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Control in the technical societies: a brief history

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By the time control engineering emerged as a coherent body of knowledge and practice (during and just after WW2) professional engineering societies had existed for many decades. Since control engineering is an interdisciplinary branch of the profession, new sections devoted to control were quickly established within the various existing technical societies. In addition, some new bodies devoted specifically or primarily to control were established. This article, a revised version of a paper presented at the IEEE 2009 Conference on the History of Technical Societies, describes how control engineering as a distinct branch of engineering became represented in technical societies in a number of countries.

By the 1930s a number of far-sighted engineers were beginning to realize that something unique was being created. It was an approach spanning electrical, electronic, aeronautical, mechanical and chemical / process engineering (as well as applied mathematics and applications beyond engineering). But it was the Second World War that saw much more rapid progress in developing the new discipline of control engineering, particularly in the USA and UK for designing gun-aiming systems, often referred to as 'fire control' [1, 2]. After the war new sections devoted to control were quickly established within many 'classical' technical societies, particularly those covering electrical, electronics, radio, and mechanical engineering. In addition, some new bodies devoted specifically or primarily to control were established outside the major technical societies, and joint initiatives also took place across the conventional discipline boundaries. This paper will examine the way in which such developments took place in the USA, UK, USSR, Germany and France.

The United States

The American Society of Mechanical Engineers (ASME) was one of the first professional bodies in the world to establish a specialist control group, when the Industrial Instruments and Regulators Committee (IIRC) was set up in 1936. By the mid 1930s there was increasing awareness of the need for better tools for modelling the action of industrial controllers and setting their parameters. The value of introducing derivative and integral action as well as proportional gain was becoming recognized in specialist circles, and brought with it challenges for modelling closed-loop dynamics that proved demanding for the engineers and manufacturers involved. Perhaps because of this industrial environment, E. S. (Ed) Smith, a major figure in American process control, put his weight behind the formation of the IIRC and guided it to full Division (IIRD) status by 1943. In 1952 the scope of the division was extended by the creation of the Dynamic Systems Committee, leading ultimately to the current Dynamic Systems and Control Division.

The situation in the American Institute of Electrical Engineers (AIEE) was much more complex. As Stuart Bennett, historian of the discipline, puts it: "Prior to 1945 the committee on Automatic Stations, which included remote control and automatic control of boilers in its brief, was the only technical committee of the AIEE to explicitly deal with control systems. The review of the technical committee structure, begun in 1944, brought about the formation of an Industrial Control Devices committee (ICD), with subcommittees on Industrial Electronic Control and on Servomechanisms. The Servomechanisms subcommittee became, in 1946, a joint subcommittee of the ICD and the Instruments and Measurement committee (IM); in 1947 the committee on Communications and Basic Sciences also became sponsors of the Servomechanisms subcommittee [... which] was upgraded in 1949 to full committee status and in 1950 in became the Feedback Control Systems committee [3]." All in all, between 1947 and 1957, control was a topic of interest at some time or other to eleven AIEE committees and associated subcommittees, as shown in Table 1. It was not until the AIEE group structure was established in 1960 that control became the preserve of a single body, the Automatic Control Group, which was, in fact, the first formal 'group' to be created.

The third US society of note to take an early interest in control engineering was the Institute of Radio Engineers (IRE), dating from 1912, which formed a servo-systems committee in 1951, renamed the Feedback Control Systems committee the following year. A full IRE

Professional Group on Automatic Control was established in 1955. Since the technical committee structure of the IRE overwhelmingly replaced that of the AIEE when the two combined to form the IEEE in 1963, it may reasonably be claimed that the IRE Automatic Control Group also marked the inception of the current IEEE Control Systems Society. Its history has been described in detail by Abramovitch and Franklin [4].

