Priorities and quality incentives for university research

A brief international survey

Countries studied: Australia, Belgium, Germany, Switzerland, UK

by

Heide Hackmann and Arie Rip
(Centre for Studies of Science, Technology and Society,
University of Twente)

A report for
the Netherlands Ministry of Education, Culture and Sciences,
November 1999

Table of contents

Voorwoord

We kennen in Nederland een lange geschiedenis van stimulering van de kwaliteit van het universitaire wetenschappelijk onderzoek, en van het stellen van politieke en maatschappelijke prioriteiten. Verschillende instrumenten zijn daarvoor in de loop van de tijd ontwikkeld. Sommige instrumenten hebben gedurende een bepaalde periode dienst gedaan, en werden vervolgens verlaten, meestal omdat hun doel (ten dele) was bereikt, terwijl geen verdere belangrijke meerwaarde werd verwacht. Dit deed zich bijvoorbeeld voor bij de voorwaardelijke financiering en de toponderzoekscholen. Andere instrumenten zijn tot dusver lange tijd blijven bestaan. Dit geldt bijvoorbeeld voor de financiering via verschillende geldstromen en het opzetten van nationale stimuleringsprogramma's die thans via NWO verlopen. Ook het stelsel van onderzoekscholen is tot nu toe een stabiel onderdeel van het bestel gebleken.

Bij het denken over de stimulering van het universitaire onderzoek zijn niet alleen de ontwikkelingen in Nederland van belang, maar ook hoe deze problematiek in andere landen wordt benaderd. Hoe liggen de verhoudingen tussen de geldstromen daar, hoe wordt daar kwaliteit gestimuleerd, en op welke manier oefenen de politiek en de maatschappij invloed uit op de prioriteitstelling?

Bij de voorbereiding van het Wetenschapsbudget-2000 en het HOOP-2000 ontstond behoefte aan een antwoord op deze vragen. Om daarin meer inzicht te krijgen heeft het ministerie van OCW in januari 1999 aan prof dr. A. Rip gevraagd een internationaal vergelijkende studie te doen naar de wijze waarop in een aantal vergelijkingslanden wordt omgegaan met prioriteitstelling en kwaliteitsbevordering van universitair onderzoek. Het resultaat is weergegeven in het hierna volgende rapport.

Dr. Ir. F.IJ. Dijkstra, directie wetenschappelijk onderwijs
Dr. J.E. van Dam, directie onderzoekbeleid en wetenschapsbeleid

Overview and analysis[*]

Five countries have been studied in some detail: UK, Germany, Belgium, Switzerland, and Australia. In this summary overview, we will discuss the two main questions, priorities for university research, and incentives for quality and excellence. The discussion is further informed by data on other countries (not studied for this report), and by our general understanding of structures and processes of modern research systems.

National governments, and in particular the Ministry (or Ministries) responsible for scientific research in universities and for the system of academic research, are developing instruments and practices to articulate national/societal priorities and to implement such priorities in the research system. They recognise there are many different actors and interests involved, and that their own role is necessarily limited. In addition, government actors can see a role for themselves where they stimulate receptiveness to societal goals and "relevance", in universities and in the academic research system. In the Netherlands, as in a few other countries, there is also emphasis on "quality", that is, the need to have high-quality or excellent research, and to develop and implement incentives to this end.

Naturally, there are also other dynamics at play: changes in the nature and organisation of knowledge production (as highlighted, for example, in the Mode 2 thesis of Gibbons et al. (1994), and in Rip's (1997) analysis of an emerging regime of Strategic Science), internationalisation in various forms, new actors (representing industry, also non-governmental organisations) which influence research agendas and are (abstract or concrete) sponsors of research. Such dynamics will not be addressed explicitly here, but form the backdrop to the discussion.

1.1. Priority setting, in particular for the academic research system

Overview

Table 1 gives an overview of priorities as formulated at the national level. We distinguish thematic priorities from structural priorities. The latter term is used in Australia, and indicates priorities for structures and processes in the system generally. In technology policy, economists make a similar distinction when they speak of specific and generic policies. We note that when such generic measures are implemented, *de facto* thematic priorities might emerge. The Australian Green Paper, in its emphasis on the autonomy of the universities and the necessity to have structures and processes which allow them to be selective in research actually intends this to happen, and thus creates a division of labour between the government and the academic research system in setting and implementing the two types of priorities.

[*] We are grateful to Barend van der Meulen for his comments and insights at several stages of the project.

Table 2 indicates how the responsibility for thematic priorities at the national level is organised in the countries studied. (For structural priorities, there appears to be no agreed and recurrent pattern.)
With regard to the roles and responsibilities, we distinguish between:

- generation and formulation of priorities: the original "making" or "producing" of priorities, sometimes only in a global form;
- articulation of priorities: their publication or utterance to a wider public. Part of this role is a sense of "ownership". Thus, for example, although the Swiss Federal Council does not formulate national priorities, the policy documents in which the priorities are listed are published as Council documents, and the priorities themselves are referred to as "priorities of the Federal Council". In the UK, on the other hand, OST/DTI published documents refer to "priorities of the national Technology Foresight Programme." Thus, the articulation actor is the Federal Council in the former case, and the Technology Foresight Programme in the latter case.
- authorisation of priorities: this can be a rubber-stamping process, but always involves responsibility for the authoritative selection. Distinguishing this as a separate role becomes important in cases where central government leaves the formulation of priorities to another actor(s), as in Switzerland and the UK.

Table 3 shows another cross-section of roles and responsibilities, now focussing on the role of government and the nature of facilitating structures and processes, as created or utilised by the government. This table indicates that are two extremes: Australia on the one hand, using the direct route, with government directly formulating and articulating priorities (with advisory input of course), and the UK on the other hand, using the indirect route, with government authorising priorities that emerge from consultative processes. In Germany, BMBF study sessions suggest that broader consultation/dialogue is seen to be important, but it is restricted to the scientific community. In Switzerland, formulation and authorisation/ articulation are split, but both lie in the hands of government actors. The difference with Australia/Germany, however, lies in the fact that the Swiss rely not only on advice from selected bodies, but also on broader consultative processes.

Analysis

One striking feature is the importance of structural priorities, and how these divide up in two broad classes: priorities for the structure and functioning of what has been called (in the UK) the science "base", and priorities for linking the science "base" to wider society (in particular, science-industry linkages). In a number of countries (including the Netherlands, according to its *Wetenschapsbudget 2000*), the government argues that it has a direct responsibility for the health of the science "base" and is thus justified in setting structural priorities. By analogy with the 'market failure' argument for government intervention in the economy, one could speak of a 'science failure' argument: scientists and scientific institutions for whatever reasons, are considered not to be able achieve an optimal state by themselves, and the visible hand of the government has to intervene.

For the responsibility of setting thematic priorities, the 'science failure' argument cannot be applied, or at least not in a direct way. Just as concrete investment decisions in the economy might be left to firms, the choice for scientific directions could be a matter of scientists (or better, scientific elite's) in the 'Republic of Science' (Rip 1994). There is no "failure" if all such decisions are equal in value and it is up to agents to choose. But as soon as one entertains the possibility that some choices are better than others (e.g. to support wealth creation, environmental sustainability, or quality of life), the fact that the goods to be created in this way are most often collective goods opens up a role for government. And governments have played that role. Procurement decisions of government ministries and agencies, in areas like the military, public works, and public health, have created priorities in scientific research since the Second World War, and sometimes earlier. The general responsibility of governments for the public interest was a further incentive to link the science "base" to national needs.

Attempts of government to identify and set sensible priorities (or just the call to government to do so) has led to ideological and political debates about the possibility and justification of setting priorities for university research (and academic research more generally). Just as the argument of 'market failure' has been countered by the argument about 'government failure', one can now ask how government can know better, and even if it does, how it can push its views through? Whatever the worth of the arguments proffered in this largely rhetorical battle, two main routes are visible, each with its own kind of justification.

In the first route, the (central) government, because of its responsibility for the public interest, has a right to make policy and set goals, and can indeed be called upon to do so. "The return of political responsibility" is one of the slogans used to characterise this position and the recent interest in it. In the case of Australia, the thematic priorities of biotechnology and information technology were decided within the political system, and the priorities were not linked up concretely with the science base other than that they could be invoked occasionally (the link with technology policy was stronger). In other countries, the situation is less clear-cut, but initiatives from the political system can be recognised. One interesting example is how the US Congress consistently increases the research budget of the National Institutes of Health, over and above the proposal from the Executive.

The second route is indirect: (central) government creates structures and processes which produce thematic priorities, and it responds – rubber-stamping them, or exercising its own discretion to modify and selectively authorise them (thus, borrowing from the first route). Consultation exercises of various kinds have been part of science policy all along, although to a different extent in different political cultures, the Netherlands in particular having a strong tradition of consultation. What one sees recently, however, in the Netherlands and in many other countries, is the application of the 'science failure' argument. While scientists have the competencies to create thematic priorities, they do not do so in a sustained fashion. Therefore, it is the responsibility of governments to create incentives for better priority setting (in the second route).

In particular, the present-day foresight exercises can be seen as a structured and forward-looking version of consultation. If the central government is jealous of its prerogatives, as appears to be the case in Australia, foresight exercises are irrelevant to (or interfere with) route-one priority setting. In the UK, on the other hand, and also in the Netherlands, foresight exercises are a structural priority (and the 'science failure' argument is mentioned explicitly: existing agenda-building processes in the science "base" are deemed insufficient). The effect is a pressure on central government to (more or less) follow the outcomes of such exercises, because these have been justified as enabling optimal outcomes. Switzerland is an interesting intermediate case, because consultation is important (although there are no systematic foresight exercises as yet), but the Federal Council has its own responsibilities.

Thinking on from these observations, we identify an interesting pattern in how a choice for the direct or the indirect route correlates with publicly expressed views on academic autonomy. In both Australia and Germany – where governments take the direct route, and where one could talk about policy as being "imposed" from above - academic autonomy (institutional or individual) is seen as a policy principle. Yet in the UK – where policy might be seen as "emergent" from below, policy documents hardly refer to academic autonomy. In the Swiss case, there seems to be an increasing emphasis on autonomy. Most noteworthy is the fact that the funding under the new National Centres of Competence scheme (which will replace the Swiss Priority Programmes as from 2000) will be allocated along the lines of broadly defined strategic themes rather than specific topics (as is the case with the Priority Programmes). Here the Bundesrat emphasises the importance of not restricting academic autonomy or limiting scientifically interesting initiatives.

The paradox in these observations is that where processes suggest that priorities are imposed (Australia, Germany), autonomy of the academic system is emphasised, while more bottom-up priority setting (UK) goes with more rigorous implementation mechanisms. The paradox may be a matter of governments having to "protest too much": if they want to be successful in imposing their priorities, they must officially recognise the autonomy of the academic actors. But if they have consulted them already, they need not tread so carefully, and can impose on them.

The actual working out of the paradox has much to do with the nature and role (the "ecology") of intermediary actors between the (central) government and the research performers. These same actors also play a key role in the implementation of priorities.

1.2. Implementation of priorities and the role of intermediary actors like funding agencies

Overview and analysis

Whatever the route is followed, the result is a portfolio of priorities at the national level. The actual content of the portfolio is produced in a variety of (mixed or hybrid) ways. Politicians and civil servants are often influenced by what happens elsewhere and what seems to become of general interest. In all industrialised countries ICT, biotech and new materials are on the list of priorities, and it is difficult not to put them high on the agenda (not going with the trend requires additional justification, and if it fails, there is no recourse). Procurement decisions of government ministries (and other actors) may influence the portfolio, and key persons can introduce their "pet" priorities. The latter possibility can sometimes be traced if there are multiple venues of national priority setting, for example through interministerial consultation, through interest representations, and through priority themes in European Union RTD programmes which reflect back on national efforts. Urban problems, or the ageing society, are examples of issues which can be pushed in each of these venues, sometimes by the same actor.

Priority themes are often formulated in a global manner, and function as an umbrella or 'rationale' for operable priorities. Additional efforts are necessary to transform the themes into programmes that can be implemented. Table 4 lists the main activities and the actors involved.

In almost all countries, targeted programmes are used as the channel from overall priorities to eventual implementation. Funding agencies can be (or be made) responsible for targeted programmes, but other actors may be involved, for example sectoral intermediary agencies (in sectors like health or energy). We note in passing that the justification for involving such agencies often includes the analogon of market failure arguments: now 'public health' failure, or 'energy provision' failure – not as such, but in terms of inadequate attention to relevant RTD.

For the university sector, steering or modulating the funding streams is a possibility. In Belgium, this does not work through national priorities (which are not formulated), but there are clear pressures towards industry and policy oriented research (federally and for the Flemish community). In Germany, on the other hand, national priorities are articulated, but not attached to funding mechanisms for the universities. Australia relies on bottom-up processes in a framework of structural priorities, including linkages of academic research to society. In Switzerland and the UK, the funding agencies play a key role, with SNF's Priority Programmes corresponding to national priorities, and the UK research councils orienting themselves to national foresight priorities (as well as their own consultation exercises).

The question how national objectives are implemented in the academic part of the research system is a complex one. The common, almost unavoidable problem definition is one of a principal (the government, in particular the Ministry or Ministries responsible for the university sector) facing a university research system with its own dynamics. This quickly leads to ideological debates about autonomy and quality of academic research, and accusations of institutional inertia of the universities (cf. earlier on science failure). Whatever the position taken in these debates, it is clear that it will not be easy to implement objectives of the principal. There are other objectives for academic research than responding to national objectives, and the traditions holding sway in academic institutions have to be taken into account.

A useful way to cut across the debates, and an important issue in its own right (even if it is not very visible in policy documents), is at which level to address the universities: institutionally, through their Boards, or professionally, through their research performers The latter occurs, for example, when research stimulation programmes invite professional academics to participate. Our impression is that the institutional route is important for the implementation of structural priorities (for example, university-industry linkage), but not for thematic priorities.

In practice, however, as a number of evaluation studies have shown, Boards of universities and their staff think it important that their university is well represented in a number of thematic priority programmes, and stimulate their professional academics to participate. In the 1990s, this is particularly visible for European Union RTD programmes.

In the UK, the funding agencies ('research councils') are the main channel to move priority themes into academe, and this works through professional researchers rather than institutions. Given their importance, we provide an overview of their implementation activities in Table 5.

The German system is based on academic autonomy. The foresight exercise is limited to informing whoever is interested, and priorities are dealt with through special, dedicated programmes. The main funding agency, the Deutsche Forschungsgemeinschaft, actually tries to keep some distance from political priorities. (In response to an evaluation study of the German research system, by an international panel, which suggested that DFG should actively steer researchers in "relevant" directions, the DFG director remarked: "The DFG cannot, must not, and should not compete with the federal and state governments, which are extensively involved in research funding that is guided by general political criteria." [quoted after a news report in *Science*, 4 June 1999, p. 1597].)

In Australia, where no thematic priorities are set for the academic research system, structural measures as the Centres program stimulate relevant research.

The Netherlands appears as a mixed case, with *de facto* priority setting through a number of activities (special programmes, sectoral advisory councils, and foresight exercises). France is another mixed case, combining autonomous research organisations with strong departmental guidance and national programmes, and now introducing contracts between government and research performing organisations.

1.3. Priorities and the intermediary and research performance levels

Analysis

In the way we have approached the issues of priority setting and implementation, starting from national level priority setting, there is a top-down bias. There may be other dynamics, bottom-up or "horizontal", i.e. not necessarily oriented toward a (government) principal. For the top-down or "vertical" process, it is clear from our survey that there is a division of responsibilities: governments are, and remain, responsible for broad themes, at least to provide authoritative selection, while funding agencies, other intermediary actors, and research performers (organisations and professionals) focus on implementation, while specifying and modifying the priority themes at the same time.

Intermediary actors are important everywhere, listening to signals from above and from below, and trying to create directions for themselves on that basis. This is particularly visible with the government funding agencies for basic and strategic research. In most countries, they graft relevance considerations on a tradition of nurturing excellence. Input from spokespersons for industry, or more generally, the private sector, is considered necessary everywhere, but takes various forms. The net effect is a "horizontal" dynamic of priorities, in the sense that government inputs are but one of a range of inputs.

A further "horizontal" dynamic is visible at the research performance level, where researchers have their own linkages to relevant scientific communities and domains of application. They can move and take up new priorities without any pressure from above; in the case of high-temperature superconductivity, this was important (see Nowotny and Felt (1997) who also analyse science policy responses). The other side of the same coin, however, is that they can also move away from priority areas after the incentives to work on it (in particular, special funding) have gone. This explains the well-known problem of *verankering*, of getting a priority "anchored" in the life of the research system, so that it will be kept after the end of the stimulation programme.

"Horizontal" dynamics introduce new ideas and flexibility, and are valuable because they build directly on relevant expertise. Various consultation exercises referred to above exploit such expertise. But they also create a barrier against direct implementation of national-level priorities. To put this more precisely: Uptake of priorities (of various kinds) in the academic research system is refracted by the interests of professionals and institutions. Funding agencies and other intermediary actors play an additional role: they can (and do) buffer research performing institutions and researchers against the whims of political decision makers – even while the decision makers themselves might call it a case of institutional inertia.

These considerations are important to understand what actually happens. As is clear from our survey, we cannot capture "what actually happens" with documentary data sources only. The detailed sociological study of the various national research systems which would be necessary is not available in the literature. There are comparative studies of some specific sectors like funding agencies in the health sector (Braun 1994), and aspects, like foresight studies (Rip & Van der Meulen 1996a, Martin and Johnston 1998). These could be complemented with data from experienced practitioners and observers to obtain a rounded picture for what happens at the shop floor.

For this analysis, we limit ourselves to a brief comment on the modalities of funding (as funding agencies would call them) or the instruments for priority implementation (as national government actors would call them).

- principal investigator initiated proposals
- special or dedicated or innovative programmes
- research centres
- infrastructure funding

Funding agencies can use all four, and it depends on their history and present situation how much importance they attach to principal-investigator initiated proposals which are deemed important for the vitality of academic research.

The programme modality occurs almost everywhere (not in Australia), and is taken up, as we noted already, by other science policy actors. The research-centre modality is common in UK, Australia and the USA, and in a modified version in France (e.g. CNRS centres). In Germany, the existence of the Max-Planck-Institutes on the one hand, and the tradition of equating professorial chairs with little research institutes was a disincentive for introducing flexible and innovative centre schemes – the main science policy innovation of the 1980s.

Infrastructure funding was common in the "Golden Age" of science of the (late) 1950s and 1960s, but fell into disrepute – it seemed a free gift of taxpayer's money. Infrastructural funding remains a category with which funding agencies work (cf. Australian Research Council, and the Big Science Facilities research council in the UK), but may well require outside assistance to meet the actual needs (an intriguing example is the initiative of the Welcome Foundation in the UK to set up an infrastructure fund together with the Department of Trade and Industry).

1.4. Quality and excellence

Analysis

In countries like Germany, quality and excellence are traditionally considered to be the responsibility of the scientists, and central government's role is to support them in this task (and does so, for example through the Max-Planck-Institutes). In Australia, similar schemes operate (the Institute of Advanced Studies), but there is additional concern about co-ordination and concentration (which led to the Special Research Centres scheme), and after the unification of higher education, a concern about 'research culture', i.e. the quality of research in the new universities. Interestingly, the same move towards unification in the UK did not lead to a similar system-wide concern, but to increased competition (partly induced by the Research Assessment exercise). In other words, while quality and excellence are considered important, they need not be a policy objective in their own right.

The Netherlands appears to be unique in having explicit policies which attempt to link selectivity at the system level with stimulating excellence (in Research Schools and Top Institutes). While excellence appears to be there (whether because of the policies or for other reasons cannot be decided unambiguously), it turns out to be difficult to achieve selectivity in the same movement (see further 1.6).

Table 6 lists the <u>means</u> to safeguard quality and to stimulate excellence. These are different things, but sometimes taken together. Both the goals and the means are more complex than the anecdotal use of simple indicators and reputational status suggest. Thus, it will be difficult to find out the value of different schemes. Available studies monitor the situation (e.g. concentration, performance and its distribution) rather than inquire into the effectivity of the schemes. The Johnston et al. (1993) report still provides an overview of the state of our understanding in the latter respect.

