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Features of the current science policy regime: Viewed in historical perspective

Aant Elzinga

Department of Philosopy, Linguistics and Theory of Science, Gothenburg University, Box 200, SE 405 30, Göteborg, Sweden; Email: aant.elzinga@theorysc.gu.se.

This paper aims to throw into relief some of the general features in the development of the history of science policy by drawing attention to the continuation and deepening of old issues in new forms within the current science policy regime. The paper presents a typology which distinguishes different ways in which policy attempts to 'account' for public funding of science by showing how science contributes to wealth and prosperity. The paper concludes that the new forms of accounting place the focus of attention on what is 'produced' in science and that science policy itself has become dominated by the logic of globalism and new public management.

Keywords: new public management; science policy; legitimation; megascience; internationalization; globalization.

1. Introduction

Two decades after the end of the Cold War finds us in a new global political epoch marked by the transition from a bipolar world to the more complex multicentred one associated with globalization. What differentiates globalization from internationalization, which was a feature of the Cold War period, is that it simultaneously heralds a shift in the economy, organization and policy of research and an intensification of previously existing trends. For instance, the boundaries between private and public actors have become more permeable and with it the public–private mix in megascience projects increases. This simultaneous intensification of earlier trends and shifting economic, organizational and policy arrangements is producing new tensions in the system. One such tension is that created by the increase in public–private partnerships in research funding and the promotion of intellectual property arrangements for the commercialization of publicly funded research. The two arrangements send different signals since public–private partnerships are intended to facilitate firm–university collaboration while the Bayh–Dole type legislation that promotes the commodification of public research usually complicates firm–university partnerships by increasing transaction costs.

Investments in big science have traditionally been closely linked to national defence efforts—a trend which predated the Cold War and continued during the Cold War. Events such as the launch of the first Sputnik (1957) may be regarded as typical of the big science–national defence link. The phenomenon of big science is also closely linked with that of internationalism and the Cold War. During the Cold War, the link between internationalism and big science was most often actualized in East–West science projects such as the International Geophysical Year 1957–8 and research in Antarctica. These were sites of competition between large powers, especially the USA and the USSR and big science served as a way of manifesting a presence on the frozen continent. Put differently, big science investments were a continuation of politics by other means. The development, of large research facilities like CERN in Geneva in 1954, and later the European Sunchroton Radiation Facility (ESFR) in Grenoble that became operational 1991–2 may be viewed in a similar perspective.

It should come as no surprise therefore that internationalism has taken different forms since its introduction. Initially, it was largely driven by initiatives within scientific communities and the international networks of national academies of science. However, as national science budgets began to impose stricter limitations on the growth and expansion of big science, the incentives for sharing costs across nations increased. This prerequisite brought with it an internationalization of policy professionals and the addition of the increasing economic globalization in the aftermath of the Cold War led to a further increase in the number of stakeholders involved in internationalization. Thus a typical big or megascience project now involves a range of interests from science, state and regional bureacracies as well as private corporations. An historical periodization of science policy shifts to highlight successive developments of this kind is useful to gain a deeper understanding of the present-day policy context and the multiplicity of factors behind arguments regarding investments in big/megascience.

This paper examines some features of the current science policy regime and contrasts it with earlier ones. The purpose is to highlight some shifts in meta-narratives of accountability in the history of science policy. The focus is therefore on different ways in which policy attempts to account for public funding of science by showing how science contributes to wealth and prosperity. It is suggested that successive policy regimes carry with them certain elements of the past that are incorporated in new lines of argument and approaches to public accountability over time. In other words, it is held that there is no linear development of policy regimes and that some significant elements even predate science policy. They reach back into the history and legacies of universities since those in some countries are the institutions in which an important part of science policy is played out (cf. Elzinga and Jamison 1995; Elzinga 2005 where a related periodizations of policy doctrines are presented).

In what follows therefore some remarks are made first of all concerning the Humboldt University model. Its history and what it is supposed to stand for has been and still—rhetorically—serves as an implicit or explicit reference point in science policy discussions. Thereafter the argument focuses on the formation of science policy as a specific policy domain, distinguishing three successive periods each of which is associated with a specific mode of tackling the problem of accountability and policy legitimacy. Two of them coincide with the Cold War era, the third concerns the present situation. They are referred to, respectively, as:

- *The legitimation period* which ran from immediately after World War II to about the middle of the 1960s.
- *The period of professionalization* with organizations like the OECD and the RAND Corporation regularly functioning as expert sources of advice on science policy in addition to national science policy advisors. It further developed in the course of an internationalization of science policy practices under the auspices of a number of UN bodies like UNESCO and UNCSTD that helped disseminate these practices to developing countries.
- *The period of accountability* which coincided with the final loss of science policy's special status and it becoming definitively subjected to the same logic as other policies as evidenced in the entry of new public management (NPM) into academe.

The rise of NPM roughly coincides with the end of the Cold War. Even though there was no direct causal link with the collapse of the Soviet Union, the rapidity with which capitalism thereafter was embraced in Eastern Europe harmonized well with the rhetoric of NPM thinking. Today, it seems that NPM, as a particular school of theoretically orchestrating resource allocation, is already on its way out (Drechsler 2005). Nonetheless, the doctrine's impact in practice in the realm of organization and management of science and higher education in the public domain is far from over. We see it in the way academic institutions and working conditions are being transformed with an influx of bibliometrics to assess performativity with measures that are frequently far from adequate.

2. The long historical view

In the long historical perspective, transformation of universities in the Western world used to mean reshaping older institutions into a modern form, spurred by the European Enlightenment movement. Sweden is a good example. There the struggle for academic freedom has been sketched by the well-known historian Curt Weibull (Weibull 1954). Weibull argued that the transformation was the result of a tenacious struggle for freedom of thought and the right of scholars and scientists to undertake research unconditionally *without* an eye to predetermined outcomes. It meant breaking with an older academic regime, one of tutelage and censorship at the behest of church authorities and an absolute monarch.