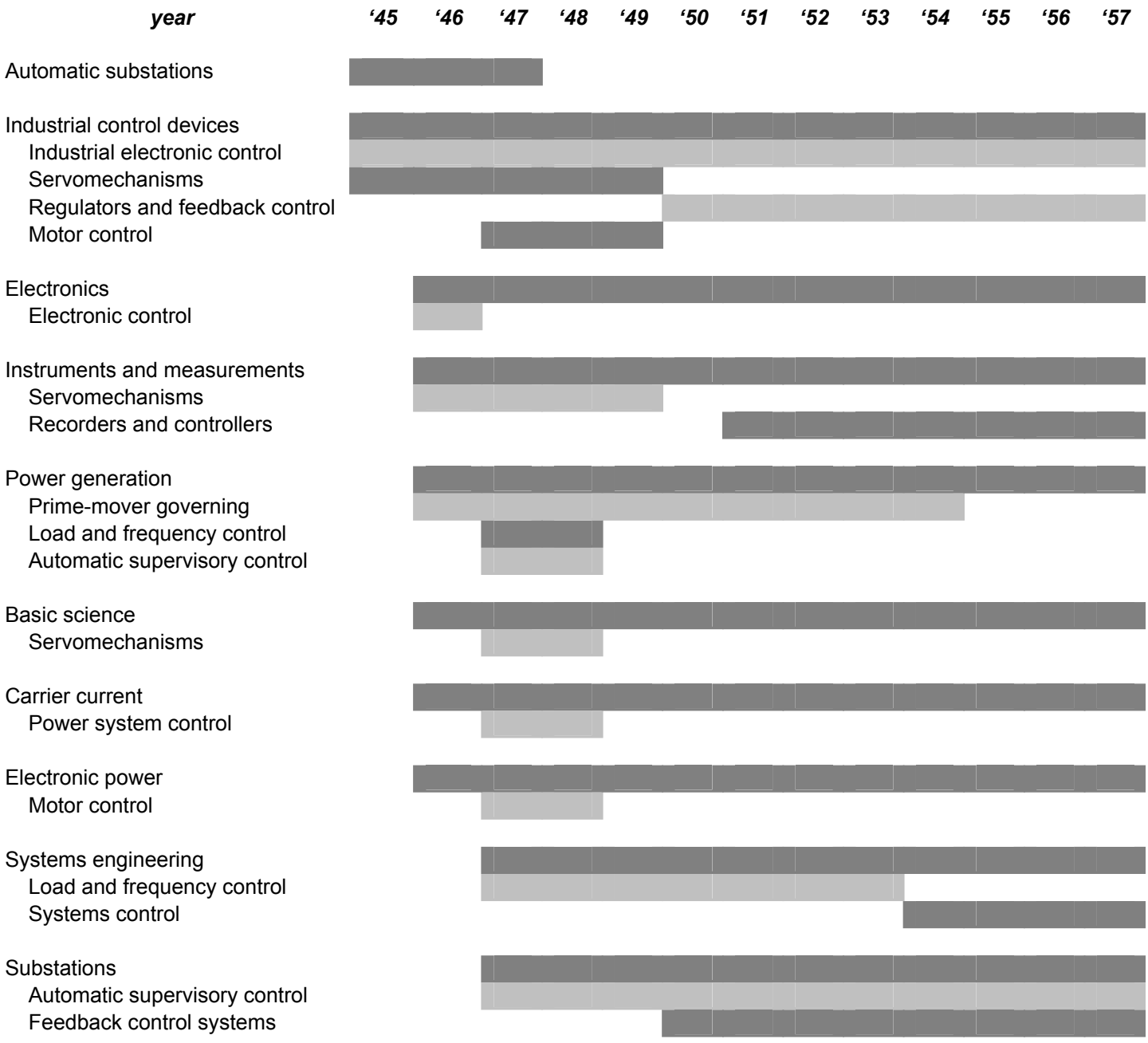

Table 1. AIEE Technical Committee structure relating to control, 1945 – 1957 (From Bennett [3])

The United Kingdom

Military research and development in servomechanism design was not so well coordinated in the UK as in the US, with its National Defense Research Committee under Vannevar Bush. However, a body that contributed significantly to the dissemination of theoretical developments and other research into feedback control systems in the UK was the so-called Servo-Panel.