The interest in quality is a pervasive feature of the science system, but appears to be taken up as a policy issue only when there is cause for concern. The ‘research culture’ discussion in Australia, mentioned above, is an example, and can be generalised to all situations where newcomers or peripherals are compared with an established centre. The other main occasion for discussion of quality is the concern about “sound science”, for example in relation to input in regulations, and when fraud occurs. Politicians and science policy makers in the USA will address these issues, while for their European counterparts the issues seem to fall outside the scope of regular science policy.

Excellence, in contrast, is often linked to science policy: when a country (at least a scientifically big country) is falling back in scoring in the league table of Nobel Prize winners, this is an occasion to ask what has gone wrong and how the problems can be redressed. Historically, such arguments were used by spokespersons for science to mobilise support for their causes, and this continues until today. Actual policies might refer to these arguments, but tended to seek their justification in other ways (health of the science base, priorities). In that sense, it is surprising to find Australia emphasising excellence (as such) as one of the pillars of its new science policy. How this will work out in practice has to be seen.

1.5. Trends and developments

Identifying trends and developments is easier in retrospect than in real time. Subjective elements cannot be avoided, but such attempts to specify what might become salient are useful to start discussion and further articulation of thinking. This is how the present section is intended.

One striking trend is the return of excellence as a goal or criterion in science policy. The instrumental arguments put forward (to achieve what you want, you must be able to do high-quality work) are not satisfactory. International competition is a more convincing argument, but rests on choices in which arenas a country wants to compete (thus, the question of selection is introduced again). What we want to highlight here is that the goal of excellence as such can now drive the system – the UK University Research Assessment Exercise is a prime example, up to the need to introduce ever higher scores (5* on top of 5). While relevance (to actual or future priorities) remains important, this is now disconnected from the quest for excellence.

The other main trend is the interest in new modes of governance: vertically, in the relations between levels in the system (delegation, decentralisation), and horizontally, how to involve other actors, how to interact productively (give & take). This is a general trend, not limited to science policy, but clearly visible there as well.

There is a trend for States (in a federal system) and regions to become more important in priority setting. Belgium has gone far in dividing up its science and science policy system, but the Flemish case study shows no new organisational features. (It does show a strong emphasis on innovation and high tech (micro-electronics, biotech), present before the federal restructuring but then coming into its own.) In this respect, it will be interesting to follow how Scotland, with its newly gained autonomy, will take up science and technology priority setting.

In this respect, the role of the European Union is particularly important. It has been more important in modulating the organisation and direction of research than its limited budget (around 2% of the total European expenditure on R&D) would suggest. And it will become more important, for two reasons. One, it introduces another level in the system which actors can invoke for their own purposes (cf. 1.2), but in doing so, they will reinforce the importance of the European level. Two, because the thrust of the 4th and the 5th Framework Programmes is in the same direction as overall changes in knowledge production, as highlighted by Gibbons et al. (1994).

Horizontally, there is the increasing role of industry (in general, the private sector): as spokesperson in priority setting and in evaluations; as participant in boards and in programme committees, as partner in collaborative research.

The new trend of consortium funding (initiated from various positions, including sometimes entrepreneurial researchers themselves) implies that priority setting and priority implementation become components of one and the same movement, instead of separate activities with delegation from the former to the latter. When such consortia live longer, and become an accepted fixture of the research system, they will function as (hybrid) intermediary actors. Funding agencies increasingly participate in consortia, with an attendant broadening of processes of priority setting.

While the role of industry has been important in some sectors (e.g. chemistry) for a long time, a new trend in all sectors is the role of new actors like ngos (non-governmental organisations) and stakeholders like patient organisations in medical research. While this is a "horizontal" process, there is a "vertical" element as well when national (or regional, or supra-national) governments decide to recognise the importance of these inputs, and thus create legitimity and become to some extent their sponsor. Government science policy makers recognise this trend, but have not yet come to terms with it.

1.6. The Netherlands

The Netherlands can be positioned along the dimensions (or range of features) visible in the five country studies, and we have offered some suggestions already. What is important is to avoid the impression that there are simple scales or rankings, and one can see whether Netherlands is ahead or lagging. All these features hang together, and should be seen in relation to each other. Each country has its own way of locating itself in these dynamics.

All countries have their structures and cultures, which enable and constrain the possibilities for the policy actor (and other actors, for that matter). This institutionalised "landscape" can be characterised as such and compared (Rip & Van der Meulen 1996b). For the Netherlands, specific issues can be diagnosed because of strong "mediation" (Van der Meulen & Rip 1998). They show advantages (what comes out of the mediations stands a good chance to work), and disadvantages (conservatism with respect to changes initiated by the policy actor). Dutch science policy has attempted changes for the better, with structural as well as thematic policies and priorities. Policies that built on the culture and structure had an easier time than those which went against it (compare the success of the (very Dutch) sector advisory council and the difficulties of shifting funds from the university block grant to the funding agency).

Any positioning of a country and its policies must take this dual situation into account. In other words, an approach, which works in the UK or Australia, need not work in the Netherlands, and vice versa.

In addition, one can ask about the overall policy philosophy: is it assertive and attempting change of the structure & culture? (UK) Or accommodating and facilitating what is there? (Germany) The Netherlands science policy philosophy continues to be one where the policy makers envision changes (for the good of science and for the good of the country, cf. above, 'science failure' argument), but work for it through a combination of facilitation and structural policies. This is again visible in the *Wetenschapsbudget 2000*, in particular in the way in which the fact that things go reasonably well is positioned as "still OK, but risks, so we should do something" (p. 15: "*Nog kan het onderzoeksbestel goed functioneren, maar er zijn belangrijke risico's*")

Ambivalence about priorities: quite strong ideas within OCW about what should be done, but not in a position to press them. So emphasis on the roundabout way (consultation, foresight etc), in the hope that "desired" priorities will come up. If not, the responsibility is with the Minister to specify the better priorities.

Excellence: cf. earlier: various attempts, which do increase overall strength (and so excellence with respect to other countries – cf. *Wetenschapsbudget 2000*, which opens with a state-of-the nation which reads as 'lean and mean'), but which do not achieve the selectivity envisaged. One could ask whether skewness of distribution is a good in itself (yes, in the USA situation where there is lots of mobility; no, in continental Europe). It is a way of preparing for cuts (close down the weaker parts), cf. UK Research Assessment Exercise.

Table 1.: The nature of explicit S&T policy priorities

Country	Thematic Priorities	Structural Priorities
Australia	Biotechnology (and uptake in medical science) Information technology	Excellence Linkages
Belgium	No explicit priorities	At the Flemish governmental level: Linkages with users (particularly industry)
Germany	High technologies as drivers of innovation, with an emphasis on bio-technology and information technology Providing for the future, with an emphasis on health research and the environment	Excellence Networking amongst higher education and other research institutions Academic-industry linkages International profile and attractivity of teaching/research Promoting women and young scientists
Switzerland	Biology and micro-biology Medicine Sustainable development and the environment Information and communication technology	International competitiveness of research Science-industry-society linkages Research capacity and the promotion of equal opportunities for men and women Networking amongst higher education institutions Excellence
United Kingdom	Foresight priorities, emphasising: Information and communication technology Biotechnology Sensor and automation technology Business processing and management Environmental sciences and technologies Markets, risk perception and the human impact of new technologies Ageing, health and lifestyle	Science-industry-government linkages

Table 2.: The formulation, articulation and authorisation of national thematic priorities: Main policy actors and their roles

Country	**Actor(s)**	**Role(s)**
Australia	Department for Industry, Science and Resources; and Department of Education, Training and Youth Affairs	Formulation and articulation of priorities
	Commonwealth Scientific and Industrial Research Organisation	Advisory input
	Australian Research Council	Advisory input
	Other spokespersons	Advisory input
Belgium	Not relevant	Not relevant
Germany	Federal Ministry of Education, Science, Research and Technology	Formulation and articulation of priorities
	German Science Council	Advisory input; and Co-ordination between Bund and Länder
	Federal-State Commission for Educational Planning and Research Promotion	Advisory input; and Co-ordination between Bund and Länder
	Council for Research, Technology and Innovation	Advisory input
	Senate of the Deutsche Forschungsgemeinschaft	Advisory input
Switzerland	Federal Council	Modification, authorisation and articulation of priorities
	Swiss Science Council	Advisory input
	Federal Office for Education and Science (of the Swiss Science Agency)	Formulation of priorities based on Consultation (with cantonal authorities and representatives from the academic, industrial and voluntary sectors)
United Kingdom	Office of Science and Technology (of the Department of Trade and Industry)	Authorisation of priorities
	Technology Foresight Programme	Formulation and articulation of priorities based on Consultation (with government, industrial, academic and voluntary sectors)

Table 3.: National thematic priorities: The role of government and facilitating structures/processes

Country	The role of government	Facilitating structures/processes
Australia	Direct, with advisory input	None
Belgium	Not relevant	Not relevant
Germany	Direct, with advisory input, and limited consultation	Study sessions organised by the Federal Ministry of Education, Science, Research and Technology serve to facilitate dialogue with, and input from, members of the scientific community
Switzerland	Direct, with advisory input and based on ad hoc, broader consultation	The Federal Office for Education and Science assumes responsibility for consulting not only with canton authorities, but also with representatives of the academic, industrial and voluntary sectors
United Kingdom	Indirect, with reliance on institutionalised, widespread consultation	The 15 sector panels that comprise the national Technology Foresight Programme undertake widespread consultation with representatives from the government, industrial, academic and voluntary sectors, by means of workshops, expert surveys, Delphi surveys, and electronic participation opportunities.

Table 4.: The implementation of national thematic priorities: Main actors and their activities

Country	**Actors**	**Main activities**
Australia	Central government	Has increased the budget of the National Health and Medical Research Council
Belgium	Not relevant	Not relevant
Germany	Federal Ministry of Education, Science, Research and Technology	Priorities are primarily implemented via contract-based project funding, which targets institutes of the Fraunhofer Society and the Großforschungseinrichtungen, but also involves universities Priorities are also attached to the funding of "Leitprojekte" managed by the Ministry.
Switzerland	Federal Council in conjunction with the Federal Office for Education and Science	Priorities are attached to National Research Programmes which the Swiss National Science Foundation manages on behalf of the Federal Council. Priorities are attached to the Swiss Priority Programmes which are managed, on behalf of the Federal Council, by the Swiss National Science Foundation as well as the Board of the Federal Institutes of Technology Domain (within the Science Agency)
	The Swiss National Science Foundation	Manages National Research Programmes and Swiss Priority Programmes on behalf of the Federal Council
	Board of the Federal Institutes of Technology Domain (of the Science Agency)	Manages Swiss Priority Programmes on behalf of the Federal Council
United Kingdom	The Office of Science and Technology (of the Department of Trade and Industry)	Has discretion in terms of deciding on the allocation of the science budget to Research Councils Has charged Research Councils with the task of implementing foresight priorities and recommendations Has set up the Foresight LINK Awards Scheme as a way of stimulating competition for innovative research in high priority foresight areas
	The Higher Education Funding Councils	Expects universities to take account of foresight priorities when internally allocating their research funds obtained from the Councils. Future plans for monitoring such allocation have been raised and are currently being debated
	The Research Councils	In most cases foresight priorities (redefined by the Research Councils themselves) are attached to directed modes of funding. In two cases (the EPSRC and PPARC) the Councils are only involved in responsive modes of funding to which no thematic priorities are attached (See Table 5 for more specific details)

Table 5.: Modes of university research funding employed by UK Research Councils

Research Council	Mode of funding	Priorities (and other special conditions) attached to allocation
Biotechnology and Biological Sciences (BBSRC)	Responsive funding via project grants	None
	Directed funding via thematic programmes	Research has to fall within one of the following priorities: ⇨Bioinformatics ⇨Biology of spongiform encephalopathies ⇨Innovative manufacture initiatives ⇨Technologies for functional genomics
Engineering and Physical Sciences (EPSRC)	Responsive funding via 8 disci-plinary-based programmes	No priorities, but research proposals have to identify research beneficiaries, and must describe the impacts of the applicant's earlier work on both the industrial and academic communities.
Economic and Social (ESRC)	Responsive funding via grants	None
	Directed funding via: ⇨Thematic programmes ⇨University research centres	Programmes and centres are linked to the following thematic themes: ⇨Economic performance and development ⇨Environment and sustainability ⇨Globalisation, regions and emerging markets ⇨Governance and regulation ⇨Technology and people ⇨Innovation ⇨Knowledge, communication and learning ⇨Lifespan, lifestyles and health ⇨ Social inclusion and exclusion
Medical (MRC)	Responsive funding via grants	None
	Directed funding via strategic project grants	These stand-alone grants are thematically defined by the RC in order to meet either the needs of government, or fulfil the priorities of the RC itself
Natural Environment (NERC)	Responsive funding via grants	None
	Directed funding	The RC determines Key areas of research.
Particle Physics and AstronomyPPARC	Responsive funding via grants	In assessing research proposals, the additional potential of a project to contribute to foresight priorities is con-sidered.

Table 6.: Means of safeguarding the quality, and stimulating the excellence of university research: Main actors and their activities

Country	**Main actor**	**Main activities**
Australia		
Belgium	Information to follow	Information to follow
Germany	Federal Government, and particularly the Federal Ministry of Education, Science, Research and Technology	Amendment (in 1998) of the Framework Act for Higher Education aimed at: Enhancing universities' autonomy to make budgetary decisions, develop research and teaching priorities, and determine the structure of study courses Introducing regular evaluations of university teaching and research activities. Research evaluation exercises are to be undertaken by the governments of the Länder Promoting young scientists via the creation of special funding programmes for doctoral and post-doctoral scientists, and the provision of resources for the early appointments to chairs
Switzerland	Federal Council	Recent policy proposals recommend the following two important changes to the Hochschulförderungsgesetz, to be implemented from the year 2000: The creation of a network of higher education institutions, to be developed and managed by the Swiss University Conference, which will build on existing strengths and foster excellence in areas deemed to be strategic for the future. A portion of the investment funds currently allocated to universities by the federal government will be redistributed to the University Conferences to enable it to fund collaborative projects aimed at promoting innovation and co-operation between universities The shift towards performance-oriented allocation of basic subventions for research.
United Kingdom	The Higher Education Funding Councils	The outcomes of regular research assessment exercises, which are designed to assess the quality of university research by peer review, determine the allocation of research resources amongst universities

References

Braun, Dietmar (1994). *Health Research and Its Funding. Country Reports. Volume I. Federal Republic of Germany & United States. Volume II. France & England*. Bundesministerium für Forschung und Technologie, Bonn. Report of a study conducted at the Max-Planck-Institut für Gesellschaftsforschung, Köln.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M., (1994) *The New Production of Knowledge. The dynamics of science and research in contemporary societies*, Sage, London.

Johnston, Ron, John Currie, Lyn Grigg, Ben Martin, Diana Hicks, E. Nigel Ling and Jim Skea (1993), *The Effects of Resource Concentration on Research Performance*. Australian Government Publishing Service, Canberra. Australian Research Council Commissioned Report No. 25.

Martin, Ben R. and Ron Johnston (1998), Foresight Activities in the UK and Australia, *Futures*.

Nowotny, Helga, and Ulrike Felt (1997), *After the Breakthrough. The emergence of high-temperature superconductivity as a research field*, Cambridge University Press, Cambridge.

Rip, A. (1994) The Republic of Science in the 1990s, *Higher Education*, 28:3-23.

Rip, A. (1997) A Cognitive Approach to Relevance of Science, *Social Science Information*, 36(4): 615-640.

Arie Rip, Barend van der Meulen (1996a), *Strategie-ontwikkeling en verkenningen. Vergelijkende analyse van ervaringen en praktijken in Nederland, Frankrijk, Engeland en Duitsland* (Universiteit Twente, februari 1996). 78 pp. Achtergrondstudie ten behoeve van de Overlegcommissie Verkenningen (OCV).

Arie Rip, Barend J.R. van der Meulen (1996b), 'The Post-Modern Research System', *Science & Public Policy* 23 (5) (Dec. 1996) 343-352. Also published in Rémi Barré, Michael Gibbons, Sir John Maddox, Ben Martin and Pierre Papon (eds.), *Science in Tomorrow's Europe* (Paris: Economica International, 1997), pp. 51-67.

Van der Meulen, Barend, and Rip, A. (1998) Mediation in the Dutch science system, *Research Policy*, 27(8): 757-769.

AUSTRALIA by Arie Rip

Introduction

Australia is an interesting country to consider in relation to the Netherlands because of the similarities (in the science base) and the contrasts (in the overall policy approach). Recently (June 1999), a Green Paper was published on policies and structures for university research and competitive research funding which outlined changes and the arguments for them (Kemp 1999; we shall refer to it as Green Paper).

The similarities include:
- a large university sector (more than half of Australia's "total research workforce" as the Green Paper (p. 7) has it, and receiving up to 40% of government expenditure on R&D);
- a research council budget which was relatively small (up to 20% of direct (block) university research funding) but has now climbed to 30%;
- an interest in stimulating scientific excellence, partly because of the shift to a "Unified System" in which many institutes of higher education with little or no 'research culture' were expected to start performing academic research. The Green Paper emphasises "a commitment to excellence" (p. 17), and translates this into concrete policies emphasising competition and selectivity.

(Appendix 1 provides some data on funding.)

Within the science base, the most interesting difference consists in the successful schemes for special research centres and key centres for training and research (administered by the Australian Research Council) and for co-operative research centres (administered by the Department of Industry, Science and Resources).

The different policy approach (compared with the Netherlands) has to do with political structure and culture in Australia, but has now been articulated into a policy where substantial decisions are taken at the level of institutions, but the Government provides a structure of incentives (Green Paper, p. 20).

Historically, the top-level organisation of science policy making is somewhat haphazard, responsibilities being part of larger Ministries (at present, primarily the Department of Industry, Science, and Tourism (DIST), recently renamed Department for Industry, Science and Resources (DISR), and the Department of Education, Training, and Youth Affairs (DETYA)), and policies and their implementation depending on political constellations and individual interests. In the box (next page), we give the example of the fate of the science & technology foresight exercise.

The autonomy of institutions was a fact of life (as was their dependence on the favours of Ministers and agencies), but has now been formulated as one of the principles of the policy for university research set out in the Green Paper. According to the Foreword, the two pillars of the new policy are the drive for excellence and innovation in the overall system, and the enhanced strategic and priority setting role for institutions. Centrepiece of the drive for excellence and innovation is an invigorated national competitive grants system, with a restructured Australian Research Council as the key actor. This also means a victory for the Australian Research Council in its struggle to become independent of the National Board of Employment, Education and Training (under DETYA); the Green Paper (p. 43) in fact indicates that the Board will be abolished.

The Foresight Study was carried out by the then Australian Science, Technology and Engineering Council (ASTEC), the official advisory body to the commonwealth government. (ASTEC has been wound up in 1998, its functions have been taken over by the Prime Minister's Science, Engineering and Innovation Council, and in particular, its Standing Committee (i.e. its non-ministerial members)).

> "The terms of reference negotiated with major government departments specifically excluded the formulation of priorities, responsibility for which remained within departments in keeping with Australia's decentralised and pluralist S&T system." (Martin & Johnston 1999; 43) Subsequently, when the exercise had been concluded successfully, its impact was limited: "ASTEC was only able to provide advice to a junior, if enthusiastic, minister." (*ibidem*; 49)

For an accessible overview of the Australian research system and portraits of some institutes, see Van der Meulen and Rip (1994; Country Report Australia). The Department of Industry, Science and Tourism [or Resources]'s website is a useful source of information (www.dist.gov.au/science, or under the earlier name www.disr.gov.au/science).

