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**FROM ROYAL ACADEMY OF SCIENCE TO RESEARCH
INSTITUTE OF SOCIETY: LONG TERM POLICY CONVERGENCE
OF SWEDISH KNOWLEDGE INTERMEDIARIES**

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Introduction

In this chapter, the formation of intermediary organizations of knowledge transfer in Sweden during the Cold War will be described and analysed. Here, intermediary organizations of knowledge transfer are defined as organizations aiming to transfer knowledge between knowledge producers and potential knowledge users (knowledge intermediaries for short).¹ In theory, such organizations supply a platform for interaction between economic and academic life with problem-solving potential as well as development capability for the former and research opportunities for the latter.

Throughout modernity, knowledge intensive resources have been considered either too expensive or in other ways too problematic for the singular user to acquire and retain and thereby more effectively pooled geographically or otherwise. Because of this, the planning and formation of institutions and organisations with the purpose of supplying a number of potential users with relevant knowledge intensive resources and services such as counsel and advice, development and testing facilities, specialists etc., have a history of centuries, not the least in Sweden. Pointing out this long tradition of pooling knowledge resources and services lends support to scholars who oppose the idea that the traditional, socially based authoritative knowledge legitimisation, usually viewed as normal or academic, has only recently been exchanged for new legitimising institutions outside the academic ones. Such industrial evaluation of knowledge production on the basis of use and application, sometimes named mode 2 or post-normal science, have been active parallel to the traditional academic one over centuries.² Thus, it is an obvious point of departure in this article that the second half of the 20th century does not entail anything radically novel with respect to knowledge legitimisation.³

Moreover, in science and technology policy research, the tendency has often been to point out national differences of knowledge intermediaries due to different political and industrial contexts as well as educational systems. More recently, however, international cooperation regarding science and technology policies has made researchers focus more on policy convergence in this field stressing the increasing trans-nationality of organizational designs, institutional solutions etc.⁴ In this article, it will be shown how knowledge intermediaries, in general regarded as the most important component for successful science and technology policies, have been a result of imitation and policy convergence for centuries, at least in

Sweden. Thus, policy convergence in science and technology policy is not a recent phenomenon, far from it. It is as old as knowledge intermediaries themselves.

In this article, it will more specifically be argued that the character of the dominating Swedish knowledge intermediaries during the Cold War—research councils, research institutes and so-called development pairs—are best understood from a long-term historical perspective. Only such an analysis can efficiently highlight how organizational models for knowledge intermediaries have succeeded and overlapped each other over decades and centuries of Swedish history. Moreover, just as so-called sector research, involving sector-wise combinations of research councils as research customers and research institutes as suppliers of research, dominated the system of knowledge intermediaries during the Cold War, earlier models have time-wise been extremely dominant on the Swedish scene. In addition, just as the Cold-war research councils and institutes, earlier role models for knowledge intermediaries have almost exclusively been imported to Sweden from abroad. Thus, the purpose here is to supply a better understanding of how a national Swedish build-up of research efforts after WWII was made in a historical context of subsequent dominating models for intermediary organizations imported from abroad.

Early knowledge intermediaries

In order to achieve a long-term historical perspective of Swedish knowledge intermediaries, it is reasonable to give a short historical account. In this vein, it has been pointed out that the *Laboratorium Chemicum* and *Laboratorium Mechanicum* were established as technical sections of the Board of Mines as early as by the end of the 17th century in order to make competence available to mining enterprises.⁵ The Royal Swedish Academy of Science (*Kungl. Vetenskapsakademien*), formed in 1739, is another early example of an intermediary organization aiming to supply and spread what was identified as useful knowledge.⁶ In the first paragraph of its rules, it was stated that only arts and sciences “owning real utility in the general services” were to be the subject of the Academy’s attention.⁷

The creation of the Royal Swedish Academy of Science and other similar congregations, for instance the *Societas Scientiarum* planned and formed in Uppsala in the 1720s, was influenced by foreign societies such as *Societet der Wissenschaften* in Berlin and the Royal Society in London.⁸ Thus, as early as the 18th century, institutional novelties from abroad

dictated the types of intermediary organisations thought of as worthwhile to establish and maintain in Sweden.

Early on, The Royal Swedish Academy of Science paid much attention to observations and ideas on how to improve agriculture.⁹ This was of course connected to the domination of farming and forestry in the Swedish economy throughout the 17th and 18th as well as the first half of the 19th centuries. Another basis for interest in agricultural problems was agriculture-friendly ideologies such as reform-mercantilists who, in comparison to many mercantilists, did not altogether discard agriculture as a productive sphere.¹⁰ From the 1770s, physiocrats entered the discussion as well.¹¹ The problem for The Royal Swedish Academy of Science was not to find observations and advice to print in their transactions, but to get the message across to farmers and others who did the actual farming. This problem, the academy shared with The Royal Patriotic Society (Kungl. Patriotiska Sällskapet), an organization formed in 1766 with much the same ambitions on the agricultural scene.¹²

In the 1810s, another congregation of both theorists and practitioners was formed in order to improve farming in Sweden, the Royal Swedish Academy of Agriculture (Kungl. Lantbruksakademien). The immediate reason was the loss of Finland to Russia and hence an incentive to improve economic output in general and farming in particular.¹³ Just as its precursors, this organization had foreign forerunners, most importantly the British Board of Agriculture.¹⁴ But the purpose of the Swedish Academy of Agriculture was also to fulfil an old idea of a central national organization with regional and local clubs in order to promote the application of new ideas of improved farming in the fields.¹⁵ By the forming of the academy, financially secured by a governmental donation, such an institutional setting was also soon achieved together with the laying out of a central experimental field in the vicinity of the capital Stockholm where different crops, soils and machines could be tested.¹⁶ In addition, regional experimental fields were promoted and built. The historical verdict over these efforts has been clear, however, they influenced science more than the peasantry.¹⁷

When the founding of knowledge intermediaries was repeated over the decades in different research areas and branches such as agriculture, the result was organizational uniformity led by initiatives from abroad. In fact, recapitulating the history of early Swedish knowledge intermediaries makes it clear that the developments is similar to policy convergence in the

sense that the organization of knowledge intermediaries usually followed patterns already established in other European countries.