The Swedish monarch Karl XI (d. 1697), a devoted Lutheran, had indeed invented an ingenious mode of censorship that made prefects and faculty deans accountable for the content of academic dissertations. If these contained anything that was in conflict with orthodoxy or the King's absolute rule then according to university statutes the first time round the prefect and dean involved would have a half-year's earnings deducted from their wages. And, if it happened a second time, they lost their positions.

This kind of historical background is a key part of the argumentation for the formation of a university based on the ideal of academic freedom and substantive autonomy. The process that led to the new form and ethos of the university coincided with the emergence of the rights and freedoms of a liberal bourgeois society and was intended to serve it. Therefore, the notion of academic freedom in the Swedish context, as in the rest of Europe, is loaded with a deeper range of political symbolism and hard-won progress that gets lost in present-day discussions which are primarily focused around the economics and organization of research or funding mechanisms.

During the period of the Cold War the freedom of science was played up in the West as a cornerstone of the Open Society, the alternative to political and ideological tutelage in the East. In the USA the sociologist Bernard Barber built on Robert Merton's famous notion of the academic CUDOS norms (articulating 'the ethos of science' as an antidote to what Merton saw happening in Nazi Germany).[1]

Barber referred to the social relations of science involving free interchange and autonomy as an exemplar, a microcosom of what a rational democratic liberal society is all about. In Germany in 1946, a year after he had been reinstated as president of Heidelberg University and presided over its reconditioning, the philosopher Karl Jaspers wrote a tract titled *The Idea of the University*. The terrible experience of intellectual dismantlement and repression during the Third Reich was still fresh in people's minds. In his tract he restated the arguments for free inquiry:

> The university is a community of scholars and students engaged in the task of seeking truth. It derives from the idea of academic freedom, a privilege granted by state and society which entails the truth in defiance of all internal and external attempts to curtail it. (Jaspers 1965: 9)

A few years later, the partitioning of Germany after the war led to the University of Berlin being located in the city's Soviet sector and it was renamed Humboldt University (1949). American political action and funding in Dahlem, promptly led to the foundation of the Free University of Berlin in the US sector. The Free University became an important symbol for institutional recovery of the values of the original Berlin University, the one founded in 1810 by the liberal educational reformer Wilhelm von Humboldt.

Humboldt had inscribed in the constitution of the old University of Berlin what are often regarded as the core values of the modern European research university. Humboldt's idea of the university was that it would serve as a critical conscience and that when needed should go against mainstream currents in society at large. In practice, however, it had to reflect consensual knowledge. The tacit assumption of the Humboldt model was that when specialists spoke outside the realm of their expertise it was to be in their own name and not in the name of their respective institution, the university. Thus, there were limits. This rule is also observed in the institution of tenure on the other side of the Atlantic.

The Free University affirmed these values: at the same time it became a West German showcase and powerhouse for the Bundesrepublik.

The foregoing facets of history are taken up here to remind us that the formation of, and changes in, institutional norms relating to research and higher education need to be understood in a broad societal context that goes beyond the realm of managerial concepts and methods.

3. The Cold War and science

The period of the Cold War began with the Truman Doctrine which was launched in 1947 to contain a perceived threat that European nations geographically close to the Soviet Union would succumb to Communism (the so-called Domino theory). This was followed the next year by the Marshall Plan which provided material assistance for rebuilding Europe as part of the free Western world. In this context the development of scientific and technological capacities was important both in relation to industrial power and from 1952 onward as part of the NATO defence system. After the Sputnik shock (1957), research spending in the USA as well as in other major Western powers escalated, with the US Department of Defense cast in the role of major procurer of research.

4. The period of legitimation

The Cold War was definitely a major driver of investments in research and development (R&D). During its entire period however, while the basic ideology and the politics of a steady confrontation and peaceful coexistence with the USSR and its allies remained the same, there were several shifts of research policy doctrine that moved the emphasis back and forth between basic and applied research or innovation.

Although several areas of research such as atomic physics, materials science and geosciences were closely linked to these military–industrial objectives, motivation for public funding still tended to be framed in terms of arguments relating to basic research conceived as a cultural good in a free society. Thus references to 'freedom of science' were used to legitimate advanced research in quantum physics, new materials and areas of the geosciences even when these were ultimately attached to military missions (Forman 1987; Hamblin 2002; Doel 2003). In the Soviet Union, in a sense, one could find the mirror image. Quantum theory, Einsteinian relativity, and even cybernetics were publicly denounced by philosophers and ideologues as bourgeois distortions to be avoided. However, behind the walls of military establishments and parts of the Science Academy, in secrecy, these areas and their scientists were thriving. Since top Soviet leaders saw these fields as important in a military strategy perspective they were actually protected by Stalin and Beria (Pollock 2002; Gerovitch 2001).

Apart from the legacy of the original German model of the Humboldt University, a newer source of rhetoric in the

West derives from a document in the USA. To justify the public funding of science a growing policy community has time and again recycled certain principles advocated by Bush (1945). Although its actual policy impact was very limited this document proved to be an important rhetorical resource in later science policy commentary. This is a factor that helps explain why over the years the report retained considerable symbolic significance.

First, Bush emphasized unconstrained research for the long term with an eye to what he called further progress of industrial development. Without this, he insisted, industrial development would eventually stagnate. Secondly, he specified that the proper concern of the federal government should be the provision of a rich fund of fundamental knowledge. Public funding in other words was recognized as important for what is nowadays referred to as the pre-competitive or pre-commercial phase of knowledge production. In retrospect this has been taken to be the benchmark of a 'social contract' of science involving a division of responsibilities located in two different sets of institutions at the level of the nation state, one for basic research another for applied research and technological development linked more directly to immediate social concerns such as: defence, health care, exploitation of natural resources, agriculture and commerce.