A. Research Priorities

1. National research priorities

Recent Government initiatives in biotechnology and health and medical research reflect priorities identified at the national level, and have implications for university research, for example through the expansion of the budget of the National Health and Medical Research Council. A further priority reflected in increased government funding is the SPIRT Programme (Strategic Partnerships with Industry – Research and Training). In the 1999-2000 Budget, an injection of A$ 614 million over six years for the National Health and Medical Research Council is announced (this will then double existing research funding by 2004) and an additional A$ 58 million over three years for the SPIRT Scheme.

The Green Paper positions such priorities as Government decisions, for example when it says (p. 7):

> The Government has recognised that biotechnology is one of the most important revolutions of the modern age, and is developing an integrated strategy for development and advances in this field; the additional funding for the National Health and Medical Research Council reflects this priority.

How such priorities are arrived at is not always clear, and their translation to university research is indirect. The autonomy of the universities in this respect is reaffirmed in the Green Paper.

Historically, there have been recurring concerns about priorities for science and technology, but these materialised primarily in the creation of institutes and councils for specific purposes, not in a national system of priority setting which would be applicable to the whole of the science base including the universities. Johnston (a key member of ASTEC, and often invited to give advice more generally) sees a combination of factors at work here, where the scientific community successfully defended the cornucopian value of undirected basic research (cf. also below, Institute of Advanced Studies), the government was averse to intervention, and industry was not interested in priority setting and/or putting pressure on the system. "All this resulted in a reliance largely on structural priority setting [that is, generic and structural measures (A.R.)] to shape the science and technology system -- for example, the Co-operative Research Centre scheme, which requires collaboration between universities, government research agencies, and industrial firms but which does not identify specific priority areas." (Martin and Johnston 1999: 40)

This diagnosis still holds, and the Green Paper in a sense builds on it. Its argument is based on two main considerations:
- “In an intensely competitive environment, research which is not of the highest quality is an opportunity lost.” (p. 17)
- “Research in our universities is too often disconnected from the national innovation system.” (p. 9)

These two considerations are reflected in the two main elements of the expanded and unified competitive grant scheme: The “Discovery” element and the “Linkage” element.
The policy principle of autonomy and responsiveness for the institutions implies that concrete choices will be made (and must be made in strategic plans) by the institutions themselves, and in a flexible manner. Diversity and mobility are keywords. “Institutions will be able to quickly pull together teams from a variety of settings to address new issues and opportunities. They will take advantage of specialist knowledge regardless of whether it exists within the institution or in a commercial setting. Their internal structure and employment arrangements will support this sort of flexibility.” (Green Paper, p. 14)
The autonomy of institutions and their discretion in spending their block grant is important, but has to be combined with a demonstration “that these resources are spent to best advantage – not only through financial accountability but also, even more significantly, in terms of the quality of the development and production of knowledge through this investment.” (Green Paper, p. 18)

In such a set-up (historically grown and now argued for as policy), the Government can identify priorities and act on them if they are structural priorities, but will be reluctant to emphasise substantial priorities. The Green Paper first tries to make a distinction between industrially relevant priorities and curiosity-driven research (which can be read as an indication that it must show its readiness to act and at the same time not interfere with the universities):

> "The Government, through such bodies as the Prime Minister's Science, Engineering and Innovation Council, has a broad role in identifying and advising on research priorities at the national level. It has been quick to act as it identifies those national priorities, as has been the case with emerging industries such as biotechnology and information technology. However, the bulk of curiosity-driven higher education research supported by Government through competitive funding is identified through the peer review process. [And this must remain so.]" (p. 19)

Subsequently, it argues that the Government can set broad priorities, based on input from its advisory councils, but will in fact limit itself to identifying them. There are no mechanisms for implementation:

> "While the Government does not conduct research directly through the education portfolio, it reserves the right to mark out some broad strategic priorities for the national expenditure of public funds in order to ensure that national priorities are properly met. For this purpose it relies on Prime Minister's Science, Engineering and Innovation Council, the Australian Research Council and National Health and Medical Research Council and similar institutions to ensure that community needs are properly identified and brought to the Government's attention. Biotechnology, for example, is one area in which the Government would wish to see greater focus at present, reflecting its potential significance to Australia. However, beyond identifying such strategic priorities, the Government does not see as its own role to direct in any detailed way the areas for research or the terms on which research should be conducted. As explained above, these roles are properly and best performed by others." (p. 20)

When the Green Paper specifies priorities, these are structural priorities. In particular, it says (for the system of "contestable research", e.g. various schemes of competitive funding):

> "Key priorities are a stronger emphasis on long-term, strategic research; greater incentives for cross-institutional, multi-disciplinary and collaborative research in all its forms; and a stronger voice for users in decisions on the allocation of limited funds." (p. 19)

While the Green Paper is important for the directions it indicates, it is a policy document (and for discussion at the moment). To indicate what is happening, we shall outline attempts at priority setting in the national research system, and then discuss special schemes and institutions.

Priority setting and (lack of) implementation at the national level

Throughout its existence as the top level advisory council, ASTEC has examined possible priorities and general priority setting a number of times, but its advice was only taken up occasionally, and then only to set up a specific initiative.
The Foresight Study (1994-1996) was successful in its own terms, in particular as a consultation and anticipation exercise, but did not lead to a priority setting scheme. This was explicitly excluded from the terms of reference (cf. quote in box), and the results were termed 'strategies' for the science and technology system rather than 'priorities.'
Four "Key Forces for Change" which will influence Australia's future in the coming fifteen years were identified:

- global integration
- applying information and communication technologies
- environmental sustainability
- advances in biological technologies.

Opportunities for Australia were identified, and strengths and weaknesses were checked through international comparisons. As Martin and Johnston (1999; 45) resignedly comment after describing these further steps: "The priorities for action identified by ASTEC have largely been implemented or examined in a low-key manner within relevant government departments." In other words, they got lost in departmental and bureaucratic politics.
More recently, the Minister for Science and Technology (at DIST) commissioned the then Chief Scientist Stocker (formerly head of CSIRO, the large public research organisation with a mostly applied mission) to look into gaps and overlaps in publicly funded scientific and technological research. In his 1997 Report, *Priority Matters*, the Chief Scientist also advocated a comprehensive approach to priority setting, and suggested that ASTEC (repositioned as a Standing Committee of the Prime Minister's Science and Engineering Council) should develop "the priority identification framework" further.
In the Government's response to the Report, the recommendations were accepted and pushed one step further in the direction of a separate treatment of structural and thematic priorities. A re-organised Prime Minister's Science, Engineering and Innovation Council (PMSEIC) will be the key actor. It has seven Ministerial members, including the Prime Minister as Chair, ten ex-officio members (heads of scientific organisations) and at least two members appointed in a personal capacity. The non-ministerial members meet more regularly and provide, through special working parties, analysis and advisory reports for discussion in the twice-a-year meetings of the complete PMSEIC.
Some quotes from the Government's Response indicate the thinking:

> Professor Stocker takes the overall view that our current, pluralistic approach to science and technology funding and performance is appropriate to a science and technology system aimed at meeting diverse national needs, but that the Government as a whole needs to consider regularly matters such as the health of the system, attracting the best people to it, and identifying threats and opportunities which require a concerted, national science and technology effort.
> (...) There is, in Professor Stocker's view, no need for any major reorganisation of science and technology funders or performers; the important thing is to ensure that they plan and conduct their work in concert (..).
> (...)

> The new Council will examine the contribution of science and technology to broad (and generally non-prescriptive) national structural goals, with the type of research to be done in support of these broad priorities being decided within portfolios [= areas of Ministerial responsibility], in close consultation with industry and other users and stakeholders. Examples of such broad structural goals could include improvement in commercialisation and technology transfer, or research training. Thematic priorities (that is, priorities which focus on the relative importance of scientific disciplines or fields of science) are a matter for negotiation between research funding and performing agencies and users of research.

The thrust of the present Green Paper is already recognisable in this response. The idea of structural priorities was mooted again by Stocker, and illustrated for the case of salinity problems (see box).

In its first meeting, of 29 May 1998, PMSEIC received a Report of the Priorities Working Group (chaired by Stocker), in which the idea of structural priorities, that is, objectives for the functioning of the science, engineering and innovation system, was developed and illustrated for the case of salinity problems (important in Australia's inland regions).
Five categories of structural priorities were distinguished:
- To develop and maintain a science base appropriate to Australia's need;
- To develop applicable knowledge;
- To promote interaction among providers and users of research;
- To stimulate innovation in industry;
- To improve awareness of science and technology.

After a brief analysis of salinity problems, these five categories were used to specify the ways in which science, engineering and innovation could be involved in addressing these problems.

It is not quite clear from the text, nor from the minutes of the PMSEIC meeting, what the added value of the "structural priorities framework" is, other than being a guideline for discussing the system-level rather than direct problem-solving contribution of science, engineering and innovation to a problem which had been recognised as important for other reasons. One of the conclusions, "that there is scope for a major initiative," is not different from the pleas made by champions for special causes. What is different is that such a plea can now be made with *prima facie* legitimacy (by a working party of the Standing Committee), and in discussion with final decision makers.

The set-up of PMSEIC, envisaged by Stocker as the pinnacle of an edifice of concerted strategic plans and national priorities cycles (see Appendix 2 for a brief description), cannot, as yet, profit from such inputs. The presentations to the Council and its discussions (and the preparations going into all this) contribute to diffuse agenda-building, but also leave free rein to the Australian tradition of ad-hoc and "decisionistic" science policy at the government level.

2. University research priorities

The Ministry responsible for university research (at present, DETYA) has not been keen to get involved in priority exercises, and has preferred to build relevance into its various schemes (often administered by the Australian Research Council) as an additional criterion. An example is how the Special Research Centres Program started, in the early 1980s, by emphasising "excellence built around eminence", but then added, in the late 1980s, "relevance" and "linkages" and "interactions" as additional criteria. Relevance gradually became "grafted" onto the criterion of (intrinsic) excellence, and in the 1991 round it was an explicit, though subsidiary criterion. In the 1997 round, the criterion of relevance was more important again. (ARC, *Submission to the Inquiry into the Organisation of Research in Higher Education*, Canberra, August 1993; Van der Meulen and Rip 1994; 105)
The Program for Key Centres for Training and Research, established in the 1980s to cater for the polytechnics and colleges of education, were oriented to external audiences (sectors and institutions where their graduates would be employed) from the beginning. The Program continues under the Unified System, and traditional universities are eligible. An emphasis on relevance to societal problems remains visible.

The Co-operative Research Centres Scheme (overseen by DIST, now DISR) plays a key role in mobilising research capacity and interactions among relevant actors for strategically important research themes, but these are not derived from overall priorities. It is (again) a competitive scheme, with selection based on quality of proposals, not on links with an eventual priority theme. The objectives of the Scheme are structural, in this case the creation of productive linkages to improve the utilisation of public sector R&D strengths. As the 1993 Budget noted, the Program had been successful since its inception in 1990, and was able to attract high-quality applications. Additional budget would therefore be made available to establish about sixty such Centres by the mid 1990s. After the 1996 round, 67 Centres were supported under the Scheme.
The Government contributes approximately A$ 140 million per annum, while industry has made commitments of more than A$ 640 million for the planned term of the current Centres.
The Co-operative Research Centres have been very successful in enhancing university research efforts in collaboration with other research actors and users. (They can be seen as locations where Mode 2 of knowledge production – to use the phrase from Gibbons et al 1994 -- is consciously stimulated.) They might be seen as an example of the productivity of the separation between structural priorities and thematic selection, and this is how the Mercer & Stocker *Review* of the CRC, position the Scheme:

> All advanced economies are seeking to develop bridging mechanisms to link public sector research and user. There is no evidence that other international approaches are likely to be more effective in Australia than is the CRC Programme. The CRC Programme addresses important weaknesses in the national innovation system, in particular the disincentives to collaboration among research providers and Australian businesses, the weak links between research organisations and users, the lack of critical mass due to the institutional and geographical dispersion of Australian research and research application, the lack of mobility of personnel between government

> research, academia and industry, and the challenges of effective international links for a country isolated from the international centres of research and innovation. (*Review*, Executive summary, pp. iii-iv)

Interestingly, after applauding the reliance on competitive submissions and selection to articulate themes to be supported, the *Review*, in its 8th Recommendation argues:

> Current initiatives, through the Prime Minister's Science, Engineering and Innovation Council, to develop national priorities for science and technology provide an opportunity to review the Programme's balance of effort in different sectors. (..) the scope for more CRCs in the service sectors, in general, and the 'information industries' in particular, should be assessed.

While this recommendation might be read as reflecting Stocker's interest in improving co-ordination and overall thrust in a concerted national research system, Australian Science, Inc. (cf. Appendix 2), the important point is that a bottom-up approach to priorities still allows, and may usefully exploit, reflection on emergent patterns in research *foci* to modulate the pattern in desired directions.

Priority setting may occur at the level of intermediary organisations, and this does happen, in particular with the Commonwealth Scientific and Industrial Research Organisation (CSIRO). This organisation actually pioneered methods of strategic evaluation and priority setting in the early 1990s "to identify priorities within CSIRO from the national standpoint." Emphasis was put on identification of potential benefits in relation to capacity, and the appropriation of the benefits for Australia. (Martin and Johnston 1999; 43; Van der Meulen and Rip 1994; 82) In the absence of explicit national research priorities, some of the assessments will be based on consultation and interaction with government agencies and politicians. Since CSIRO is (also) a research performing organisation, it can draw concrete implications from its priority setting exercise. Under the present directorship of Stocker (until recently Chief Scientist at DIST), bottom-up inputs were emphasised as well, and "brokers" between overall priorities and ongoing research programmes were appointed.

The Australian Research Council (ARC), established in its present form in 1988, does not see a priority setting or priority articulation role for itself, and emphasises responsive funding modes. This is how it presents itself on its website (jointly with the Research Branch of DETYA). It may administer targeted schemes, but these have an (infra)structural or capacity-building character, and do not refer to thematic priorities.

In its new role, as envisaged in the Green Paper, the emphasis is still on whatever priorities emerge as a consequence of (i.e. as patterns in) the development and evolution of Australian research (adapted from Green Paper, p. 24), but there are two ways in which this evolution will be modulated. One, by an increasing role of users in defining the research agenda, including having users in a broad discipline area becoming members of the ARC committees of general discipline experts responsible for peer review (Green Paper, p. 23). Two, by creating positions of programme managers (modelled on the USA National Science Foundation approach) with a pro-active role, who will identify "emerging disciplinary and cross-disciplinary developments and innovative approaches to research" (Green Paper, p. 46).

If there are no priorities, there is no reason to ask how they are (or are not) implemented. One can inquire, however, into the outcomes of measures and schemes, as these add up to *de facto* implemented priorities. Attempts to classify ongoing research and research outputs, for example in terms of NABS categories, are beset with difficulties, however. Data are relatively straightforward when arranged according to scientific fields, but even there caution is necessary in interpreting the data (cf. Australian Research Council 1996). In line with the overall Australian science policy culture, the interest is in what the ARC called, in a 1994 report, "the capacity of academic research to support broad national objectives" (quoted in the Foreword to ARC 1996) rather than in having priorities and checking on their implementation. A similar diagnosis is visible in Turpin et al (1998; xvii), when they note: ".. there has been considerable emphasis on retrospective analysis of the excellence of research, but less on the current or potential 'value' of the research to contribute to socio-economic objectives."
From reading of the Green Paper, it seems probable that this diagnosis will continue to apply.

B. The Quality of University Research

"Excellence must be the hallmark" is one of the recurrent themes in the Green Paper (this phrase is quoted from p. 32), the other being linking university research to the national innovation system. The emphasis on excellence is not new in Australia, and has to do with its concern about being on the periphery and about not having a strong research tradition (until the late 1940s, no PhD training was available in Australia).
The first attempt to stimulate excellence in research was the establishment of the Institute of Advanced Studies (IAS) at the Australian National University (Canberra). To put it informally, IAS is like a lot of Max-Planck-Institutes on one campus. It is funded separately from the universities, and gets a sizeable part of the budget (A$ 135 in 1997). Because of this protected position, it is not allowed to compete for ARC grants (but this may change, according to the Green Paper, pp. 38-39). The regular universities have been critical of IAS and its being protected, but it is maintained, albeit on pain of regular and careful performance evaluations (see Van der Meulen & Rip 1994 for more details about IAS, and Turpin et al 1998 for a discussion of the IAS evaluation).
It is generally agreed that IAS is "one of the world's great research institutions" but also that it cannot expect to be funded in the earlier lavish style (Carver, in Van der Meulen and Rip 1994; 130). The argument for an institution like IAS is the importance of making long-term investments interesting in research directions, even if these have little peer appeal.

Excellence in regular university research has developed over time, without special measures. The seven research universities, which were excellent during the 1970s, have remained on top. Research income (both block and competitive) is distributed in a highly skewed manner across the university system.

With the advent of the Unified System, the question of research excellence was further thematised as the challenge of building a 'research culture'. A number of policy studies have shown up the difficulty of capacity building (as such, and because nothing much can be changed through generic measures). New/small universities do create niches for themselves (ARC 1996, p. xviii). Research capacity building in general continues to be a challenge, recently also taken up in relation to indigenous researchers.

Partly because of these developments, Australian universities pay explicit attention to the management of research at the level of the university, most of them having created posts of Dean or pro-Vice-Chancellor for Research. The Green Paper devotes a separate chapter to "Improving institutional management of research and research raining", which opens with the following paragraph (p. 27):

> Ensuring the excellence of Australian research and research training is a task which is shared between the Government, funding agencies and universities. Governments and funding agencies have a responsibility to ensure that funding arrangements, incentive structures and regulatory arrangements enable the generation of high quality research outcomes. Institutions have the key responsibility to create the conditions and manage the resources entrusted to them to achieve the best possible research performance.

The Research Quantum

Further interesting aspects are the increase in academic and academically-related research expenditure as a percentage of total commonwealth support for research (from a stable 37% in the early 1990s to 43% in 1996; in the S&T Budget Statement 1998-1999, the percentage appears to be 44%), and the introduction, in 1995, of the Research Quantum, a component of university funding directly related to research output (relatively to that of the university system as a whole). In 1997, A$ 222 million was distributed under the Research Quantum (a 20% slice of the original direct university research funding of circa A$ 1100 million).

The idea of rewarding performance through Research Quantum funding is that incentives to perform will increase research quality. That there are system-level effects as well, was already pointed out in ARC (1996; 34):

> It is important to note that the research reporting requirements of the Department of Employment, Education, Training and Youth Affairs, and the 'research quantum effect', could well have consequences which operate in direct opposition to government policies of promoting multi-disciplinary collaboration, collaboration between universities and between universities and other research institutions, and the development of boundary-crossing entities like CRCs. (..)
>
> The introduction of a composite research index (CRI) based allocation of the research quantum has introduced a new level of *uncertainty into university budgeting*. Universities can make very precise estimations of their performance against absolute student intake targets. However, the outcome of the research quantum distribution depends on the relative performance of an institution against that of the university system as a whole. For larger universities, the variation could be in the order of millions of dollars.

The same report makes, in passing, a very important remark: the concreteness of the performance indicators (in the research quantum, but the point is more generally applicable) implies that "calculations are being driven rapidly and vigorously into the universities and down to the level of the faculty, the department, the research group and the individual researcher." (p. 85) This speed should be contrasted with the difficulty of realising excellence (unless there are special schemes as the Special Research Centres (see below), or block-grant protection of highly exposed excellence as in the Institute for Advanced Study), and the re-labelling and other strategic action undermining the implementation of strategic priorities.

The Green Paper recognises the problems associated with the particular form of the Research Quantum formula. The publications part (10%) is based on unreliable data, and has led to increased volume of publication at the expense of quality. "This is not in the best interests of Australian research," and the publications measure will be dropped in any future indices used to allocate block research funds (p. 29). The input component in the form of research income from other sources (now at 80%) used to weigh national competitive grants twice as heavily as income gained from other sources. "This is inappropriate in an environment in which universities should (…) engage more closely with the national innovation system," and disadvantages "universities which have made the decision to focus their research effort on links with their regional economies and communities, rather than winning competitive grants" (p. 29). Th Government proposes to equalise the weight given to national competitive grants and other research income, and the definition of research income will be refined to include consultancy income which contributes to innovation (p. 29). The exact balance and definition of the Composite Index of the Institutional Grant Scheme, of which the Research Quantum is a part, will be subject to further discussion and negotiation (p. 39).

