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THE DYNAMICS OF SOCIAL SCIENCE RESEARCH EXPLOITATION

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1 INTRODUCTION

Research in the natural and social sciences has come to be seen as crucial to economic and social progress across a wide range of fronts, from wealth creation through technological advances and the imputed shift to a Knowledge Economy to the development of more effective, evidence-based public policies (Cabinet Office 1999). These issues have attracted the early attention of the new Scottish government, with wide-ranging reviews and consultations set up in relation to the creation of a Knowledge Economy in Scotland (Scottish Office 1999) and a 'Science Strategy for Scotland' (Scottish Executive 2000). They are also of pressing concern for those bodies responsible for funding research and education, which are charged to ensure not only the quality and value for money of the academic work they support, but also the effectiveness by which it is disseminated and exploited and the benefits it delivers. The Higher Education Funding Councils in the UK for England, Wales and Scotland, which fund teaching and the infrastructure for research, are undertaking fundamental reviews of their policies and methods for the funding and support of research (HEC02/00). The growing emphasis on the economic and social outcomes of research is reflected by the fact that the recent consultation by the Scottish Higher Education Funding Council **Research and the Knowledge Age** (SHEFC 2000a) was directed separately to both the higher education community and the community of potential research users.

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Policymakers are under pressure to demonstrate that the research they support is effectively exploited and has tangible benefits. However, there are deep uncertainties about both the mechanisms whereby research is exploited and the extent to which this can be monitored. This paper examines how social science research is being exploited, based on an audit of research carried out at the University of Edinburgh between 1992-97. The study was sponsored by the Economic and Social Research Council (ESRC), one of the five UK Research Councils charged with supporting basic research in Universities. Social scientists have been quicker than natural scientists to respond to a political climate demanding greater evidence of the societal benefits of public funded research, perhaps because policymakers and wider publics have tended to greater scepticism about the benefits of social sciences than natural sciences. One manifestation of this has been the ESRC's growing commitment to engaging non-academic users in all aspects of research. Prof. Ron Amann, then Chief Executive Officer of the ESRC, explained the ESRC's increasing commitment to exploitable social science research:

> I envisage that the ESRC's commitment to 'user engagement' will strengthen over the next few years and that we will be looking for even more imaginative ways to support the efforts of the academic community and to act as brokers between them and the wide range of institutional stakeholders whose expectations are now very high.
> (Economic and Social Science Research Council, October 1997, p. 2)

This is not to say that academic researchers are only now being asked to think about the practical or policy implications of their findings. There is a history of social science research being recruited, often by national policy makers, to support, and sometimes to inform, particular political perspectives. At the same time researchers have always wanted their ideas to be exploited more widely. The difference is that researchers are increasingly being asked to make this much more explicit, and to use formal mechanisms. The traditional dissemination model of an arms length relationship between researcher and non-academic users is being supplanted by one where the researcher is being asked to take responsibility for engaging the non-academic user in a variety of research activities. For example, since about 1994 the ESRC has been requiring Research Grant applications to indicate the point at which researchers planned to involve non-academic users; specifically the extent to which users would play a part in research design, the conduct of the research, and the dissemination of findings, and to describe their plans for such engagement. Moreover, researchers are being asked to articulate the potential impact of their research. These developments are taking place, however, in a context in which there is little understanding of the process of exploitation of

academic research, and in particular social science research, concerning, for example, how best to achieve engagement between researchers and their various audiences; of the mechanisms by which research, especially social science research, is exploited and influences public and commercial policy; let alone of the means by which such influence can be monitored and assessed. This study has been undertaken because of the concerns about these issues amongst research policy makers.

Clearly there are growing expectations for the relevance and utility of research, by research funders, users and beneficiaries (including users that fund research), policy makers, industry, and professional regulatory bodies. These expectations are forcing university departments and research centres to rethink traditional ideas about what constitutes good research practice and consider how their research activities should be organised to meet these diverse goals.

In seeking insight to how social science research is being exploited, we begin by drawing on a body of research into the exploitation of research in the physical and life sciences and technology (section 2). Section 3 then describes the research method employed in auditing the exploitation of social science research at the University of Edinburgh. Section 4 analyses themes that emerged from the audit. In particular we argue that, for the social sciences, research exploitation is intermediated rather than linear. We describe the mechanisms of intermediation. In section 5 we draw on these analyses to discuss the extent to which social science research exploitation can be audited. Conclusions and research policy implications are discussed in section 6.

2 BACKGROUND: LESSONS FROM EXPLOITING THE PHYSICAL AND LIFE SCIENCES AND TECHNOLOGY

In seeking to make sense of the exploitation of social science, there may be insights from the exploitation of research in the physical and life sciences - an area which has been extensively studied. Some have sought to identify a direct relationship between social science research and changes in public and private policy, drawing an analogy with the linear relationship that was widely presumed to exist between advances in basic and applied science, and the innovation of new technologies and economic and social advances. However there are fundamental questions about the applicability of this linear model to science and engineering (Williams and Tait 1999), let alone its extension to social science.

Governments have long looked to science and engineering as key drivers of economic growth, and have consequently sought to steer public sector research in particular directions regarded as being of strategic significance for the country. There has been increasing recognition in recent decades that there is no simple and direct link between knowledge production in scientific and technological fields, and its exploitation in successful innovation, wealth creation and improvement in the quality of life (Nelson 1986; Berman 1990; European Science Foundation 1991).