Taken at face value because of its simplicity, this model has retrospectively been regarded as a blueprint for the preferred order in science policy instruments in many Western countries. In the USSR a somewhat similar arrangement evolved in as far as there was a division of labour between the Academy of Sciences (basic research) on the one hand and applied institutions under the auspices of various central state ministries on the other (Pollock 2006).

The distinctions between basic research, applied science and development were codified in the OECD Frascati Manual in 1963 (Godin 2003; regarding changes in the concept of basic research 1963–2000 see Calvert and Martin 2001; Godin 2007). The idea of a linear model of innovation is closely associated with the foregoing distinctions that were originally introduced as convenient statistical categories (Godin 2006). As the model gained credence so did the notion that a nation's investment in basic research with no strings attached ultimately leads to a steady increase of the gross national product (see Balconi et al. (2010) for recent arguments in favour of the linear model). At the same time the difference between institutional arrangements for promoting applied science and technological development and those for basic research in turn implied an articulation of two different policy categories: first, policy for science (basic research); and secondly, science for policy (socially and politically mandated science).

Epistemologically the foregoing distinctions coincided with the boundary drawn up by Alvin Weinberg, the director of the Oak Ridge National Laboratory (for nuclear research) in the USA, in an invited lecture in 1961 entitled 'An agenda for science'. He contrasted his own view with what he called Michael Polanyi's model of the 'Republic of Science' in which the course of science is determined by a myriad of independent scientific practitioners. By comparison his own approach, he suggested, involved a 'much more socialist and centralized' top-down government steered model for allocating funds. In a sense he was here taking a leaf from Bernal (1939) and incorporating it into what later came to be called socially mandated or sectoral science policy (as distinct from basic research policy).

The title of Weinberg's classical paper 'Criteria of scientific choice' was later suggested by Edward Shils, editor of *Minerva* when it appeared in that journal in 1963 (Weinberg 1963). In the paper a distinction was made between internal and external criteria for assessing the value (he calls it merit) of a given scientific endeavour. Internal criteria pertain to the intrinsic value and feasibility of a research task. External criteria pertain mainly to relevance to engineering and other applications as well as achievement of social goals, thus science for policy. Polanyi's democratic republic was seen as a good model for 'little science' while Weinberg's model applied to 'big science'.

During *the period of legitimation* the conception of science as autonomous was philosophically elaborated by logical positivism and empiricism. In the history of science furthermore, 'internalism' was pitched against socioeconomic explanations of the growth of science (i.e. against 'externalism'). In the immediate post-World War II period mainstream history and philosophy of science was formed around a perspective and methodologies that systematically promoted an image of purity. Science as disembodied was for a time the received view among these scholars (although not in Weinberg's policy community). When challenged it was under the influence of the repercussions of the Vietnam War and a counter-image of deep entanglement amplified in critiques by several civil society movements of radical students, anti-imperialists and scientists for a socially responsible mode of research.

Leading science advisors who influenced the research policy discourse early on were physicists. They tended to define the boundary between science and society in terms of concepts that portrayed themselves as 'truth speaking to power'. This is a tradition that continued in new forms when in the next generation molecular biologists and environmental scientists successively entered the policy advisory arena.

However, it would be wrong to conclude that there was no opposition to the military–industrial entanglements before the late 1960s. The critical movement for the social responsibility of science as it was called actually had roots going back to the crisis period of the 1930s. The atomic bombs dropped on Hiroshima and Nagasaki gave rise after the mid-1940s to an anti-nuclear arms campaign in which scientists played a leading role. One platform for critical policy discussions was the *Bulletin of Atomic Scientists*, a non-technical journal devoted to global security and issues of science and public policy. In the 1950s it was involved in the formation of the Pugwash movement launched after the famous Russell–Einstein manifesto, an appeal to humankind to abandon nuclear weapons and work for peace. Under its auspices annual conferences were held with scientists concerned about nuclear proliferation as well as the role of science, more broadly, in modern society. Pugwash served as a forum for dialogue and building trust between scientists from both sides of the Iron Curtain on the basis of a common belief in the power of critical reason to sway politicians (the 1995 Nobel Peace Prize was awarded jointly to Joseph Rotblat and Pugwash Conferences on Science and World Affairs).

Critics in the late 1960s and early 1970s drew inspiration from the anti-nuclear movement. Even more they re-focused attention on how many branches of science were actually entangled with a military–industrial complex while McCarthyism had already historically falsified the official claim of academic freedom as the hallmark of the Open Society.[2] The upside of the image of 'speaking truth to power' is that as in the case of the Pugwash movement it can contribute to dialogue across political barriers and influence the policy community in methods of conflict resolution in turbulent times. The downside, as critics in the late 1960s indicated, is that the image may obscure the many ways in which science and society are already entangled with each other and how some parts of the scientific community tend towards collusion with power elites in the political and state bureaucratic spheres.

5. The period of professionalization

The arguments and distinctions introduced by Alvin Weinberg together with the science advice delivered by institutions like the OECD and the RAND Corporation went beyond the earlier attempts to justify investment in basic science by reference only to the utility of basic research in the long term or to the benefits of an Open Society. With escalating costs some stakeholders in both the defence sector and in industry felt that researchers acted as though they were entitled to blank cheques. By the late 1960s there was a particular concern that research in the policy for science category did not meet satisfactory accountability criteria. This prompted the famous Hindsight vs TRACES debate in the USA between corporate and military interests on the one hand and the National Science Foundation on the other. This dispute spilled over into science policy discussions in many other countries and led to the growth of a special sphere of international science policy investments. Scientific infrastructure became a major beneficiary of this turn, a feature that will be illustrated in Section 6. In the present section focus is on a systematization of decision-making in the policy community supported by a further refinement of criteria and distinctions in setting priorities.