Special Research Centres

The Program for Special Research Centres started in the early 1980s, emphasising "excellence built around eminence," and has been quite successful. The Special Research Centres are similar to Max-Planck-Institutes because of key role of eminent scientist who becomes director. The difference is the open competition, and the maximum lifetime of nine years (with triennial reviews). After that time, Centres can submit a bid in the regular competition. In the 1991 round, four out of the thirteen newly awarded Centres were based on existing Centres.

In a 1997 booklet, the 19 Centres then being supported at a cost of A$ 14.5 million are described. Funding for a single Centre is set between A$ 0.4 and 1.0 million a year, depending on the field of research and the proposed programme of activities. A key selection criterion is the degree to which proposals enhance the concentration and co-ordination of research in the particular discipline; an important check is the compatibility with goals and directions enunciated in the host institution's management plan. Interestingly, the objectives of the SRC Scheme include also relevance and linkages. After four objectives referring to excellence, the final two are quoted as:

> "- promote research in areas of national importance which will enhance Australia's future economic, social and cultural well-being;
> - serve as points of interaction between higher education institutions, government, industry and the private sector." (booklet 1997, p. 51)

The overlap in objectives with the Co-operative Centres Scheme, administered under DIST, is clear. Some of the Special Research Centres are indistinguishable from Co-operative Research Centres, the Centre for Photovoltaics at the University of New South Wales being a clear example. (See Van der Meulen and Rip 1994 for details about this Centre.) Interestingly, it was quoted as one of the five highlights ("The discoveries, advances in understanding, improvements in technique, and steps in commercialisation from Australia's publicly-funded research are impressive.") in the *Science and Technology Budget Statement 1993-94*, and again in the Green Paper (p. 27) as an example of commercialisation activities and linkages more generally.

In a detailed evaluation of the Special Research Centre Scheme in 1992, the conclusions were generally positive: "SRCs often provided a much needed refocusing of the research effort, upgraded the standard and reputation of the discipline involved, promoted interdisciplinary work, and had a very positive effect on students." (Lazenby Committee 1992; iv) In particular, the Special Research Centre Scheme allows high-risk strategies in setting out research. This appears to have worked well (apart from some failures in management and administration). Johnston, Martin et al. (1993) note that such strategies will create high international visibility and recognition, but need not be reflected in high values on quantitative performance indicators. Such indicators should, therefore, be used sparingly when assessing individual Centres in the light of the objectives of the Scheme.

The Scheme continues to be considered successful. It is an integral part of the range of funding schemes for university research. It allows excellence to be pursued (if an application is successful), and introduces considerations of co-ordination, concentration and excellence more widely, through the effort to prepare applications. In the absence of a detailed evaluation study, it is not possible to be more precise about system-wide effects.

The Green Paper proposes to merge the Special Research Centres and the Key Centres for Teaching and Research ("which aim to promote excellence in teaching and research activities in higher education institutions, particularly in areas of national importance, and to encourage interaction with industry and other user groups", p. 53) into a single scheme for Centres of Excellence:

> Key and Special Research Centres will be refocused into a single Centres of Excellence programme which spans both Discovery and Linkage and which supports significant national research. The programme would be directed at collaborative ventures involving universities, industry and research institutions such as CSIRO, with a multi-disciplinary focus. It is envisaged that the annual maximum government funding would be A$ 1 million for seven years, with matching contributions from the partners. (p. 59)

Excellence, important in its own terms, is clearly seen as compatible with relevance (operationalised here as linkages, to the national innovation system, to regions and communities, and respect to public awareness of science).

Partial bibliography

Australian Research Council, *Patterns of Research Activity in Australian Universities. Phase One: Final Report*, Canberra: National Board of Employment, Education and Training, July 1996. Commissioned Report No. 47.

Michael Gibbons, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott, Martin Trow, *The new production of knowledge. The dynamics of science and research in contemporary societies*, London: Sage, 1994.

Ron Johnston, John Currie, Lyn Grigg, Ben Martin, Diana Hicks, Nigel Ling, Jim Skea, *The effects of resource concentratioon on research performance*, Canberra: National Board of Employment, Education and Training, November 1993. Commissioned Report No. 25.

David Kemp (Minister for Education, Training and Youth Affairs), *Ne Knowledge, New Opportunities. A Discussion Paper on Higher Education Research and Research Training*, Commonwealth of Australia: Canberra, June 1999

Ben R. Martin and Ron Johnston, 'Technology Foresight for Wiring Up the National Innovation System,' *Technological Forecasting and Social; Change* 60 (1999) 37-54.

Don Mercer, John Stocker (Steering Committee), *Review of greater commercialisation and self funding in the cooperative research centres programme*, Canberra: Department of Industry, Science and Tourism, 1998.

B.J.R. van der Meulen & A. Rip, *Research Institutes in Transition*, Delft: Eburon, 1994

Tim Turpin et al., *Valuing Unversity Research: International Experiences in Monitoring and Evaluation Research Outputs and Outcomes*, Wollongong: Centre for Research Policy, November 1998. Draft Final Report.

APPENDIX 1: R&D expenditures

There is no simple overview, partly because R&D funding is distributed over many government departments, and not always visible as a separate category. The Green Paper (p. 5) mentions business investment in R&D as just over A$ 4 billion (0.72% of GDP) and public expenditure on R&D at 0.86% of GDP (1997-98, realised). The S&T Budget Statement for 1998-1999 has A$ 3.7 billion as the "Commonwealth Support for Major Programs of Science & Innovation", which is much less than the figure of A$ 4.8 billion that can be calculated from the percentage of GDP for 1997-98).

A breakdown of the 1998-1999 budget is as follows (in A$ millions, estimated):

Targeted higher education R&D (incl. ARC funding)	445
Other higher education R&D (block grants)	1200
Co-operative Research Centres[*]	138
R&D Start, other initiatives for industry[†]	210
IR&D tax concession	417
Rural R&D	159
National Health & Medical Research Council[‡]	176
Other health R&D	21
Other R&D grants	13
Major research agencies (CSIRO, DSTO, …)[–]	955
Total	3734

[*] Down 9% from the previous year, but the Government will maintain funding for the program, and a new round is announced for 1999.

[†] Up 30% from the previous year.

[‡] Up 9% from the previous year. Other health R&D grants increased with 38%.

[–] Down 21 million. Budget support for CSIRO, the major agency, will be 482m, and the external earnings will bring total income to about 720m. The Defence Science and Technology Organisation's budget of 236m includes some overheads and capital appropriations.

An interesting breakdown of funding of university research and research training is in Appendix B of the Green Paper, showing current elements regrouped according to the proposed new policy.

Programme, Objectives	Allocation
Discovery element of the National Competitive Grant Programme ("to support excellent fundamental research by individuals and teams") Current elements include ARC Large Grant Fellowships, Special Research Centres, part of the infrastructural overhead funding (RIBG).	177m
Linkage element of the National Competitive Grant Programme ("to seed fund collaborative ventures between institutions; between institutions and industry; and between institutions and research institutes, such as CSIRO. To also fund investment in strategic national and international infrastructure.") Current elements include SPIRT, Key Centres and part of the Infrastructural overhead funding (RIBG).	103m
Postdoctoral and senior fellowships ("postdoctoral research opportunities for high performing individuals and for experienced researchers to move between universities and industry")	6m
PM's Scholarships ("stipends for exceptional research students")	2m
Institutional Grant Scheme ("to support institutional investment in research and the development of a vibrant research training environment" Formula based allocation, institutions required to have research management plans.) Current elements include ARC Small Grants and a share of the Research Training Component of operating grants.	458m
Australian Postgraduate Research Student Scheme ("to support high quality and responsive research training". Formula based allocation of scholarships to institutions, once awarded to individuals scholarships are portable) Current elements include most of Research Training Component of operating grant.	432m

APPENDIX 2

Given the articulated picture, in the Green Paper, of the arrangements for university research and devolved priority setting, it is interesting to quote the world as imagined in the recommendations of the Stocker Report (1997) – an alternative world which did not make it. After discussing within and across portfolio co-ordination, the Report sketches the process of defining national priorities for science and technology as follows:

> The Government should articulate a preferred vision for Australia's development toward national goals in the spheres of economic and industry development, quality of the environment, and social well-being. The science and technology advisory bodies restructured as proposed in this report should be charged with defining and implementing national science and technology priorities. National level priority identification for science and technology should be undertaken by PMSEC, supported by ASTEC and the CCST, with the Chief Scientist taking the leading executive role. (...)
>
> This national-level identification of priorities should concentrate on the structural level. Thematic priorities (related to disciplines or socio-economic objectives) should only be included when there is a very strong case that the objective or field of science concerned needs special attention.
>
> An early step in identifying national science and technology priorities should be the gathering, analysis and publication of statistical and other information which presents Commonwealth allocation of resources (for both funding and performance of science and technology) against agreed structural and thematic priorities for science and technology. This work should then be repeated at regular intervals as part of a national science and technology priorities cycle.

While some of the cognitive steps resemble the ASTEC Foresight exercise (but with less consultation), the focus is on a co-ordinated and monitored system with priority setting at the top. The latter is legitimated by limiting it to structural objectives. Within this overall framework, actors can continue to negotiate thematic priorities, with some accountability after the fact.

BELGIUM by Heide Hackmann

Introduction

Belgium is a federal state which consists of three communities and three regions. Whereas the communities – Flemish, French and German – are distinguished on linguistic and cultural lines, the regions – Flemish, Brussels Capital, and Walloon – represent economic areas. Both communities and regions have autonomous powers in a number of policy sectors. With regard to the research and technological development (RTD) sector, competencies are shared between the federal state and the federated entities. Yet the latter take prime responsibility in this regard, controlling almost 70% of public R&D appropriations in Belgium.

As far as the university research sector is concerned, the communities have been assigned autonomous powers. Yet activities undertaken at the federal level do contribute towards shaping the profile of this sector. This report focuses on university research within the Flemish community. Where relevant, the influence of federal level initiatives is outlined.

There are eight universities within Flanders. They are:

- Universitair Centrum Antwerpen (UCA)
- Universitaire Faculteiten St-Ignatius in Antwerpen (UFSIA)
- Universitaire Instelling Antwerpen (UIA)
- Limburgs Universitair Centrum (LUC)
- Katholieke Universiteit Brussel (KU Brussel)
- Katholieke Universiteit Leuven (KU Leuven)
- Universiteit Gent (UG)
- Vrije Universiteit Brussel (VUB)

Together with 29 “hogescholen” (polytechnics), which offer non-university vocational training and undertake research which is mainly of an applied nature, these institutions comprise the Flemish higher education sector.

A. Research Priorities

1. National research priorities

The systematic formulation and articulation of an explicit list of national thematic research priorities in official policy statements is absent at both the federal and Flemish community level. In terms of structural priorities, the Flemish government repeatedly stresses the need to:

- Strengthen basic research;

- Foster applied research in technology-oriented economic networks; and
- Enhance international collaboration.

2. University research priorities

The various structures and institutions (at the federal and Flemish community level) that comprise the Flemish research system reflect both thematic and operational priorities, thus functioning to stimulate university research in particular fields and to give an impetus to certain modes of conducting such research. Whereas the thematic priority emphasises policy-oriented research, structural priorities focus on the development of collaborative networks between Belgian universities, as well as those priorities mentioned in point 1 above.

2.1 At the federal level

Of the science policy initiatives undertaken and managed by the Federal Office for Scientific, Technical and Cultural Affairs (OSTC), two are particularly important in shaping the nature and profile of university research activities. They are:

(a) Scientific support programmes

The OSTC currently runs 16 targeted research funding programmes which are intended to address the policy needs of federal authorities by diagnosing and providing solutions for a range of socio-economic problems of national and international importance. The policy-oriented research conducted (by a range of research performers, including university researchers) under the auspices of these programmes focuses on three central issues, namely:

- The information society;
- Sustainable development; and
- Conditions for new social cohesion.

The titles of the current programmes are listed below:

- Diffusion of telecommunications
- Support plan for the information society
- Support plan for a policy of sustainable development
- Global change and sustainable development
- Sustainable management of the North Sea
- The Antarctic
- Earth observation by satellite
- Sustainable mobility
- Protection of workers' health
- Scientific support for standardisation
- Prenormative research in the food sector within a context of sustainable development

- Prospective socio-economic research
- Federal socio-economic databanks
- Public economics
- Legal protection of the citizen
- Levers for a sustainable development policy

(OSTC, 1997: 71)

Programmes run for an average of four years. Project proposals are assessed by a panel of international experts as well as individual programme co-ordination committees, which consist of representatives of the OSTC and other federal and/or community/regional government departments. Apart from scientific quality, the policy needs of federal authorities, as well as the inter-disciplinary and inter-sectoral nature of research teams is taken into account during the assessment phase. The final selection of project proposals occurs at ministerial level.

The design and implementation of scientific support programmes is closely managed by the OSTC. The initial drafting of a programme by the OSTC takes into account the broad lines of federal policies and international – particularly European – recommendations, as well as the signals, needs and opinions of scientists and potential users of the research results. Consultation at this stage appears to be largely an ad hoc activity. Once drafted, a proposed programme is scrutinised by the Interministerial Science Policy Committee (ISPC) which is chaired by the Secretary General of the OSTC and includes senior civil servants from other federal ministries. If relevant, community or regional representatives are also asked to comment on the draft, which is then submitted to the Minister for Science Policy, who in turn submits it to the Cabinet for approval.

(b) Research networks

Since 1987, the OSTC has funded the Interuniversity Poles of Attraction (IPA) system. The latter is intended to develop research teams which cross scientific, institutional and community (in other words, linguistic) boundaries, thus strengthening existing forms of co-operation or fostering new ones. The system targets basic research activities, and is motivated by the belief that "the advancement of science (is) inseparable from work in groups" (OSTC, 1997:38).

The current set of IPAs covers the period 1997-2001, and comprises 35 networks involving 154 research teams. Each network is structured around a main laboratory which co-ordinates and promotes co-operation with associated laboratories. Proposals for networks are submitted by universities and assessed for their scientific merit and structural coherence by international experts. The OSTC assumes responsibility for the operational control and management of the networks. This includes periodic assessments of the progress of research undertaken within a network, as well as the synergy between the research teams it involves.

It is significant to note that by means of the programmes and networks outlined above, the OSTC annually finances approximately 1300 people assigned to research (of whom about 1200 are researchers) at universities and other research centres.

2.2 Priorities of the Flemish government

The Flemish government does not attach any priorities – thematic or operational – to the core funds it provides to universities (via its Departments of Education and Science, Innovation and Media) for teaching and research purposes. The only direct way in which it imposes priorities on the university research sector is via the targeted research funding programmes it runs. Currently there are three, namely:

- A programme for policy oriented research (Programma Beleidsgericht Onderzoek) which is aimed at promoting specifically social scientific research in support of the policies of the Flemish government;
- A programme focussing on strategic technologies for the promotion of welfare and socio-economic development (Strategische Technologieën voor de Bevordering van Welzijn en Welvaart Programme); and
- A programme aimed at stimulating internationally collaborative research (Bilaterale Wetenschappelijke en Technologische Samenwerking), which currently focuses on collaboration with partners from Chile, China, Hungary, Romania and South Africa.

Apart from these programmes, the Flemish government imposes – albeit indirectly – priorities on the university research sector by way of supporting and monitoring a number of public funding and research institutions. These institutional arrangements reflect the government's broad science policy objectives, namely to strengthen basic research and to foster applied research in technology-oriented economic networks (ICCR, 1997:29). To the extent that university researchers (including doctoral and post-doctoral students) are involved in the activities of these institutions, and/or depend on them for research funds, the Flemish government exerts an influence on the profile and nature of research conducted within the university sector. This is particularly the case as far as applied research is concerned. Thus, for example, it is worth noting the central role played by university departments and laboratories in two of the three public research institutions in Flanders, namely:

(a) The Interuniversity Microelectronics Centre (IMEC), which was founded by the Flemish government in 1984. The Centre collaborates with both industrial companies and R&D organisations world-wide, and is associated with the laboratories of the Department of Information Technology at the University of Gent, and the Electronics and Digital Signalling Processing Department of the Brussels Free University. IMEC also finances and supervises the doctoral work of students registered at several Flemish universities, affording them the opportunity to participate in a range of industrial research activities. IMEC research priorities include:

    - The development of novel design methodologies for monolithic as well as multichip systems and ATM;

- The development of processing technologies for the next generation of ULSI chips, microsystems, sensors, solar cells, multi-chip modules and optoelectronic components; and
- The support of the training of VLSI design engineers.

(b) The Flanders Interuniversity Institute for Biotechnology (VIB), which was founded by the Flemish government in 1995. VIB is a virtual institute located on the campuses of its four partner universities (involving nine departments and five associated laboratories). In collaboration with industry, it conducts research in various areas of biotechnology, undertakes technology assessment, provides policy advice to governmental authorities, and takes responsibility for stimulating public dialogue about biotechnology.

The strong emphasis on academic-industry collaboration evident in both the work of the VIB and IMEC, is also evident in the modus operandi of the Flemish Institute for the Promotion of Scientific-Technological Research in Industry (IWT). As the largest source of public funding of applied research in Flemish universities, it is significant to note that most of the university project grants are obtained via the submission of proposals by industrial companies. Government is thus able to strengthen academic-industry ties by channeling research funds to universities through companies.

With regard to basic research conducted within universities, no attempt is made to direct either its content or form. Here the Fund for Scientific Research – Flanders (FWO) is the primary source of public grants and awards. Its policy of not attaching priorities to such funding is explicit, as is evident from the following statement:

> "In geen geval kan en mag het niet-georiënteerde basisonderzoek dirigistisch worden gestuurd. Het is de taak van het FWO ruimte te scheppen voor het initiatief van de wetenschappelijke gemeenschap om met originaliteit snel in te spelen op de allernieuwste stromingen, talent te ontdekken en aldus onderzoek aan de kennisgrens van het onbekende te steunen" (FWO, 1995)

In its most recently policy document, the Flemish government has identified the strengthening of basic or fundamental research as a concrete goal. As such, government subsidies to the FWO have increased substantially. The reasoning behind this move is that fundamental research acts as a feeding bed for other, applied forms of research.

Although the institutions mentioned above – IMEC, VIB, IWT and FWO – function autonomously, the Flemish government – and specifically the Department of Science, Innovation and Media – takes responsibility for monitoring the way in which they implement Flemish science policy. In this way government is clearly involved in steering the university research sector. In doing so, it is advised by the work of the Flemish Council for Science Policy, which is itself a part of the Department mentioned above. An additional policy actor is the Flemish Interuniversity Council (VLIR) which consists of senior representatives (usually the Rectors) of each of the six Flemish universities.

B. The quality of university research

Apart from the peer review of proposals submitted to institutions such as the FWO and IWT, and the emphasis on scientific quality that is stressed in this regard, the importance of monitoring and evaluating university research at governmental level is increasingly being raised amongst policymakers. According to a member of staff of the Department of Education, personnel within the Department of Science, Innovation and Media have started gathering information about the methods and practices of research assessment exercises conducted elsewhere in Europe. This will be done in conjunction with the Flemish Interuniversity Council. (Vercruysse interview). An initial evaluation exercise, within the fields of law and linguistics has recently been undertaken. A report outlining its process and outcomes is currently in the process of being prepared.

APPENDIX: AN OVERVIEW OF SOURCES OF UNIVERSITY RESEARCH FUNDING

1. Federal Government

(a) The Federal Office for Scientific, Technical and Cultural Affairs (OSTC)

The OSTC funds Flemish university research activities primarily via:
- Scientific Support Programmes, and
- The Interuniversity Poles of Attraction System.

(b) Other Federal Departments

Several other federal government departments procure academic research for their own, policy-oriented departmental needs.

2. Flemish Government

(a) Department of Education (OND)

The OND provides basic funding to Flemish universities in order to cover the costs of teaching, research, scientific services and administration. Approximately 25% of these resources are used for research purposes.