Public institutes and engineering schools, two models for knowledge dispersion in the 19th century

Later in the 19th century, the functions of the academy of agriculture started to be transferred from the private hands of the academy to the state. An early step was the forming of the governmental Entomological Institute (Statens entomologiska anstalt) in 1897 under the auspices of the Royal Board of Agriculture (Kungl. Lantbruksstyrelsen). Ten years later, much of the activities of the academy had been taken over by the Institution for the Agricultural Services (Centralanstalten för det agrara försöksväsendet).¹⁸

These institutions had public precursors in other fields such as The Royal Board of Telegraphy (Kungl. Telegrafverket), the Swedish Public Railroads (Statens järnvägar) and the Board of Forestry (Kungl. Skogsstyrelsen) dealing with areas where private enterprises were important generators of change. Different types of investigations and testing were arranged within these organizations. However, in order to determine how much they acted as intermediary organizations, cooperating with private industry, closer mapping of their activities than can be supplied here is needed. The same can also be said to hold for military organizations and in particular The Royal Swedish Academy of War Sciences (Kungl. Krigsvetenskapsakademien) formed in 1796 in order to facilitate the application of science to the Swedish defence.¹⁹

Other research-oriented authorities were the Geological Survey of Sweden (Sveriges geologiska undersökning) formed in 1858 and Swedish Meteorological and Hydrological Institute (Sveriges meteorologiska hydrologiska institut) from 1919, but with a history reaching back to 1873 when The Royal Swedish Academy of Science had established a meteorological institute.²⁰ The Geological Survey of Sweden made a geological inventory, but in the course of time its research undertaking grew as well as its staff.²¹ The same can be said of the Meteorological and Hydrological Institute and again it is hard to establish their position as intermediary organization without closer scrutiny of primary sources. In the medical and social sector, the Board of Medicine (Medicinalstyrelsen) formed in 1877 organized specialized laboratories a few decades later and the National Board of Health and Welfare (Socialstyrelsen) from 1912 had rather far-reaching responsibilities for social research.²²

During the 19th century, the most important institutional changes promoting competence in different fields in general was otherwise the forming of professional institutes for higher education besides the universities of Uppsala and Lund, some of them to a certain extent also housing research. Best studied are the engineering schools of Stockholm and Gothenburg, the Royal Institute of Technology and Chalmers Institute of Technology respectively.²³ Other educational institutes in the same vein are the institutes of agriculture in the vicinity of Uppsala and Lund, Ultuna and Alnarp, and that of forestry in Stockholm, which also housed the institute of veterinary science.²⁴ The trend throughout the 19th century, to found educational institutes in order to supply different important sectors of society with skilled human resources was influenced by trends from abroad. The origin of professional systems of education besides the traditional ones of law and medicine, is often attributed to the engineering education of Ecole Polytechnique in Paris formed in the 1790s. Similar institutes of professional higher education were then formed in Great Britain, Germany and subsequently in the rest of the West. The Swedish focus on professional education in the 19th century was from this perspective nothing else than a way to follow suit, or again the concept of policy convergence can indeed be used.

So far, the efforts of the public to promote the supply of the knowledge base for society have been described. But similar efforts were also made on the private side. Most important was perhaps Swedish Steel Producers' Association (Jernkontoret), which promoted publications, travels as well as laboratories, such as one for testing materials in the mid-1870s, and much more in connection to metallurgical research. In agriculture, the private correspondence was The Swedish Sowing Association (Sveriges utsädesförening) formed by farmers in southern Sweden in 1886 and through a merger in 1894 expanded to cover all of the country.²⁵ The Sowing Association, as so many other similar organizations formed by private hands to promote the build-up of knowledge in one field or another, soon enough also acquired public funding. The same was valid for The Swedish Fen Culture Association (Svenska mosskulturföreningen) with the purpose of promoting the cultivation of fenlands as well as the acquisition of peat as fuel. A private association dealing with forestry was the The Swedish Forest Care Association (Svenska skogsvårdsföreningen) with its correspondence in freshwater fishery, The Fishery Association of Southern Sweden (Södra Sveriges fiskeriförening). The two most important private organizations for bridging knowledge between publicly funded education and research institutions and private industry and trade

was however the Swedish Society of Medicine (Svenska Läkarsällskapet) founded in 1807 and the Swedish Association of Engineers (Svenska teknologföreningen) formed in the 1860s.

In sum, it can be concluded that, with the exception of the more generally acting associations as the last two mentioned, these privately formed organizations dealt with production sectors of relative economic stability. Thereby, they point towards better possibilities for research and knowledge dispersion in those industrial branches that were prosperous enough to generate revenue to at least partly cover the sometimes rather substantial costs for such activities. In fact, it can be hypothesized that these associations meant more for the possibilities of research than for the development of the sector they represent. Again, a decisive verdict on such a hypothesis entails closer study of primary sources.

Thus, by the turn of the century 1900, quite a few pieces of an institutional network for development and dispersion of knowledge were in place. In the 18th century, academies had been formed as a type of intermediary organization aiming to supply and spread what was identified as useful knowledge, especially such observations that could be useful for agriculture. The 19th century, the public focus had been on institutions of professional education for engineers, agronomists, medical doctors etc. During the second half of this century, private groups of different sectors more generally channelled their interest in different associations.

Industrial research institutes, a model for knowledge transfer in the interwar period

These developments were to be continued in the 20th century through the forming of industrial research institutes. First of these was Wood Pulp Research Association (Pappersmassekontoret) formed in 1917 by enterprises in the pulp business which contributed in proportion to their respective production, the research was thus commissioned by the owners.²⁶ An economic crisis in the early 1920s however, put an end to the association, which was closed down in 1922. That same year, The Swedish Institute for Metals Research (Metallografiska institutet) was formed as the result of a collection managed by Stockholm University College (Stockholms högskola) and Swedish Steel Producers' Association. Also the State participated by supplying housing and an annual allocation of money for the running of these institutes. It was no coincidence that these two research institutes represented the two most important industrial branches, at least when listed according to export value.

