The Emergence of Computing Disciplines in Communist Czechoslovakia: What's in a (Sovietized) Name?

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Abstract. Drawing upon archival evidence from the Czechoslovak government and its ministries from the 1970s, this paper presents a preliminary snapshot of the institutional processes that drove the emergence of computing disciplines separate from the rubric of Soviet cybernetics in Communist Czechoslovakia (nowadays, the Czech Republic and the Slovak Republic). We show that the new disciplines were created by a top-down order of the Czechoslovak government, which, in turn, was motivated by a larger scale initiative in the East Bloc. The disciplines created in the 1970s were as follows: *Numerical Mathematics* for an area of education akin to computer science, *Electronic Computers* for an area of education akin to computer engineering, and *Automated Management/Control Systems* for applied computing education. The evidence suggests that the cybernetics metaphor lost its organizing power in 1973 over the broad field of information processing in Czechoslovakia. This disciplinary shift, albeit not immediate, redistributed power between cybernetics and informatics. Indeed, it appears that even nowadays the distribution of power between the two disciplines in the Czech Republic is still in negotiation; what we term a "residual drift" has continued for almost 50 years as an impressive afterglow of the past fame of cybernetics in the east. In sum, the paper raises awareness of the fact that the emergence of computing disciplines behind the Iron Curtain was very different from the West. It also suggests that while academic research analogous to computer science thrived, other computing disciplines in Czechoslovakia were in more complicated positions. Although this paper focuses on Czechoslovakia, the method is generalizable and the data on enrollments may be compared to other countries. Thus, we provide a framework for the further study of similar disciplinary efforts in the remaining East Bloc countries.

Keywords: Comecon · CMEA · History of computing · History of informatics · Institutionalization · Scientific community · Soviet cybernetics · Sovietization

Juliet.

What's in a name? That which we call a rose
By any other name would smell as sweet.

While obviously paraphrasing Shakespeare, the subtitle of this paper also makes reference to a section title in Coy's seminal paper on the definition of informatics in Germany [1].

Published by Springer Nature Switzerland AG 2019
C. Leslie and M. Schmitt (Eds.): HC 2018, IFIP AICT 549, pp. 16–39, 2019.
https://doi.org/10.1007/978-3-030-29160-0_2

1 Introduction

Academic disciplines in the area of computing are known under various names that reflect their focus, historical development, and regional specifics. For example, the very same topic may be researched in an U.S.-based department of computer science and a Europe-based department of informatics [1]. In applied fields such as information systems, this is even more diverse [2]. Although the development of computing disciplines represents an important aspect of the history of computing, little effort has been put into mapping the disciplinary histories of Central and East European computing so far. Specifically in this geographic region, such histories are intertwined with the histories of Soviet-originated cybernetics [3]. During the 1960s and 1970s, cybernetics – as a powerful "umbrella science"[1] – combined several computing fields in the East Bloc (i.e., the Soviet Union and its satellites), while their disciplinary cousins emerged as partly or completely separate domains in the capitalist west (i.e., the United States and Western Europe). Later, as this paper shows, some computing fields were given a certain level of autonomy in the east.

This paper contributes to a better understanding of the idiosyncrasies connected with the rise [4] and fall of cybernetics in the East Bloc. Driven by the commitment to building a gigantic, automated socio-technical system in the East Bloc countries [3, 5], a significant change in the disciplinary landscape occurred in Czechoslovakia in 1973. The present paper suggests that 1973 can be seen as a turning point when cybernetics lost its monopoly over the problems of control and computing in this country, being regarded as "too broad" and thus unable to cope with upcoming challenges. This resonates with Gerovitch's [3] observation that during the 1970s the popularity of cybernetics was already in decline in the Soviet Union. However, a topic not covered in Gerovitch's work is the role of a broader East Bloc initiative that caused a similar disciplinary shift in the remaining East Bloc countries. Our intention is to connect this initiative with tangible disciplinary changes observable in Czechoslovakia during the 1970s.

Currently, our perspective is limited because this paper reports on an ongoing research effort. Specifically, our aim here is to provide a bird's eye view of the disciplinary landscape of Czechoslovak computing disciplines in the 1960s and 1970s. In our subsequent research, this view will be possibly expanded into a geography-based perspective similar to the one presented in [6]. The underpinning philosophy that drives our current macro view is inspired by the perspective of the sociology of science. In that regard, we propose to view concrete disciplines as "amoebas putting out pseudopods as they move in a multidimensional intellectual space" [7]. In taking such a view, it is imperative to recognize the essential role of institutional structures and forces. However, we admit that only a part of the story can be told here. This is mostly due to the fact that our current research has concentrated primarily on governmental archival sources. Thus, it largely omits the perspective of individual thought leaders and professional organizations (e.g., [8]). Nonetheless, we do not view this as a major

[1] Reflecting on cybernetics prominent position, Arbib [4] labelled cybernetics during the 1960s even more expressively – as "the superscience of the Soviet Union".

detriment, given that in Communist regimes, the influence of both groups was often limited. This was due to the fact that state administration structures were frequently at the center of decision-making power, instead of academic disciplines as it was in the west. Such a configuration clearly prioritized the ideology of the ruling Communist party over self-governing professionalism [9].

Conceptually, it is also important to emphasize that while this paper may at first sight appear as a taxonomy exercise focused only on Czechoslovakia, it rather aims to offer definite knowledge that should be generalizable beyond this particular context. By doing so, it lays important grounds for the further study of similar disciplinary efforts in the remaining East Bloc countries. In addition, Sect. 4.5 provides, presumably, a complete picture of then existing computing programs in whole Czechoslovakia, supplemented by the numbers of admitted students. This opens a possibility for other researchers to compare the presented data with different countries.

2 A Broader Context: Education in Communist Czechoslovakia

John Connelly's work *Captive University* [9] provides a broader understanding of the educational systems that communists built in Czechoslovakia, Poland, and East Germany (i.e., the German Democratic Republic) during the post-war period. In general, Connelly argues that university systems in these countries – which had previously had strong ties with the West, and whose university traditions had been commonly linked to Humboldtian ideals – were completely remodelled after the Soviet example. The newly introduced form exhibited little academic autonomy due to the subordination of universities to the state. In Czechoslovakia, a similar process of purging and disciplining universities was introduced soon after 1948 when the Communists took over the government. Notably, the process resulted in both numerous ideologically motivated dismissals from academia and also the creation of an atmosphere of fear. Another salient effect was singling out scientific research as an activity that would only be carried out at the Czechoslovak Academy of Sciences, a research-based institution created according to a Soviet example. The new view of universities was purely utility-based. Simply put, universities were the places where new cadres for the centrally planned needs of the Communist regime were trained. The original, Western ideal of universities – being typically viewed as cathedrals of knowledge and academic freedoms – was gradually removed.

However, universities were not the only affected parts of society. In fact, the above countries were expected to fully duplicate the elements of the political and administrative system that then existed in the Soviet Union. Connelly argues that the

> process of duplication … was unprecedented; within a few years, a once multifarious scenery of cultures and histories between Elbe and Bug resembled a belt of miniature Soviet Unions, each with collectivized agriculture, steel and coal industries, broad alleyways of socialistrealist communal housing, marching columns of uniformed youths, omnipresent banners of little Stalins like Walter Ulbricht, Klement Gottwald, or Boleslaw Bierut. Western observers were stunned at the apparent totality and uniformity of [the] transformation (p. 1).