(b) Department of Science, Technology and Media (WIM)

The WIM funds university research activities in a number of ways. These include:
- Subsidies to Special Research Funds, which are provided to all universities as a lump sum. Distribution of these funds within the universities themselves is determined by the institution's own research policy and priorities.
- Policy-oriented Research Programmes addressing the policy needs of the Flemish government.
- The Strategic Technologies for the Promotion of Welfare and Socio-Economic Development Programme.
- The Bilateral Science and Technology Collaboration Programme.
- Funding of participation in European Union Framework Programmes and other international programmes, provided to universities annually as a lump sum.
- Contract funding.

3. The Fund for Scientific Research – Flanders (FWO)

The FWO receives the bulk of its resources from the Flemish government, and acts as the primary source of public funding for fundamental, curiosity-driven research in Flemish universities and other research or scientific institutions. As such its mode of funding is essentially responsive. The selection of all applications for funding is based on scientific evaluation by scientific commissions comprising local and international experts. The commissions are also involved in evaluating work funded, and providing feedback to grantholders.

The FWO has various funding categories. These include:
- Individual appointments (covering the salary costs of permanent appointments)
- Studentships and fellowships
- Individual project grants
- Group project grants
- International contacts and collaboration

4. The Flemish Institute for the Promotion of Scientific Technological Research in Industry (IWT)

The main purpose of the IWT is to finance the research projects of industry. University researchers cannot apply directly to the IWT for project grants. The latter are awarded to industrial companies who are then able to approach universities for relevant research capacity. University researchers can, however apply directly to the IWT under the following funding categories:
- Fellowships and studentships
- EUREKA projects

5. Other

Apart from the above mentioned sources, Flemish universities receive resources from
- Industry
- The European Union, as well as other international sources.

Table 1 below gives a financial breakdown of the various sources and modes of university funding as outlined above.

Table 1.: Belgium: Sources and modes of Flemish university research funding, years specified (in BEF Mio)

Source	**Funding Mode***	**Total** **B=Budget** **E=Expenditure**
Federal Office for Scientific, Technical and Cultural Affairs	- Scientific Support Programmes - Interuniversity Poles of Attraction System	1 214.30 800.00
	Total	**(B 1998) 2 014.30**
Other Federal Departments	Contract funding	**Figure not available**
Flemish Department of Education	Basic funding for R&D purposes	**(B 1999) 4 932.54**
Flemish Department of Science, Innovation and Media	- Subsidies to Special Research Funds - Policy-oriented Research Programmes - Strategic Technologies for the Promotion of Welfare and Socio-Economic Development Programme. - International collaboration (including the S&T Collaboration Programme and funds for participation in EU and other international programmes - Contract funding.	2 242.70 450.00 653.60 456.20 23.90
	Total (100%)	**(B 1999) 3 826.40**
Fund for Scientific Research – Flanders		**(E 1998) 4 347**
Flemish Institute for the Promotion of Scientific-Technological Research in Industry		**No figure available**
Industry		**No figure available**
International sources		**No figure available**

References

FWO (Fonds voor Wetenschappelijk Onderzoek – Vlaanderen), 1995. Beleidsplan 1996-2000. http://www.nfwo.be/beleid/beleid0.html

http://www.belspo.be (Website of the Federal Office for Scientific, Technical and Cultural Affairs)

http://www.imec.be (Website of the Interuniversity Microelectronics Center)

http://www.iwt.be (Website of the Flemish Institute for the Promotion of Scientific-Technological Research in Industry)

http://www.nfwo.be (Website of the Fund for Scientific Research – Flanders)

http://www.ond.vlaanderen.be (Website of the Flemish Department of Education)

http://www.vib.be (Website of the Flanders Interuniversity Institute for Biotechnology)

http://www.vlaanderen.be/ned/sites/overheid/mvg (Website of the Flemish Department of Science, Innovation and Media)

http://www.vlir.be (Website of the Flemish Interuniversity Council)

ICCR (Interdisciplinary Centre for Comparative Research in the Social Sciences), 1997. Country Profiles. Technical Annex of the INCOPOL National Systems of Innovation Report.

OSTC (Office for Scientific, Technical and Cultural Affairs), 1997. Tasks and activities. Brussels. OSTC.

OSTC (Office for Scientific, Technical and Cultural Affairs), 1999. Heeft België nog een federaal wetenschapsbeleid nodig? http://www.belspo.be

Vlaamse Raad voor Wetenschapsbeleid, 1999. Het Vlaams Wetenschaps-, Technologie- en Innovatiebeleid. Beleidsbrief voor het Jaar 1999. Brussels. VRVW-CWB.

Telephone interviews:

Mr P. Ribouville: Information Department; Federal Office for Scientific, Technical and Cultural Affairs

Mr N Vercruyse: Higher Education and Scientific Research, Flemish Department of Education

GERMANY by Heide Hackmann

Introduction

Within the German higher education sector, research is primarily conducted within Hochschulen (universities), of which there are 90. In 1997, these institutions (together with several comparable institutions, including 16 colleges of theology and 6 colleges of education) accounted for almost two thirds (63,3%) of expenditure on education and research. There is, however, an increasing tendency amongst the 146 Fachhochschulen (technical universities, or polytechnics) to undertake research of an applied nature. This report focuses on research conducted within the Hochschulen or universities.

A. Research Priorities

1. National research priorities

In its most recent annual report (Faktenbericht), the Ministry of Education, Science, Research and Technology (Bundesministerium für Bildung und Forschung or BMBF) presents the objectives of the Federal government's research and technology policy as being driven by a leading idea: "To make the future possible". It goes on to specify the following generic goals:

- Promotion of high technologies as drivers of innovation,
- Research to provide for and shape the future,
- Safeguarding scientific excellence,
- Strengthening and networking the research system,
- Developing research in the new Länder, and
- Strengthening international co-operation.

In terms of substantive priority themes, the report states that "The priorities of Federal government funding for research include key technologies of the future such as biotechnology and information technology; in addition, provision for the future in areas such as health research and environmental research is of major importance". (BMBF, 1998:Introduction).

These generic goals and substantive priorities provide a broad framework which guides and justifies governmental activity (both at Federal and Länder level) in the research and technological development (RTD) policy arena. They are based on the policy advice and opinions of numerous actors, yet they are not the product of regular or systematic national priority setting exercises. It is the BMBF that is responsible for formulating and articulating the overall policy framework for publicly funded research. In doing so, it draws on the input of three bodies, all of which have important policy tasks. These are:

- The Science Council (Wissenschaftsrat or WR) which was established in 1957 to negotiate between, and co-ordinate the plans of Federal and Länder governments, and scientific organisations such as the institutes of the Max Planck Society (MPG), the Fraunhofer Society (FhG), etc. With time its role has shifted from one of co-ordination to one of actively developing the overall framework within which the various governmental actors plan their activities (Schiene, 1998:77). Council members include scientists, industrialists, unionists and politicians.

- Together with the WR, the Federal State Commission for Educational Planning and Research Promotion (Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung or BLK) takes responsibility for co-ordinating research policy between Federal and Länder governments.

- The Council for Research, Technology and Innovation (Rat für Forschung, Technologie und Innovation) was founded in 1995 as a policy instrument for identifying opportunities for new technologies and the need for action in important fields of application. Its membership composition is similar to that of the WR.

In addition to these bodies, policy input and advice to Federal government is sought from scientists participating in BMBF study sessions, as well as the advisory input of the Deutsche Forschungsgemeinschaft (DFG) Senate (which includes the Presidents of the German Rector's Conference (Hochschulrektorenkonferenz or HRK) and the MPG.

Despite the (Federal) articulation of national research goals and priorities, government's policy framework does not have an authoritative reach over the myriad of intermediary and performing actors within the research system. Being decentrally structured and having a fundamental division of labour and authority, the German research system is characterised by its absence of a strong, central policy body – a principal - with regulatory powers. The BMBF does steer strategic research, but this takes the form of contract-based project funding, which is primarily targeted at the institutes of the FhG and the Großforschungseinrichtungen, but also involves universities (see Appendix: Point 5). It is here that thematic priorities – such as those mentioned above – hold sway. The Leitprojekte introduced by the BMBF (see Appendix: Point 5) provide a good example of such steering efforts. Apart from them, however, policy rhetoric is marked by the emphasis it places on the self-regulating – and even self-organising – capacities of the system, a philosophy which is constitutionally grounded. This is particularly evident with reference to academic research performed within universities.

2. University research priorities

In 1995, 90,7% of the R&D expenditure of the higher education sector was financed by the Federal and Länder governments (this figure includes funding categories 1 through to 5 listed in the Appendix). It is the Länder governments that take prime responsibility for academic research in universities (and other higher education institutions). Nevertheless, through the Framework Act for Higher Education (Hochschulrahmengesetz), the Federal government can contribute towards determining the overall direction and structure of the university system (see also Section B below). To some extent it can also do so by virtue of the funding it allocates to university research, especially via the DFG. Yet neither Federal nor Länder governments attach substantive priorities to the resources they allocate (often jointly) to this sector of research performers. Thus the DFG, although involved in advising governmental actors about research policy making, pursues its own policies and does not implement thematic programmes as these are defined (and steered) by government.

The DFG's philosophy of respecting academic autonomy is clearly expressed in the following statement:

> "DFG interprets its statutory mandate "to serve all branches of science and the arts" as an obligation to act consistently in the best interest of the individual researchers, their institutions (which make up the membership of DFG) and their research fields. It therefore practises a 'bottom-up' approach following the basic principle that responsibility for scientific and scholarly work rests with the scientists and scholars carrying out this work in their various institutional settings under the guarantee of the freedom of teaching and research, art and science laid down in Art. V of the Constitution of the Federal Republic of Germany. In contrast to the research and development programmes sponsored by the Federal Ministry of Education, Science, Research and Technology (Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie, BMBF), DFG selects research projects as well as programmes among those proposed to it exclusively by criteria of scientific merit and promise" (http://www.dfg-bonn.de/).

The statement goes on to address the question of the societal relevance of research, again emphasising the responsibility, and autonomy, of the scientific community itself.

> "This does not mean that DFG is an 'ivory tower' institution turning a blind eye on the needs of society. Application of research results for the benefits of society (including, for instance, job and wealth creation) is an integral part of the values held by the German academic research community (like all others). Application oriented research is typical for many research fields as diverse as economics, education, medicine, and engineering, all of which figure in the DFG's research portfolio and, together with the more basic scientific and scholarly pursuits, form its constituency" (Ibid.).

Implicit in this statement, is a conception of the broader policy framework set by Federal government as the articulation of a shared value, and hence no more than a reminder, a signal or prompt to actors within the system as to what that value entails.

Turning away from thematic research priorities, it is worth noting that a number of more generic policy priorities formulated at Federal and Länder level are actively promoted and pursued within the system. These include issues such as fostering a research capacity within the Fachhochschulen (technical universities) and developing higher education institutions in the New Länder. In terms of universities throughout Germany, it also includes:

- Increasing the internationality of university teaching and research structures. In this regard, the BMBF has initiated (on the basis of consultation with the Länder governments, the HRK and the German Academic Exchange Service (Deutscher Akademischer Austauschdienst or DAAD)) the "Internationally oriented pilot study courses" programme. Designed to offer excellent training, encourage the use of a foreign teaching and working language, and offer the possibility of obtaining internationally comparable degrees, the first 14 pilot study courses have been selected (out of 170 proposals submitted by higher education institutions) and are currently being established. In addition to this programme, Minister Edelgard Bulmahn has announced that resources for stipends for foreign students and researchers will be increased. The aim, according to her, is to win the best scientists for German universities (BMBF, 1999).

- Promoting women within science. As part of the Special University Programme HSPIII (see Appendix: Point 3), the Federal and Länder governments have (through the co-ordinating capacity of the BLK) urged universities to make equal rights for women in science and research a reality and a top priority. According to a report by the BLK, promoting women should be seen as "tapping an innovation and qualification potential that has not been used adequately so far" (http://www.bmbf.de). In terms of specific measures, emphasis is placed on using the need to fill leading positions - caused by the current age structure amongst academics - with women scientists. In addition, the intention is to monitor progress in this regard through the regular reporting by, and evaluation of, university and research institutions. HSPIII allocates a total of DM 720 million to promoting women in science.

- Promoting young scientists. One of the HSPIII goals is to promote young scientists by implementing special programmes for doctoral and post-doctoral scientists, and providing the resources for early appointments to chairs (see Appendix: Point 3). Inclusive of basic statutory funding of universities, direct project funding by the BMBF, as well as funding of individual grants by the DFG, the BMBF estimates that more than DM 1 billion of its funds are used annually to directly or indirectly benefit young scientists.

More recently, Minister Bulmahn has called attention to the need for German universities to co-operate more intensely with non-university research organisations, as well as industry. With regard to academic-industry linkages, she spoke of the need for science to open itself to industry, and stressed the role universities can and should play in fostering the development of independent business enterprises. According to her, this is an imperative in ensuring that research speaks to the needs of society (BMBF, 1999)

B. The quality of university research

In 1997 the BLK issued a report entitled "Sicherung der Qualität der Forschung" (Safeguarding the quality of research), in which the principles for enhancing the performance of research institutions, and ensuring their integration into the innovation process, are spelt out. The institutions concerned are those of the MPG, FhG, Gottfried Wilhelm Leibniz Scientific Association and the Großforschungs-einrichtungen. The principles are:

- Greater competition through programme-oriented and performance-driven allocation of funding; and
- Greater administrative flexibility and budgetary autonomy, and hence empowerment of the relevant institutions.

The same principles - competition and autonomy - have found their way into recent discussions and initiatives aimed at reforming the higher education sector. An amendment of the Framework Act for Higher Education, which was adopted by the Bundestag in February 1998, underlies this trend. It aims to "make competition possible through deregulation, performance-orientation and the creation of incentives, and to secure the competitiveness of the German higher education sector in the 21st century" (BMBF, 1998:90). Central elements in achieving this aim include:

- Enhancing the university's autonomy to make budgetary decisions and to determine the structure of study courses, as well as the development of research and teaching priorities;
- Higher education financing based on teaching and research attainments, which should be made more transparent to enable institutions to be compared on performance measures;
- The introduction of regular reviews or evaluations of university teaching and research activities; and
- The promotion of young scientists.

The concerns underlying this initiative are that increasing student numbers (more than threefold since 1970) without a matching growth in staff numbers is affecting research; there is too little competition for resources as university chairs come with guaranteed research funds; and there are too few opportunities for young scientists, with professors holding jobs that are secured for life regardless of their performance. The upshot of such concerns is the widespread perception that "the quality of university research is not what it should be, and that universities are losing their attractiveness as a location for top scientists" (Nature, January 1998:5-6). Such a perception clearly places credibility pressures on universities.

These discussions about the reform of the higher education sector, and more specifically, about enhancing and safeguarding the quality of university research, are uppermost in the minds of policy makers, university administrators and academics alike. The issue is in its infancy, and apart from existing mechanisms to promote young scientists (particularly as part of the HSPIII), it is the implementation of regular university research evaluations that has received the most concrete attention. Given their responsibility for the higher education sector, it is the governments of the Länder that have been tasked with initiating and implementing such evaluations.

Given that there is no legal basis for enforcing individual universities to commit themselves to evaluation exercises, some of the Länder are offering financial incentives to those institutions willing to restructure departments and/or faculties on the basis of the results of such exercises (Interview: Küppers). In addition, it is interesting to note that the Federal government is using the threat of lesser institutional autonomy as a way of encouraging institutions to participate. In Minister Bulmahn's words, "the willingness of universities to participate in regular evaluation of their research and teaching activities, is a requirement for their continued self-regulation" (BMBF, 1999, translation H. Hackmann). Here the philosophy of autonomy – one that underlies the non-interventionist nature of government's approach to university research – is part and parcel of a strategy that can be interpreted as leaning towards interventionism.

Of the various Länder governments that have initiated reviews of the universities under their jurisdiction, Lower Saxony has been one of the forerunners. (Its role as a leader in this matter may have to do with the pressures associated with the Land's relatively difficult financial situation). In 1998 it set up a scientific commission to assess research performance in its 12 universities. The commission is currently in a planning phase, and hence many of the practical and substantive details have yet to be decided. It has, however, been agreed that the exercise will start by focussing on two areas of research, these being biochemistry and history. This choice was determined by the age profile of professors within these fields: given the high numbers of professors that are due to retire in the year 2005, these fields offer the highest possible opportunity for institutional restructuring, and the promotion of young scientists (and presumably women) into leading positions. It has also been decided that the evaluation of these fields will target departments and/or faculties rather than individual scientists, and that it will be based on peer review. Assessment criteria are still under discussion, but are likely to include a personnel profile, numbers of students, amount of external funding secured, as well as publications (Interview: Schiene).

Over and above the evaluation issue, a mechanism to promote competition between both academics and universities was recently proposed by the HRK. The suggestion entailed linking academic salaries to performance, and allowing universities to pay industrial-level salaries to top quality scientists. In essence universities would no longer be obliged to restrict themselves to Länder determined salary scales, and would thus be free to negotiate starting salaries with a candidate for employment. Increments would then be performance-related, with assessments being based on number of publications, amount of external funding secured, prizes and/or awards, numbers of examinations set, and the results of student teaching evaluations. Enormous opposition to this suggestion has been generated by the German Association of Universities, which represents approximately 17 000 professors. Not surprisingly, a popular line of defence has been to draw attention to the constitutional right of scientific freedom. The argument is that "if professors are distracted by worries about whether they will qualify for a pay increment, they will not be psychologically free to carry out their research effectively" (Nature, December 1998). This controversial proposal by the HRK continues to inspire debate, yet no further action has been taken to give it any legal basis.

From the above one would be inclined to conclude that the strongly entrenched autonomy of the German academic community may be regarded as both an aid and an obstacle in the reform attempt of German policy makers. It is an historically rooted institution which now finds itself at the centre of a move towards modernising the German university. It is – as has already been mentioned – part and parcel of what may be interpreted as steering impulses emanating from government, and at the same time is used as a defence against such impulses.

APPENDIX: AN OVERVIEW OF SOURCES OF UNIVERSITY RESEARCH FUNDING

University research is funded from four main sources, namely government (at Federal and State or Länder level), industry, foundations, and international sources such as the European Union (EU). In terms of Federal government funding, the lion's share of these resources come from the Ministry of Education, Science, Research and Technology (Bundesministerium für Bildung und Forschung or BMBF). A brief description of the various funding categories is provided below. Where available, relevant expenditure statistics are given.

1. **Basic statutory funds provided to universities by governments of the Länder.**

   These funds comprise core resources for both teaching and research within universities. They are intended to cover both the cost of permanent staff, as well as operating costs. Additional resources for temporary staff members are provided on a competitive or performance basis. The research share of general university funds is determined by using a constant R&D coefficient, which is based on past surveys of the amount of time spent on research and teaching by a sample of scientific staff. This share is earmarked for providing professors with the necessary resources for staff, infrastructure and the time to actual do research.

2. **Funds for the construction and extension of higher education institutions (including university hospitals) provided jointly by the Federal and Länder governments** (roughly on a 50%-50% basis).

   These funds are intended to cover the acquisition of land, construction costs, as well as equipment, including large-scale scientific equipment, information and communication technologies, and basic book stocks. In terms of Federal government's contribution, approximately 28% of the budget for this funding category (DM 583 million of the 1997 budget of DM 2083 million) is classified as R&D expenditure.

   In addition to this funding category, the BMBF channels approximately 14% of its budget (DM 1040 million in 1997) for large-scale equipment for basic research to university institutes involved in the following areas of work:
   - Nuclear and particle physics dealing with atomic and subatomic matter;
   - Structure and dynamics of condensed matter;
   - Earth-based astronomy and astrophysics.

3. **Special University Programme funded jointly by the Federal and Länder governments** (roughly on a 60%-40% basis).