But it was the planning of third institute during WWI that caused a more long-lasting change in the institutional landscape mediating publicly funded knowledge of industrial relevance. This was an institute for power and fuel research, generated not by affluence in an industrial branch but by problems in finding domestic supplies needed to secure the industry's needs for fuel and power. These problems were addressed by a number of representatives of public authorities as well as industry resulting in a number of public investigations and reports regarding such an institute. The outcome was The Royal Swedish Academy of Engineering Sciences (Ingenjörsvetenskapsakademien), an organization that housed several smaller institutes for consulting research and commissions.²⁷

Again, the pattern of publicly and privately co-funded research institutes had already been established abroad. One important source of inspiration was Kaiser-Wilhelm-Gesellschaft zur Förderung der Wissenschaften in Germany, which established institutes in different research areas of industrial interest such as chemistry.²⁸ Similar organizations had also been introduced in Great Britain and the USA by the beginning of the 20th century. Modelled on the German Physikalisch-Technische Reichsanstalt founded in 1887 in Berlin, the British National Physics Laboratory and The Bureau of Standards in America dealt with materials testing as well as standardization issues and control of scientific instrument from 1900 and 1902 respectively.²⁹ These efforts were intensified during WWI with the founding of The Department of Scientific and Industrial Research in Great Britain in 1916. The same year, the National Research Council was formed in the USA mostly funded by private foundations and with only loose connections to the federal government. Like the academies and professional institutions of education as well as most other organizational institutions of knowledge transfer from the public to the private spheres in Sweden, the forming of industrial research institutes had foreign forerunners. Again, policy convergence influenced the design of intermediary organisations.

During the interwar period, The Swedish Academy of Engineering Sciences received substantial public as well as private funding for research and investigations regarding fuel and power technologies and building technology. The financial backbone was the public contribution of 100.000-200.000 SEK annually for establishing fuel and power research, a handsome sum considering that the total public allocation to the Royal Institute of Technology 1919 was 360.000 SEK.³⁰ Fuel and power research was partly established by the forming of an Electro-heating Institute (Elektrovärmeinstitutet) in 1923, a Coal Laboratory

(Kolningslaboratoriet) in 1929 and an Institute for Steam-heating Research (Ångvärmeinstitutet) in 1931, all co-financed by public funding and private industry.³¹ In 1929, a Concrete Laboratory (Cementlaboratoriet) was formed and throughout the 1930s, additional committees and commissions, e.g. for welding and corrosion was set up to support technical areas in need for support.³² In addition, the academy funded investigations of a total of 230.000 SEK for about a hundred different studies during the 1920s, a sum that slowly rose so that about 100.000 SEK was paid out annually towards the end of the 1930s.³³ In total though, these sums were far from those 400.000 SEK that the academy had hoped to annually distribute and the lack of financial resources was a constant problem for the academy throughout the interwar period.³⁴

There is no analysis available of relations between the members of the academy, the state and the industrial branches when institutes were formed. However, a reasonable hypothesis would be that there were stronger links between the academy and industry while weaker between the academy and state. In any case, the standard tool-kit for building research institutes early on included joint financial submissions from both industry and public life, i.e. private capital and tax revenue in one form or the other. Therefore, the successful establishment of research institutes often enough relied on intense networking on behalf of both academics and industrialists, the most important single organization promoting the forming of research institutes in the interwar period being The Swedish Academy of Engineering Sciences. As a result, the traditional academic social system of peer-review guaranteeing legitimacy for knowledge production (mode 1) had to be accepted side by side with an ethos of utility (mode 2). There was, as stressed in other chapters of this volume, more than one example of how representatives of these two ideals of knowledge legitimacy clashed, not only in The Academy of Engineering Sciences but also at engineering schools and industrial research institutes.³⁵

Cultural clashes of this kind could lead to failed efforts. One area where the engineering academy rather unsuccessfully tried to establish research was within rationalization, especially organization of industrial work processes and analysis of working conditions in order to improve efficiency. From the founding of the academy of engineering sciences in 1919 to the mid-1920, efforts were made to establish a psycho-technical institute. However, it proved hard to get enough funding and the initiative was eventually abandoned.³⁶

In one way, the failure to create a psycho-technical institute in the 1920s was an exception. Prior to 1919, when The Swedish Academy of Engineering Sciences appeared as an important intermediary organization, institutes and associations had exclusively been established within areas where revenue was large enough to support the type of more uncertain and long-term investments that research activities often require. The academy of engineering sciences, however, seems to have brought better possibilities for funding analysis of technical problems of broader social interest such as a psycho-technical institute, although this was never realized.

To sum up, the first half of the 20th century saw intensified founding of industrial research institutes, jointly financed by government and private interests coordinated by The Swedish Academy of Engineering Sciences.³⁷ Institutes and laboratories were mostly formed within branches where there was no distinguishable governmental agency acting as major customer, typically industrial branches related to natural resources such as pulp and ore. Regarding other technical problems of broader scope, the establishment of the academy of engineering sciences improved possibilities of research funding, at least on a smaller scale.

Development pairs, an unplanned model

In other branches, however, typically those with competent public customers, bridges were created between private suppliers and government agencies through long-lasting business relations, so-called development pairs in which procurement projects were designed both to suit a contractor's capabilities and to push its abilities to develop new technology.³⁸ By this, the public customer purchased state-of-the-art equipment and the private supplier was given reference plants to use when hitting international markets. Examples of such pairs are the telephone and switch manufacturer Ericsson and the Royal Board of Telegraphy as well as the supplier of electrical power technology, ASEA (later ABB), and the Royal Waterfall Board (Kungl. Vattenfallsstyrelsen).

The relations between firms and authorities in development pairs not only lasted over extended periods of time and thus could be characterized by trust between the public customer and the private contractor. The relations were also built up on personal networks between employees of both organizations, formed early in their careers, often during professional training. There were also occurrences of employees on one side or the other of a development pair changing employer moving from a public customer to a private contractor or vice versa.