The squeeze on national research budgets and a stronger focus on specific economic, social and other benefits initiated a new phase, one in which basic research as a science policy priority receded into the background. Discursively the turning point came with the. Here we also find some of the strands of later research policy doctrines that followed, right up to the incorporation of NPM in the 1990s. An important factor in the late 1960s and 1970s was that many countries experienced a reduction in government expenditures on science and the demand was to do better with less: a key word then as now was 'accountability'. Competition for funding has always been an important aspect in the development of science. In the 1970s, however, the role of the scientific entrepreneur became more common. Still, it was in a mode quite different from the one we find today associated as it is now with 'academic capitalism' and NPM (see below).

The relative limits imposed on budgetary growth together with constantly expanding numbers of scientists serves as an internal dynamic for greater competition for funding. It was the beginning of a situation Ziman (1994) later described as 'science in steady state'. He also noted that it induced a 'collectivisation' of research efforts, i.e. it forced researchers to join in cooperative ventures more than before, not only nationally but also internationally. The trend to more extensive modes of internationalization is also evident in the period of professionalization of the policy community. Research policy practices developed in one country—mostly the USA—tended to be mimicked in other countries, oftentimes with a certain time-lag (Lundin et al. 2010). Peer review procedures to select projects for funding also became more strongly formalized in this period. In this process of developing and disseminating policy standards the OECD was an important hub in the industrial world while within the UN system, UNESCO and UNCSTD developed statistical categories and methods for monitoring R&D investments and fostering science policy thinking as well as priority setting for developing countries.

The Brooks (1971) report was a watershed in OECD history and guided the work of its science directorate for decades. Together with the impact of the anti-imperialist and radical science, environmentalist and women's movements developed around critiques of the Vietnam War and industrially produced environmental degradation and other types of 'risk', the report also put the finger on the fuzziness between issues of science and those of society. In response to this, Weinberg proposed a new epistemic boundary between 'science and trans-science'. He argued that:

> . . . many of the issues which arise in the course of interaction between science, technology and society – e.g., the deleterious

> side effects of technology, or the attempts to deal with social problems through the procedures of science – hang on the answers to questions which can be asked by science and yet which cannot be answered by science. (Weinberg 1972: 209)

The latter he called 'trans-scientific' questions. Epistemologically speaking they are questions of fact but transcend science when it comes to dealing with them in a social context.

Weinberg contended that many areas of engineeringand much of social science (perhaps with the exception of economics) involve decisions based on incomplete data and therefore belong to this category of trans-science. This uncertainty, he maintained implied that decision-making must follow other rules than the procedures characteristic of science e.g. adversarial and legal procedures as well as moral and aesthetic judgments enter the arena. Thus the task of the scientist includes responsibility to help articulate the elusive boundary between science and trans-science.

By the 1980s the landscape had become even more complex as several new generic high technologies such as information and communications technologies, biotechnology and new industrial materials emerged. This class of technologies has their knowledge base in fundamental research and at the same time were regarded as strategic or targeted areas of high economic and social import. Within the framework of a Cold War science policy regime one now had a new phase with a reemphasis on basic research. The key differentiating characteristic was the focus on elaborating strategic goals using priority setting instruments like foresight and new evaluation methods with checklists including a mix of criteria encompassing scientific excellence and societal relevance (Martin 2010).

The research foresight methods introduced from the mid-1980s onward differed from the earlier more technocratic type of technological forecasting emanating from the RAND Corporation that owing to a failure to take into account relevant social factors had not foreseen the 1973 energy crisis. These new methods using broad consultations involving scientific, policy and user communities tried to move beyond the narrow scope of 'futurology' when identifying preferred areas for future large-scale investments. Significantly, in the mid-1970s the very term 'futurology' itself was replaced by the less pretentious one of 'future studies' that for a while also allowed input from advocates of alternative technology, for example under the heading of 'small is beautiful'.

In the decade that followed, the Reagan Administration initiated the Star Wars program to construct a vast shield in space against possible attacks by Soviet nuclear ballistic missiles. For reasons of national security restrictions on the free flow of scientific information were introduced in strategically sensitive fields. In turn, this generated a politicization of science and the development of a critical social movement comparable to that during the war in Vietnam. Strong protests from the scientific community in the USA and elsewhere defended the 'free flow' of ideas as the lifeblood of good science. There was also alarm over for funding cuts in other areas as investments in the Star Wars program escalated. Paradoxically, although a technological failure, the Star Wars program helped break the back of the USSR's economy in this new round of a longstanding geopolitically and militarily motivated technoscientific race.

With the collapse of the Soviet Union and the Cold War the tenor of the science policy discourse took a new turn, and 'big science' was partly overlaid with megascience. The changes that began in the 1980s with the strong linkages between fundamental research and high-tech also intensified so that basic research became even more intertwined with the production of goods and technological development for all realms of society (Elzinga 1997: 420). With new forms of socially mandated strategic research under headings such as: sustainable development and mitigating global climate change emerged the notions of 'post-normal science' and extended peer review (Ravetz 1999). These may in part be viewed as an extension of some elements in Weinberg's thinking around 'trans-science' to a much broader range of so-called technoscientific activities.

6. The period of accountability: Megascience

The application of foresight exercises and the articulation of criteria for priority setting in big science as a basis for international negotiations or science diplomacy involves both scientific and policy communities. This type of hybridization entails a further step onward that is evident with the introduction of the notion of megascience and a special OECD forum to deal with it (OECD Forum 1995). As the ceiling for individual nation's budgetary commitments for international projects increased meta-narratives of accountability also changed and sharpened. A contributory factor to a shift in these narratives is related to the collapse of the Soviet Union, the end of the Cold War and globalization, which meant a move from a bipolar to a multicentred world. In the new context, Cold War rhetoric of policy legitimation had no traction. This is reflected in some of the accountability discussion that followed.