Originally established informally in 1942 as the result of an initiative of A. K. Solomon (head of a special radar group at the government research establishment in Malvern), it acted rather as a 'learned society' with approximately monthly meetings from May 1942 to August 1945 [5]. The UK wartime infrastructure devoted to servomechanisms did not survive the war, however. Arthur Porter, in a report issued in October 1945 argued strongly for continued government support. He noted that: "although British scientists and engineers have contributed very appreciably to the theory and design of control systems, America is far ahead in applying this theory in industrial practice". He attributed this to three factors: "(i) the American industrialist appears to be more 'control-minded' than his opposite number [in Britain]; (ii) the number of research personnel engaged on control problems is far greater than the number so engaged in Britain; (iii) the design and application of control systems is included as a subject for postgraduate study at several American universities and technical colleges" [6]. The British government, however, ignored Porter's recommendations and retained the servomechanisms technical committee (which had subsumed the Servo Panel in 1944) as a purely military body, rather than playing the much wider role in both industry and government envisaged by Porter. Indeed, the British Government also rejected a suggestion that either the Institution of Electrical Engineers (IEE) or that of the Mechanical Engineers (IMechE) should be asked to take over the civilian aspects of the work.

Belatedly, in 1950, the government asked the Society of Instrument Technologists, formed in 1944 and subsequently becoming the Institute of Measurement and Control, to form a Control Section, which it did in 1950. The IEE's Measurements Section formally agreed to include control in its brief in 1951, and the section became Measurement and Control in 1955. The IMechE formed its Automatic Control Group in 1961.

The Soviet Union

There had been engineering societies in Tsarist Russia, where both engineering schools and societies had been founded very much on Western European (particularly French and German) models in the second half of the nineteenth century. The oldest, and largest, pre-revolution body was the Russian Technical Society (RTS), founded in 1866, but there were also societies of, for example, civil, electrical, mining and hydraulic engineers. In the years following the revolution, however, such institutions found themselves in conflict with the Bolshevik government, and by the end of the 1920s all autonomous professional organizations had been abolished or reorganized, including the post-revolution All-Union Association of Engineers. Meanwhile, VMBIT (All-Union Intersectional Bureau of Engineers and Technicians), dating from 1921, and VARNITSO (All-Union Association of Workers of Science and Technology Building Socialism), set up in 1927, were supposed in some sense to act as 'replacement' bodies. VMBIT was the national trade union organization for the technical intelligentsia until 1941, and VARNITSO a Marxist ideological organization that sought to enlist members from the scientific and technical sectors [7]. As an article from the Soviet period, marking a century since the founding of the RTS, baldly and with breathtaking inaccuracy put it: "as a result, the activities of the old scientific-technical societies established even before the revolution were revived and also those of the postrevolution technical societies [8]"! Professional activity in the field of automation and control engineering (as in other disciplines) therefore took place in a very different academic and political environment from that of the West, in an environment marked with purges, investigations for anti-Soviet activities, and even show trials.

Despite the fraught political and economic context, the Soviet Union saw a great deal of interest in control even before the Second World War, mainly for industrial applications in the context of five-year plans for the Soviet control economy. It is noteworthy that the *Kommissiya Telemekhaniki i Avtomatiki*, KTA (Automation and Remote Control Commission) was established in 1934, and the *Institut Avtomatiki i Telemekhaniki*, IAT (Institute of Automation and Remote Control) was founded in 1939 (both under the auspices of the Soviet Academy of Sciences, which controlled most scientific research through its network of institutes). The KTA corresponded with numerous western manufacturers of control equipment in the mid 1930s and translated a number articles from western journals. Indeed, Russian researchers at that time demonstrated considerable awareness of many of the developments of the 1930s in the UK and the USA. The early days of the IAT's work were marred, however, by the 'Shchipanov affair', a classic Soviet attack on a researcher for 'pseudo-science', which detracted from technical work for a considerable period of time [9].