More generally, the idea that networks of industrial entrepreneurs such as engineers as well as other actors such as venture capital representatives and institutions are linked to a specific industrial activity has been promoted by business historian Erik Dahmén, who introduced the concept of development blocks to capture the phenomenon.³⁹ Dahmén claims that development blocks change over time generating structural tensions that can be resolved, for example by organizational innovation, new technology, better education etc. In order for a development block to grow, it is also necessary to develop supporting activities in complementing areas. A development block becomes stable when there is a market for the industrial activity. In the examples dealt with here, long-lasting business relations between private suppliers and government agencies prove to be very important for the success of some development blocks. In this sense, the forming of a development pair is a way to create complementing support in order to achieve stability of a development block in a given institutional framework.

Although development pairs are found outside Sweden and Scandinavia, for instance in France, they seem to have evolved without a conscious search for models from abroad or even without awareness of foreign precursors.⁴⁰ Thus, in contrast to the earlier examples given, development pairs were no conscious import, but instead a type of relation that occurred in different industrial branches due to the importance of informal networks in a country with a small population and a strong central administration like Sweden. Together, industrial research institutes and development pairs constituted two major institutions for knowledge transfer between public and private actors throughout the 20th century after WWI.

Within both industrial research institutes and development pairs, the universities and engineering schools, such as the Royal Institute of Technology, acted as generators of competent individuals for both the public and the private spheres and were, as a result, producers of useful personal networks. In this way, the institutions for higher education in Sweden, together with the academy of engineering sciences, supplied the glue for different organizations and institutions promoting knowledge transfer throughout the interwar period. The role of universities and engineering schools was further strengthened by the founding of research councils in the middle of the 20th century, in this context primarily The Swedish Council for Technical Research (Statens tekniska forskningsråd).

Research councils and sector research, two new models for research funding after WWII

These developments took place both as a consequence of WWII and, again, under strong influence from organizational changes abroad, i.e. the same type of policy convergence already mentioned. The investigations preceding the founding of the Council for Technical Research not only included trips to the war-ridden European continent as well as Great Britain, but also experience and contacts with Americans, at least on the individual level.⁴¹ Most notable is perhaps Edy Velander's six-months-trip to the U.S. by the end of 1943, when he was president for the academy of engineering sciences as well as member of the Council for Technical Research.

Contacts made with Americans were not only made on Swedish initiatives. It was of equal interest to U.S. authorities and other American interests to exercise influence over Sweden and, more importantly, over European developments in general during the Cold War.⁴² Such active influence from across the Atlantic had existed already in the 1930s through different programs supported for instance by the Rockefeller Foundation. Under the slogan "make the peaks higher", the foundation had supported such notable Swedish scientists as Nobel laureates Manne Siegbahn and Theodor Svedberg.⁴³ During the Cold War, the monetary support was further intensified. Science had become an instrument of foreign policy.

But the establishment of research councils was not imitated without alterations. In Sweden, the research councils established did not generally run research institutes as was common abroad. Here, customers and contractors were usually separated, on one side councils and on the other universities, research institutes and private enterprises. A notable exception from this rule was the Swedish Defence Research Agency (Försvarets forskningsanstalt), which both carried research and planned programmes.

These adjustments of the model of foreign research councils originated from a lively discussion in the early 1940s whether the planned expansion of the public technical and scientific research efforts during WWII should be governed by The Swedish Academy of Engineering Sciences or some other yet non-existent, authority.⁴⁴ A third alternative would be to simply add the planned resources to the annual budgets of the since-long established engineering schools. This was at least the meaning of a professor from the Royal Institute of Technology, who raised his voice against the emerging "research-institute-rage".⁴⁵ Thus,

important influence also came from domestic discussions of how to connect research to education at the two institutions for higher technical education in Sweden at this time, the Royal Institute of Technology in Stockholm and Chalmers Institute of Technology in Gothenburg.⁴⁶ Other phenomena paving the way for the forming of a national research council for technology was the often ideologically founded discussion of the need for industrial and workers' interests to unite in an effort to improve the organizational, institutional and material conditions for technical research.⁴⁷ Taken together, these voices and discussion themes all contributed to a clearer organizational separation between research customers and contractors in Sweden than in many other countries.

To what extent The Swedish Council for Technical Research acted as an intermediary organization can be discussed. Most of the monetary support went to engineering schools rather than industry, at least during the 1940s and 50s. Towards the end of that decade, the technical research council made efforts to reach industry more frequently.⁴⁸ More importantly, this organizational model functioned as a blueprint for other areas of research such as the sciences, humanities, social sciences etc.⁴⁹

In comparison, the industrial research institutes were more efficient intermediary organizations, formed as they were in specific industrial branches such as building research, textiles research etc. and created as a consequence of the same public investigation that had led to the technical research council. These were co-financed by the state as well as private stakeholders, and the ownership was often organized in foundations.⁵⁰ As has been shown, these industrial research institutes had forerunners in the interwar period. After WWII, The Swedish Academy of Engineering Sciences were just as active in forming new institutes and supporting existing ones as they had been in the interwar period.⁵¹ Many of them were still run in close connection with institutions for higher engineering education, their buildings being on, or close to campus and their directors being professors.

With the three Swedish knowledge intermediaries in place—industrial research institutes, development pairs and research councils—with universities and engineering schools supplying the necessary glue, the functions of knowledge intermediaries were to be tested during the 1950s and 60s, especially with the military sector as a competent public customer. Half of the governmental support for research in the beginning of the 1960s was granted to the military.⁵² An indication that this system of organizations and institutions fulfilled high

demands was the production of Swedish fighter aircrafts from the 1950s and, later on, the building of domestic nuclear power plants. Success was no wonder considering that research institutes of different industrial branches in general increased their funds five or six times during the 1960s and 70s, the rise being evenly distributed over both public and private grants.⁵³

Obviously, there were competent public as well as industrial customers of research although so-called sector research (i.e. research carried out by request in order to solve a problem or to develop some sector of society) did not become more common in Sweden until the late 1960s and early 70s.⁵⁴ The military sector had led the way with a substantial part of public research investments and the largest research institute in Sweden, which also planned and worked out long-term programmes such as the one for nuclear weapons. Such weapons, however, seem to have constituted the roof for the accomplishments of Swedish military research, but not through the lack of knowledge or competence to build such weapons. Instead, explanations of why Sweden never managed to acquire the Bomb are either based on Sweden's foreign relations or on domestic conditions.⁵⁵