Interestingly, this process was largely improvised because – despite the Soviets' grandiose visions – concrete steps and guidelines for certain areas were not adequately communicated by the Soviets. While local political leaders in Czechoslovakia, Poland, and East Germany were desperately seeking tangible information about certain problems that had presumably been already solved in the Soviet Union, it was almost impossible to acquire such information for two reasons. First, the real state of the problems' solution in the Soviet Union was far from ideal[2]. Second, the Soviets were afraid of "ideological contamination" from satellite countries; consequently, they provided to them as little information as possible (p. 46). So, while Sovietization worked seemingly well in the areas where mimicking simple cultural artefacts such as red flags and banners with enthusiastic slogans was enough, it was imperfect when dealing with complex ideas and notions. In other words, while the organization of annual May Day parades celebrating work was easily graspable, it was much harder to translate the Soviet educational system beyond its original territory. In such complex areas, the imperfect duplication in turn resulted in variations of the original concepts.

This brings us to an important conceptual problem. From a North American perspective, the process of the *emergence* of new disciplines is largely decentralized and consensus-based (e.g., driven by curricula standardization efforts). In general, a new discipline is considered fully established when the majority of new professors appointed in a certain field come from Ph.D. graduates in the new discipline. These professors are then set to reproduce epistemic patterns of the newly established discipline [7]. A similarly formulated criteria cannot be applied to the problem analyzed in this paper due to the fact that the *creation* of new disciplines in Czechoslovakia was *artificial*. That means, it was centrally decided and administered by the government. Neither diploma programs (i.e., 4–5-year non-structured educational programs leading toward a first university degree) nor programs for "scientific preparation" (i.e., leading towards the Candidatus degree – a PhD equivalent) were under the full control of particular universities. Rather, disciplinary taxonomies were centrally administered by the government and ministries and were updated only irregularly by passing a new implementing regulation (e.g., [10]). Central planning extended even to the number of students admitted to study in each field; universities were then provided with quotas they were obliged to fulfill.

Moreover, comparing some of the historical taxonomies, one can notice significant inconsistencies between the disciplinary landscapes of diploma and "scientific preparation" programs in various areas of computing through time. For example, for a long period, future computing scholars were "prepared" in two broad cybernetics programs [10], while diploma students were already taught in specialized computing programs (see Sect. 3.2). So, when we discuss in this paper the process of the emergence of new computing disciplines, we basically mean the moment when a new undergraduate program appeared due to governmental fiat.

[2] See, for example, the story of the Czechoslovak Jiří Pelikán's visit in the Soviet Union [9]. Attending a hastily organized meeting in Moscow, "[h]e had learned the fundamental lesson of Sovietization: that basic ideas on the implementation of Soviet models would have to be formed locally" (p. 21).

3 The Beginnings: The Reign of Cybernetics

This section aims to briefly explain the historical role of cybernetics in the Soviet Union (Sect. 3.1). Then, the realities of cybernetics in Czechoslovakia are presented (Sect. 3.2). Following this, the central concept of management/control in both technology and human-based systems is introduced (Sect. 3.3).

3.1 The Position of Cybernetics in the Soviet Union

The role of cybernetics in the East Bloc in general and in the Soviet Union in particular was crucial. In fact, much of the progress in computing was initially carried out under the label of cybernetics. The importance of cybernetics spurred from the Soviet delimitation of this discipline, which "included almost any form of computing and systems of control, communication, or information" [11], including economic modelling and operations research.

Interestingly, in the early 1950s, the future cybernetics discipline was still associated with ideological labels such as "reactionary" or "bourgeois pseudo-science." Yet, cybernetics was rehabilitated by the late 1950s [3]. Aside from other key protagonists [5, 12], a great effort was put into this rehabilitation (both in the Soviet Union and in Czechoslovakia) by Arnošt Kolman[3] (1892–1979), who daringly argued [13] in 1956 that the

> nihilistic relationship to cybernetics … is just as harmful as a nihilistic relationship to the Theory of Relativity; the use of quantum mechanics in chemistry; the study of heredity on the basis of [knowledge from] physics and chemistry; mathematical logic (p. 38).

While he further stated that "cybernetics is not [yet] an autonomous scientific discipline" (p. 17), efforts to institutionalize cybernetics were accelerated during the late 1950s and the early 1960s. For the Western audience, the key Soviet theses regarding cybernetics were, with a noticeable irony, summarized by Arbib [4] in 1966: (1) "Cybernetics is the science of control, and will help build socialism", (2) "Cybernetics is a science … and must not be considered a philosophy. It cannot compete with material dialectics [dialectical materialism]", (3) "Bourgeois [i.e., Western] cyberneticians gloss over the vital distinctions between man, machine, and society. To understand the brain of man is the task of Pavlovian research on higher nervous activity. To understand society, we need Marxism-Leninism." Interestingly, while visiting the Soviet Union in 1960s, Arbib noticed the overarching popularity of cybernetics:

> [E]verybody I met (including a pianist, a customs official, Intourist guides, and hotel staff) knew of cybernetics, and commented on my luck in working in such a new and exciting field – a change from the blank looks the word "cybernetics" calls forth in the West (p. 198).

By the 1970s, however, the popularity of cybernetics started to decline. This was due to the unfilled promises of cybernetics, but also due to the previous

[3] Kolman was a controversial Soviet figure of Czech origin – a mathematician and Marxist philosopher with a problematic reputation [41].

overpopularization of cybernetics and its conceptual misuse [3]. There seemed to be a gap in the intellectual space asking to be filled in. It was soon filled by informatics – a discipline labelled by a term with unclear boundaries in European context. By some, the term "informatics" might be (even nowadays) used as a synonym for computer science. However, a more appropriate usage, at least from the perspective of disciplinary traditions within continental Europe, is to employ the term to refer to the conglomerate of *all computing disciplines* (e.g., computer science, software engineering, information systems, etc.) [14]. In the Soviet Union, however, a crucial complication lied in the fact that the Russian term *informatika* had previously been established to denote a discipline akin to library science [15].

Following Afinogenov [16], we connect the beginning of the East Bloc shift from cybernetics to Western-style informatics primarily with Andrey Petrovych Ershov (1931–1988), who was very active in redefining the latter term in the Soviet Union. The shift became salient especially after 1976, when F.L. Bauer's *Informatik* was translated from German to Russian, supplemented by a foreword by Ershov. However, as Afinogenov shows, cybernetics never entirely disappeared from the Soviet space due to the strong position it used to have during the 1960s (pp. 573–4). This position can be contrasted with the much weaker role of cybernetics in the West, where "[p]eople [either] stayed in their home disciplines" [17] and never associated their scholarly identity with cybernetics *per-se* (e.g., in the USA), or rejected cybernetics entirely due to its image of "babble" science (e.g., in France) [8].