The IAT (now the Institute of Control Sciences) together with other associated centres elsewhere in the Soviet Union continued to lead control research in the USSR, playing a major role in the development of so-called 'modern' control techniques after WW2 (to distinguish the approach from 'classical' control developed in the West during the war).

Germany

The two main engineering professional societies in Germany had long been the *Verein Deutscher Ingenieure* [Society of German Engineers], founded in 1856 and the

Verband Deutscher Elektrotechniker [Association of German Electrical Engineers], founded in 1893 (from earlier electrical societies dating back to 1879). During the Nazi period these bodies were incorporated into the fascist political structure and were denazified and reconstructed in the West in the immediate postwar period, while retaining their names and much of their character. In East Germany, the 'professional' reorganization of engineers took place under the aegis of the *Kammer der Technik* [Chamber of Technology], which incorporated numerous specialist organizations for various engineering disciplines, including measurement and control.

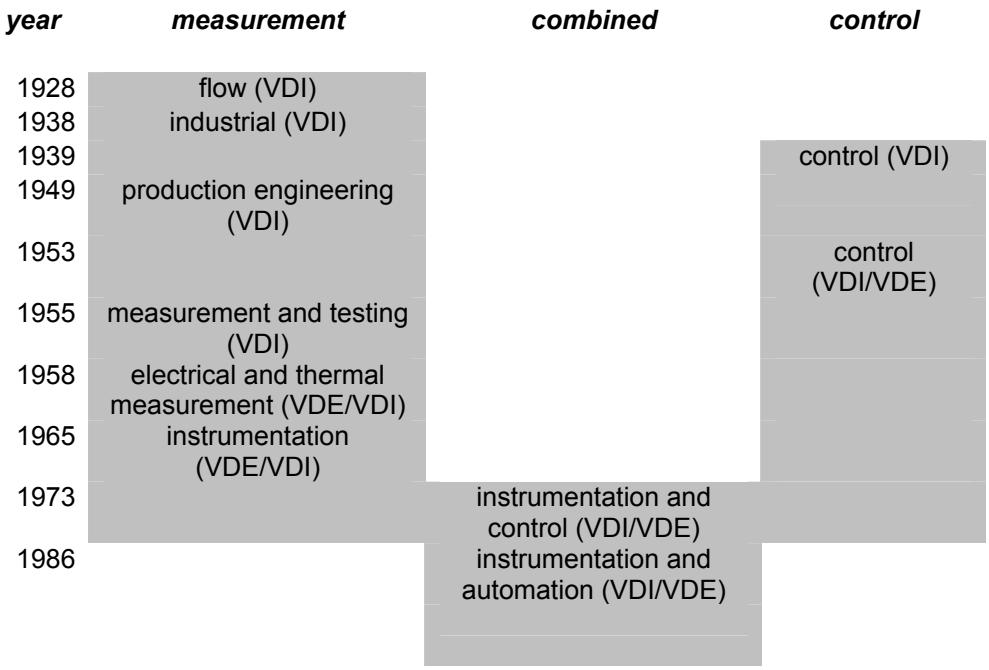

Table 2. Subject areas of the major VDI and joint VDI/VDE committees and groups in measurement and control. (From Lauber [11])

In 1939 the VDI set up a specialist committee on control engineering. As early as October 1940 the chair of this body, Hermann Schmidt, gave a talk covering control engineering and its relationship with economics, social sciences and cultural aspects – very similar to what later became termed 'cybernetics'. Rather remarkably, this committee continued to meet during the war years, and issued a report in 1944 concerning primarily control concepts and terminology, but also considering many of the fundamental issues of the emerging discipline [10]. The VDE cooperated with this body, and in 1953 a joint VDI/VDE control committee was formally established, followed in 1958 by a specialist measurement committee. The two committees were combined in 1973 and joint activities have continued, currently as the VDI/VDE-*Gesellschaft Mess- und Automatisierungstechnik*, GMA [Society for Instrumentation and Automation]. In East Germany, the corresponding body was the *Wissenschaftliche Gesellschaft für Mess- und Automatisierungstechnik*, WGMA [Scientific Society for Instrumentation and Automation], which joined with the GMA in 1991 following German unification. Apart from the break immediately after the war, therefore, German professional activities in control engineering can boast a continuous tradition since the first VDI committee of 1939 [11]. Some of the major stages in this development are shown in Table 2.