Looking abroad, researchers have pointed out the American resistance to spread nuclear weapons and thus to export know-how to build them hampered the Swedish efforts. In addition, the Swedish interest for nuclear weapons should have cooled off considerably during the second half of the 1960s when more experts and decision-makers became convinced that neutral Sweden, without NATO membership, was nevertheless covered by the nuclear defence of the West.⁵⁶ Domestically, it has been pointed out that the research community's support for a nuclear programme was weak already from the beginning of the Cold War.⁵⁷ Although there was support for a Swedish nuclear programme among the military, it was never unanimous and declined during the 1960s, especially in the light of the rather substantial costs related to nuclear weapons and their carriers, costs that threatened the ability for conventional warfare.⁵⁸ It also seems as if the strategic advantages of nuclear weapons could be questioned. For a small neutral country, the possession of nuclear weapons could in fact attract military aggression rather than deter from it, especially if the number of warheads was limited.⁵⁹ In addition, the ideological and political basis for Swedish nuclear weapons seems to have been weak. From a macro-economic perspective, nuclear weapons threatened social reforms such as an expansion of the retirement programmes.⁶⁰ The example of Swedish nuclear weapons can thus be used to show how shortcomings of high-tech industrial projects

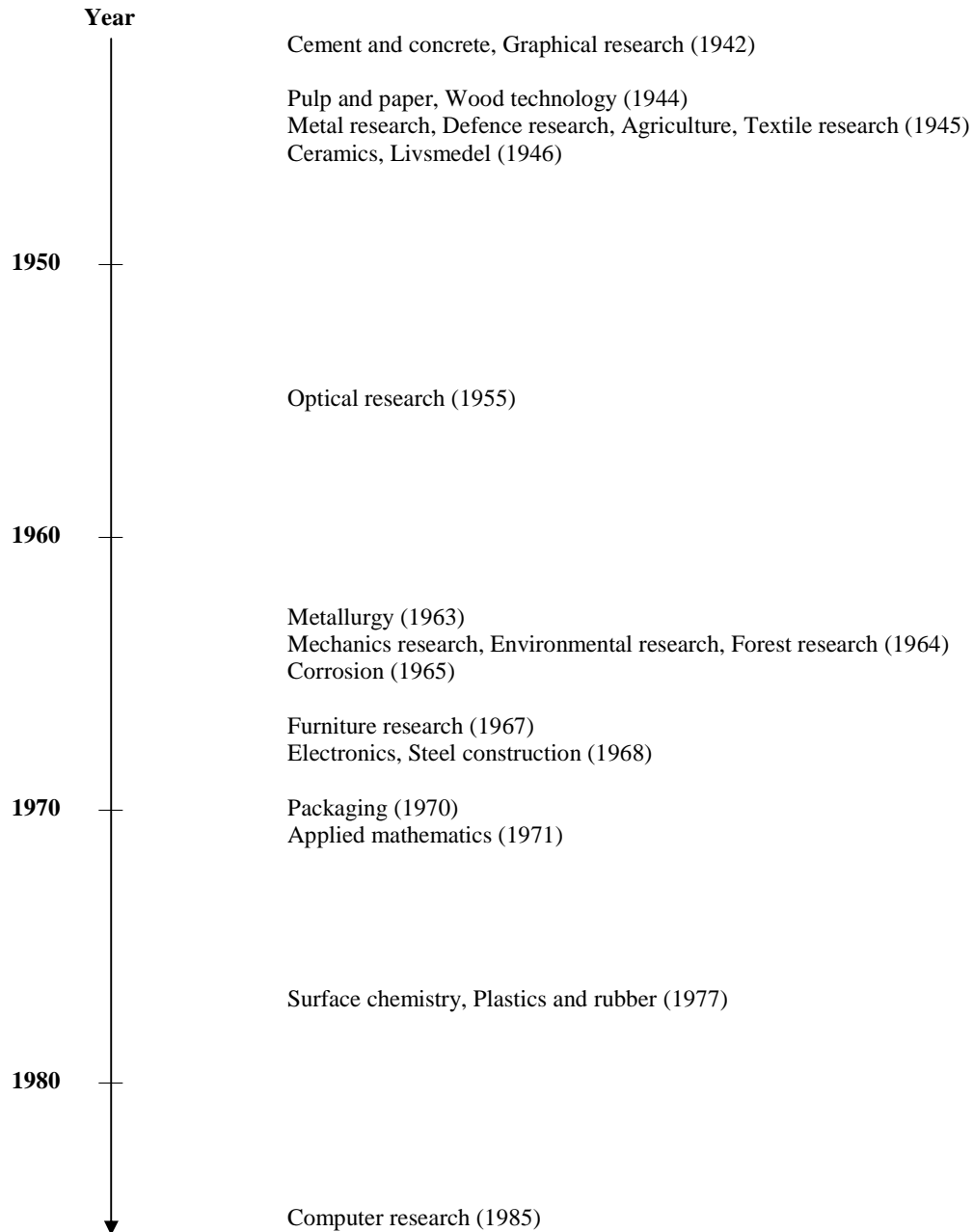
not automatically are to be attributed to inadequate intermediary organizations of knowledge transfer. Other considerations may be much more important indeed.

When the Swedish nuclear weapons programme was abolished in the late 1960s, the Swedish Defence Research Agency, established in 1945 on smaller research institutes formed during WWII, was the biggest of all sector research institutes.⁶¹ The nuclear weapons programme was of considerable importance in this build-up—in the mid-1950s, almost a fourth of the total workforce at Swedish Defence Research Agency were engaged in nuclear weapons research.⁶² In absolute numbers, the workforce engaged in the atomic bomb project rose from approximately 200 person-year equivalents in the mid-1950s to 300 person years in the early 1960s. Simultaneously, however, the defence research agency grew even faster making this considerable group constitute about a fifth of the total workforce by then.