However, the exact nature of the above shift in the Soviet Union remains an open question. In any case, it would be futile to seek an exact date when cybernetics "died." In the Soviet Union as well as other East Bloc countries, cybernetics has, in fact, never entirely disappeared from the mainstream intellectual space due to the remarkable ongoing co-existence of cybernetics with computing[4]. Yet, due to this set-up, the jurisdiction of cybernetics in this geographic region significantly changed several times during the past few decades.

3.2 Cybernetics in Czechoslovakia

In Czechoslovakia, cybernetics was defined as an autonomous scientific field by a directive of the Minister of Education and Culture of 20 January 1965 [18]. This directive codified a formal list of scientific disciplines in which one can acquire a *Candidatus degree* (CSc., an equivalent of a Ph.D.). The directive stated that Cybernetics is divided into *Theoretical Cybernetics* (within the taxonomy of "Physical-Mathematical

[4] See, for example, Ershov's statement from 1988: Although informatics has taken the lead, "we [in the Soviet Union] are not attempting to change either the name of the Council on Cybernetics or the traditions of its first chairman, Aksel' Ivanovich Berg" (a third source quoting Ershov as cited in [16]). Also note that it was not before 1990 that the word "informatics" was added to the official title of the scientific societies focused on control and computing in both republics that then formed the Czechoslovak Federation. Even nowadays – in the two now completely independent countries – two scientific societies with almost identical names continue to span the scientific worlds of control and computing: *The Czech Society for Cybernetics and Informatics* (http://www.cski.cz/) and *The Slovak Society for Cybernetics and Informatics* (http://www.sski.sk/).

Sciences") and *Technical Cybernetics* (within the taxonomy of "Technical Sciences"). *Applied Cybernetics* was not explicitly mentioned in the directive. However, in a seminal 1960 article authored by Soviet Academician Aksel Ivanovich Berg (1893–1979) and translated to Czech the same year [19], *Applied Cybernetics* was explicitly defined as an application-oriented, cross-disciplinary field. (For an early taxonomy of key research topics in Soviet cybernetics, including namely theory of "electronic computers", see [12].)

Institutional Basis. Two salient professional organizations related to cybernetics were The Czechoslovak Cybernetic Society (CSCS, *Československá kybernetická společnost*) and The Society for Applied Cybernetics (SAC, *Společnost pro aplikovanou kybernetiku*). CSCS emerged from an informal and conspirative "cybernetics circle" that got together thanks to the mathematician Antonín Špaček (1911–1961) in the mid-1950s. This group also included the computing pioneer Antonín Svoboda [20]. CSCS was formally founded in 1966 when cybernetics was already considered politically "purified" in the Soviet Union (see above). The organization had close ties to the Czechoslovak Academy of Science, and was represented by the first CSCS's chair Albert Perez (1920–2003). This researcher was an interesting figure. Born in Greece, he moved to Paris after the war and then to Prague in 1949. As a mathematician with a lot of international contacts, he became a salient representative of the Czechoslovak school of information theory [21]. The imprint of scientific spirit remained with CSCS, a society with selective membership, even in the following decades.

In contrast, SAC was founded by the end of the 1960s with a totally different organizational grounding. Dominated by engineers and having primarily an application-oriented mission, this professional organization fitted well within the structure of engineering societies, i.e., under the wing of the Czechoslovak Science and Technological Society (*Československá vědeckotechnická společnost*). The philosophy of this organization promoted a broad membership base, including also many engineers working in industry. In 1969, SAC was led by Milan Balda (1924–), a professor of mechanical engineering interested in advancing industrial automation. While conceptually imported from the West, in Czechoslovakia the field of systems engineering was organizationally subsumed under applied cybernetics. Having strong overlaps with the disciplines discussed below,[5] its main aim was to integrate all possible disciplines in order to bridge theory and practice focused on large, complex, socio-technical systems, including the systems of control and computing. Institutionally, the field was represented by a special SAC section formed in 1969 by Zdeněk Dráb (1925–). This section became very active in organizing of popular local conferences (e.g. Systems Engineering, Automatics – *Automatika*) attended during the 1970s and 1980s by both academics and industry professionals.

While CSCS maintained international contacts with the International Federation for Information Processing, SAC maintained contacts with other international organizations. For example, the latter organized the seventh world congress of AICA (*Association Internationale pour le Calcul analogique*) in Prague in 1973. In a similar vein,

[5] This was not only due to the eclectic nature of systems engineering as established in the west. The other reason was the central role of cybernetics and control concepts in the East [3].

the discipline of operations research – and related international contacts with IFORS (International Federation of Operational Research Societies) – also belonged under the auspices of SAC. Interestingly, a SAC section fully dedicated to operational research was only founded in 1984.

Yet, one should not think of SAC as an umbrella for all thinkable applications of cybernetics. As a contradictory example, Czechoslovak medical cybernetics[6] was associated instead with the above mentioned multidisciplinary "cybernetics circle" that became institutionalized as CSCS in 1966. The key figure in this area was Zdeněk Wünsch, MD (1926–), a professor of psychiatry and a cybernetics enthusiast who co-translated Norbert Wiener's famous book into Czech in 1960.

Institutional Constraints. At this point, however, an important matter should be noted. In essence, it would be illusory to regard any of the above Czechoslovak societies as independent professional bodies with little or no dependence on the political establishment. As early as the 1950s, the Communist state and Communist political bureau were directly involved in passing certain reformist laws related to the organization of scientific and technology-intensive activities. These laws commanded an organizational restructuring and merging of some former (i.e., "bourgeois") scientific and professional societies (e.g., the Czech Academy of Sciences and Arts, which was originally founded in 1890). Hence, one should not think about the above societies as having a total autonomy from the Czechoslovak state.

Below, we provide details of the three important areas of cybernetics officially defined in Czechoslovakia in 1965.

Theoretical Cybernetics – An Interdisciplinary Field Anchored in Mathematics. Following the 1965 directive, Theoretical Cybernetics emerged as a specialization in diploma programs at Charles University in Prague in 1969 [22]. Almost in parallel, the Department of Mathematical Logic was founded there. Inspired by the industrial success of applied and numerical mathematics, Theoretical Cybernetics was intended, in essence, as a tool for "mathematization" of disciplines such as biology, medicine, or social sciences. A concrete vehicle to realize this vision was seen in supplying the mentioned disciplines with the conceptual backing of exact thinking and formal methods. A corresponding idea was to send mathematicians to "non-mathematical workplaces", so they could apply "mathematical disciplines, especially mathematical logic, within non-mathematical fields".

Technical Cybernetics – An Engineering Discipline. The origin of this disciplinary title can be traced to a 1954 book entitled *Engineering Cybernetics*. The book was authored by Tsien Hsue Shen and translated in 1960 into Czech as Technical Cybernetics (Technická kybernetika) [23]. While the term "mathematical machines" was slowly dying away, first computer engineering departments in the Czech Socialist Republic were founded in Prague and Brno in 1964 (also see [24] with regard to

[6] Note the promise of medical cybernetics in the Eastern Bloc countries, and the "universalism" of key scientific figures active in cybernetics in general. For example, Soviet scientist Anatoly Ivanovich Kitov (1920–2005) spanned several cybernetics fields, including medical cybernetics [5; see also Kitova and Kitov, "Anatoloy Kitov and Victor Glushkov", this volume].