France

France has some of the oldest academic and learned societies in the world, yet the French professional engineering bodies have arguably had considerably less influence and status than those in the USA, UK and Germany. At the danger of oversimplifying a rather complex and evolving system, the French situation is partly due to its unique system of engineering education, centred on the traditional, élite, *Grandes Ecoles* engineering schools. It is these institutions, rather than the universities, that confer the most prestigious titles of engineer, and some of their alumni associations have had a huge influence in a country where many leading figures

in politics and industry were trained in this way. The *Grandes Ecoles* alumni associations are grouped with a number of other engineering organizations in a federation known since 1992 as the *Conseil National des Ingénieurs et Scientifiques de France*, or CNISF [National Council of Engineers and Scientists of France]. There are not really any bodies that are quite comparable to, say, the IEEE, the IET or the VDE (although it must be said that these last three are all very different!). The nearest French equivalent is the *Société de l'Electricité, de l'Electronique et des Technologies de l'Information et de la Communication*, or SEE [Association of Electrical, Electronic, Information and Communication Engineering]. An influential learned society, it traces its history back to 1883, when the *Société Française des Electriciens* was founded. The French Ministry of Higher Education and Research currently lists over 100 learned societies in a whole range of academic disciplines [12], and some of these, relating to scientific and engineering fields (including SEE), are also members of CNISF.

Nineteenth-century French scientists, mathematicians, and engineers had made enormous contributions to the study of dynamics, including analyses of governors and regulators, which we now view as important precursors of the modern discipline of automatic control. By the late 1930s, at least some French engineers were aware of the advances in the analysis of feedback that had been made in the USA in the preceding decade. Yet, during the Second World War, France found itself isolated, and neither the occupied zone nor Vichy offered a conducive environment for the sort of R&D that was taking place not only in the USA and the UK but also in Germany and the USSR, and that led to the discipline of classical control. Immediately after the war, though, a great deal of French activity took place in promulgating the new ideas and developing a professional network [13].

