systems. The second component provides professional library support for the complementary EOSC-CZ project focused on research data. This involves defining a metadata model for describing research data, establishing and operating a metadata support office, creating and piloting the National Catalogue of Repositories (NKR), coordinating the Metadata working group for EOSC-CZ, and establishing and operating a National Centre for Persistent Identifiers covering ISSN, ORCID, DOI, ROR, and RAiD. Now in its second year, the project is on track in terms of timeline and other parameters.

The NCIS RDI project sort of forced us to build a strong Advisory Board, comprising leading scientists, funding agency heads, vice-rectors, deputy minister, and others. In the Czech Republic, there is still a lack of strong legislation or a clear strategy in many areas concerning the organisation of science and research. The Advisory Board helps us advocate for necessary progressive changes. It is fair to say that NTK generates many proposals and – based on surveys and statistical data – provides numerous legislative suggestions and supporting documents to public administration. In this regard, the Advisory Board plays a crucial role in

facilitating communication between decision-makers at institutional and governmental levels.

9 Conclusion

Today, it is evident that artificial intelligence tools will fundamentally transform not only technical processes but also the conceptual foundations of acquiring, evaluating, and utilising existing knowledge to gain a deeper understanding of the world. However, that will be a new chapter for Czech librarianship.

This year, after 27 years, I have requested my Minister to allow me to step down from my position as Director. However, I do not object to remaining committed to serving as Chair of the NTK Advisory Board and continuing to engage with challenging and exciting problems, aka opportunities.

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