Also the efforts to build a Swedish atomic energy programme was structured around an industrial research institute. In 1947, a joint venture between government and industry was formed as an enterprise, Atomic Energy.⁶³ In reality, however, this was an industrial research institute organised as a holding company in order to avoid the broad principle of public access to official records of public authorities. In the mid-1960s, the academy of engineering sciences suggested that Atomic Energy was to be transformed into a regular jointly financed research institute, but the Atomic Energy argued against the idea pointing to the importance of company secrecy.⁶⁴

In the early 1970s, pure public customers were more commonly established also outside the military sector and other traditionally technology-dense areas such as the energy sector, in Sweden often dominated by a development pair.⁶⁵ Again, influence from abroad determined the developments in Sweden. The idea of framing research in customer and contractor relations between organizations sector-wise for the bettering of society was imported from the American defence industry via its Swedish counterpart.⁶⁶ Although the expansion of sector research cannot be seen as planned and organized, these institutional efforts mirrored a belief in transformational power of research that had become highest fashion in both the East and the West after WWII.⁶⁷

Table 1. Industrial research institutes were commonly founded towards the end of WWII and in the 1960s when sector research became a dominating model. Here is a timeline containing the most important industrial research institutes by year of establishment.



As a consequence, both research customers and contractors of different sectors could note rising government spending and better possibilities for research efforts from the beginning of the 1960s to the late 1970s thus complementing rising research expenditures already noted

within research institutes of different industrial branches. For example, the funding of the Delegation of Transport Research doubled between 1973 and 1983.⁶⁸ The energy sector went through a similar raise of research funding.⁶⁹ In some sectors such as the drug industry, private enterprises were used as contractors as commonly as public institutes and institutions for higher education. In others, public funding and contracting dominated thoroughly. Thus, both contractors in the form of institutes and customers could play the role of intermediary organizations depending on the structure and dynamics of private industry and trade as well as the public authorities of a specific sector.

In the building sector, for example, the Research Council for Building Research (Statens råd för byggnadsforskning) was formed in 1960 in connection to public efforts to build away the problem of housing.⁷⁰ A precursor had been The Swedish Committee for Building Research (Statens kommitté för byggnadsforskning) formed in 1942 to fund research. In the early 1950s, the introduction of a fee for employers in the building sector improved the funding possibilities enormously. Subsequently, the building research committee was transformed under a new name (Statens nämnd för byggnadsforskning) to both fund and perform research projects. In 1960, this organization was divided into two parts, one being the building research council funding research, the other being The Swedish Institute for Building Research (Statens institut för byggnadsforskning) to pursue research. By the launching of the building research council, the public took on a greater responsibility in this sector and expanded possibilities to function as a research customer, and to some extent as a coordinator.

Sector research can thus be seen as an expansion of the model of funding through research councils formed after WWII. By combining well-known intermediary organizations for knowledge transfer—research customers organized as councils with research suppliers organized as institutes—in a specific sector, a new model for generating relevant knowledge called sector research was created. In Sweden, the scale and scope of sector research seem to have taken relatively large proportions in international comparison. Potentially, this can be explained by the specific character of Swedish research councils in an international perspective, with their rather clear customer role. In many sectors of society where research councils had already been established, it was not a very big step to introduce more rigid planning of activities in order to develop some specific sector of society. Research councils and sector research dominated Swedish cold-war research policy.⁷¹

In the sector of occupational safety, for example, the National Board of Occupational Safety and Health (Arbetskyddsstyrelsen) had been formed in 1949. By the forming of the Occupational Safety Foundation (Arbetskyddsfonden) in 1972, this research area received additional funding and from 1977, research was coordinated through the new Swedish Centre for Working Life (Arbetslivscentrum), which also was to carry out investigations in-house. The transport sector constitutes another example of how research could be organized in the 1960s and 70s, through public customers contracting suppliers of research. Here, the National Council for Traffic Safety (Trafiksäkerhetsrådet) acted as both customer and supplier of research from 1949.⁷² As a result of a public investigation appointed in the mid-1960s, the Delegation of Transport Research (Transportforskningsdelegationen) was formed in 1971 as a research customer for the transport sector. Simultaneously, the Swedish National Road and Traffic Institute (Statens väg- och trafikinstitut) was formed as a research contractor through a merger of the Swedish Road Institute (Statens väginstitut) from 1939 and the road institute of the Royal Swedish Automobile Club (Kungl. Automobilklubbens väginstitut) formed in 1923.⁷³

Of all research and development customers established in this period, the perhaps most important was the National Board for Technical Development (Styrelsen för teknisk utveckling) founded in 1968 by a merger between the Council for Technical Research and some smaller institutes in order to coordinate technology development projects, technical research and innovation projects in firms.⁷⁴ But already from the start, the Board had problems defining its role as a sector research organization and what sector it was to cover. Was it a heuristic industrial sector or more technical research and development in general irrespective of sector?⁷⁵ In the 1970s, it seems as if the second alternative became a better description of the activities of the Board.

The Research Institute of Society

By the late 1970s and early 80s, research investments in Sweden were generous and covered a lot of ground. By this time however, a fast divestiture took place. The positive trend for sector research started to weaken from the mid-1970s when a series of reforms of public research policy strengthened the public research grants to institutions of higher education at the expense of sector research, including development pairs and industrial research institutes.⁷⁶ By the end of the 1970s, institutions of higher education were to be substantial contractors of sector research. They were to form a “research institute of society”.⁷⁷ Simultaneously, private

business to a larger extent chose to pursue research in-house. The result was a crisis for Swedish intermediary organizations and a national research and development system with two strong poles, one in academic research at universities and another in industrial development work in the private sector.⁷⁸ Between these two poles, there were only few and weak intermediary organizations.

The situation was primarily created by the re-regulation of markets for public goods earlier run as state monopolies such as electricity and telecommunications. In this way, old and established institutions such as development pairs were abolished.⁷⁹ With them, the focus on large-scale enterprise such as ABB and Ericsson was blurred and shifted to expectations of a more heterogeneous structure of Swedish industry. Parallel to this, the public debate and innovation policy became more focused on markets for consumer products. In 1995, Sweden became a member of the European Union, which in addition led to formal obstacles in the form of rules and regulations, for instance prohibiting the support of national enterprise in procurement processes. It was no longer possible to support a national growth policy by the protection of certain markets. Destructing reductions and a following paralysis due to the end of the Cold War also meant that problems arose within the up until then perhaps most important sector for innovation, the military.