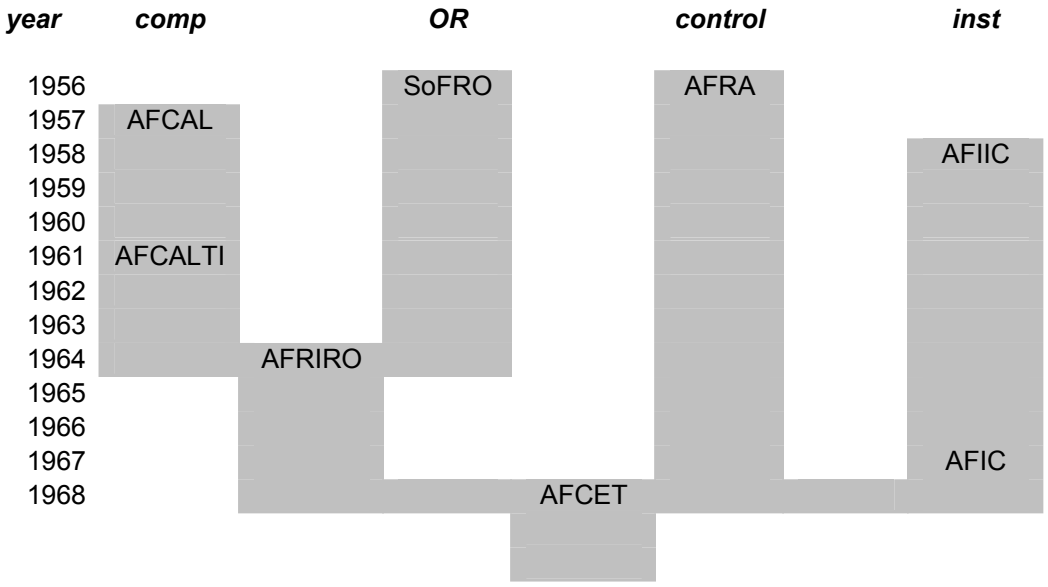

Table 3. Major early strands and mergers in French professional societies for control, computing and operations research (From Hoffsaes [13])

Lecture series were given on control engineering at the *Conservatoire National des Arts et Métiers* in Paris as early as 1945, and in particular in 1947 by French engineers who had already become acutely aware of the significance of the new discipline, and a number of higher education establishments soon began teaching the subject. But it was in 1956 that professional activity in the field really took off. In January of that year the journal *Automatisme* was founded as the first specialist publication in the field, and the *Association Française de Régulation et Automatisme* (AFRA) was founded in May. AFRA has subsequently had an interesting history. In 1968 it was one of three organizations that came together to form a new body, the *Association Française pour la Cybernétique Economique et Technique*, sometimes paraphrased in English as the "French Society of Computer Scientists" [14]. The other founding societies of AFCET were the operations research association AFIRO (*Association Française de l'Informatique et de Recherche Operationnelle*) and the instrumentation society AFIC (*Association Française de l'Instrumentation et du Contrôle*). AFRIRO itself was the product of the merger of two existing bodies, SoFRO (*Société Française de la Recherche Operationelle*) and

the computing and data processing organization AFCALTI (*Association Française de Calcul et Traitment de l'Information).* Table 3 summarises the various mergers on the road to AFCET. In 1998 AFCET itself was reorganized as what is still ASTI (*Association des Sciences et Techniques de l'Information et de la Communication*), a federation with 28 constituent member associations. A more natural home for control engineering in France is now the SEE, mentioned above.

Early conferences and publications

Early scientific conferences are always a useful indication of the development of an emerging discipline, and control is no exception. Naturally, the technical societies presented so far in this paper played an enormous role.

Possibly the earliest conference to be devoted to the emerging ideas of classical control was held in 1940, in Moscow, organized by the Institute of Automation and Remote Control. It is interesting to note how aware many of the presenters were of early work in the United States and the UK. The conference was held at the time of the 'Shchipanov Affair', mentioned above, so as is so often the case in the Soviet Union, the technical discussion was enormously influenced by infighting and politics.

Of much more lasting significance for the development of the discipline was a series of conferences held in various countries in the decade or so after the war. The British Institution of Electrical Engineers (IEE) was soon off the mark with a conference on automatic regulators and servomechanisms in 1947, which included a number of classic papers by British wartime researchers. In 1951 the first real international conference was held in Cranfield, England, co-sponsored by the IEE, IMechE and the British Government's Department of Scientific and Industrial Research. The conference was attended by participants from North America, Australia, Western Europe and Japan, and appears to have inspired other nations to organize similar conferences in the coming years.

1953 saw an important Frequency Response Symposium at the ASME annual meeting in New York, but 1956 was the real turning point for the new discipline. As many as eight conferences were held that year in Europe, including an international one in Paris in June. In retrospect, however, the seminal event was the conference in Heidelberg in September organized jointly by the two German engineering societies VDE / VDI. This drew wide international participation, including delegates from Eastern Europe and Japan; but perhaps most importantly it marked the inception of IFAC, the International Federation of Automatic Control.

The late 1940s and early 1950s, too, saw a rash of publications in the journals of the professional societies, as well as conference proceedings and the first textbooks covering what we now term classical control. Discussion of the most significant of the latter can be found in [15] and [16].