Studies of knowledge flows between publicly funded science and engineering research and non-academic users do throw some light on the complexities of the exploitation process. For a start, the users' capacity to exploit public sector research depends on their readiness and ability to absorb externally generated knowledge. In their study of scientific and technical inputs to industrial innovation, Faulkner and Senker (1995) show that firms need to have some appropriate expertise already in-house in order to make sense of new public sector research knowledge. Our evidence suggests, further, that in addition to a cognitive capacity, an organisation's social capacity (structures, aims, priorities) also shape the take up of research. The flow of knowledge was not one-way. Many firms possess levels of technical expertise that equal or exceed those of the public sector, particularly in high-technology industries such as biotechnology or pharmaceuticals with substantial research and development facilities. The contribution of new knowledge to innovation depended not just on its novelty but on its creative combination with other pieces of knowledge, both technical and social - a process in which it is transformed into applicable knowledge. Novel and useful products and services emerge from the combination of various kinds of knowledge, including ideas and information that may have been around in the firm and industry for some time, for example about market threats and opportunities or production problems.

Firms do not only resort to public sector research to gain access to specialist technical knowledge, as the linear model implies, but also to gain access to social knowledge, for example to find out 'who is doing what' in the research community, to assess reputations, identify potential recruits - what Fleck (1999) calls 'meta-knowledge' - and to extend networks. Faulkner and Senker (1995) stress the relative importance of informal over formal channels for knowledge transfer, with important implications for the visibility of knowledge transfer. For example knowledge is passed on through the transfer of embodied tacit knowledge in the course of social interaction, rather than through the delivery of tangible technology or formal and codified knowledge.

For the foregoing reasons the utility of research findings may not be immediately apparent, and may only emerge as a result of broader changes over time as other factors enter the equation, including demographic changes, shifting user expectations and new discoveries, and the serendipitous mixing of hitherto unrelated areas of knowledge, both old and new. The observation that much innovation seems to grow out of the convergence of spatially and temporally separate forms of knowledge helps explain what Drucker (1991, p. 16) calls 'the peculiar rhythm of knowledge-based innovation'.

These findings from innovation studies suggest various implications for the exploitation of social science research. First, that social science research findings are unlikely to be directly usable. Exploiting research may depend on the researcher being able to translate research outcomes to match the user's context, and in particular show how it might help solve specific user-defined problems. Second, even given the role of the researcher as translator, users are not passive recipients of social science research output. Users must also be sensitive to new knowledge, and the costs and other problems inherent in its use. Third, a broad range of channels, both formal and informal, may exist for communicating and exploiting social science research, with implications for auditing invisible transfers of knowledge. Fourth, the exploitation of social science research is likely to be slow and uneven

There are important correlations between these findings and the (rather limited) body of research into the exploitation of social science research itself. Bulmer's classic (1982, p. 160) study of how social science influences policy making flags the importance of two forms of influence:

- 'conceptualisation' - the capacity of social science for offering new or revised ways of defining problems, through which the results of social science research, through a process of diffusion, slowly become the intellectual frameworks which policy makers and broader publics use;
- 'interaction' in which 'participants pool their efforts and knowledge in an attempt to tackle a particular problem [by] engaging in mutual consultations and discussion'.

As Bulmer (1982, p. 161) noted, the latter form of influence 'depends on politicians and administrators being willing to listen and on the legitimation of social science as having something to contribute'. Rather than looking for a direct relationship between research findings and their impact (or even variants of this which expect a simple time lag in uptake with the implication that there is a linear process of application of new knowledge, but that this is slow), over time we can expect to find a slow and uneven set of developments

involving both researchers and policymakers in more or less gradual shifts in shared beliefs, assumptions, and concepts, reinforcing some coalitions of ideas and redefining others, always involving some integration and evolution of new ideas with the old rather than a linear process of displacing old knowledge by the new.

3 CONDUCT OF THE STUDY

Here we describe the method developed to explore the variety of ways that social science research translates into new ways of thinking and practice. More specifically we explore how different kinds of links between researcher and users (e.g., formal and informal structures and relationships), and diverse research outcomes, generate particular forms of social science research exploitation.

The study involved two phases. Phase one was a broad mapping of the range of research projects undertaken by departments and research centres within the Faculty Group of Law and Social Sciences at the University of Edinburgh, between 1992 and 1997. This provided a context for phase two: an analysis of the research exploitation process, based on selected case studies involving discussions with researchers and users of their research.

3.1 Phase one: mapping research activity at departmental level

The mapping was based largely on semi-structured interviews with approximately twenty eight individuals, including: heads and or research directors of academic departments, research centres and institutes, and central research support and research exploitation services. This information was supplemented with archival material, in particular departmental research reports.

As part of this mapping exercise we sought to develop a schema to capture the various possibilities for engagement or interaction between research and users.

Bulmer's work and the observations in section 2 highlight the importance of research outcomes and researcher-user relations as key dimensions of research influence. These insights suggested that research proposals may be assessed in terms of how they approached two dimensions:

1. Researcher-user relations: direct and indirect relations

These relations refer to the extent to which some form of direct exchange takes place between the researcher and user. There may be many user groups with different agendas (funder-users, policy makers, industrial or commercial organisations). Direct linking mechanisms include research service contracts, consultancy work, collaboration. Indirect linking mechanisms include: membership of regulatory bodies, committees, journal publications, reputational effects.