Slovakia). These departments were to carry almost identical names: Department of Computers (Katedra počítačů) and Department of Automatic Computers (Katedra samočinných počítačů). From a disciplinary perspective, however, they were oriented on teaching and research within the realm of Technical Cybernetics programs. Following this constellation, Mathematical Machines survived as a specialization within the "scientific preparation" programs of Technical Cybernetics for a number of years. Also, it was not until 1973 that Electronic Computers became a diploma program in its own right in Czechoslovakia (see Sect. 4).

Other Relevant Disciplines. Although not completely subsumed under cybernetics, there existed several important sister disciplines in the 1960s that should be mentioned to complete the big picture. Currently, however, we have quite a limited understanding of the circumstances under which these disciplines emerged.

First, in 1963, an undergraduate program called *Mechanization of Economic Evidence (Mechanizace národohospodářské evidence*) was transformed into a program called *Mechanization of Administrative Work* (*Mechanizace řídících prací*). At the same time, a new program called *Computation in Economics/Mathematics (Ekonomicko-matematické výpočty)* was created. In the Czech Socialistic Republic, both programs were taught only at the *University of Economics, Prague*. Finally, there were another two programs focused on heavy industry automation. Both programs had some interest in the use of computers. One had its disciplinary home in mechanical engineering, the other in chemical engineering. Their names were *Instrument, Automation and Regulation Technology* (*Přístrojová, řídící a automatizační technika*) and *Processes, Devices and Automation of Chemical Production* (*Procesy, zařízení a automatizace chemické výroby*) respectively. All the names stated above indicate that all these disciplines were application-oriented.

3.3 The Doctrine of Management/Control

There was a crucial concept that stemmed from the Soviet cybernetics discourse of the 1960s [3]. In Czech, the concept was labeled *řízení* – a direct equivalent of Russian *upravlenie*. Based on their connotation, these terms were used very broadly both in Czech and Russian. Conceptually, the use of these terms typically did not differentiate between people-based systems vs. technology-based systems. Accordingly, there is no one-to-one English equivalent for these terms. As noted in the English-written administration literature already in 1973 [25], "[i]n various contexts … [the original terms] may be translated [into English] as administration, management, control, regulation, guidance, or government". In this paper, we use for Czech *řízení* the English equivalents "administration" and "management/control", as appropriate.

Having provided this terminological background, it is also imperative to point out that the concept of *řízení* (*upravlenie*) was essential, as was cybernetics [3]. Extremely open to individual interpretation, the concept of *řízení* was simply overarching: it ranged from the "scientific management of society" [26] to the regulation of technological processes in individual factories (owned by the state). This was fully in line with the philosophy of central planning, which was fundamental for the Socialist regimes. It should thus come as no surprise that the doctrine of management/control

(*řízení*) was later reflected also in the disciplinary titles. On the one hand, Soviet cybernetics itself, as an early prophet of the management/control philosophy in the East Bloc adapted from the West, remained faithful to its international label.[7] On the other hand, a new broad field – Science of Administration (*věda o řízení* in Czech, *nauchnoe upravlenie* in Russian) – was defined as a partly overlapping conceptual science, including also the "Cybernetics School of Administration". This resulted in what Vidmer [27] later called a "'jungle' of competing views"; these views were ideologically dependent on political economy and largely incompatible with Western approaches to management.

In addition, the technology-oriented disciplines that were to transform the conceptually neat theoretical ideas of *řízení* (*upravlenie)* into the messy East Bloc reality acquired their own specific titles (see Sect. 4). Even disciplines recognizable by their titles in the West (e.g., systems engineering) should not be confused with their Soviet/East Bloc equivalents because the latter had quite unique features and unclear boundaries. For example, in Czechoslovakia, *Systems Engineering* de facto conceptually competed with *Technical Cybernetics*, which should also justify the presence of both disciplines in this paper. Interestingly, Czechoslovak *Systems Engineering* also covered many aspects of Western industrial engineering, because the latter never emerged as a distinct discipline in Communist Czechoslovakia.

4 The Emergence of New Computing Disciplines

In this section we provide original findings based on our archival research of previously unexplored archival materials[8]. In line with our goal to focus on the beginnings of autonomous computing disciplines in Czechoslovakia, we have primarily studied two different versions of *The Conception of Higher and Middle Education of Qualified Cadres/Experts in the Area of Computer Technology* (in short "Conception", in original: *Koncepce výchovy kvalifikovaných vysokoškolských a středoškolských kádrů/odborníků v oblasti výpočetních techniky*). We regard the first one [28], stored in the Ministry of Education archival collection (the T-73-7-72 version), as a draft from 1972, while the second one [29], stored in the Government Office archival collection (the 245-12-72 version), as the finalized document presented to the government in January 1973. There are important differences between the documents (e.g., different arguments, different names that were proposed for the emerging disciplines, added phrases

[7] Gerovitch citing Berg's statement from 1961: "Many people don't seem to like the word cybernetics. I don't like it either, but we haven't yet come up with a better one. It would be better to use a Russian word. That's why we often speak of a new science of government [upravlenie]." [3] (here "Science of Administration").

[8] The archival collections we benefited from in this research are presently uncatalogued and not freely accessible. The pre-selection of archival documents was carried out by the archivists of the National Archives, Prague. It could happen that the resulting material available for our study did not include all the items essential for getting a complete picture of the presented historical events.

such as "based on foreign [i.e., Soviet?] experience", etc.). Some of them are analyzed below. Unfortunately, we have not yet succeeded in locating the archival documents that would reflect inter-ministerial and other comments, i.e., what was happening with the content of the proposed Conception in the meantime, and why.

To begin with, the key idea underpinning a broader East Bloc initiative was to promote the creation of *four* types of computing disciplines by defining certain common principles shared among the East Bloc countries. As shown further, this proposal was implemented imperfectly in Czechoslovakia – below we explain the creation of *three* concrete disciplines which were adjusted to the Czechoslovak reality.

4.1 The Role of the Council for Mutual Economic Assistance

Following the Soviet example [3], the use of computers for various activities, especially for *řízení,* had become a cardinal topic for most of the Socialist governments in the East Bloc by the end of 1960s. Attempts to eliminate overlapping research and development activities gradually resulted in the centralization of these efforts under the wing of the *Council for Mutual Economic Assistance* (CMEA), also known as *Comecon*.[9] CMEA was an economic organization comprised of East Bloc countries and dominated by the Soviet Union [30]. Czechoslovakia was among its six founding members in 1949. Under the auspices of CMEA, an agreement in the area of computing was signed on 23 December 1969 in Moscow [31]. The agreement was focused on research, development, production, and supplies of computer technology among CMEA members. The signing members were as follows: the Soviet Union, Poland, the German Democratic Republic (East Germany), Hungary, Bulgaria, and Czechoslovakia. Cuba and Romania later joined. Following this agreement, a governing body for these activities was instituted – the *Intergovernmental Commission for Computer Technology* (ICCT, *Mezivládní komise pro výpočetní techniku*). Under the auspices of ICCT, several working groups and sub-commissions were created. Two of them are of particular interest: the *Council of Chief Designers* (*Rada hlavních konstruktérů*) and the *Working Group for Automated Management/Control Systems* (*Pracovní skupina pro automatizované systémy řízení*). Put simply, the former focused on the research and development of third generation computer hardware including peripheries, and the latter on the use of computers for *řízení*, i.e., for controlling the national economy from the top (i.e.,. macro level industry management) to the bottom (i.e., organizational management and technology control within individual enterprises).