Megascience is a concept coined by policy circles in the OECD:

> . . . to describe large scientific projects or programmes which, in view of their unique size, importance, complexity or duration, deserve special attention of the public and require long-term governmental commitment, often through international co-operation. (Metha 2002: 270; also see Haddeson et al. 2008)

Further, megascience projects are defined as those primarily undertaken for the production of knowledge, facilitated by cutting-edge technologies. They require formal management structures and resources that cannot be provided by a single agency, firm or perhaps even a country (OECD Forum 1995: 66–7).

Since its establishment in 1992 OECD's Megascience Forum (now called the Global Science Forum) has counted synchrotron facilities as belonging to this category (OECD Forum 1994). The term megascience was apparently chosen to emphasize the fact that it is not only a matter of scale or state support evident in traditional forms of 'big science' (e.g. the Manhatten project) but also the complex character of strategic partnerships across many different institutions and even national borders. In the European context particularly the role of science diplomacy involving several different nation states has come to be a key issue (Tindemans 2010).[3]

In 1997 John Krige wrote a brief historical chapter on the politics of European scientific collaboration. In a table (Krige 1997: 899) he listed nine important European organizations for scientific collaboration, ranging from EURATOM's Joint Research Center (JRC) at Ispra in 1952, to CERN in 1954, and onto the European Synchrotron Radiation Facility (ESRF) at Grenoble in France that was decided in 1984 and opened ten years later.[4] In conclusion he noted how competition (but also cooperation) with the USA was an important driving force throughout. Another driver was the Cold War.

In Krige's words:

> It has taken European science one generation, perhaps two, to reach parity, or better with the US in some parts of basic research (and technological development). Organizations like CERN, EMBL, ESA, ESO and JET have played an important role in establishing that equilibrium. However, as we have stressed, their creation and expansion has taken place in a specific global political epoch, an epoch marked by superpower rivalry and the Cold War and the building of a Western alliance in which a united Europe was a key element. (Krige 1997: 917)[5]

Commenting on the role of the OECD Megascience Forum, in 1996, Irving Lerch, the Director of International Affairs of the American Physical Society observed that scientists tended to be too individualistic and that they had to start realizing that major decisions such as the siting of megascale facilities are matters where nations and politics necessarily have to play a central role:

> Scientists cannot decide where a facility is best sited, the size of each participant's contribution, and how such facilities will be funded. Whether we like it or not, OECD represents the economic and political interests of its members, not the intellectual interests of scientists. Thus, if the physics community is to play a substantive role, it must enlarge its horizon and call upon its leaders to face the broader facts of life. Physicists are no longer able to conjure the ghosts of their Cold War status. We are now forced to demonstrate anew what physics contributes to international amity, prosperity and peace. (Lerch 1996: 6)

In other words the old sense of entitlement nurtured by the ideology and geopolitics of the Cold War has to be uprooted and replaced by a different kind of accountability. Thus the issue of accountability surfaced yet again, but this time in terms quite different from those discussed in Washington and OECD policy circles in the late 1960s and early 1970s. With the bipolar world gone a new geopolitics and concomitant ideology took shape, and with the nascent dynamic of both cooperation and competition that emerged in the 1980s now flourished.

The predominant aspect in intergovernmental sharing of facilities continues to be economic and political as parts of a formula for mutual benefit and pragmatism. With the Cold War rationale gone, science still had the dual function of simultaneously advancing knowledge and being a continuation of politics by other means, now with an even stronger focus on global economic competitiveness between countries and supranational trading blocks. This is the politics of science we see played out today and it has a distinctive tenor, one that reflects the new policy regime. New mechanisms of inclusion and exclusion rouse fears among scientists that cost-sharing obligations will cut deeply into academic budgets in ways that will enhance research in certain fields but disable it in others. This is nothing new, but with the end of a bipolar world and the era of globalization the stakes appear to be higher. In addition the term 'science diplomacy' has been added to our present-day vocabulary. In a sense it marks a further extension of professionalization.

The concept of 'science diplomacy' covers several areas of international relations. Facilitating the removal of barriers to international scientific collaboration (i.e. diplomacy for science) is only one aspect. Two others are: informing foreign policy objectives with scientific advice (i.e. science in diplomacy), and using science cooperation to improve international relations between countries (science for diplomacy). All three aspects of science diplomacy tend to be present and interwoven in the case of megascience (Royal Society 2010: iv).

7. The period of accountability: NPM

The discussion in Section 6 is closely linked to what may be called the logic of globalization. Closely linked to it but at a different level it is matched with another logic that has its own dynamic (Cope et al. 1997). NPM is shorthand for applying private sector or market-based techniques to public services, an approach that rapidly spread through the Anglophone world in particular (Hood 1994). It has brought with it an extreme accentuation of accountability. In science policy recurrent evaluations were already prevalent during the latter part of the period of professionalization, but now bibliometrics was introduced on a regular basis to produce 'hard' seemingly objective numbers. Successful researchers who come out ahead because their fields seem most amenable to this approach to accountability and are—whether they like it or not—enticed into colluding with members of the policy community, are helping to legitimate the process.

Competition for resources, as already noted, has always been a driving force in science and in the 1970s with a perception of 'limits to growth' it intensified largely on the basis of what Ziman later referred to as a steady-state dynamic. In the present situation, however, competition in science is increasingly driven by a different logic, an external one induced by new management practices. As a politico–administrative regime NPM has been successively introduced into one sector of society after another, hastening, systematizing and legitimating these developments, making it appear that it is only a technical–administrative question mainly of cost reduction, increasing flexibility, and greater accountability and efficiency of performance on the part of public service agencies and their various practitioners (Lane 1994, 1995, 2000). The process began to take form in the UK during Margaret Thatcher's government (1977–90). The label NPM is usually attributed to Christopher Hood, the renowned Oxford professor of government (Hood 1991, 1995).