IFAC

Prompted by the growing internationalization of control engineering, and the Cold War climate of the mid 1950s, a number of delegates to the Heidelberg conference expressed interest in establishing a new, international, association [17]. The driving force for this initiative came from G. Ruppel (Germany), R. Oldenburger (USA) and V. Broïda (France). A meeting of 25 interested participants was held and a resolution adopted to found "an international federation of automatic control [… with] the following objectives: 1. To facilitate the interchange of information in automatic control and to promote progress in this field. 2. To organize international congresses in this field." A provisional committee was set up which met at the offices of the VDI/VDE specialist control group in Düsseldorf in April 1957, and IFAC came into being at a meeting in Paris in September that year. The first president was the American Harold Chestnut and the Vice-Presidents were the Russian A. M. Letov and V. Broïda. It was also agreed that Letov would be the second president and that the first IFAC Congress would be held in Moscow in 1960.

IFAC's constitution provided for one National Member Organization (NMO) per nation state. Countries such as the USA and the UK with more than one technical society with interests in the field established new overarching NMOs such as the American and UK Automatic Control Councils. The only sticking point was Germany, whose divided status made this politically impossible, and not until 1971 were both East and West Germany allowed to be represented by separate NMOs. After reunification the reconstituted GMA became the unitary NMO. German interests, however, were supported from start as a result of the establishment of the IFAC secretariat initially in Düsseldorf. Incidentally, French representation also has an interesting history, relating to the complex development of relevant societies in France, as outlined above. AFRA was originally the French NMO, replaced by AFCET. With the demise of the latter and the formation of ASTI, however, NMO status passed to the French electrical and electronics association, SEE.

The 1960 IFAC Moscow Congress was a huge affair, and an important event in the development of automatic control. A number of seminal papers in the new area of modern control were presented, the most famous being Kalman's paper on his radical approach to linear filtering

and prediction. It was also an opportunity for a meeting between East and West, even though Soviet suspicion limited informal contact between Russians and international delegates.

Conclusion

This brief review of how control engineering was established in the world of engineering societies demonstrates a great deal of commonality from country to country in the technical issues, but enormous differences in technical society structure and engineering professional history, as well as in the political environment.

Control sections in the professional societies were mainly established post-war, although both the ASME committee and the Soviet KAT date from before the war and thus predated the emergence of classical control techniques. There was also remarkable wartime activity in Germany – not part of military R&D – including the specialist VDI committee under Hermann Schmidt, which anticipated many of the ideas of Wiener on cybernetics, and which laid a firm basis for post-war cooperation between the VDI and VDE on measurement and control.

US and UK wartime activity, heavily supported by the relevant governments as part of the war effort, involved various official and ad hoc groupings, which led to the immediate post-war flowering of the discipline in the two countries (secrecy had prevented wide dissemination of new techniques outside the military during WW2). The American societies were larger than the British, and produced a more impressive range of technical publications, which soon became the focus of world-wide information dissemination. As in other areas of science and technology the USA was on a clear course to dominance. German engineers were keen to re-establish themselves in the international community after the disaster of WW2, and regain something at least of their former status (as well as disseminate the undoubted progress that had been made in that country during the war, almost entirely outside German military R&D). The French, in professional developments in control engineering that paralleled those in other areas, made great strides in the 1950s after their marginalization during the war, including supplying one of the first Vice-Presidents of IFAC. This was a time of great debate in France about its post-war relationship with the United States, and to what extent a native French technology could be developed [18]. In the Soviet Union anti-Western sentiments soon became strong with the onset of the Cold War, yet Russian scientists and engineers were extremely keen participants in IFAC, not simply because of a political need to present Soviet achievements on the world stage, but also out of a genuine desire to be part of an international community. A number of western delegates to the IFAC Moscow conference remarked on how well their Russian colleagues knew their work [19] or at least commented on the growing potential of Russian work in control and computing, and the narrowing technological gap between East and West [20].

The mid twentieth century history of the development and professional recognition of control engineering thus offers a fascinating case study of how a new engineering discipline achieved full professional status – both within existing technical societies, and also by the creation of new specialist bodies and groupings where necessary.

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