2. Research outcomes: tangible and intangible outcomes

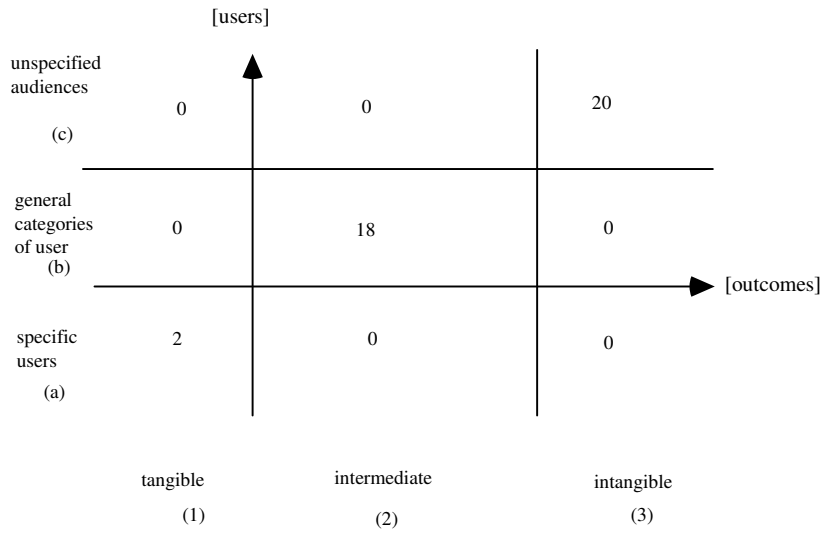
   Outcomes are tangible where they can be clearly identified in terms of their use (rather than defining tangibility in terms of the manner in which findings are presented, e.g., a book). They include hardware, written guidelines to policy makers or end users, the introduction of new work practices. Intangible outcomes include: identifying changing attitudes; introducing some new way of thinking about a problem; or enhancing our understanding of some complex issue.

From this we derived a framework for categorising different kinds of research project in terms of its scope of exploitation. This formed the basis of Phase 1 of the study (Raman-Bacchus, Williams and Bechhofer 1998a) and was also used for selecting cases for study in Phase 2.

3.3 Phase two: developing case studies

The second phase of the study focused on specific research projects. We examined projects within the University of Edinburgh Faculty Group of Law and Social Sciences completed in the period 1992-7. Figure 1 shows the distribution of 40 ESRC-funded projects. Projects were classified according to the extent to which the original research proposal submitted to ESRC expected i) engagement with users and ii) exploitable research outcomes. This classification was used to guide our selection of projects for detailed case studies.

Figure 1
Distribution of 40 ESRC funded research projects



The projects are located along the diagonal (a1, b2, c3). This is to be expected. Though the ends of this spectrum would appear to correspond with traditional dichotomies between 'pure' and 'applied' research, it is notable that projects did not fit neatly within these categories. Narrowly applied, instrumental projects (eg category a1) were rare and atypical as research projects[51]. Most of the projects had both theoretical and practical objectives – and even the more 'academic' projects, as we shall see, often ended up with practical implications (Rayman-Bacchus, Williams and Bechhofer 1998a).

The 40 ESRC funded projects represent only a small part of the 200 live projects in the Faculty Group of Law and Social Sciences in any one year, funded by a range of institutions, including charities, industry, government departments, EC, research councils. Projects funded by ESRC were selected

[51] *We must remember that our sample was of Research Council funded projects, which tend to have broader intellectual ambitions, and did not include consultancy or privately commissioned work.*

because their research application framework allows a straightforward and systematic assessment of the researcher's intended outcomes and user benefits. Moreover, in important areas there appears to be broad similarity between ESRC funded research and research supported by charitable trusts and institutions: a focus on research that is likely to have some utility, as well as contributing to the pool of knowledge.

Based on a close reading of each of these 40 project proposals to ESRC we chose ten case studies: two category (1a), four category (2b) and four category (3c). It transpired that the two 1a projects were closely related and they are discussed as a single case: UK Borders. In order to broaden the scope of the study, three non-ESRC funded projects were added – which were funded directly or indirectly by the Scottish Office: two (1a), and one (2b) case studies. This gave us a total of twelve cases (13 projects) to study.

Interviews were conducted first with the researchers and then with some of those identified as users.

3.4 The researcher perspective

We interviewed the researcher(s) involved in each selected project about four broad aspects of their work: research aims and scope of project; users; engagement with potential users; research outcomes. For these case studies, interviews were carried out with seventeen researchers drawn from the thirteen projects.

In the course of interviewing, important ethical issues surfaced, which influenced the course of this study and also provided important insights to the tensions that may emerge in relation to the use of research findings. Researchers involved in three of the projects raised ethical concerns. For example, being very close to users gives access to privileged information that may offer valuable lessons to a broader community. Against this is a risk that mishandling of such situations could unwittingly compromise the collaborating organisation, or its relations with the researcher, either now or in the future.