   An amount of DM 3,68 billion has been earmarked for the third Special University Programme (Hochschulensonderprogramm or HSPIII), which will cover the period 1996 to 2000. The HSPIII is aimed at enhancing the teaching and research performance of higher education institutions. In doing so, it has identified the following priorities:

- Improving higher education structures (mostly focussed on teaching arrangements, but includes increasing the number of postgraduate research groups).
- Developing the sector of Fachhochschulen (mostly focussed on teaching arrangements. Note, however, that since 1992, the BMBF has run a special programme to fund application-oriented research projects within all disciplines taught at Fachhochschulen. The programme is called "Application-oriented research and development at Fachhochschulen (aFuE)", and its aim is to improve the ability of Fachhochschulen to attract external funding. In 1998, the BMBF allocated an amount of DM 11 million to this programme).
- Developing and enhancing university libraries.
- Intensifying European and international co-operation (includes fellowships for young scientists to go abroad and funds for visiting or guest lecturers).
- Promoting young scientists (emphasis is placed on special programmes for doctoral and post-doctoral scientists, and providing the resources for early appointments to chairs).
- Promoting women (Includes fellowships for postgraduate refresher courses, and programmes to promote female professorial candidates).

In addition to the above priorities, a special scheme aimed at supporting innovative research units within the new Länder has been incorporated into the HSPIII. Under this scheme, an amount of DM 100 million has been allocated to encourage university researchers in the new Länder to enter into collaborative projects with industry. As from 1997 this scheme has been complemented by an additional DM 100 million (for the period up to 2000), which is jointly provided by the Federal government, the new Länder, and Berlin.

4. **The Deutsche Forschungsgemeinschaft (DFG) funded jointly by the BMBF and governments of the Länder** (on roughly a 60%-40% basis, but this depends on the specific programme involved).

(Note that the DFG also receives funds from several other sources, including the Donor's Association for the Promotion of Sciences and Humanities (Stifterverband für die Deutsche Wissenschaft), but these amount to about 1% of its overall budget).

The DFG is Germany's largest research funding organisation, allocating approximately 90% of its budget to higher education institutions for research purposes, (including doctoral scholarships). The DFG has several modes of funding. These include:

- Individual grants (40% of total funding budget.
- Priority programmes (15% of total funding budget) focussing on specific themes selected by the DFG's Senate for a period of up to five years. These programmes may be transnational in scope (in which case the DFG co-operates with partner organisations in another country). Fourteen programmes are currently funded.

- Research groups (4% of budget), which are intended to foster inter-disciplinary collaboration between researchers in innovative areas of research
- Collaborative Research Centres (27% of budget): Known as Sonderforschungsbereiche, these centres bring together researchers from several disciplines in one or more universities.
- Fellowships (3% of budget), awarded to post-doctoral and habilitation scholars.
- Graduate Colleges (5% of budget): Operating since 1990, graduate colleges are funded for a maximum period of nine years. They aim to promote high quality doctoral studies, often in inter-disciplinary areas, and emphasise shortening the average time to acquire a PhD to three years.
- Scientific Awards (1,5% of budget
- "Innovationskollegs" (2% of the budget): This programme is based on special funding from the BMBF, and is aimed at strengthening the research profile of universities in the new Länder. It seeks to encourage co-operation between these universities and partners in independent research institutions and/or the private sector, as well as international co-operation. The programme ends in the year 2002.
- "Supporting cutting-edge research" (% not available): This special programme is intended to support, and set up as role models, outstanding researchers by reducing their administrative work, creating improved working conditions, and enabling co-operation with other scholars.

5. Project funding provided by Federal and Länder governments.

Project funding from either the BMBF or a number of other Federal and/or Länder Ministries mostly takes the form of contract research, and relies heavily on the work of the ministries' own scientific institutions and/or facilities jointly funded by the Federal and Länder governments. The latter facilities include the institutes of the Max Planck Society (MPG), the Fraunhofer Society (FhG), the Helmholtz Association of German Research Centres (the Großforschungseinrichtungen), and the Gottfried Wilhelm Leibniz Scientific Association (formerly known as "Blue List" institutions). Universities and other higher education institutions also benefit from direct project funding under various specialised programmes of the BMBF or other Federal and/or Länder ministries.

A new element of government research funding and promotion are the so-called **"Leitprojekte"** (Lead Projects) managed and funded by the **BMBF**. Their purpose is to foster "a strengthened innovative orientation of German science and industry", by bringing together businesses, universities, research institutions and users in consortia and co-operative research networks (BMBF, 1998:132). Participants compete in a two-round contest of ideas, which involves independent expert jurors, for funding of innovative projects under several subject areas. Winners of the first round of ideas are invited to submit detailed project proposals for a second round of consideration. It is at this stage that other potential partners – and particularly small and medium-sized enterprises – can apply to project teams for inclusion in the project. Subject areas are defined by high-level representatives from science and industry, and include:

- Innovative products based on new technologies including the associated production processes;
- Utilisation of knowledge for initial and continued training and for innovation processes;
- Diagnosis and treatment using molecular medicine;
- Mobility in conurbation;
- Man-technology interaction in the knowledge-based society;
- Energy generation and storage for decentralised and mobile use;
- Nutrition: modern food production processes.

Up to five projects are selected per subject area. The first Leitprojekte were selected in March 1998.

6. Project funding provided by the business enterprise sector.

In 1995, 8,2% of R&D expenditure within the higher education sector was financed by industry. Funding primarily takes the form of contract research.

7. Foundations.

There are two important foundations in the German research landscape. They are:

- The Donors' Assocation for the Promotion of Sciences and Humanities (Stifterverband für die Deutsche Wissenschaft): Currently managing 253 foundations, this association seeks to identify and contribute to the solution of structural problems in higher education and research. Its field of activities includes establishing research networks, supporting fellowship programmes, promoting dialogue between universities, industry and government, etc. Most of the funding that benefits university researchers is channelled through other organisations such as the DFG.
- The Volkswagen Foundation: Established in 1961 as a private, non-profit organisation, this foundation aims to support university research and teaching in problem-oriented basic research, and to enhance the infrastructures of such activities. Grants are made available to institutions rather than individual researchers, and cannot be used to augment budgetary deficits.

8. European Union.

According to Reger & Kuhlmann, the financing of research in German higher education institutions has grown rather slowly. Whilst hardly perceptible in 1985, it comprised just under 2% as a proportion of research financing of these institutions in 1990. Although it is gaining in importance as a source of funding, it continues to play a fairly auxiliary role (1995:81/106).

Apart from the basic statutory funds provided by the governments of the Länder (point 1 above), all other funding categories are regarded as external funding (Drittmittel). Thus the funding of university research in Germany has a dual basis.

References

BMBF. 1998. Facts and Figures 1998: Report of the Federal Government on Research. Abridged Version. Bonn. BMBF.

BMBF. 1990. Hochschulen sollen modernisiert und reformiert werden. Press release of a speech by Edelgard Bulmahn. Bonn, 09.03.1999.

Bulmahn, E. 1999. Mut zur Veränderung: Deutschland braucht moderne Hochschulen. Bonn. BMBF Report.

http://www.bmbf.de (website of the BMBF)
http://www.dfg-bonn.de/ (website of the DFG)
http://www.stifterverband.de (website of the Stifterverband für die Deutsche Wissenschaft)
http://www.volkswagen-stiftung-de (website of the Volkswagen Foundation)

Kaiser, F. et al. 1998. Separating teaching and research expenditure in higher education: A pilot-study into the potential of the subtraction method. CHEPS Report.

Nature, Vol 396, December 1998

Nature, Vol 391, January 1998

OECD. 1998. Universities in transition. Paris. OECD.

Reger, G., & S. Kuhlmann. 1995. European technology policy in Germany: The impact of European Community policies upon science and technology in Germany. Heidelberg. Physica-Verlag.

Rip, A., & B. Van der Meulen. 1997. The post-modern research system. in Barré, R., M. Gibbons, J. Maddox, B. Martin., & P. Papon. Science in tomorrow's Europe. Paris. Economica International.

Schiene, C. 1998. Research and technological development in Germany. Unpublished report for the TSER Project "Self-organisation of the European Information Society".

Senker, J 1999. University research financing. Paris. OECD.

Interviews

Christof Schiene of the Ministry for Science and Culture of the Land Lower Saxony.

Günter Küppers of the Institute for Science and Technology Studies at the University of Bielefeld.

SWITZERLAND by Heide Hackmann

Introduction

The Swiss Confederation consists of 23 sovereign cantons, of which three are divided into six half cantons. Whilst each of the cantons reserves for itself important local powers, competencies are shared within the research and technological development (RTD) policy sector. This is particular evident within the Swiss university sector, which comprises ten cantonal universities and two federal technical universities (Eidgenössische Technische Hochschulen or ETHs).

Whilst the federal government is solely responsible, in both financial and decision-making terms, for the two federal technical universities – ETH Lausanne and ETH Zürich - federal and cantonal authorities share these competencies when it comes to the ten cantonal universities. The latter are:

- Universität Basel
- Universität Bern
- Università della Svizzera Italiana
- Universität Freiburg
- Universität Genf
- Universität Lausanne
- Universität Luzern
- Universität Neuenburg
- Universität St. Gallen
- Universität Zürich

Apart from the institutions mentioned above, the Swiss higher education sector includes several polytechnics (Fachhochschulen), which are currently the focus of federal government initiatives aimed at the development of both their teaching and applied research capacity. The ultimate goal of these initiatives – to be reached by 2003 - is to bring the polytechnics and universities into closer alignment, and to develop a higher education sector policy that encompasses both types of institutions. This report excludes from its scope research activities within the polytechnics. Instead, it focuses on the ten cantonal universities and two ETHs mentioned above.

A. Research Priorities

1. National research priorities

Ultimate responsibility for Swiss science and technology (S&T) policy rests with the Bundesrat or Federal Council, which is elected by Parliament and advised by an independent body known as the Swiss Science Council (Schweizerische Wissenschaftsrat). The latter is primarily composed of leading scientists, but includes representatives of important political and economic institutions. Since 1997, responsibility for the actual co-ordination and implementation of federal policy on education and training, research and technology, has been the joint task of two Federal Departments: the Department of the Interior and the Department of Economic Affairs. The former subsumes the Swiss Science Agency as well as the Federal Office for Education and Science (Bundesamt für Bildung und Wissenschaft or BBW); and the latter embraces the Federal Office for Education and Technology (Bundesamt für Berufsbildung und Technologie or BBT). This arrangement reflects a fundamental split between science policy on the one hand, and technology policy on the other.

In a recent national policy document (Botschaft of 25 November 1998) the federal government has articulated its combined S&T policy goals for the immediate future (2000-2003). They are:

- To strengthen the profile and competitiveness of Swiss S&T.
- To promote access to new knowledge, which will enable both the state and society in general to cope with an ever increasingly complex and global environment. In this regard, a new partnership between science, industry and society has to be forged.
- To support basic research required for innovation.
- To promote applied research in the following thematically defined priority areas:
  - Life sciences (particularly biology, microbiology and medicine) that contribute both to technological progress and the quality of life.
  - Humanities and social sciences that offer new knowledge to the individual and navigation tools ("Orientierungsinstrumente") to society as a whole.
  - Sustainable development and the environment.
  - Information and communication technology.
- Within these priority areas, to adhere to the following guiding principles:
  - Building research capacity and promoting a new academic generation.
  - Meeting the needs of the users of research.
  - Building bridges between different research fields and disciplines.

The explicit linking of both thematic and structural priorities to applied research – and hence the "freedom" of basic research – is noteworthy, and is even more marked in federal policy goals as these relate specifically to the Swiss university sector.

Also noteworthy is the clear articulation of priorities at a federal level, despite the claim of shared decision-making powers between federal and cantonal authorities. Whilst the latter are involved in the consultation and co-ordination processes undertaken by the Science Agency as well as the BBW and the BBT, there is a clear sense of federal government assuming the role of a central, steering actor within the research system as a whole. Again, this is particularly evident within the university sector.

2. University research priorities

2.1 The current situation

Under current conditions, thematic and structural priorities for university research are most notably attached to the allocation of approximately 25% of the research resources managed by the Swiss National Science Foundation (Schweizerische Nationalfonds or SNF). The SNF was established in 1952 as a foundation under private law, in order to fund research at universities and other scientific institutions, and to award fellowships to new and established scientists. The lion's share of its budget comes from the federal government, via the BBW.

The SNF reserves approximately 75% of its annual budget for research grants intended for independent basic research in all scientific disciplines. No priorities are attached to this mode of funding. It is with regard to the other 25% of the SNF budget that priorities, which are determined by the federal government, are attached to the allocation of university research resources. A brief description of the relevant modes of funding, as well as the formulation and nature of the associated priorities, is provided below.

- National Research Programmes (Nationale Forschungsprogramme or NFP)

  Research funded under the auspices of an NFP is intended to contribute to the solution of specific problems deemed to be of national importance. Programme topics are chosen by the Federal Council from a list of suggestions submitted to it by the BBW. In preparing such a list, the BBW gathers the input of relevant cantonal authorities, as well as representatives from universities, technical universities (Fachhochschulen), industry and the broader public. In making its choice, the Federal Council is advised by the Swiss Science Council mentioned in Section A above.

  In 1993, the Federal Council ratified the following NFP topics:
  - Nano sciences
  - Somatic genetic therapy
  - Illnesses of the nervous system
  - Migration and intercultural relations
  - Violence in everyday life and organised crime
  - Transport and the environment
  - Changing developments between Switzerland and Europe
  - Basic principles and possibilities of Swiss foreign policy

  In 1998, the Council announced an additional four NFP's, the topics of which are:
  - Education and employment
  - Problems of the nation state
  - Implants and transplants
  - Supra-molecular functional structures

- Priority Programmes (Schwerpunktprogramme or SPP)

SPPs are intended to build networks and centres of excellence in strategically important areas of research, thus ensuring that Swiss strategic research is on par with international research. The programmes are managed by the SNF in conjunction with the Council of the two Federal Technical Universities of Lausanne and Zürich (the ETH-Rat).
Applications for funding under a SPP are evaluated, and projects are supervised, by a committee of experts appointed by the SNF and ETH-Rat. The research itself ranges from basic to problem-solving, applied research, and projects should aim to:

- be multi-disciplinary in nature; and
- involve collaboration with other organisations, including universities, government departments and industry.

Both the topics and financial resources of SPPs are determined by the Swiss Parliament. The current programmes include:

- Environment
- Biotechnology
- Information and communication structures
- Switzerland: Towards the future

❑ Fellowships

SNF fellowships serve to support both prospective and advanced researchers. In addition to fellowships awarded to doctoral and post-doctoral candidates, the SNF has two special fellowship schemes, namely:

- For women who interrupted their careers in medicine, natural or engineering sciences in order to have families; and
- For industry-related research

In addition to the thematic and structural steering of university research via the SNF modes of funding described above, the Commission for Technology and Innovation (Kommission für Technologie und Innovation or KTI) plays an important role in defining the university research agenda. The KTI is subsumed under the BBT (see point 1 above) and has been tasked to promote industry-related research, with a specific emphasis on the needs of small and medium sized enterprises. It awards project grants with the intention of combining the innovation potential of industrial organisations with the scientific and technical competencies of Swiss higher education and other research institutions.

Although the nature of KTI itself is indicative of a structural priority attached to the public funding of research, the organisation claims to practice a bottom-up approach in that the research topics it funds are primarily defined by the applicants (industrial organisations and/or higher education and other research institutions). Nevertheless, thematic priorities are occasionally identified and used to direct resource allocation, albeit on an ad hoc and temporary basis. Unlike the thematic priorities attached to the SNF's programmes however, the KTI's research agenda is in no way interfered with by, or subject to the approval of, federal government authorities. Examples of current KTI priorities include:

- Integrated production
- Micro-electronics
- Medical technology
- Software engineering
- Integrated construction planning and production

2.2 Priorities for the future

As already mentioned, the Swiss federal government has recently announced its RTD policy goals for the period 2000 to 2003 (Botschaft of 25 November 1998). Apart from those mentioned in point 1 above, several priorities, and associated policy changes, related specifically to the higher education sector have been articulated. These are primarily structural in nature, and they clearly address concerns about Swiss universities as these have been outlined by State Secretary Kleiber, head of the Science Agency and the BBW.

In Kleiber's assessment, the following issues represent major weaknesses within the university sector (Kleiber, 1998):

- The complexity and lack of transparency of decision-making processes, and hence the difficulty of governing the system.
- The fragmentation of the sector, as evident in the fact that inter-institutional co-operation and sharing is a rarity.
- The undervaluing of women and juniors.
- A rupture in the science-society interface.
- The failure to make adequate practical use of knowledge, and hence the restriction placed on the system's innovation potential.
- The absence of a global programme, and hence the difficulty of establishing common goals and objectives for the future.
- A paralysis of the resource allocation system, which is based on previous budgets and hence limits the production of new knowledge.

In response to the above, the federal government has announced the following policy goals for the higher education sector as a whole (Botschaft, 1998):

- To promote the unity of the sector by
  - creating a network of universities and technical universities; and
  - mandating the Swiss University Conference (Schweizerischen Universitätskonferenz) – from both federal and cantonal level – to assume ultimate responsibility for the network, and to facilitate the combined federal and cantonal decision-making processes.
- To ensure that this network is integrated in the international sphere.
- To ensure the quantitative and qualitative development of the network, particularly by emphasising the promotion of equal opportunities for men and women.
- To further the excellence of teaching and research (see section C below)
- To promote the valorisation of knowledge by:
  - building an innovation network amongst universities
  - facilitating the science-society dialogue with support from the Association for Science and Society (Stiftung Wissenschaft und Gesellschaft).

With regard to the implementation of some of these goals, two specific policy instruments have been suggested. They are:

- The partial redirection of that portion of federal funding known as Investitionsbeiträge (investment funds) towards competitive project funding aimed at the promotion of innovation and co-operation between universities. Management of these funds will comprise the main steering instrument of the (renewed) Swiss University Conference. In allocating the resources, it will be guided by the following priorities:
  - Building on existing collaborative projects.
  - Boosting the development of a new academic generation, and promoting equal opportunities between men and women.
  - Building a Swiss Network for Innovation (SNI)
  - Promoting new information and communication technologies within the individual universities.

- The replacement (as from 2000) of the current Swiss Priority Programmes (SPPs) outlined above with national centres of competence in line with specified national research priorities (Nationale Forschungsschwerpunkte). Here the idea is to promote the establishment of specific thematic centres of excellence that will support related research networks. Each centre will have an home institution or "Leading House" (to be either a university or one of the ETHs), which will manage a network of partners from both academic and non-academic institutions.

  With an envisaged life span of up to 10 years, the centres objectives should be to facilitate and promote:
  - Close co-operation between research and its application.
  - The more efficient integration of scientific achievements into university teaching (it is, for example, suggested that centres may undertake to establish Graduiertenkollegs).
  - Inter-disciplinarity.

  In terms of thematic priorities for the centres, the Federal Council - in conjunction with parliament, and on the basis of advice from the Swiss Science Council (which is to be renamed the Swiss Science and Technology Council) – will assume responsibility for defining several strategic topics. These are only intended to provide very broad guidelines, since the idea is apparently not to limit scientifically interesting initiatives and/or the autonomy of universities. Hence the application process will remain open-ended.

  In terms of process, it is foreseen that proposals will be evaluated by ad hoc panels drawing on international expertise, and decisions to award funding will be taken by the Department of the Interior and the Swiss University Conference. It is also suggested that a wider group of users – including representatives from industry, the service sector, the health sector and public administration) should be involved in processes of selection, management and evaluation. The specifics of how this is to happen have not yet been revealed.

As far as selection criteria are concerned, the following list has been suggested:

- Scientific quality, originality and innovation potential.
- Stimulation of inter-disciplinarity
- Strategic relevance in terms of federal policies, as well as the impact on Swiss economic competitiveness and the quality of life.
- Added value in comparison to single projects, e.g. in terms of the potential for playing an international role in the field.
- Suitability of the organisational structures involved, and the potential to improve role allocation between universities.
- Reputation of leaders and partners.
- Potential for knowledge and technology transfer, including the potential for partnerships with non-university actors, and mechanisms for improving the relationship between research and application.
- Impact on further education and the promotion of women.