The Working Group for Automated Management/Control Systems was further hierarchically organized into temporary sub-working groups called "councils of specialists" (*rady specialistů*). Among these, one such council was designated to deal with specific problems of computing education. The rather complicated formal title of the council was *Council for Educational Matters of the Cadres for Automated Management/Control Systems* (*Rada specialistů pro výchovu kádrů pro automatizované*

[9] See Sikora, "Cooperating with Moscow, Stealing in California", this volume.

systémy řízení). This computing education council took the lead role in the curriculum standardization efforts carried out across all the countries involved.

Although the process of unification was reportedly cumbersome, a tangible result emerged. Specifically, a common nomenclature of computing disciplines valid across CMEA countries was defined. However, instead of using the term "computing" as such, the areas proposed by the nomenclature had another common denominator – the concept of Automated Management/Control Systems (AMCS, in Russian: *avtomatizirovannyje sistemy upravlenija*[10]). Arguably, such a focus can be attributed to the previous importance of cybernetics and systems disciplines in the East Bloc, and to the dominance of the Soviet Union where the concept was very popular [3].

The nomenclature defined four specialization areas in computing/automation education. The areas of education for specialists in AMCS were:

- economic/organizational and informational problems
- mathematical/programming problems
- technology-related problems
- applications in industry

The above nomenclature represented the key framework for the subsequent changes in the computing education landscape in Czechoslovakia (and presumably also in the remaining CMEA countries).

A detailed local report explaining the above nomenclature and the aims of the new computing programs was published by Milan Balda (1924–) and Jan Ehleman (1930–2010) in 1973 [32]. In their paper, they also described the existence of the Conception (see below) and highlighted the fact that the working group had already "discussed and approved the structure of the disciplines, the requirements for [related] educational programs and a list of courses for [educating] the first group of specialists".

Meanwhile, following the Soviet paragons and the activities of ICCT at the international level, on 22 December 1971 the government of the Czech Socialist Republic adopted a seminal resolution (No. 306/1971 [33]). It contained one high-level instruction for the Minister of Development and Technology, and one for the Minister of Education. While the first one was an assignment concerning country-wide coordination of the implementation and use of computer technology, the second one gave instructions to *deepen the education in the area of computing at secondary schools and universities*. Also, the task of preparing a conception of the training and education of "expert cadres" in the area of computing by 30 September 1972 was formulated.

Following the events described above, a local commission of experts was appointed to work on the *conception of training and education for computing*. It is highly probable that there was significant overlap in membership in the local commission and the Czechoslovak part of the international computing education council. Specifically, we assume that both M. Balda and J. Ehleman took parts in all these activities. In the following subsections, we examine several basic elements of the Conception.

[10] Автоматизированные системы управления.

4.2 The Conception

The Conception was a document aiming to formulate the key principles of future education of computing professionals in the Czech Socialist Republic. As a motivation, the Conception claimed [28] that other countries had been concerned with the "education of experts capable of [applying] systems approaches to solve complex problems of current society, and well-versed in related theoretical and technical tools". The earlier version of the Conception further stated that other countries had already "concentrated such education into new study programs …, especially informatics [!] and Automated Management/Control Systems". It is debatable what countries were meant by the term "other countries", but presumably the authors of the Conception had in mind Bulgaria, Hungary, East Germany, Poland, and the Soviet Union (see Appendix 3 in [29]). The Conception also mapped the situation in Czechoslovak academic computing at that time. Table 1 provides an overview of computing programs that already existed in 1972. These programs represented the starting point for changes implemented subsequently.

4.3 Learning from the Soviets

Observing the development in the Soviet Union closely, the authors of the final version of the Conception supplied it with several new attachments. Arguably the most interesting one is Appendix No. 3, which summarized some features of computing education in the remaining countries of the East Bloc. On top of that, the Russian-to-Czech translation of a Soviet paper about computing education [34] was included. The paper was authored by Vjacheslav Petrovich Eljutin (1907–1993), the Minister of Higher and Middle Education of the Soviet Union. In his paper, Eljutin described the organization of computing disciplines in the Soviet Union. Referring to the directives of the *24th Congress of the Communist Party of the Soviet Union* in spring 1971, he repeated that Soviet economy had been in need of more specialists on administration, management, planning, economical modelling, and modern computing methods. He also mentioned that several new computing programs had been created in the Soviet Union in 1968, for example *Automated Management/Control Systems* (0646), *Applied Mathematics* (0647), *Design and Production of Electronic Digital Devices* (0648). In addition, an older program had been transformed into *Electronic Computers* (0608). He also highlighted the importance of *Economic Cybernetics* programs.

Not surprisingly, many of the disciplinary titles presented by Eljutin were incorporated into the Czech proposal on the new computing disciplines word-for-word (see below). Nonetheless, two vital questions to be asked here are: To what degree was this duplication accurate in terms of the "inner content" of the disciplines? And was the mimicking process enforced officially from the top, or decided by the authors of the conception themselves, given the political context they lived within? (Regarding the conceptual dilemma of Sovietization vs. "self-Sovietization", refer to Connelly [9]). Unfortunately, this paper does not provide these answers due to the early stage of development of our research project.

Table 1. The starting programs with an overlap to computing as of 1972. Adapted from [29]. The acronyms have the following meaning: CU = Charles University in Prague; UJEP = University of Jan Evangelista Purkyně (today Masaryk University), Brno; CTU = Czech Technical University, Prague; BUT = Brno University of Technology; CMEE = College of Mechanical and Electrical Engineering (today University of West Bohemia), Plzeň; UCT = University of Chemistry and Technology, Prague, Pardubice; UE = University of Economics, Prague; TUO = Technical University of Ostrava.

Program	University	Branch
Mathematics (specializations: Numerical Mathematics, Programming and Statistics) [Matematika (zaměření numerická matematika, programování a statistika)]	CU Prague UJEP Brno	Mathematics
Instrument, Automation and Regulation Technology [Přístrojová, automatizační a regulační technika]	CTU Prague	Mechanical Engineering
Technical Cybernetics [Technická kybernetika]	CTU Prague BUT Brno CMEE Plzeň	Electrical Engineering
Processes, Devices and Automation of Chemical Production [Procesy, zařízení a automatizace chemické výroby]	UCT Prague, Pardubice	Chemical Engineering
Computation in Economics/Mathematics [Ekonomicko-matematické výpočty]	UE Prague	Economics/Management
Mechanization and Automation of Administrative Work [Mechanizace a automatizace řídících prací]	UE Prague	Economics/Management
Systems Engineering [Systémové inženýrství]	TU Ostrava	Engineering (General)

4.4 Academic Programs to Be Created

A major contribution of the Conception [29] was the new taxonomy of academic programs and disciplines in the area of computing. This taxonomy was meant to be mappable to the four specialization areas codified as the CMEA nomenclature (see Sect. 4.1). However, such a clear mapping was not provided in the Conception. Nonetheless, the key argument regarding the already existing programs, such as *Technical Cybernetics*, was that currently "the education is carried out within [too] broad study programs, not fully assuring [the required specialization in computer skills] in an adequate extent and quality" (p. 18).