It should be noted that NPM is an international trend, but that is has not been adopted wholesale as a package in all countries. One finds different versions in different countries. These differences have been explained by differences that exist between countries with regard to legal and administrative traditions, political style and cultural determinants (Christensen and Laegeid 2005). This means that it is wrong to assume that the increasing adoption of NPM methods brings with it a general global homogenization in methods of policy development and implementation. What we see rather is a common fundamental rationale or logic combined with variety in implementation practices in different countries. Further, with globalization one has to do with the changing character of the nation state signified already by the shift in terminology from the traditional concept of 'government' (and in the Scandinavian tradition, that of the 'welfare state') to the currently more fashionable notion of 'governance' which suggests relatively more decentralized and looser arrangements. Under conditions of globalization, privatization and regionalization, the state has become more diffuse. One might perhaps speak of a 'hybridization' of state powers or a 'hybrid' or non-centrist distributive state replacing a former unitary state. Governance involves interaction with a diversity of stakeholders and trying to harmonize their (often) conflicting interests. It is a process in which the stronger partners tend to be the winners. With this patterns of bottom-up and top-down communication converge and modes of conflict resolution take on new forms.

The full range of aspects involved in NMP will not be discussed in this paper. Some of its elements may be summarized in key words such as: agentification, contractualization, quasi-markets, entrepreneurialism, profiling, strategic behaviour, new incentives to induce competition, to 'produce more with less' (see Table 1). Agentification, also called 'corporatization', converts departments into free standing units with downward delegation of responsibilities for tasks to lower managers while strategic choices are centralized. Decentralization–centralization goes hand-in-hand. In terms of human resources a corresponding feature is a move from a Weberian style civil service career system to a contract system with short-term appointments in the lower ranks of employees as well as the emergence of an array of private–public partnerships. This is meant to increase flexibility but in practice it also introduces lack of continuity and lapses in institutional memory that can ultimately have a negative effect on the delivery of utilities, products and services in the public sector and other 'market' policies. Degrees of goal fulfillment are determined by introducing performance assessment schemes (accountingization).

One obtains what I want to refer to as 'orchestration policy', where 'good governance' tends to be equated with 'sound economic development' and in practice (when applied) is routinely taken to mean investment liberalization, services commercialization, generalized privatization and increased deregulation (compare Shore and Wright 1997).

8. Four aspects of NPM impacting on university life

In what follows the focus is on four features that are singled out because they impact universities in particular:

- Each unit has to cover its own costs.
- The quest for resources occurs in an environment where managers promote incentives for extreme competition even within the university system itself.
- Accountability involves external audits to rank levels of performance and the outcomes of these audits are used in decisions regarding future funding.
- Branding has become an important element in marketing services, be it research or higher education.

Taken together these elements of NPM when applied to science and higher education systems entails a situation some scholars have come to refer to as one of 'academic capitalism' (Slaughter and Leslie 1997; Greenberg 2007). The suggestion is not that most entrepreneurial individuals in research and teaching have become small capitalists. Rather the point is that a capitalist-like behaviour and (contractual) relationships have become rather prominent within the moral economy (norms or ethos) of academe. It is a system in which the academic entrepreneur is boosted as a role model. These features follow from a number of more general policy premises or logic.

One of the main arguments for the shift to business-mindedness in public utilities or services has been to

Table 1. NPM notions

- More for less
- Marketization (including creation of quasi-markets in administrative organizations)
- Commodification of health care services, welfare benefits, teaching packages and research results (also those generated by publicly funded institutions)
- Inducing competition between task performers
- Turning citizens into consumers and clients (this goes for students too)
- Agencification (contractification)
- From administration to management (fostering the entrepreneurial bureaucrat)
- From input to output/outcome control
- Performance-based management (and funding)
- Reputation and image management (PR and branding)
- Entrepreneurialism
- Partnering
- Performativity metrics (accountingization)

introduce greater cost consciousness, flexibility and efficiency, to make do with less in order to produce more (Barzalay 2001). Put differently, the shift from an ideology of government to that of governance in the public domain has necessitated a shift at the level practice from administration to management. Units responsible for delivering products or services are impelled to cover their own costs as far as possible, and to encourage this, quasi-markets are set up in relation to which various units delivering similar kinds of products or services are induced to compete with each other. Another factor is to diminish traditional bureaucratic forms of administration with the intention of opening for greater sensitivity to public needs and by extension the possibility of more 'user' participation in decision- and policy-making processes. In market economic terms the user of services and products supplied by public institutions is framed as customer or client and 'the customer is always right'. What this means in practice is, however, a contentious issue.

Manifestations of NPM differ across policy areas in any given country and between countries. However, a point of commonality lies in a general shift from accountancy of resource inputs to evaluation and assessment of outcomes or outputs. This is a necessary corollary to the fundamental change in doctrine relating to accountability for public sector institutions. One important implication is that ideal, typically former, trust in the wisdom and behaviour of traditional civil servants and professions as non-opportunistic is replaced by mistrust. This follows logically from the premises of a regime in which the supplier of utilities, services and other goods has to carry the mantle of a rational calculator of opportunity costs without concern for the impact that cutbacks and speedups might ultimately have on externalities. By the same token it is therefore logical also to find an increasing demand for control by means of externally initiated evaluations and assessment or auditing procedures as well as the design of internal control systems to harmonize and comply with the new external conditions or demands. Power and Laughlin (1992) have called this 'accountingization' (also see Almqvist 2006: 24). They also argue that a significant consequence for public organizations is the emergence of new types of cultures of compliance. In science policy we see it in the use of bibliometrics, that is publication counts and citations to measure research performance, and the results of such exercises are then related to economic cost–benefit assessments (econometrics).