3.5 The views of users

Users of research were determined by asking researchers to identify those with whom they had engaged. We expected to interview at least one per project. Our success here has been uneven: fifteen users have been interviewed from eight projects. The researchers of two projects felt unable to provide access to users. In one case the researcher politely refused to identify his subjects, since many issues within the area of his research topic remain

politically sensitive, and identifying those who co-operated with his study risked compromising those individuals. In the second project the research team decided that on balance they would rather we did not approach the users because research activity and collaboration were on-going, even though the project had formally ended, and they feared that our intrusion could damage their carefully nurtured working relationship with the user. Moreover, the focus of two further projects on issues of broad policy interest meant that specific users were too diffuse to be clearly identified.

Users were asked to reflect on five broad areas related to a particular research project: the origination of the research topic; whether the user was involved in any of the stages of research design, carrying out of research, implementation; who interacted with the researcher and why; how was the new knowledge useful; what investment did the user make in time, personnel, money, and other resources.

The case studies

The features of the case studies are summarised in Tables 1, 2, 3 below. We discuss these and give summaries of selected cases in section 4.

Table 1
Group 1a: specific users, tangible outcomes anticipated

Topic	Sponsor	Researcher	Users	Users interviewed
Smart wheelchair	Scottish Office (to 1989)	Nisbet, Millar, Odor	NHS, education authorities, children, schools	school, education authority
Devolved School Management in Scotland	SOEID	Adler et al.	SOEID, schools, local government	(SOEID)
UK Borders: a national service for UK digitised boundary data	ESRC programme: Census	Burnhill and Morse/ Mackaness	Further Education & Higher Education institutions	research institute, university

SOEID: Scottish Office Education and Industry Department.

Table 2
Group 2b: broad user groups, intermediate outcomes anticipated

Topic	Sponsor	Researcher	Users	Users interviewed
Unifying academic & vocational learning	ESRC programme: The learning society	Raffe et al.	SOEID, education authorities, SQA, local government	SQA, SOEID, HMSCI
Life cycle analysis and eco- labelling	ESRC programme Global environmental change	Collins et al.	EC, paper and pulp industry, local government	consultant, business, trade body
Workplace health education and lifestyle change	HEBS (to 1989), local government, Polaroid, others	McGlew	HEBS, local health boards, business, local and central government	HEBS
Women and Scottish politics	ESRC research grant	Brown	central government, women's activist groups, Scottish polity	None. Only general users identified
Workplace innovation	ESRC programme Innovation	Findlay et al.	Industry, government	None. Researcher unwilling to give access
Sociology of food choice and domestic situation	ESRC programme: The nation's diet	Kemmer	government departments	None provided. Only general users identified

SOEID (Scottish Office Education and Industry Department); HEBS (Health Education Board for Scotland); SQA (Scottish Qualifications Authority); HMSCI (Her Majesty's Senior Chief Inspector).

Table 3
Group 3c: unspecified users, intangible outcomes anticipated*

Topic	Sponsor	Researcher	Users	Users interviewed
Sociology of proof within software development	ESRC research grant	MacKenzie	industry (software developers), MOD	One consultant, another former academic and entrepreneur
environmental activism movement	ESRC research grant	Fiddes	activist groups, security services	None. Researcher unwilling to identify
Social identity through community arts	ESRC research grant	Rose	community arts producers, arts promoters, local govt	consultant

**Two of the projects, initially classed as 3c in terms of the content of research proposals, were part of broader ESRC research programmes which provided a context and resources for more structured engagement with potential research users – they have therefore been re-allocated to the 2b group.*

MOD: Ministry of Defence,

These case studies, and our initial findings, were discussed at a workshop (University of Edinburgh, 12 March 1999) to which the various participants (researchers and their users) and other interested parties were invited in order to verify and elaborate our understanding of exploitation processes.

4 FINDINGS

These findings confirm that in most cases the exploitation of social science research is far from a linear process. The few cases in which it conforms to a largely linear model are rather atypical examples. The contribution of this

study is to show how research exploitation involves a complex interactive relationship between researchers and their potential users. The exploitation of research is intermediated, and takes place through social networks, through various means of communicating research findings in the form of formal knowledge and through embodied knowledge, and depend upon the user being already sensitised to the potential value of research findings. The evidence also highlights the need to understand the structural context of research in trying to make sense of the exploitation process.

4.1 Death of the linear model, long live the linear model

In the linear model research is presumed to generate new knowledge that is diffused to potential users and will then give rise directly to changes in user behaviour. Such linear 'impacts' might readily be attributed to particular projects and could thus be captured by audits and research evaluation procedures. In practice, both researchers and users agree that this model is inappropriate in most cases. Despite this sharp divergence from reality, the rhetoric of the linear model has proved remarkably resilient. Though research funding bodies do occasionally acknowledge the criticisms that have been made of linear expectations of research impacts, organisational thinking seems to revert to this traditional set of presumptions, which are evident in their pronouncements and practices (for example of research evaluation). This perspective is most easily seen through the use by research policymakers and others of language, symbolism, and recipes of success:

i) a tendency to impute tangibility in describing the potential consequences of research, through talk of research 'impact' and 'exploitation';

ii) the desire to see a clear 'contribution' in evaluating social science research: through measuring 'value added', or delineating the policy relevance of a piece of research;

iii) valorisation and attribution of exemplar status through labels like 'successful exploitation' where a clear link is perceived between research and its take up by identifiable users.