These instruments, as well as the policy priorities underlying them, are currently being debated by the Swiss Parliament, and hence it is possible that the details of what has been proposed may change. Despite this, it is interesting to note a general shift away from thematic prioritisation towards the articulation of fairly explicit and extensive structural priorities. The shift is accompanied by a renewed emphasis on academic autonomy that, it is suggested, will allow universities to respond more quickly and more flexibly to societal demands. Together with this “renewed” respect for academic autonomy, the impression of federal government as a central steering actor, is lessened, and a sense of striving towards a more socially distributed process of agenda setting is created.

B. The quality of university research

In the 1998 Botschaft, which outlines Swiss S&T policy goals for the future, the question of safeguarding and furthering the quality of Swiss teaching and research is emphasised. The focus, however, falls more on teaching than research. In this regard, the federal government has proposed the establishment of an Institute for Quality Assurance (Institut für Qualitätssicherung) to introduce (or support existing) quality assurance measures by undertaking tasks such as bringing accreditation mechanisms in line with European standards, and establishing an information and documentation centre.

With regard to research, three proposals relating to the quality issue have been made:

- In the first place, the need to stimulate competition between higher education and other research institutions has been stressed.

- Secondly, it has been suggested that instead of trying to build a competence which covers the full range of scientific fields, universities and other higher education institutions should be building on existing strengths and developing excellence in areas deemed strategic for the future. This imperative will be addressed within the network of higher education institutions which the University Conference has been tasked to develop and manage.

- Finally, it has been proposed that basic subventions for research should increasingly be performance oriented. Rather than being based on previous expenditure, the allocation of core funds should be related to criteria such as:
  - citations
  - proportion of external funding secured
  - impact of research.

  The exact nature of the mechanisms, criteria and procedures to be used in this regard are not dealt with in the Botschaft document. The proposal entails a change in the Hochschulförderungsgesetz, an issue that is currently being debated at parliamentary level, and the results of which are still unknown.

APPENDIX: AN OVERVIEW OF SOURCES OF UNIVERSITY RESEARCH FUNDING

With regard to university funding, the Swiss Federal Office for Statistics (Bundesamt für Statistik) distinguishes between three categories of funding. These are:

- First stream (or basic) funding includes:
  - Core funds (covering personnel, equipment, building and other infrastructural costs) from both federal and cantonal levels.
  - Own income of the university.
  - Additional funds from the university cantons.

  Note: Within this category, no distinction is made between funds allocated for teaching and research activities.

- Research funding from the Swiss National Science Foundation (SNF)

- Third stream funding (Drittmittel) includes:
  - Public funds which are either project-related or take the form of contracts and commissions. Research funds allocated by the Commission for Science and Technology (KTI) are included in this category.
  - Donations and/or contracts from the private sector.
  - Contributions from public and private non-profit organisations.

Table 1.: Swiss university funds allocated during 1996 (in 1000 Fr.)

Funding Category	Amount
First Stream	2 859 120
SNF Research funding	190 629
Third Stream	408 128
TOTAL	**3 457 877**

(from Bundesamt für Statistik, 1997: 25)

References

Botschaft über die Förderung von Bildung, Forschung und Technologie in den Jahren 2000-2003. November 1998. http://www.admin.ch/bbw/bbtd/bbtdindex.html

Bundesamt für Statistik, 1997 Hochschulfinanzen: Bildung und Wissenschaft. Bern. BFS.

http://www.admin.ch/bbt (website of the Bundesamt für Berufsbildung und Technologie)

http://www.admin.ch/bbw (website of the Bundesamt für Bildung und Wissenschaft)

http://www.admin.ch/gwf (website of the Swiss Science Agency)

http://www.snf.ch (website of the Schweizerische Nationalfonds)

Kleiber, C. 1998. Towards a society founded on education, science and culture: Program for the future of Swiss higher education.
http://www.admin.ch/gwf/doc/e_zukunftsprojekt.html

Schweizerische Nationalfonds, 1996. Jahresbericht. Bern. SNF

Schweizerische Wissenschaftsrat, 1997. Zielvorstellungen für die Entwicklung der Schweizerischen Hochschulen: Periode 2000-2003. Bern. SWR.

THE UNITED KINGDOM by Heide Hackmann

Introduction

The structure of higher education and university research funding in the UK changed significantly after 1992 when the former polytechnics were given the right to the title of "university". With this move, funding arrangements for the two sectors were unified, and the former polytechnics – now referred to as "new" universities – started being explicitly funded in order to maintain a general research infrastructure. Today there are 115 higher education institutions, which call themselves universities, in the UK. This report focuses on the priorities for research in these institutions.

A. Research priorities

1. National research priorities

The 1993 Government White Paper "Realising our Potential" spelt out a number of important changes in government's policy and organisation of science, engineering and technology. The central theme of the Paper was competitiveness: making UK research more responsive to the needs of the country, and particularly, to industry.

A key element of the White Paper was the announcement of a national Technology Foresight Programme (TFP) to inform government priorities. The TFP was launched in 1994 under the management of the Office of Science and Technology (OST) in the Department of Trade and Industry (DTI). With government committed to the next foresight exercise, which was launched on the 1st of April 1999, this mechanism of national priority setting has become a fixture of the UK's research landscape.

1.1 About foresight

The overall purpose of foresight is to develop visions of the future: to identify possible future needs, opportunities and threats and to decide what to do now in order to be able to meet these challenges. "We live in a world of change. The need to anticipate and prepare for the future is crucial. That is Foresight" (http://www.foresightdemo.cmgplc.com/-default.htm). From a policy perspective, foresight's primary intention is to contribute to the development of long-term policy objectives; and the identification of shorter-term actions to support them. More specifically, the aims of the TFP are to:

- "Increase UK competitiveness;
- Create partnerships between industry, the science base and government;
- Identify exploitable technologies over the next 10-20 years; and
- Focus the attention of researchers on market opportunities and hence to make better use of the science base" (Senker, 1998:21).

The UK's first foresight exercise was undertaken by 15 sector panels whose work was overseen by a steering group. Both the panels and the steering group comprised leading figures from industry, academia, government and the so-called voluntary sector. In essence, panels were responsible for producing reports based on processes of widespread consultation. Government claims that the work of the sector panels – involving regional and topical workshops, surveys of experts, as well as Delphi questionnaire surveys – tapped in on the views and opinions of over 10 000 people (Interview: Peter Healey). In May 1995 the steering group published a report, which distilled cross-sector priority themes from the recommendations made in the individual panel reports (see 2. below).

The new foresight exercise will follow a broadly similar modus operandi. A change in the panel structure has lead to the establishment of thematic panels over and above the sector panels. The latter will carry forward and develop the work of the existing (first round) panels by focussing on business sectors or broader areas of activity. The new thematic panels have been tasked with addressing broad social and/or economic issues that might drive wealth creation and affect quality of life in the future. A number of "Associate Programmes" have also been created. These will be run by professional institutions and research and technology organisations, and will support the work of the panels by investigating the future of specific topics.

A further addition to the foresight process is a brand new website which, amongst other things, enables one to interact with panel members and/or contribute to what is called the "knowledge pool". The latter is a freely accessible "electronic library of strategic visions and information about the future, which supports and informs the work of Foresight panels and Foresight networks" (http://www.foresight-demo.cmgplc.com/default.htm). By developing this on-line consultative process, the OST hopes to broaden the spectrum of stakeholders involved in foresight, thereby enhancing the legitimacy of its outcomes. The OST is specifically interested in facilitating the involvement of young people and SMEs. The website is also part of government's strategy "to spread the Foresight philosophy throughout the UK" (DTI/OST, 1996:7).

1.2 Foresight priorities

The priority themes published by the foresight steering group in May 1995 were published in the 1996 "Forward Look", an annual DTI/OST publication which provides an overview of publicly funded R&D and reports on initiatives taken to meet government policy objectives. The themes that were presented and that comprise the national thematic research priorities that shape the UK public research system are listed in Box 1. Underlying these priorities, is the more generic structural priority of enhancing the industrial relevance of research by fostering academic-industry linkages. Other structural priorities – promoting the role of women in science, for example – are occasionally referred to in the policy rhetoric, but have not been attached to specific implementation mechanisms.

Box 1.: Foresight priorities themes as presented in the 1996 Forward Look

"The Technology Foresight Steering Group report pointed to six priority themes having long range competitive potential in terms of markets, strong scientific capabilities in the UK and pervasive effects across the economy and society. They are:

- harnessing the future power of communication and computing technologies;
- building new products and processes from the expansion of biological and genetic knowledge;
- improving the range, flexibility and quality of materials;
- securing high standards of products and services through sensor and automation technologies, business processing and management systems;
- securing a cleaner world through the development and application of environmental sciences and technologies for pollution control, clean processing and clean energy, and product life cycle analysis; and
- applying knowledge of social trends and social factors to the better understanding of markets, risks perception and the human impact of new technology.

Ministers have identified a seventh theme in which these fields for advance come together to provide a focus on quality of life objectives:

- "Extending Quality Life" (EQUAL) through better understanding of the interactions between health, diet and lifestyle, and the development of technologies for healthy aging, for neighborhood and individual security, and for improved access to leisure, learning and financial services.

A drive towards more investment in these fields will enable the UK to build on its strengths and to influence its competitive future rather than having to react to global competition." (from DTI/OST 1996:6)

2. University research priorities

Amongst other things, the new foresight website spells out the benefits of foresight to a number of stakeholder groupings. As far as the university researcher is concerned, foresight is said to enable the identification of future opportunities (new areas for research, new applications for existing research, new partnerships and networks); and raise awareness of work among organisations and sectors one might not have dealt with before. In addition, researchers are reminded that "alignment to Foresight priorities can help when applying for funding" (http://www.foresight-demo.cmgplc.com/-default.htm). This reminder signals the extent to which foresight priorities – both thematic and structural - have been attached to the numerous sources of public funding of university research.

Government has instructed its various departments involved in procuring academic research, as well as the Higher Education Funding Councils (HEFCs) and Research Councils (RCs), to take foresight priorities into account in their policies and decisions about allocating public research funds. The instruction has been accompanied by a call for public accountability. Thus government departments, HEFCs and RCs are expected to report on the steps they have taken to implement foresight recommendations and priorities, and orient the system towards increased competitiveness. They did so in the 1996 Forward

Look. Overviews of the relevant (actual or intended) activities reported by the RCs and the HEFC for England (HEFCE) are provided in sections (b) and (c) below. (Note that the combined budgets of the HEFCs (the General University Fund allocated by the Department for Education and Employment (DFEE) and the RCs (the science budget allocated by the DTI) comprise the bulk of government funding of university research). Section (a) focuses on important initiatives set up by the DTI/OST.

(a) DTI/OST-initiated technology transfer and/or university-industry collaboration schemes

    Table 1 (see page 83) provides an overview of the several technology transfer and/or university-industry collaboration schemes initiated by government. These schemes comprise government's own response to implementing the generic objective underlying foresight, namely to enhance the industrial relevance of research by bringing the science base into closer partnership with industry. The majority of the schemes draw partly on funding from the science budget. As such they are the instruments for reaching one of the targets set by the OST in the 1998 allocation of the science budget, namely to "increase by 50% the number of companies established annually as a result of the public sector science base" (DTI/OST, 1998:9). The participation of the individual RCs in such schemes during 1995/1996 is reflected in Table 2 (see page 84).

(b) Activities and initiatives of the Research Councils (RCs) towards implementation of foresight priorities and recommendations within the university sector.

    The charge to implement foresight priorities and recommendations, and to allocate a percentage of their funds to the various technology transfer and/or university-industry collaboration schemes, has been tackled by the different RCs in a variety of ways. The overview presented in Table 2 (seep page 84) summarises those activities and/or initiatives reported in the 1996 Forward Look. Where available, this has been supplemented with more recent information. It also distinguishes between those directed at thematic priorities (as mentioned in section 2 above) and those aimed at meeting the more generic goal of enhancing the industrial relevance of research.

    With regard to the RCs, it is worth noting the extent to which mechanisms aimed at enhancing the industrial relevance of research rely on the incorporation of the so-called users of research in an advisory, consultative or evaluatory capacity. In most cases users are equated with representatives of industry. The engagement with industrial users has been regarded as an imperative of the activities of RCs since the 1993 White Paper "Realising our Potential".

(c) Activities and initiatives of the Higher Education Funding Council for England (HEFCE) towards implementation of foresight priorities and recommendations within the university sector.

Charged by the DFEE to maximise the commercial exploitation of university research, the HEFCE reported in the 1996 Forward Look that it has:

- Launched a joint initiative - together with the OST, the Scottish and Irish FCs, and the RCs - aimed at funding research equipment in foresight priority areas.
- Initiated a review of its funding methodology with a view to shifting funds towards foresight priorities.
- Urged universities to take account of these priorities when allocating FC funds internally. The HEFCE has also indicated that it intends monitoring such processes. In this regard the organisation reported that "the Council has recognised that the chief response to Foresight by the higher education sector will be through the individual decisions of universities and colleges. It has made clear that it expects them, in allocating their research funding locally, to take full account of the national priorities identified. The Council will judge and report in due course on how institutions are responding to Foresight priorities using evidence from the research plans provided for the 1996 RAE, institutions' annual strategic plans and their research accountability returns. HEFCE will then consider the need for greater stimulation and for raising awareness of Foresight and other SET White Paper priorities" (DTI/OST, 1996:149).

Some critics have argued that the HEFCs should not be involved in encouraging university departments to concentrate their expertise on areas of national priority. This task, it is argued, is already being performed by the RCs. Given the dual support funding system (see Appendix: Section 1), it is suggested that RC funding (the science budget) may be used to steer university research, but that universities should be setting their own agendas as far as the use of HEFC funding (general university funds) is concerned. In response to this criticism, the policy director of the HEFCE claims that "It is up to universities to decide how to spend money they receive from the funding councils. They may want to give it to their existing centres of excellence. On the other hand, they may want to develop other areas. These are decisions for them, not for us" (Nature, June 1998).

This statement seemingly contradicts the intentions of the HEFCE as outlined in section 3(c) above. As such it raises an important question: What weight does foresight carry? How authoritative are the priorities and recommendations it generates? How strictly or rigidly are they to be implemented, in this case at the level of university research? If the response of the HEFCE's policy director to the organisation's critics is anything to go by, foresight priorities are not intended to be rigidly imposed on the university research community. On the contrary, his message sends an assurance of autonomy to that community.

As far as the RCs are concerned, there appear to be degrees of determination to take up and implement foresight priorities (see Table 2). At the one end of the spectrum the ESRC has announced its intention to allocate 75%-80% of its budget to programmes and research centres directed at foresight priority themes. At the other end, the MRC has explicitly opposed directing the research it funds, and stresses that it will allocate resources purely on the basis of excellence and originality, whatever the topic may be. In assuming this stance, it can of course defend itself by recourse to the claim that the nature of the research it supports falls within the broadly defined foresight priorities as it is.

Despite this variance in attitudes towards implementing nationally defined research priorities, there is a general perception that the RCs as a whole are taking foresight really seriously, and more specifically, that government is making them do so. References to government ‘instructing’ or ‘charging’ the RCs to implement foresight priorities are indicative of the extent to which government is seen as a principal steering the university research system. So is the conclusion, made by several commentators, that the RCs long standing arm’s-length relationship with government has been replaced by an arm’s-length relationship with the universities. The diminishing rate of responsive mode funding, and the accompanying “duty-of-care” to a subject area, is seen as evidence of such a shift (NAPAG, 1996:3).

Of course government itself has contributed to its image of being the controlling actor by pushing foresight in the way that it has. Undertaking to produce publications like the Forward Look in which the RCs have to account for their actions in support of foresight, is a case in point. Nevertheless, the image is tempered by an equally emphatic assertion, by government, of the autonomy of both the RCs and university researchers themselves. In the document which presents the allocation of the (1999-2000) science budget, for example, the OST refers to the ‘Haldane principle’ (which was formulated nearly 80 years ago) as providing an operating framework defining the relationship between government and the RCs. Accordingly, OST sees its role as setting broad guidelines, including specifying some broad areas of science that should be prioritised. Beyond this, however, it “has no involvement in deciding which people or which particular research projects are to be funded. … within this, the Councils are free – and are expected – to set their own policies” (DTI/OST, 1998:Addendum). The differences in responding to foresight between, for example, the ESRC and MRC suggest that the RCs do exactly this. At another point in the document, it is stated that “Government wishes to see responsive mode, in general, increased even within specified priority areas”(Ibid.:8). This particular comment is made in a discussion about the ROPA scheme, thus contradicting – or at least diminishing - the concern about the RCs duty-of-care responsibilities.

An interview with an OST member of staff confirmed the non-interfering nature of government’s approach. “Government will not dictate to professors what they study. In broad, general terms, universities should contribute towards economic development, but we don’t want to lead them down a short-term path towards technology exchange programmes, etc.”. In support of this argument, the interviewee referred to the actual figures involved in the latest science budget: ROPA, LINK, and similar schemes (see Table 1) represent a fraction of the resources that are allocated to RCs for supporting university research.

These comments and insights serve to soften – if not dispel – the perception of government as a steering principal, and further, suggest that academic autonomy is not nearly as threatened as some would claim it to be. How then does one interpret the meaning of the foresight exercise and the weight attributed to its outcomes? In the words of the OST staff member interviewed, foresight is regarded within OST circles as "telling people what they already know. It is accepted wisdom. The trick, however, is to send a signal to universities to develop links with industry". Here is the crux of the matter: foresight priorities are signals which serve to constantly remind the research community of values that they themselves were involved in articulating. Government primarily takes responsibility for ensuring that the signals are visible, but the onus of responding to them ultimately lies within the research community itself.

Given the above discussion, as well as the way, in which foresight has been marketed by the OST, it invariably dominates any discussion of national research priorities in the UK. As such, equally important (parallel) priority setting processes at governmental level, as well as the actors involved in them, tend to be obscured. With regard to university research, the process whereby government decides on allocating resources to the RCs (the science budget), is a case in point.

A number of actors are involved in advising government about the allocation of funds between the RCs. They include:

- The Council for Science and Technology (CST), which is chaired by Sir Robert May (Chief Scientific Adviser) and includes the chief scientists of various government departments, academics, and industrialists. In providing advice to government, the Council is expected to consider the extent to which universities are set up to meet the needs of the customers of publicly funded research, and as such is required to take account of the recommendations and priorities of foresight.
- The Director General (DG) of RCs is advised by a small group of independent experts.
- The Committee of Vice-Chancellors and Principals (CVCP) plays an important role in representing UK universities in governmental policy debates. Apart from an advisory function, the Committee actively campaigns for universities by means of media relations and parliamentary lobbying (http://www.cvcp.ac.uk/cvcp.html).

According to the OST member of staff interviewed, the actual process whereby the science budget is decided upon lies in the hands of the DG of RCs, who has "absolute discretion" in this regard. "Sir John Cadogan (former DG) discussed the allocation with Sir Robert, but beyond that no formal consultation process was involved. This is where prioritisation is taking place, at the very highest level". (Interview: Roger Higginson). This statement reveals the informality – and to some extent the non-transparency - of governmental policy making processes. It also serves to highlight a point already made (see Section 4 above), and that is that important policy decisions are not necessarily led or dominated by foresight.

B. The quality of university research

In the latest allocation of the science budget, the OST emphasises the imperative of maintaining the quality of academic research. The mission statements of the individual

RCs place a similar emphasis on excellence, mostly referring to the peer review of proposals as a way of ensuring it (DTI/OST, 1996). In this regard there is little that distinguishes the UK system from others. Instead, it is the research assessment exercises (RAEs), which have been institutionalised as a regular national activity undertaken by the HEFCs (and their predecessors), that mark the UK's difference.

Beginning in 1986, there have been four RAEs: the second in 1989, third in 1992, fourth in 1996, and a fifth round is scheduled for 2001. They comprise the basis on which the allocation of HEFC research funding is made, and are motivated by the belief that research resources should be distributed selectively between and within universities, on the basis of excellence. In essence, the RAEs have been designed to assess the quality of university research by peer review. The units of assessment are subject areas, and the main focus of assessment falls on publications.