Accountability and 'accountingization' using numbers takes on this particular form in the research and tertiary educational sector. The new buzzword is 'metrics' (Lane 2010; NIRPA 2010). In this connection the USA is taking a lead role, with the National Science Foundation in Washington DC currently promoting novel research into 'science for science policy' (Lane 2010). Work on quantitative measurement issues has existed for a long time but it was often insufficiently utilized or even ignored by policymakers. Today, however, there is a definite upswing, with renewed efforts to address questions relating to the use of suitable proxies and models to map relationships between inputs of human and material resources and outputs in terms of new knowledge, products, processes, technological developments as well as benefits to society.

The *culture of compliance* is expressed in an acceptance of the practice of *branding and ranking lists* when appropriate to increase the visibility of one's university or department. Making future funding dependent on external audits using metrics recommended by the policy community is another aspect. For parts of the scientific community that find themselves on the winning side it is easy to slide into collusion with the policy community. At least this is how it may appear to those parts of the research community that end up on the losing side.

An important aspect, then, is that researchers and university administrators—whether they like it or not—are drawn into evaluation exercises that target specific performance measures as a tool for reallocating segments of funding in a chain of contracts from government and industry to the vice chancellor's office, the faculty deans, and research and teaching units at the heart of university departments (classrooms, laboratories and seminars)

(Shore and Wright 1999). In publicly funded higher education and research systems, faculty funding and even basic (as well as some sectoral) research council funding in the traditional university system was based on the government's trust in professors as academic civil servants. NPM as already noted is ultimately premised on systemic mistrust of contract workers on tap, whence a ritual auditing of performance is brought in to check (or 'secure') accountability.

In Alvin Weinberg's day the discussion of criteria mostly hinged on qualitive assessments involving peer review. Much of the current discussion about suitable models for resource allocation to research and accountability is framed in terms of quantitative and measurable impact. This may also be seen as part of a broader trend of affording evidence-based decision-making that is already prevalent in several areas such as: medical care, social work, criminology and education. Nowotny (2007) has noted that although the word 'evidence' is seldom used in science policy, the epistemology that encompasses it nevertheless lies behind the attempts to construct metrics for fine-grained evidence regarding performance as a basis for decisions on continued financing in a part of the public sector (for a recent overview see Husbands Fealing et al. 2011). While the use of quantitative measures to evaluate research performance has increased enormously there is a dearth of literature with a reflexive take on the subject, particularly when it comes to relating policy practices and tools back to the broader ideological perspective within which the framing occurs.

9. Critical voices and opposition channeled into nostalgia

One finds that traditional fields in the arts and humanities and some areas of the social sciences, as well as areas of natural science that do not fit the new utilitarian logic, on the losing side. The introduction of university ranking lists has led to protests from scientific communities (Butler 2007) that need to be understood in the context of broader trends. There are also sober warnings that come from scholars in the social studies of science and technology. Some of them have long called for caution and the need for both reflexivity and a better understanding of contextual contingencies in order to avoid simplified modes of governance that may impact negatively on science (Woolgar 1991; Weingart 2005).

Further analysts have homed in on the deeper issue of trust. It is argued that a new moral economy of science follows upon the heels of the shift from trust in civil servants to systemic mistrust associated with the shift in budgetary focus from input accounting to fine-grained calculations of performance in terms of outcomes. Trow (1996) had already made this point in the mid-1990s. For him accountability is an alternative to trust, and efforts to strengthen it usually involve parallel efforts to weaken trust. Moreover, he used to add:

> . . . accountability and cynicism about human behaviour tend to go hand in hand. (Trow 1996)

The German sociologist, Uwe Schimank (2005: 363) recalls how Burton Clark once described the 'traditional' German university as a combination of political regulation by the state and professional self-control by an 'academic oligarchy'. He then goes on to make an interesting point. Analysing the entry of NPM, Schimank finds that a reduction in academic self-governance is one of its goals:

> NPM strengthens hierarchical management by rectors and deans, as well as by state authorities and external stakeholders – including industry – while implying deregulation in budgeting and personel management, and the approval of programmes. This is what government usually means when it promises greater (institutional – *not* professional) autonomy to universities. (Schimank 2005: 365)

It is to open universities up to external stakeholder influence. Deeply mistrustful, policy-makers dismiss as ivory tower intellects those who give vent to nostalgic fear of a loss of professional autonomy. These policy-makers read professional 'autonomy' as 'irresponsibility' and therefore substitute local institutional autonomy to reduce old-style professional autonomy. Schimank argues that we have to be alert when the word autonomy is uttered and ask ourselves what kind of autonomy, for whom and why. Seen in this light the audits that are becoming part of daily life in academe are disempowering academic professionals.

Schimank goes on to say:

> In this game, the academic profession is the loser. External interests, university leaders, and especially the government seem to be the winners. (Schomank 2005)

And again

> . . . to achieve competitiveness, universities deregulate, create new leadership, and accept a greater measure of public intervention. Spelt out in this way, it becomes clear that NPM is not just a bundle of loosely coupled changes, but rather an integrated approach, seeking an overall redirection of the entire system. Its message: replace the old regime, dominated by a state regulated profession, with a new regime, dominated by a market- and state-driven organization. (Schimank 2005)

This is also what Mirowski and Sent (2008) have in mind when they call the post-Cold War regime the globalized privatization regime of science policy. Mirowski's most recent book gives an analysis of neoliberal economics of science as it in his view has developed in the case of the USA (Mirowski 2011). At the end of a largely positive review of the book Krimsky cautions the reader not to jump to the conclusion that the harm market mechanisms brings to the conditions of science and its quality is necessarily as inevitable as Mirowski insists. He writes:

> It's true that the commercialization of universities has created an obsession with intellectual property and has produced impediments to the free flow of information. But indicators of scientific health are not easy to measure. Many universities (though not all) still assess candidates for tenure primarily by looking at whether they have published high-quality scholarship in prestigious journals—not at whether they have attracted commercial dollars. (Krimsky 2011)

A definite overall assessment of the situation, he says, must wait until we achieve a better understanding of the effects that conflicts of interest and commercial partnerships are having on the quality of scientific results.