It would seem that research funders and many science policy makers feel drawn to resort to a linear framework - even while acknowledging its limitations - in order to demonstrate the usefulness of the activities they support to government funders and to industry and other potential users of research. Presumptions of a rationally predictable relationship between policy initiatives and societal outcomes are, understandably, central to the policy context. In this situation the policy maker may look to evaluation research to

demonstrate such a causal link. For example, in describing the tension between reality and rhetoric within which much policy making unfolds, one policy maker observed that (in relation to measuring the effectiveness of the career guidance that young people receive),

> the main reason for looking for a causal link would be to make a case to the paymasters. But none of the research done so far shows such a link. We have to make a leap of faith and say that 'we believe that doing so and so is worthwhile'. This is what we are effectively doing at the moment. We have to dress it up in terms of the number of interviews that have been carried out to address the value for money aspect, but there is little likelihood of being able to categorically determine the benefits. … One constructs an answer to fit with existing structures, which expects to see causality: 'we are putting this money in, what are we getting out?'
> (Scottish Office policy maker, 11 May 1998)

The danger of course is that such rhetorics by repetition come to be accepted as accurately reflecting reality. In this way they may come to shape policy and, for example, the selection and evaluation criteria adopted by research funders. Clearly pursuit of such a model of research relevance or impacts in most cases is unrealistic and could be counter productive. Only two of the 40 ESRC-funded projects identified in our mapping exercise fit the linear model: the twin projects underpinning UK Borders. Another example is the Smart Wheelchair, initially funded by the Scottish Office. These projects have delivered tangible outcomes to identifiable users.

UK Borders

UK Borders is a service that was developed to provide staff and students at UK higher education and research institutions with a means of producing UK census data (and other spatially-related data) within digitally defined boundaries. UK Borders was first developed in the mid 1990s by Burnhill and Morse, and subsequently enhanced by Mackaness, under separate awards from the ESRC. The project aimed to provide a defined user (the UK higher education community) with a comprehensive set of data, via the JANET network. Mackaness enhanced the service by allowing the user to download a quick and dirty picture (yet sufficiently accurate for most purposes), so that the user did not spend a disproportionate amount of time downloading overly detailed boundary data; Mackaness's aim was to 'enhance the cost-effective use of UK digitised boundary data'. ESRC Research Resources Board has supported the development and provision of similar kinds of tools and research services for social scientists over the years. However UK Borders is far removed from most ESRC research projects.

The Smart Wheelchair

Nisbet and Millar developed the Smart Wheelchair almost a decade ago. It continues to receive media coverage for being innovative in its impact on the lives of disabled children. Some of that impact has been measured, often in minute detail, through observing children's behavioural changes. The Smart Wheelchair is regarded as a learning aid, and has been, or is being, incorporated into mainstream school education, supported by a manual, **Moving smartly through the curriculum, on how to get the most out of the Smart Wheelchair**. QED, a wheelchair manufacturer, has been licensed to exploit its commercial value. Indeed a wide variety of users are able to articulate its benefits and value adding opportunities: Children, teachers, parents, educational authorities, UnivEd (Edinburgh University's technology transfer company), QED.

4.2 The importance of user sensitivity to research insights

Where research findings have been directly exploited, for example in changing policy, a key factor has been the sensitivity or openness of the policy maker or research user to the availability and potential contribution of research findings.[52] For example, in a case documented for a prior assessment of research impacts, representatives of the Department of Trade and Industry (DTI) approached Fleck (a researcher) because they saw his research findings under the ESRC Programme on Information and Communications Technologies (PICT) as having some bearing upon policy that they were developing (their Manufacturing & Planning Initiative to promote industrial automation) (Williams 1996). Though this might appear to an outsider as exemplifying a linear exploitation process, this is to ignore the importance of antecedent conditions. This case could be seen as an example whereby policy makers looked for evidence in support of a policy already largely determined. It would be misleading to attribute the policy shift to Fleck's work alone. Both Fleck's work and the DTI policy can be seen as part of a broader shift in understanding in the UK and beyond, about how industrial automation could best be achieved and promoted.

Another area where research might appear to feed relatively directly into policy is in evaluation research. For example, the Scottish Office Education and Industry Department (SOEID) research unit encountered Adler's study of

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[52] *We should not always presume that users want to utilise research findings. For example, in her study of social identify through community arts, Rose wanted to maintain close links with her interviewees, but it emerged that their strategies for pursuing their desired ends did not require her involvement.*

Devolved School Management through its monitoring of ESRC funded research, and commissioned him to carry out a similar evaluation of DSM in schools in Scotland. Adler was not particularly enthusiastic about merely replicating work already done in one region of Scotland and a region of England; the SOEID were not however seeking academic novelty.

In both of the above cases, the existing policy context for research exploitation was relatively well-defined at the outset. This is far from the only model of research exploitation - nor even, arguably, the most significant contribution of social science to policy and practice. We can find instances at the other end of the spectrum in which the researcher enters an area of potential discourse, before it has crystallised into policy or an industry-wide view, and where there is no clear framework for judging use or utility. One example is MacKenzie's contribution to practitioner understanding, policy debates and commercial disputes about the role of formal methods in computing.