Hence, the newly proposed Czechoslovakian disciplinary taxonomy codified three new study programs at university level. These were as follows (p. 19): *Electronic Computers*, *Numerical Mathematics*, and *Automated Management/Control Systems.* Correspondingly, it was suggested that three new programs for "scientific preparation" should be created. Interestingly, the first one was not to be named "Electronic

Computers", but rather "Computer Technology" (*výpočetní technika*)[11]. The remaining ones were to carry the same name as their diploma siblings.

Aside from that, it was also discussed how non-computing university programs might benefit from the introduction of computing-related knowledge into their curricula. Some changes in secondary school programs were also proposed. Last but not least, the Conception discussed how the universities could be equipped with computers necessary for teaching students in the new programs. In the following, we limit our discussion to the three new university programs created. We briefly delineate these programs and sketch what was meant as the typical job duties and job titles of their graduates.

Numerical Mathematics. Evolving from general mathematics, the *Numerical Mathematics* program was to be created at (classical) universities. The requirements on the graduates of this program were defined as: they should be taught to acquire strong background in "common mathematical terms, methods, and [to strengthen their] ability of conceptual thinking". The studies were thus to focus on mathematical "analysis, functional analysis, algebra, discrete mathematics, numerical and graphical methods in linear algebra, differential calculus, theory of errors etc." [29] (n.p. – Appendix 7). The graduates were to be prepared for work mostly as analysts and system programmers.

Electronic Computers. Stemming from the roots of *Technical Cybernetics*, the *Electronic Computers* program was to be created at technical universities, within their faculties (schools) of electrical engineering. The graduate profile was defined more comprehensively than the previous one. It was further stated that graduates should be fluent in mathematics, physics, and electrical engineering. Interestingly, they should also be able to "design and realize basic software such as operating systems and compilers" [29] (n.p. – Appendix 7). As stated, this program was to make them ready for positions of design engineers, system and operations programmers, analysts, or even computing researchers.

Automated Management/Control Systems. Driven by the doctrine of management/control [3], the AMCS programs were to be created at "some technical universities, [and] The University of Economics [, Prague]" (p. 26). The focus was thus on computer applications in various domains (e.g., mechanical engineering, chemical engineering, electrical engineering, and administration), where computers were seen as ideal vehicles for *řízení* (i.e., technological control, organizational management, industry segment control at the macro level, and state administration). It was stated that graduates should gather background in "natural science disciplines, especially mathematics and physics" [29] (n.p. – Appendix 7). In addition to that, they should understand their specific domain, i.e., they would be well educated in the "main engineering and economical-administrative disciplines of their [engineering or administration core] programs". The studies should focus on "economical/administrative and informational,

[11] Comparing both versions of the Conception, we speculate that the authors simply forgot to adjust the name of the "scientific preparation" program to the Soviet example. Alternatively, there might be no example to follow. In any case, the three proposed "scientific preparation" programs were not materialized anytime soon.

mathematical/programming, and technical aspects of AMCS". Moreover, the studies should provide a "broad background, emphasizing system approach for problem solving" (n.p. – Appendix 7).

Taken together, the disciplinary landscape in the area of computing can be visualized as follows (Fig. 1). The central part of the picture (black boxes) represents the new programs proposed by the Conception and confirmed by the government of Czech Socialist Republic on 31st January 1973 [35]. The part above them shows the original programs and specializations of the 1950s and 1960s. The part below the black boxes portrays the future development and unification of these disciplines under the tent of "Informatics", which happened roughly at the end of the Communist period (1989). This progress will be briefly discussed in Sect. 5.

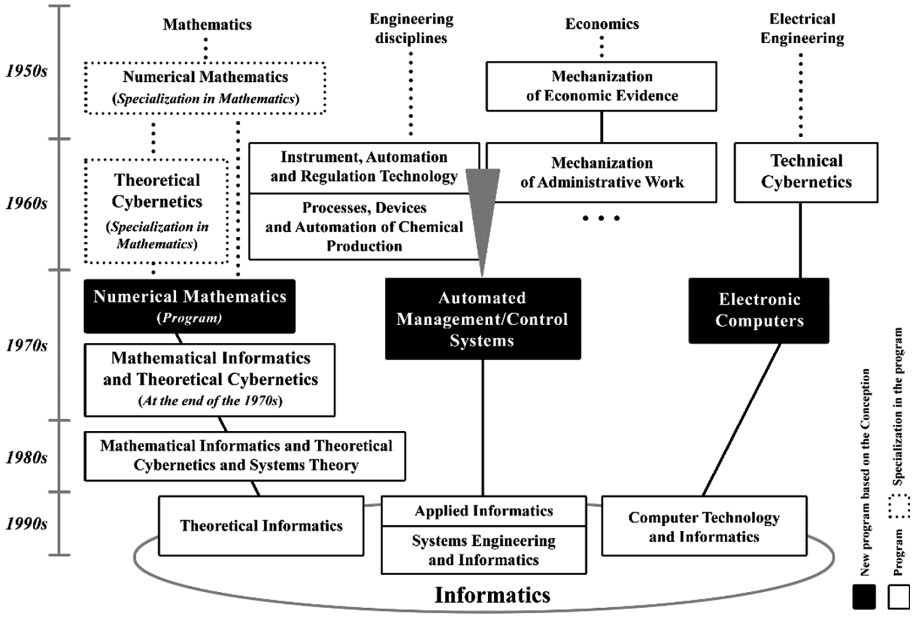

Fig. 1. The genealogy of Informatics in Czechoslovakia (1950s–1990s).

4.5 Results One Year Later

In early 1975, the Czechoslovak Government debated a material that dealt with the use of computer technology and the "implementation of AMCS by all authorities" in Czechoslovakia during 1974 [36]. Part of this material was a discussion of computing education in Czechoslovakia after the taxonomy reforms. Table 2 provides a look at the number of admitted students (in term 1974/75) into respective computing programs in the Czech Socialist Republic (CSR), the Slovak Socialist Republic (SSR), and a sum for Czechoslovakia (CSSR). While the new programs (marked with an asterisk – ours) were clearly gaining attention (especially the AMCS program), it is also interesting to see that junior students were still admitted to the original programs as well, with an

exception of Theoretical Cybernetics. Programs marked by us with "O" (for original) were listed in the Conception as those that had already existed prior the reform. Currently, we know little about the emergence of the two remaining programs (i.e., Theoretical Cybernetics and Cybernetics in Transportation and Communications) since they were not explicitly discussed by the Conception. Perhaps, the latter one existed only in Slovak Socialist Republic.