Due to changes within Sweden and abroad, the bridges between public and private did not seem as important any longer. Contradictorily enough, however, the burning of knowledge intermediaries between industry and the public is, together with the formation of development pairs, an exception in Swedish research policy in the sense that this turn of events did not follow precursors abroad. For once, Swedish research policy liberated itself from the chains of convergence and went its own way, at least in international comparison.

This situation did not last for long however. In the mid-1990s, the concept of innovation systems developed within policy research, becoming an ever more important buzzword in policy circles as well, both internationally and in Sweden.⁸⁰ Again, and for the umpteenth time in Swedish history, we find policy convergence regarding the organization of knowledge intermediaries with solutions developed and used abroad.

A long-term perspective on Swedish knowledge intermediaries

This article started with the claim that policy convergence in science and technology policy is not an exclusively recent phenomenon, but instead as old as knowledge intermediaries, established and developed in Sweden for centuries. As a result, the build-up of research in Sweden after WWII resulted from a quantitative expansion of intermediary organizations rather than a qualitative one. To be sure, this expansion occurred simultaneously with a militarization of knowledge formation and a redirection of focus towards social problems of a burgeoning welfare state. Research for innovation in the military sector before and during WWII has indeed been seen as a major condition for the formation of research policy in post-war Sweden.⁸¹ But, these changes affected an existing system of knowledge production, transfer and use as well as knowledge construction, appropriation and incorporation, launched and developed before WWII.

That knowledge intermediaries have a long history does not, however, imply stability. On the contrary, models for how knowledge intermediaries should be and in reality are organized have changed from century to century, creating historically overlapping layers of organizations with the purpose of transferring knowledge between knowledge producers and potential knowledge users. While older organizations, such as the royal academy of sciences, persist over time, new ones have been created with similar purposes but with different organizational means to achieve them.

The two most striking features of these long-term changes of organizational models for setting up knowledge intermediaries are their international character and their time-wise domination on the Swedish scene. Thus, the exceptional scale and scope of sector research in Sweden during the Cold War is not a historical peculiarity, but mirrors a general Swedish enthusiasm for new organizational models from abroad for knowledge intermediaries, an enthusiasm that can be traced back centuries. For any given time period, there has been an imported model that dominated the way knowledge intermediaries were thought of and implemented. This has led to time-wise homogeneously set up knowledge intermediaries, a historically repetitious policy convergence. When new models are imported and used, new knowledge intermediaries are set up while the older ones persist creating annual rings of different types of knowledge intermediaries. The year of establishment for a knowledge intermediary in Sweden can almost unexceptionally be traced accurately from its name, legal status and activities.

Combining these two features, the international origin of organizational models for knowledge intermediaries and their time-wise domination on the Swedish scene, makes it rather easy to view the founding of knowledge intermediaries as a form of imitation. Once an organizational model was given attention and became common abroad, it seems to have been broadly imitated and thus dominant also in Sweden regardless of its possible advantages or disadvantages from a Swedish perspective.

Much has been said about organizational imitation, it can be analysed in many different ways.⁸² Some, for example, have claimed its origin in identity crisis.⁸³ Such an analysis can be further specified in terms of local construction of problems, or in this case national construction of problems. According to Swedish business researcher Kerstin Sahlin-Andersson, local organizational problems are constructed through comparison with other organizations. The gaps observed between the two can then be identified as a problem suggesting a solution by imitation.⁸⁴ When this is repeated for the founding of knowledge intermediaries in different research areas and industrial branches, the result has a strong resemblance to fashion, i.e. differences observed by comparisons are viewed as a problem that can best be solved by imitation.

In this context, it is important to point out that the process of organizational imitation isn't equivalent to copying. Instead, Sahlin-Andersson has described it as a process of editing including de-emphasis, omissions, clarifications, etc. of different features.⁸⁵ In a similar way, following fashion gives certain degrees of freedom as well as constraints. When it comes to the establishment of knowledge intermediaries in Sweden, the imitation of foreign models are as striking as the lack of discussions of how these different models can be adjusted to fit national conditions. When the models are discussed, the issue at stake is, with only few exceptions, whether they should be imported or not rather than how they can be edited to be effective in a national Swedish context. Admittedly, the debate regarding research councils established in Sweden in the 1940s indeed resulted in an editing process where engineering schools were seen as alternatives. Another exception to the general rule of import without editing was the forming of the holding company Atomic Energy as an industrial research institute for the atomic energy programme. But in conclusion, fashion seems to be an adequate way to characterize the organizational and institutional efforts in Sweden to secure the availability of scientific competence in industry and trade over decades and centuries. In addition, since the origins of these fashionable organizational patterns were to be found in

quite a few foreign countries once they were introduced in Sweden, this fad for fashion is well understood as policy convergence.

Conclusions

Different intermediary organizations have handled the transfer of knowledge between producing and using spheres of society over decades and centuries. Scientific academies dominated in the 18th century, educational institutions and public institutes in the 19th and research institutes as well as research councils forming sector research in the 20th century with development pairs as an important complement in certain branches. By the cut-downs of military expenditures, a shift towards traditional educational institutions occurred by the end of the 20th century.

To be more specific, Swedish Cold-War research is best characterized by an ambitious build-up organized by the formation of publicly funded research councils and industrial research institutes as well as long-lasting business relations between competent government agencies and private suppliers, so-called development pairs, materialized in ambitious and forward-reaching procurement projects. A sector-wise combination of research councils as research customers and research institutes as suppliers of research, so-called sector research, came to dominate Swedish society including the military sector and sectors viewed as central for the creation of welfare. To be sure, similar ideas and models were common internationally. But given the size of the Swedish population, rising from seven to eight million from 1950 to 1970, it seems as if the scale and scope of sector research in Sweden was exceptional also in international comparison.