Sociology of proof

MacKenzie began his study of formal methods of software development at about the time that technical practitioners, in both the UK and USA, were beginning to question the integrity of proven products like the VIPER microprocessor. Through meeting MacKenzie, his practitioner co-workers became more aware that the limits of proof are more than technical, that they also have a social basis. Technologists, commercial, military, and regulatory organisations, each with differing vested interests were either challenging the robustness of competing products, or defending the integrity of their own technical developments, and MacKenzie's contribution was to draw these claims and counter-claims together, and 'weave them into a tapestry that everyone could recognise') (research user). Alongside a growing scepticism that robust systems could ever be developed, MacKenzie's work, in highlighting the social dimension of mathematical proof and technology, helped modify the expectations of those within the safety critical systems community. Through producing draft papers and taking feedback from subjects, both the research user and MacKenzie (the researcher) shared in the process of constructing an account that was meaningful to most of those interested in the robustness of software systems intended for use in safety and security applications.

These examples suggest that research exploitation depends significantly upon the mutual sensitivity of the researcher to the policy or discourse context, and the policy maker or research user to the availability and potential contribution of research findings. Overall it points to the interactive nature of the research

exploitation process. In many cases the initiative lies with the policy maker. However our study more frequently found examples where researchers have taken the initiative to ensure uptake and use of their research. We return to these points in the next section.

4.3 Research exploitation as a process of intermediation

The importance of mutual sensitivity suggests that the exploitation of research is typically an interactive process. In most cases there is need for some kind of dialogue directly or indirectly between researcher and user, as both search for common understanding. The evidence is that the policy significance of research emerges through interaction between research and practitioner or policy maker. We identified a range of features of the interaction processes by which research may be exploited:

Translation for the policy making context. Where particular research findings do contribute to policy formation they must usually be transformed and combined with other types of knowledge (from other sources) and with emergent policy aims.

Relationship between researcher and user. This may vary from relatively arms-length to a co-production model (i.e., contractual, advisory, collaborative, collegiate). Closer relationships are important for sensitising researchers to user perspectives and concerns and vice versa.

Status bestowed upon the researcher. Embodied knowledge is important. Over time a researcher may gain the status of trusted expert and sought for their expert opinion.

Social networks. Informal as well as institutionalised social networks are key to the kinds of interaction needed for effective research exploitation. They may spring from a particular piece of research, bringing together researcher and user, perhaps through knowledge brokers or other intermediaries linking the two. More commonly, however, social networks pre-date research projects, with the researcher forging links with other researchers and users and bringing together previously separate networks into knowledge communities.

Intermediation then is a two-way process, helping to make research findings relevant to users while at the same time helping the researcher to understand the user context.

1) The transformation of academic research findings

An important feature of the exploitation of academic research findings is their creative combination with other types of knowledge (e.g., about the context and purposes of users) to convert them into a usable form. As members of Scottish Office research departments told us, this would involve at least changing the form of their expression - for example shortening reports and turning them into language that is more accessible and geared to the ultimate decision-makers' concerns, as well as combining a variety of offerings together to create an overall picture. This transformation may be carried out by academics or by other knowledge gatekeepers or brokers, for example, consultants, think-tanks, the media, and research departments of policy bodies. Knowledge brokers can help to make new formal knowledge (e.g., research findings) available to policy makers and users. However in this process, attribution of the original source of new knowledge and its contribution to policy is likely to be extremely tenuous; in the process it becomes well nigh impossible to establish any kind of audit trail from the specific findings of a research project to policy. For example, according to one Scottish Office source, policy makers tend to work through their own internal research unit, rather than having any direct contact with (external) academic researchers. This remoteness is reinforced by 'the turnover of staff many of whom will not have been in post long enough to know …' the source of the original idea (Scottish Office Research Officer, 26 March 1998).

2) Development of a relationship between researcher and user

The relationship between researcher and user may take a variety of forms: from relatively arms-length (Adler's contract with SOEID) to more engaged relationships including the co-production model where the user participates in the development, analysis and dissemination of the research (MacKenzie's close engagement with his formal methods subjects). Establishing such a relationship can be important as a means of ensuring mutual understanding between researcher and policy makers, both to allow new knowledge deriving from research to be made usable, and also to establish the user's status in the policy community as a relevant and reliable source of knowledge and advice.

Researchers seeking to influence policy may be drawn to make the investments needed to become trusted members of a practitioner or policy community, aware of its requirements. An example from our study is McGlew's efforts in his health education project: raising public awareness, orchestrating public meetings, maintaining political and financial support from Polaroid and the Scottish Office.

3) Embodied knowledge - the researcher achieves status of trusted expert

Research exploitation and impacts arise from the academic becoming a trusted specialist expert as well as through the embodiment of knowledge into formal outputs, such as reports and conference presentations. Where the research area is poorly understood, ill defined, or contested, personal contact may be needed to communicate research findings, rather than formal reports. Both the understanding needed to make sense of such knowledge, and the reputation needed to add credence to such offerings, are likely to emerge over time from continued dialogue between researchers and their audiences and users: a dialogue which is likely to be of longer duration than, and may not be directly related to, any specific project.

Indeed it seems likely that the expert's embodied knowledge will more readily shape policy or practice than new formal knowledge outputs of specific research projects. However, where the research area is well defined and understood, embodied knowledge may be substituted by formal reports or other artefactual output, including tools and services like UK Borders.