Table 2. Diploma computing programs in Czechoslovakia in 1974/75 (adapted from [36])

Program	Code	Number admitted		
		CSSR	CSR	SSR
Numerical Mathematics (*)	11-70-8	78	78	-
Instrument, Automation and Regulation Technology (O)	23-37-8	224	144	80
Technical Cybernetics (O)	26-15-8	542	330	212
Electronic Computers (*)	26-62-8	160	80	80
Processes, Devices and Automation of Chemical Production (O)	28-28-8	114	80	34
Cybernetics in Transportation and Communications	37-28-8	46	-	46
Automated Management and Control Systems (*)	39-43-8	298	268	30
Theoretical Cybernetics	39-50-8	-	-	-
Computation in Economics/Mathematics (O)	62-36-8	154	56	98
Mechanization and Automation of Administrative Work (O)	62-37-8	87	87	-
Systems Engineering (O)	62-40-8	154	40	114
Total		**1857**	**1163**	**694**

5 Discussion and Epilogue

Although somewhat limited due to space constraints, the material presented in this paper offers some interesting insights. First and foremost, by providing important archival evidence the paper contributes to the body of knowledge on the specifics of historical developments in computing/informatics in Europe (e.g., [1, 6, 8]). The perspective taken in this paper was motivated by our own earlier struggle to understand the genealogies of Czech computing communities and the unique taxonomy of their titles.

There was truly a diverse, unique disciplinary landscape created in the area of Czechoslovak computing and automation in 1973. In this context, a natural question to ask is: *Were the disciplines really that different from each other?* At this point, we must admit that it is very hard to answer this question without clarifying the detailed content of the particular study programs. Nonetheless, it seems that the creation of the CMEA nomenclature of computing disciplines was intended as a declaration that there *should exist* a significant differentiation and specialization within the studies of computing/automation in the East Bloc. However, what is missing here is an understanding of how

exactly this idea was implemented in different East Bloc countries, including Czechoslovakia, and to what extent the disciplinary content was copied from the Soviets.

To analyse the problem further, it seems appropriate to draw on the already mentioned observation recorded in Connelly's work [9] stating that "basic ideas on the implementation of Soviet models would have to be formed locally". In the case of the emergence of new computing disciplines in Czechoslovakia, there could be a similar pattern. While the new disciplines were administratively created and named according their Soviet siblings, we do not propose that their content was absolutely identical with the Soviet paragons. If it were, there would hardly have been any need to run a later initiative called "the convergence of university study programs in Czechoslovakia and the Soviet Union" (ca. 1980). This later initiative focused on curriculum details, including unification of the syllabi of core courses. However, due to currently missing details about this later initiative, we just make a note about its existence for a future study.

Finally, we propose that while the above disciplines grew up from distinct roots of their reference disciplines (e.g., mathematics or electrical engineering), it would be very hard to draw clear boundaries between various branches of computing/informatics that one can encounter in the Czech Republic nowadays. In fact, we suggest that after 1989 informatics became a *melting pot* in which the original computing disciplines described in this paper have become increasingly interdependent. Below we provide some details about how this happened.

5.1 From Numerical Mathematics to Mathematical Informatics

Few years after the Conception defined the field of *Numerical Mathematics*, the term "mathematical informatics" slowly started to dominate the area of research and education similar to computer science. According to our preliminary findings, this finally brought "informatics" into Czechoslovak academic computing space as an official term. This was roughly the same year when Bauer's *Informatik* was translated from German to Russian (1976, see Sect. 3.1).

However, it was not before 1986 (!) that *Mathematical Informatics* became officially listed among scientific fields in which a Candidatus degree could be obtained [37]. Still, the legacy of cybernetics continued to be salient even after 1986. The full title of the scientific field remained *Mathematical Informatics and Theoretical Cybernetics*, while the diploma program contained the additional addendum *and Systems Theory*.

The reason for the observed conceptual struggles was that in the Soviet Union the term "informatics" had been previously reserved for a field akin to library science [15], and Czechoslovakia closely followed an official taxonomy of scientific disciplines established in the Soviet union [38]. The Soviet understanding was in turn influenced by the dominance of cybernetics [3]. We believe that the development in Czechoslovakia can be contrasted, for example, with development in Poland or East Germany, where the term "informatics", presumably, was part of the official expert discourse much earlier. It is imperative to note, however, that the term had been semi-officially present in the Czechoslovak community since (at least) 1972. That year the international conference *Mathematical Foundations of Computer Science* (MFCS, Matematické základy

informatiky) was first held in Jablonna, Poland. The 1973 conference was organized in the High Tatras, Czechoslovakia.

The MFCS conference was a pivotal forum attended also by many reputable Western academics. Based on this observation we are convinced that Czechoslovak *Mathematical Informatics* succeeded in maintaining important knowledge links with outside (i.e., western) computer science communities even during the Communist era. From today's perspective, we consider it fully integrated in relevant global scientific communities.

In Czechoslovakia, the diploma programs in *Mathematical Informatics* have been located at classical universities (a rough equivalent of liberal arts and science colleges in the U.S. system). Presently, these programs might also be labeled as *Theoretical Informatics*, or controversially just as *Informatics.*

5.2 From Electronic Computers to Computer Technology and Informatics

The position of the *Electronic Computers* discipline was more complicated due to its primary focus on hardware aspects of computing. Given the lower maturity of computer technologies in the East Bloc [30], the discipline obviously lagged behind computer engineering in the West. Interestingly, the discipline also encountered significant administrative problems in Czechoslovakia when it was striving for a greater level of autonomy from electrical engineering. For various reasons, this was basically not possible until 1989. Finally, around 1990, the programs were renamed mostly to *Computer Technology and Informatics* (*Výpočetní technika a informatika*[12]). So, one can say that the post-revolution liberalism of the 1990s finally enabled these programs to be accepted into the broad "informatics family".

Nowadays, one can study this area of computing education in engineering programs residing at electrical engineering or information technology faculties (schools) of technical universities (the latter typically split from the former during the 2000s). These days, however, there is a much greater diversity in the computing program titles that can be studied in this academic environment. This diversity indicates that such programs do not closely follow the original focus of the area of education in computer engineering. In fact, the programs repositioned themselves and became wide computing education platforms, including also many areas of applied computing. Considering the broadness of the term "informatics" in Western Europe [39], this development is perhaps not surprising.

5.3 From Automated Management/Control Systems to Applied Informatics

Finally, we think that the discipline *Automated Management/Control Systems* represented a unique phenomenon that deserves further attention. We put this phenomenon in the broader context of Soviet cybernetics, because, in our view, the popularity of

[12] Or vice versa – *Informatics and Computer Technology (Informatika a výpočetní technika).*

AMCS largely stemmed from the former catchiness of the ideas of cybernetics. These included the desire of the Soviets to scientifically "manage Russia" [40] by using sophisticated technical means. As presented, for example, by scholars in the fields of communications and history of science [11, 41], cybernetics became a technocratic tool promising improved information control at all levels of the Soviet society. Importantly, the mechanism it represented was quite different from the "control by fear" imposed during the previous era of Stalinist totalitarianism. In addition, cybernetics was seen as a means of salvation for the national economy. These were arguably the two most appealing aspects that inspired the passion for cybernetics-driven administration aiming at all levels of the gigantic socio-technical system (i.e. the Soviet economy and society). As time passed, however, not all promises of cybernetics were fulfilled. We suggest that as a result, the AMCS discipline (being at that time a "blank slate") was designated to become a key successor of the stale cybernetics. Building on the ideas of control and backing them up with the support of computers, it *de facto* became a form of "Technical Cybernetics 2.0".