With the kind of long historical perspective supplied here, some salient features of Swedish intermediary organizations for knowledge transfer as well as some hypothesis for future investigation should be mentioned conclusively. Most striking is of course how organizational solutions from abroad have dominated the Swedish scene with only a few notable exceptions, for instance the burning of knowledge intermediaries between industry and the public from the 1980s. In addition, it is equally striking how different sectors of society have been in focus for research and knowledge transfer efforts at different times thereby using different models for knowledge intermediaries. In the 18th century, agriculture relied on a national and several regional academies for knowledge transfer. In the 19th century both agriculture and different sectors of a burgeoning manufacturing industry relied on educational institutions and to some

extent public institutes and private associations. In the 20th century, research institutes were formed to support different industrial sectors, most notably the energy sector. After WWII, these were combined with research councils to form sector-wise planning, funding and practice of research, originally in the military sector and later in sectors viewed important for supporting welfare state. After the Cold War, research funding dropped and the sector-research model was abandoned for traditional educational institutions.

It is quite clear that the sectors of interest when establishing intermediary organizations for knowledge transfer were those pointed out as particularly important for the wealth of the nation in general, either export industries such as mining in the 17th century or those of particular domestic interest such as agriculture in the 18th and 19th centuries and the energy sector in the 20th. In this context, it is equally important to point out that the establishment of knowledge intermediaries, although most often with arguments stressing the need to supply relevant knowledge for practical problem-solving and development work, probably just as often have been used in the opposite transfer direction supplying researchers with problems, methods and most of all resources for the benefit of improved knowledge production. Thus, knowledge intermediaries work in both directions although it is only commonly one that is mentioned explicitly, from knowledge production to application.

It is not clear, however, if each of the models for knowledge intermediaries can be considered optimal for the sectors viewed as important in a specific time period. In fact, two observations point towards the conclusion that models for knowledge intermediaries were not tailored after identified problems and shortcomings, but given designs that at least partially depended on other considerations, if any at all. The first observation is that the intermediary organizations for knowledge transfer set up at a given time interval were congruent to a model blueprint such as industrial research institutes or research councils. In this sense, they were time-wise homogeneous. This can be contrasted to the assumption that knowledge intermediaries that are organized according to different requirements depending on institutional settings are likely to be time-wise heterogeneous.

The second observation is that most of these model blueprints were imported from abroad and thereby more dependent on fashion and international policy convergence than the structure and dynamics of trade and industry as well as other public institutions and technological opportunities and problems of a specific sector of society, industrial branch or knowledge

area. Thus, knowledge intermediaries seem to have been less modelled after thorough analysis of the demands a specific situation and more the result of a desire—one is tempted to say obsession—to do *anything* about a situation deemed as unsatisfactory. The imitation of foreign models dominate at the expense of discussions on how these different models could be adjusted to fit national conditions. When the models are discussed, the issue at stake is whether they should be imported or not rather than how they can be edited to be effective in a Swedish context.

One last observation will also be mentioned, more as a suggestion for future investigations than as an established fact. It touches upon the issue of what happens to old and since-long established knowledge intermediaries when new forms are introduced from abroad. It seems as if many, if not all of them, have had a tendency to become more and more academic over time—i.e getting to be more interested in knowledge production without clear and externally defined applications or goals—a process captured by the concept academic drift.⁸⁶ This is certainly the case with academies founded in the 18th century and institutions of professional education of the 19th century. To some extent, it also seems to be true for many research institutes of the 20th century. Whether the claim holds for research councils and universities and university colleges more intent on their respective region is perhaps too early to judge. But the long-term academic drift of knowledge intermediaries is a hypothesis worth to be tested in future studies.

Notes

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⁷"äga någon wärckelig nytta i det allmänna wäsendet", se: Bengt Hildebrand, *Kungl. Svenska Vetenskapsakademien: Förhistoria, grundläggning och första organisation: Noter bilagor m.m.* (Stockholm, 1939), 760.

⁸Axel Liljencrantz, "Polhem och grundandet av Sveriges förstanaturvetenskapliga samfund", *Lychnos: Årsbok för idé-lärdomshistoria* 4 (1939), 289-308; Axel Liljencrantz, "Polhem och grundandet av Sveriges förstanaturvetenskapliga samfund", *Lychnos: Årsbok för idé-lärdomshistoria* 5 (1940), 21-54; Hildebrand, 1-118.

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⁶³Stefan Lindström, *Hela nationens tacksamhet: Svensk forskningspolitik på atomenerginområdet 1945-1956* (Stockholm, 1991).

⁶⁴Maja Fjæstad, Ph.D. thesis, Department of History of Science and Technology, Royal Institute of Technology, Stockholm, forthcoming.

⁶⁵Annerstedt, *Makten över forskningen*; Björn Wittrock & Stefan Lindström, *De stora programmens tid—forskning och energi i svensk politik* (Stockholm, 1984), 13.

⁶⁶Wittrock & Lindström, 13.

⁶⁷Stevrin, 191-192.

⁶⁸Anders Englund, ”KFB och dess föregångar: En exposé över delar av statens insatser för kommunikationsforskning”, *KFB-information 2000:26* (2000), 20-21.

⁶⁹Wittrock & Lindström, 155.

⁷⁰Ulf Sandström, *Mellan politik och forskning 1960-1992* (Stockholm, 1994).

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⁷³Pär Blomkvist, *Den goda vägens vänner: Väg- och billobbyn och framväxten av det svenska bilsamhället 1914-1959* (Stockholm, 2001), 116-119.

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⁷⁵Weinberger, 392-393.

⁷⁶Aant Elzinga, "Universities, research and the transformation of the State in Sweden", in *The European and American university since 1800: Historical and sociological essays*, eds. Sheldon Rothblatt & Björn Wittrock (Cambridge, 1993), 191-233.

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⁸⁰Magnus Eklund, *Adoption of the Innovation System Concept in Sweden*, Acta Universitatis Upsaliensis, Uppsala Studies in Economic History 81 (Uppsala, 2007).

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⁸⁴Kerstin Sahlin-Andersson, "Imitating by Editing Success: The Construction of Organizational Fields", in *Translating Organizational Change*, eds. Barbara Czarniawska & Guje Sevón (Berlin, 1996), 69-92.

⁸⁵Op. cit.; Kerstin Sahlin-Andersson & Guje Sevón, "Imitation and identification as performatives", in *The Northern Lights—Organization theory in Scandinavia*, eds. Barbara Czarniawska & Guje Sevón (Copenhagen, 2003), 249-265.

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