4) The development of a network linking researcher and user

Utility does not derive solely from particular knowledge content, but depends also upon the context of use, for example pre-existing policy or industry debates, noted in item one above. We also know from studies of policy formation that change in policy is mediated by social networks, and the coalescing of commitments and political negotiation and the formation of advocacy coalitions (Sabatier and Jenkins-Smith 1993). A key feature in research exploitation comprises the formation of a network linking the researcher and potential research users. These networks play an important role in the dissemination and transformation of new knowledge and in communicating policy agendas to research and vice versa, and in establishing researchers as trusted experts. We use the concept of network in this broad sense to capture the range of possibilities. The particular form of these networks is critical to understanding whether and how research is being exploited.

For example, Raffe is regarded by policy makers as a trusted expert on post-compulsory education. His reputation is maintained through periodic but intensive interactions with policy players through a range of fora, and Raffe is active in maintaining these networks. For example, he would invite senior policy makers to act as chairs and discussants at his workshops, these policy makers in turn seeing such occasions as a productive investment of their time. Brown similarly was able to raise issues arising from her study with a range of audiences in Scottish Government through her extensive range of contacts

- leading on to her engagement as a policy adviser on the involvement of women in Scottish politics with a range of specific policy bodies.

The networks deployed by the individual researcher may be complemented by, or developed through, institutional arrangements. A significant example of this is the planned and resourced collective dissemination and engagement effort of the ESRC Programmes[53]. It was through the formal networking activity of the ESRC Global Environmental Change Programme that Collins's research was brought to the attention of the various protagonists debating UK and EU waste policy (a community that was already constituted in response to public policy). The ESRC Innovation Programme operates in relation to a large but diffuse user community (UK industry) and addresses a particular range of concerns. Its dissemination efforts involve links to existing professional bodies and fora (e.g., in Human Resource Manageme.t), as well as developing its own club of industrial users. The activities of the Innovation Programme put Findlay and co-workers in touch with managers in other firms and trade unionists who were potential broader users of their findings.

The successful exploitation of MacKenzie's work illustrates the importance of institutional networks, and their legacy effects. His project did not take place in a context of clearly established networks - however he became an established contributor as debates took off within the practitioner community. However this achievement has to be seen in the context of MacKenzie's activity through a range of related projects dating back to his involvement in the ESRC PICT programme since 1987. Furthermore, due to his concurrent involvement in these projects, we cannot separate the influence of his research into the sociology of proof from these other projects because he will have drawn from these other projects in developing his ideas, contacts, and reputation. Differences in how far researchers are able, or willing, to participate in collaborative networks then prove central to questions of research exploitation. Of particular importance are the extent to which

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[53] *Whereas most projects funded by ESRC are funded in 'responsive' mode, whereby the researchers submit a research proposal to ESRC, an increasing share is now being allocated under initiatives which are of two main types:*

ESRC Programmes – in which academics submit proposals to investigate a research agenda set by ESRC, typically in an area of policy relevance, which also provides a coordinator to encourage links between projects and with potential users; and,

ESRC Centres – in which HEIs bid to run long-term (5-10 years) large scale centres of research excellence in areas selected by ESRC, with substantial resources to support diseemination etc.

linkages are institutionalised, and the ability of the researcher to control their access to these networks.

One further point follows on from this. It should not be presumed that the resort by a policy maker to external experts derives solely because they have conducted specific pieces of research. Users may value individual researchers because s/he possess broader expertise, and also because they may be a node in a complex network and may give the user access to that network. Thus the value of an expert may derive not just from their formal knowledge arising from research in the field, but also from the networks to which they gives access. For example one of MacKenzie's subjects sees MacKenzie as having 'opened a number of doors' for him; he was a useful contact, who 'broadened access to [MacKenzie's] community and other people doing similar work'. This was more significant for him than any direct influence of MacKenzie's research. Similarly, key staff of Fife Education Authority feel that the CALL Centre, in which the Smart Wheelchair is based, keeps itself relevant to their needs in two ways: academic research and expertise in developing novel and useful ideas; and through the links the Centre has with a range of other users.

4.4 The nexus between the researcher and the policy process

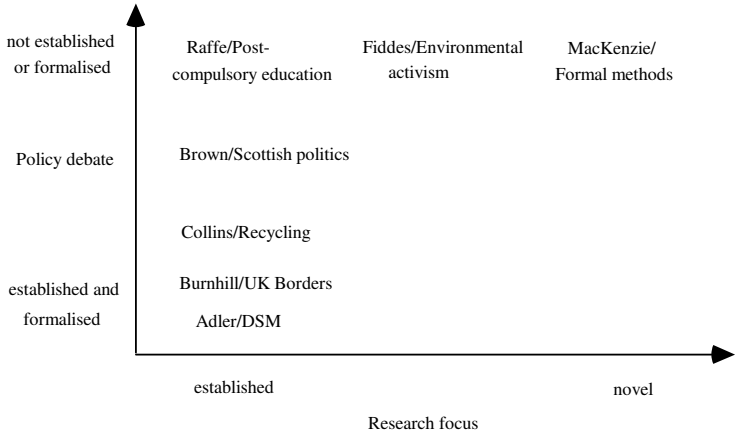
These observations point to the wide range of relationships between the researcher and policy and user communities. There are a number of factors which condition these relationships, notably:

- the intellectual terrain - the extent to which research perspectives in a field are proven, and whether the lines of policy debate are well-established;
- the structural context of research and policy - in terms of the number of players, and the extent to which there are formal channels for policy debate and engagement with research.