However, it is also important to recognize that the ideas of *řízení* (formalized as *Science of Administration*) were not only about using computers for control. Briefly stated, *řízení* was an over-arching philosophy of the administration of state and society. The use of "automated management/control systems" (i.e., computers) was just one important piece in the controlling puzzle [26]. At the time, this fact was perhaps dismissed by some. It is also worth noting that while the AMCS discipline – keeping the original title – survived for two decades in Czechoslovakia (1973 – ca. 1990), the embodied meaning of the title surely evolved. We are convinced that, as AMCS approached the end of its journey, arguably only very few people remembered much about the original wide cybernetics vision. For those in mechanical engineering, the AMCS discipline became perhaps a form of applied control theory – a purely technical discipline. For those in schools of economics and "business", it morphed into managerial informatics. For others, it simply became a synonym for applied informatics (i.e., applied computing). The overarching aspect of *řízení* (*upravlenie*) – the state administration philosophy ranging from the top to the very bottom by combining society and technology – gradually disappeared.

There is yet another important aspect of AMCS as a discipline. Viewed from a global perspective, the doctrinal constraints related to AMCS had a devastating influence on the level of western-oriented contacts in applied computing fields such as Business Informatics or Management Information Systems. Given that these disciplines as such did not exist in Communist Czechoslovakia[13], only the last decade has seen certain attempts to establish stronger links between the emerging Czech Business Informatics community and the partner communities in the west [42]. It may be thus argued that the applied computing fields in what was then Czechoslovakia, now the Czech Republic and the Slovak Republic, have been clearly among the losers of the former CMEA standardization game dominated by the Soviets.

[13] This was partly due to the non-existence of the science of business administration/management in its prevailing international meaning [26].

6 Conclusion

This paper provides an overview of the disciplinary realms related to computing and automation in Communist Czechoslovakia, and more generally, in the East Bloc. First and foremost, the paper points out that while "informatics" has been a common term in Western Europe for a number of decades [1, 8], the Central and East European realities were different. Specifically, we have argued that the term "informatics" was introduced to fill the intellectual vacuum left by emasculated cybernetics in the first half of the 1970s. Interestingly, this happened under the Western influence. Together with Afinogenov we believe that the existence of the informatics discipline in Germany and France significantly influenced a prominent Soviet figure, Andrey Ershov, to argue in favour of informatics in the Soviet Union.

Yet, being a complex social structure, informatics in the Soviet Union did not emerge from nowhere nor was entirely copied from the West. We propose that while the term was adopted from the West, the "cybernetics DNA" of Soviet-style informatics continued to play a major role within the latter discipline. Further, while in 1973 cybernetics was officially considered "too broad" in Czechoslovakia, we believe that the main reason for the disciplinary reform was *de facto* similar as in the Soviet Union – the cybernetics fashion simply passed, as did the catchiness of "cyberspeak" [3]. Expressively and speculatively stated: In 1973, Czechoslovak cybernetics, as a wide conceptual umbrella, was sacrificed, because the key people felt (or were instructed by the Soviets) that the end of the "cybernetics game" [3] is near.

While, as a discipline, cybernetics continued its journey even after the changes implemented by the Conception, it clearly lost part of the previous scope. The next big thing was computers. From 1973 onwards, the technological concept of automated management/control *(automatizované řízení),* which had been rooted in cybernetics [12], was institutionalized within the boundaries of computing (see the full title of the Conception and its prevailing tone). Considering this, one should recall that the title of AMCS came from the Soviet Union where it was introduced into the educational segment ca. 5 years before the Conception was debated in Czechoslovak government [34].

However the Conception resulted in a significant overlap between the concepts of applied computing and automated management/control, it clearly made a huge step towards Western-style informatics. But was the key outcome of the Conception just in renaming some of the disciplines and adding a few new ones? We do not think so. Resulting directly from the import of Western knowledge by boundary spanners like Ershov, in our view the Conception rather initiated a complex transformational process. The full story of this transformation, so as of the disciplinary conflicts the transformation presumably caused in the intellectual space of Czechoslovak universities, is still to be told. Yet, the emergence of the three disciplines described here was arguably the most salient manifestation of the transformational process in Czechoslovakia.

In sum, this paper suggests that 1973 can be seen as a turning point when cybernetics lost its monopoly in the broad field of information processing in Czechoslovakia. The Conception, as put into practice that year, triggered a disciplinary drift which started redistributing power between cybernetics and informatics. Naturally, the drift did not stop anytime soon; it was a rather long, complicated process. In fact, one can

argue that the drift still has not ended because it appears that even nowadays the distribution of power between the two disciplines in the Czech Republic is renegotiated from time to time [43]. From our personal perspective, this "residual drift", which has continued for almost 50 years, is probably the most impressive afterglow of the past fame of cybernetics in the East. Viewed from a different perspective, however, the persistence of the drift seems to be quite natural. In the metaphorical terms proposed by sociologists of science [7], both amoebas (i.e., cybernetics and informatics) simply continue to fight for their intellectual living space.

Turning finally to administrative issues discussed in this paper, an interesting feature of computing education in Communist Czechoslovakia was the high level of state involvement in computing education standardization – an initiative primarily driven by CMEA dominated by the Soviets. Naturally, the state effort did not stop with the unification of disciplinary titles. Curricula content and profiles of graduates were also largely standardized (at least across Czechoslovakia). This fact had significant influence on the disciplines that were fighting for greater autonomy from their reference disciplines (e.g. *Electronic Computers* from electrical engineering). In general, all these processes might be of interest to researchers who strive to understand how academic disciplines evolved in Central and Eastern Europe under the Communist reign.

Lastly, elaborating on the above ideas, there are numerous avenues open for future research. In our subsequent research we want to focus on gaining a deeper understanding of the activities of the above mentioned Intergovernmental commission under the wing of CMEA. Specifically, we plan to explore the extent of its international involvement in curricula standardization. It would also be extremely interesting to map the geography of computing disciplines [6] across the former CMEA countries. However, the key challenge is that aside from the Conception, only a very limited number of archival sources have been found in relevant collections of the National Archives, Prague so far. We thus call to action also researchers from the remaining countries that were formerly allied in CMEA, who might want to explore their national landscapes. In parallel, we plan to continue our research in archival collections of the Czech universities mentioned in this paper.

Acknowledgement. We thank archivists of the National Archives, Prague for their helpfulness and the time spent while pre-selecting archival materials in uncatalogued collections of the Ministry of Education and the Governmental Office of the Czech Socialist Republic. We also thank the reviewers for their valuable feedback.

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