This section briefly outlines the salient features of the modus operandi and assessment criteria of the four RAEs undertaken thus far. This overview draws extensively on the work of Ball, 1997. It concludes by summarising their widely perceived advantages and disadvantages, and by indicating some of the more important changes to be made to the next RAE.

(a) The 1986 RAE

The first attempt to undertake a national research evaluation exercise was severely criticised for its lack of transparency, and particularly for not making the basic procedure and assessment criteria clear.

(b) The 1989 RAE

With the review period defined as the five years preceding this RAE, assessment by subject panels (in consultation with outside experts and RCs) was based on the following items of information supplied by the universities:

- One or two publications per academic/research staff member;
- The numerical total number of publications for all staff;
- The number of research students and successful doctoral submissions;
- The number of research grants awarded and contracts secured;
- An overview of the research objectives and priorities for each subject area, as well as an indication of how successfully these had been pursued.

Panel membership included representatives from universities, subject associations, professional bodies, learned societies, and government departments.

(c) The 1992 RAE

This RAE differed from the previous one in that it included assessment of what had been known as polytechnics (the "new universities"). In addition, it required universities to submit information only about those staff actively engaged in research and was based on a snapshot approach, focussing on those staff holding posts in June 1992.

Publications comprised the core of the review of the 72 subject areas included. With an emphasis on quality rather than quantity, the RAE required universities to list two publications per researcher (this could include work accepted for publication), plus two other forms of public output. Panels dealing with smaller numbers of submissions would attempt to read the publications submitted. Those with larger submissions focussed more on the vehicle of publication (e.g. particular journals). In general academic journal articles were given most weight. Within the arts and humanities, however, books and chapters in books were considered to be the most important.

(d) The 1996 RAE

As with the 1992 RAE, this RAE involved peer reviewed assessment of research quality by specialist subject panels. In this case, the number of subject areas had been reduced to 69. Moving even further in the direction of an emphasis on quality rather than quantity, universities were required to submit four publications (excluding work accepted for publication) per staff member being taken into account for the period 1992 to 1996 (rather than 2 publications for one particular point in time). In addition to publication details (which carried approximately 40% of the weight of assessment), universities were asked to provide the following information:

- The number of research students and studentships;
- The number of doctoral and research masters degrees awarded;
- The amount of external research income secured;
- An overview of current arrangements for promoting and supporting research;
- An indication of future research plans.

On the basis of the results of the 1996 RAE, about 70% of the HEFC research budget will be allocated to approximately 30 UK universities (those that received the three highest possible scores). Thus the exercise leads to a concentration of resources in existing centres of excellence.

(e) Advantages and disadvantages of the RAEs

Senker summarises the widely perceived benefits of the system of RAEs by identifying two points. On the one hand, the emphasis on selectivity that they represent is seen to encourage universities to concentrate on the strengths. Secondly, university departments have tended to increase their grades without additional expenditure from government. This is taken as an indication of the system's potential for encouraging growth. Here Senker includes the more cynical interpretation, namely that improved ratings reflect little more than an improved skill in preparing for a RAE (1998:35-38).

The perceived disadvantages of RAEs are far more numerous. A report by the National Academies Policy Advisory Group (NAPAG) summarises them as follows:

- Whilst the RAEs promote competition between universities, there are also good reasons for encouraging collaboration and networking between them. This presents policy maker with an irreconcilable tension.
- In order to optimise their allocations, universities engage in patterns of action which, in a more general sense, are undesirable. The distortion of internal procedures/definitions so as to maximise the numbers involved in research is a case in point. Recruitment and retention policies are significantly affected. Due to the practice of headhunting, staff mobility became almost frenetic during 1995.
- The review periods impose a time frame which militates against more speculative research and/or research which may lead to publication in the form of a book.
- The RAEs tend to disadvantage interdisciplinary research.
- Combined with pressures on public funding, the RAEs make it difficult for new researchers and/or new universities to establish a research role for themselves.
- Investment in research at the expense of teaching is a danger. (An article in the June 1998 edition of Nature reports that HEFCs had begun consulting with universities about how to improve teaching whilst retaining high-quality research departments).

(NAPAG, 1996:14-24).

In response to some of these criticisms, the HEFCs have announced a number of changes to be reflected in the 2001 RAE. These include:

- Overseas scientists will be drawn into the RAEs. The idea is for each subject panel to choose a corresponding "virtual panel" of overseas experts.
- Interdisciplinary research is to be fairly treated by appointing interdisciplinary researchers to the panels and urging other panel members to beware of inadvertently undermining interdisciplinary research. At the same time universities should specifically mark those submissions that are of an interdisciplinary nature so as to alert panel members to potential problems.
- Universities will be given feedback on their performance.

(Nature, June 1998:720).

These responses do not address yet a further critique launched against the RAEs. This comes from the industrial sector, and is aimed at the fact that the predominance of academics on the subject panels do not permit the RAEs to adequately assess applied work. The Confederation of British Industry (CBI) has repeatedly criticised these evaluation exercises for supporting a philosophy of "ivory tower funding" Perhaps not unrelated to such critique, the HEFCs have recently started – in conjunction with the DTI - working on an initiative known as HERO (Higher Education Reach Out Fund). The aim is to create a separate budget (separate from the science budget that is) for academic-industry collaborative research. The initiative is apparently gaining in momentum, but the primary concern is how to create a separate funding scheme without reducing the science budget (Interview: Roger Higginson). Although not articulated as such, this initiative could also be interpreted as signalling a concern – from the HEFCs and the DTI/OST – about attaching policy priorities – in this case the priority of stimulating collaboration between academics and industry – to resources (the science base) which have historically been earmarked for research defined as excellent in the standard, Frascati definition of the term.

Table 1.: DTI/OST-initiated technology transfer and/or university-industry collaboration schemes.

Scheme	Description	Sources of funding
Co-operative Awards in Science and Technology (CASE)	To support doctoral research or projects jointly devised and supervised by a university department and a company.	Science budget Participating firm (minimal)
Realising Our Potential Awards (ROPA)	Rewards academic researchers who have secured industrial funding for basic or strategic research, allowing them to pursue curiosity-driven, speculative research of their own choosing.	Science budget
Faraday Partnerships	Supports collaborative research projects which a research and technology organisation (industrial research association, government laboratory, university consultancy firm), university departments (from various universities or several departments within one university), and companies. The research and technology organisation assumes responsibility for acting as an intermediary in developing a programme relevant to industry, and particularly to SMEs.	Science budget
LINK	Supports collaborative research in areas of strategic importance to the economy, with the aim of enhancing both the competitiveness of UK industry, plus the quality of life. Public sector participation in this scheme was originally confined to the universities, but has recently been expanded to allow research/technology organisations (including privatised government research organisations, industrial research associations and RC Institutes) to participate.	Science Budget DTI Industry (Government-Industry: 50-50)
Foresight LINK Awards	As part of the LINK programme, these awards are intended to stimulate competition for innovative research projects in high priority foresight areas.	DTI Matched by industry
Teaching Company Scheme (TCS)	Enables university researchers (young graduates) to work with companies in order to contribute to the implementation of strategies for technical or managerial change. This scheme is associated with the LINK scheme in that TCS programmes are often initiated as follow-ons of LINK projects.	Science budget DTI Participating firm
University Challenge Seed Fund (UCSF)	Funding aimed at bringing university research discoveries to a point where their applicability can be demonstrated, and action towards securing their utility can be initiated. The aim is to reduce technical risk and assist in the commercialisation process.	Science budget Charities (Welcome Trust and Gatsby Foundation University (25%)

(Sources: DTI/OST, 1996; DTI/OST, 1998; Senker, 1998)

Table 2.: Activities and initiatives of the Research Councils (RCs) towards implementation of foresight priorities and recommendations.

Research Council	Implementation of thematic priorities	Enhancing the relevance of research
Biotechnology and Biological Sciences RC (BBSRC)	• 14 Strategic programmes which are relevant to user industries and take account of foresight priorities. • Thematic programmes focussing on the following: ⇨Bioinformatics ⇨Biology of spongiform encephalopathies ⇨Innovative manufacture initiatives ⇨Technologies for functional genomics • Foresight fellowship scheme to support innovative post-doctoral research.	• Participation in LINK and TCS.
Economic and Social RC (ESRC)	• Nine thematic priorities identified on the basis of a national consultation exercise (with researchers and users) aimed at incorporating and supplementing foresight results. • Approximately 65% of the RC's budget are devoted to these themes via programmes and the funding of research centres within universities. The goal is to dedicate 75%-80% of the budget to them by the end of the decade. • Themes are expected to be valid for 10 years, but are subject to annual review. Responsive mode grants are expected to introduce emerging fields into the development or renewal of the themes. • The themes are: ➪Economic performance and development ➪Environment and sustainability ➪Globalisation, regions and emerging markets ➪Governance and regulation ➪Human communication and the social shaping of technology	• Programmes and centres are overseen by Research Priorities Boards which include in their membership an equal number of academics and users.

(Table 2 contd.)

Research Council	Implementation of thematic priorities	Enhancing the relevance of research
ESRC (continued)	➪Innovation, organisation and business processes ➪Knowledge and skill ➪Lifespan, lifestyles and health ➪Social integration and exclusion	
Engineering and Physical Sciences RC (EPSRC)	• The impact of foresight priorities on the existing 14 (discipline-based) programmes has been taken into account by both the Technical Opportunities Panel and the User Panel.	• Participation in LINK and Faraday Partnerships. • Research proposals have to identify research beneficiaries, and must describe the impacts of the applicant's earlier work on both the industrial and academic communities. • Developing a framework which would allow the results of programme evaluation review teams (comprising a mixed academic/industry membership) to feed into the annual business planning exercise for each programme. • Procedure for project evaluation has been revised to include a consideration of the impact of research in terms of people trained and links with potential users. • Theme days organised around specific aspects of the RCs portfolio bring academics and industry representatives together to judge the progress of multi- or inter-disciplinary research.
Medical RC (MRC)	• There is an intention to strengthen linkages with the relevant foresight panels, but there is also explicit opposition to directing the research it funds. • Priorities for research funding are based on excellence and originality regardless of the subject matter. • Foresight themes are reflected in the existing portfolio of research activities.	• Participation in LINK

(Table 2 contd.)

Research Council	Implementation of thematic priorities	Enhancing the relevance of research
MRC (continued.)	Main themes to be addressed in the next 5 to 10 yrs: ➪Delivering the genetic promise ➪Cell systems in health and disease ➪The environment, infection and variations in health ➪Mind and brain ➪Ageing ➪Public health and health care	
Natural Environment RC (NERC)	• Set up a Technology Foresight Implementation Group (comprising scientists and users), which identified 15 priority topics for the RC on the basis of foresight panel reports plus a survey of users. • The topics include: ➪Industry environment interactions ➪Environmental valuation ➪Land and soil ➪Urban environments ➪Prediction of extreme atmospheric events ➪Mechanisms of climate change ➪Fluid dynamics in natural resource management ➪Coastal zone modelling and management ➪Structure and properties of the subsurface ➪Use of natural processes and materials ➪Sustainable use of marine resources ➪Ocean circulation ➪Remote data acquisition ➪Social and human health impacts of environmental change ➪Management of freshwater resources	• Participation in LINK • Launched CONNECT, which is a scheme to promote science-industry partnerships through workshops and pilot projects. This scheme complements the RCs participation in LINK. • Mechanisms are in place to facilitate industrial and academic researchers to work at RC Institutes.

(Table 2 contd.)

Research Council	Implementation of thematic priorities	Enhancing the relevance of research
Particle Physics and Astronomy RC (PPARC)	• Argues that the nature of the RCs research programme (long-term and focussed on fundamental research) cannot be targeted at specific applications. • Yet acknowledges that advanced technologies can potentially be transferred to other applications. • In assessing research proposals, the additional potential of a project to contribute to foresight priorities will be considered.	• Established an Industrial Programme Support Scheme to encourage links with industry.

(Sources: DTI/OST, 1996; Senker, 1998)

APPENDIX: AN OVERVIEW OF THE SOURCES OF UNIVERSITY RESEARCH FUNDING

1. Government: The Dual Support System

Government funding of university research comprises what is known as the dual support system. Within this the Higher Education Funding Councils (HEFCs) are responsible for allocating the General University Fund and the Research Councils (RCs) the resources comprising the science budget. Details of each are provided below:

(a) The HEFCs (General University Fund)

There are four HEFCs: one for each England, Scotland, Wales, and Northern Ireland (where the Department of Education assumes the responsibilities of an HEFC). Falling under the Department for Education and Employment (DFEE), the HEFCs allocate resources to universities in the form of a block grant. Despite accounting procedures, universities are essentially free to spend these resources at their own discretion (those for teaching may be used for research and vice versa). At the HEFC level, however, funds for teaching and research are separately identified. According to Kaiser et al, in 1995-1996 the HEFCs spent just over a quarter (£ 776 million) of their total budgets on research (1998:39). The research allocations are based primarily on the outcomes of national research assessment exercises (RAEs) (see Section B), and they are intended to cover the following costs:

- The salaries of permanent academic staff members;
- Premises; and
- Central computing facilities (the Joint Academic Network for Education and Training (JANET) which is currently being upgraded to SUPER-JANET).

In 1992, the HEFCs transferred for covering research project overheads to the RCs, to enable the latter's grants to meet the full costs of research (excluding the costs of premises or permanent staff salaries).

(b) The RCs (The science budget)

There are seven RCs in total, namely:

- Biotechnology and Biological Sciences RC
- Economic and Social RC
- Engineering and Physical Sciences RC
- Medical RC
- Natural Environment RC
- Particle Physics and Astronomy RC
- Council for the General Laboratory of the RCs

As yet there is no RC for the Humanities, and the British Academy (which is funded by the DFEE) has been assuming responsibility for allocating government support to researchers in this field. The establishment of a Humanities RC was recommended by the National Committee of Inquiry into Higher Education (NCIHE, also known as the Dearing Report) in 1997.

The RCs falls under the Office of Science and Technology (OST) of the Department of Trade and Industry (DTI). They operate in order to allocate research funds primarily to university researchers and RC institutes (although during the 1990s the RCs have been encouraged to fund a wider range of institutions or organisations). Funding is essentially distributed on a prospective, competitive basis via a combination of responsive and directed modes of funding. Project proposals are submitted for peer review prior to the selection process. Project grants provide for direct project costs, and make a contribution towards indirect project costs (overheads). Many universities have argued that the overhead costs gained from RC grants are insufficient to meet actual or intended costs. Hence there is significant dissatisfaction about the transfer of funds from the HEFCs to the RCs (see (a) above).

2. Government: Other

Apart from the dual support system described above, government (directly or indirectly) funds university research in a number of ways. These include:

(a) Technology Transfer and University-Industry Collaboration Schemes

Seen as instruments for enhancing collaborative university-industry research, these schemes draw partly on the resources allocated to the science budget, and partly on other DTI funds. In some cases, industrial funding supplements government funding of these schemes. They are described in Table 1 in Section A above.

(b) Research infrastructure and equipment

In response to concerns expressed in the Dearing Report (NCIHE, 1997) about the status of research infrastructure and equipment within universities, the DTI/OST recently launched the Joint Research Equipment Initiative (JREI) which provides equipment to universities on the basis of a partnership which involves funds from industry. In 1997 this initiative provided £ 80 million's worth of equipment. These funds do not include the funds for equipment contained in the RC project allocation.

In addition to the JREI a one-off programme – the Joint Infrastructure Fund (JIF) – has been sent up by the DTI and the Welcome Trust. The partnership is on a 50-50 basis and involves an amount of £ 600 million. The JIF covers the full spectrum of science, engineering, economic and social sciences, and will provide for buildings, major equipment and other infrastructural needs of universities. The Welcome Trust component will be used for biomedical and related research facilities. Applications for funding will be peer reviewed, and the first criterion will be scientific excellence.

(c) Procurement of research

Several government departments – and particularly the departments of defence, health, the environment and agriculture – procure academic research for their internal needs.

The contribution of government departments to research conducted in higher education institutions (HEIs) in 1996/97 is shown in Table 3 below.

3. Industry

Research funds from industry take the form of:
- Direct contracts
- Consultancies
- Contributions to government technology transfer and/or university-industry collaboration schemes (see Table 1 in Section A).

The industrial contribution to research conducted in HEIs in 1996/97 is shown in Table 3 below.

4. Charities and Foundations

Apart from the Welcome Trust (see point 2 above, as well as Table 1 in Section A), several other charities/foundations play an important role in funding university research. They include:
- The Leverhulme Foundation
- The Nuffield Foundation
- The Rowntree Foundation

The contribution to research conducted in HEIs by UK-based charities and foundations in 1996/97 is shown in Table 3 below.

5. The European Union

The EU's contribution to research conducted in HEIs in 1996/97 is shown in Table 3 below.

Table 3 below gives a breakdown of the various sources of funding of HEIs in 1996/97. It includes a breakdown of resources allocated to RCs. Research within HEIs and RC institutes comprise the so-called science and engineering base.

Table 3.: Sources of funds for science and engineering base R&D in 1996/97

Nature of support	Source	Target	£ million
Support for RCs' own activities (including intramural research, international subscriptions, and other OST initiatives funded by the science budget	From DTI/OST	To RCs	568,1
General support for university research and postgraduate students	From RCs*	To HEIs	168,0
	From HEFCs#	To HEIs	1 027,5
Research grants and contracts	From RCs	To HEIs	525,1
	From Govt Depts	To RCs	158,6
		To HEIs	296,7
	From Industry	To RCs	34,8
		To HEIs	188,1
	From the EU	To RCs	23,4
		To HEIs	157,7
	From Charities	To RCs	28,3
		To HEIs	364,4
	From Other Sources±	To RCs	21,1
		To HEIs	110,4
Total research grants and contracts		**To RCs**	**266,2**
		To HEIs	**1 642,3**
GRAND TOTAL		**To RCs**	**834,3**
		To HEIs	**2 837,8**
		TOTAL	**3 672,1**

* Studentships and fellowships
# Postgraduate and academic infrastructure
± Including local authorities and HEIs

(Based on Table 5.1 in http://www.dti.gov.uk/ost/SETstats98/)

References

Ball, D.F. 1997. Quality measurement as a basis for resource allocation: Research assessment exercises in United Kingdom universities. in R&D Management, 27, 3. p.281-289.

DTI/OST (Department of Trade and Industry / Office of Science and Technology). 1996. Forward Look of Government-funded Science, Engineering and Technology. Cm 3257-I. London. HMSO.

DTI/OST (Department of Trade and Industry / Office of Science and Technology). 1998. Allocation of the Science Budget. London.

http://www.cvcp.ac.uk/cvcp.html (website of the Committee of Vice Chancellors and Principals or CVCP)

http://www.dti.gov.uk/ost/SETstats98/ (website of the DTI/OST SET 1998 statistics)

http://www.first.foresight.gov.uk (website of the TFP)

http://www.foresight-demo.cmgplc.com/default.htm (website of the new foresight exercise)

Kaiser, F. et al. 1998. Separating teaching and research expenditure in higher education: A pilot-study into the potential of the subtraction method. CHEPS Report.

NAPAG (National Academies Policy Advisory Group). 1996. Research Capability of the University System. London. The Royal Society.

Nature. Vol 393. 25 June 1998.

Nature. Vol. 396. 24/31 December 1998.

NCIHE (National Committee of Inquiry into Higher Education). 1997. Higher education in the learning society.

Outlook on Science Policy. October 1998.

Senker, J. 1998. Changing structure, organisation and nature of PSR Systems: United Kingdom. TSER Project “European Comparison of Public Research Systems” Report.

Senker, J 1999. University research financing. Paris. OECD. (UK Section a summary of above report).

Times Higher Education Supplement. 11 December 1998.

Interviews:

Roger Higginson of the Finance and Central Issues Directorate, OST, and secretary of the Science and Engineering Base Coordinating Committee (SEBCC).

Peter Healey, Director of the Science Policy Support Group, London.