Going back to our starting point, research policy in its classical sense had to do with setting goals and priorities for R&D and budgetary constraints on unbridled growth (Ziman 1994). The question of allocating resources to R&D activities was, and still is, one of science policy's most classical components. For the most part it is a matter of allocating resources from the public purse at the national level, but it can also concern investments on regional or local municipal levels decided by actors at these levels to stimulate new and emerging technologies (high-tech) with an eye to the region's and the nation's future competitive advantage in a global marketplace. Thus academic values and those of extramural stakeholders become intertwined, but no longer in the way they did during the Cold War when the former also served as the hallmark of the Open Society.

The more entrepreneurship and the measurable utility of science are emphasized, it seems, nostalgia regarding a lost imaginary past on the other hand is also expressed as part of a resistance against the 'new' (Ylijoki 2005). Traditional academic values in a new moral economy of science associated with academic capitalism are contrasted with a historically significant moral economy associated with classical 19th century ideals of the Humboldt university. However, in the absence of a closer analysis of the administrative mechanisms used by today's policy-makers to try and obtain compliance with the new regime, the globalized privatization regime, the discourse of opposition tends to remain very general.

10. Conclusions

The purpose of the present paper has been to throw into relief some of the general features in the development of the history of science policy by drawing attention to the continuation and deepening of old issues in new forms within the current science policy regime. A typology is used to structure the paper's line of presentation. The typology distinguishes different ways in which policy attempts to account for public funding of science by showing how science contributes to wealth and prosperity.

It is argued that within general political frameworks the discourse of legitimising public expenditure and demanding accountability concerning science has specific characteristics of its own (an internal dynamic). These are traced from an initial period of legitimation through a period of professionalization of policy. Even though there is no linear development of successive policy doctrines elements of these first two periods are found to continue in a third period when demands for legitimation and accountability partly change and are further sharpened. Therefore the latter period is characterized as the period of accountability. It coincides with a situation where research policy becomes more strongly subjected to a combination of two external logics in society at large: globalization and NPM.

A long historical perspective has been used to indicate how the science policy discourse in a given period nust also be understood against the background of a broader societal framework of ideology, politics and economics that influences meta-narratives of legitimation. In terms of meta-narratives of legitimation it is suggested that the rhetoric of freedom of science that drew on principles inscribed on the banners of Enlightenment and the French Revolution were held high in the anti-fascist struggle of the 1930s and after the end of World War II continued during the Cold War in opposition to ideas of socialism and centralized steering of scientific agendas.

At the same time, in practice, chief science advisors like Alvin Weinberg and the OECD (sectoral) doctrine of science for policy that ran parallel to the linear model of innovation entailed direct entanglement of science with shifting military strategy, economic, social and political goals.With the collapse of the Soviet Union and the development of a multicentred world Cold War rhetoric of legitimation became outdated. In the new era the scale of investments into infrastructure for science has in the meantime also grown considerably. New forms of internationalism in science appear, shaped in part by privatized globalization. In this framework more stakeholders than before are drawn into policy arenas. The added value of science and higher education at national levels is measured in terms of quicker and more direct contributions than before to economic wealth creation and competitiveness on a global market. Accountability audits are sharpened under the auspices of NPM methods and regular use of 'metrics' to output-focused measure of research 'performativity', among other in terms of publications counts and relative impacts in highly cited journals. A culture of compliance tends to be generated that helps legitimate the new policy practices and sharper accountability demands. Some analysts point out that this is also altering publications strategies in fields like the humanities and social sciences where monographs used to be a customary mode of publication. The rhetoric of the freedom of science on the other hand appears to count for less in the official policy discourse but all the more amongst those who are critical of the new managerial trend or put up passive resistance to the same.

Notes

1. CUDOS: (intellectual) communism, universalism, disinterestedness, and organized skepticism.
2. McCarthyism is the practice of making accusations of disloyalty, subversion and treason without regard for evidence. It originated during the years 1950–1954 when Senator Joseph McCarthy started a political movement to attack professed and suspected communists, not least in the academic community but also in the arts, to silence and remove them from their jobs through a process of aggressive investigations and demagogic attacks on the characters of a large number of persons accused of carrying out or supporting 'un-American activities'.
3. It is interesting to note that Peter Tindemans, the Chair of the European Spallation Source Preparatory Phase Board was Chair of the former OECD Megascience Forum.
4. The ESRF is an international research institution for cutting-edge research with photons to study the complex structure and dynamics of our complex world. It involves 19 countries. As a cooperative research project, it is based on a convention to which are appended four annexes. It was the first of the third-generation hard X-ray sources to operate, coming online for experiments by users with a 6-GeV storage ring and a partial complement of commissioned beamlines in 1994. The Grenoble facility is one of the cases studied by Hallonsten (2009). He also analyses the case of the MAX-lab in that book.
5. ESRO (1956–9) = European Space Research Organization; ELDO (1962) = European Launcher Development organization; ESO (1964) = European Sothern Observatory with its telescopes in Chile. EMBL (1973) = European Molecular Biological Laboratory, ESA (1975) = European Space Agency, JET (1977) = Joint European Torus.

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