The intellectual terrain: range, tensions, evolution

We can begin to differentiate some of our cases along two related axes, as shown in Figure 2. The (horizontal) research dimension distinguishes between research approaches that are novel and exploratory and approaches that are well-rehearsed and proven. The vertical dimension draws a spectrum, similarly, between contexts in which the terms of policy debate are still open and exploratory and those which are well-established and formalised. This schema has an obvious relationship to the categorisation exercise undertaken in our mapping exercise. The location of projects on this schema has important implications for the exploitation of research.

Figure 2
Extent to which the research and policy terrain is well-established



At the bottom left we find cases in which the research and policy questions are largely well-established and understood. Adler's evaluation of the implementation of DSM in Scottish schools, commissioned by SOEID, provides an example. Here, there was a relatively arms-length relationship between the two - within an already well-delineated policy discussion and established research setting. At the end of the project, SOEID merely wanted a report from Adler containing the information arising from the study. There is a clear context for using research in this kind of setting. In that sense, the circumstances exist for a degree of auditing: a link between research and a policy debate can be made. On the other hand it is not necessarily the case that such research will in fact have substantial social and policy impacts: Adler's study was commissioned largely to verify that his earlier findings also applied throughout Scotland.

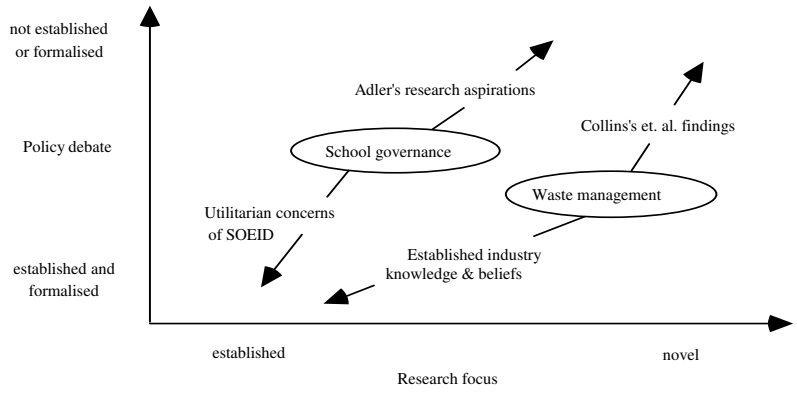
The top of Figure 2 shows some rather different examples. MacKenzie's research was more exploratory and also took place alongside an emerging area of policy and practitioner debate. Comparing the mechanisms of research exploitation between Adler and MacKenzie reveals a striking difference between the kinds of communication and engagement involved. In the latter, richer and more open-ended communication was required, involving more

protracted exchanges through closer and more direct contacts, with both users and researcher sharing in the production of knowledge claims and policy perspectives. In the former, formalised knowledge could be exchanged at a distance between researcher and user, whose relationship has some resemblance to the linear model. However we also found clear evidence of a tension here between SOEID's requirement for a straightforward evaluation of the existing DSM programme and Adler's desire to redefine and broaden the research agenda on DSM.

This is shown diagrammatically in Figure 3, which also indicates how the finding by Collins and co-workers that incineration was better than recycling - economically and ecologically - cut against the prevailing view of policymakers and environmentalists, but was taken up and given prominence by established industrial critics of recycling policies.

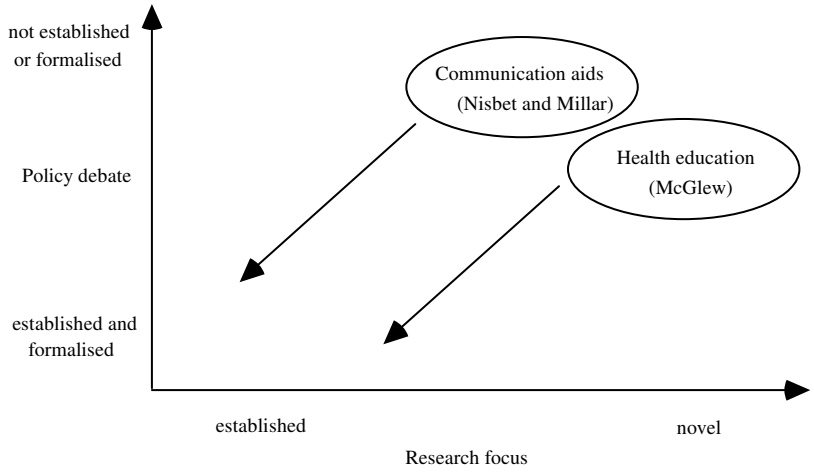
These observations highlight two important points. First, researchers may not be in a position to determine whether their findings contribute to a rethinking of policy. Policy actors are the key gatekeepers here. Second, researchers and policymakers may want to construe the research-policy interaction in different ways. For example policymakers may seek closure by gathering evidence to select between a range of finite policy options and validate particular choices, while academics are perhaps more likely to want to problematise current approaches and terms of debate.

Figure 3
Tensions between existing policy discourse and research direction



Researchers are very aware that the topicality of their study is likely to wax and wane. More importantly, what counts as socially relevant research evolves as part of some wider debate. Particular projects may gradually move from the margins of policy discourse to occupy a more central position, in part propelled by the tensions noted above. For example, over the last two decades Nisbet and Millar, led by Phil Odor, have played an important part in encouraging the Scottish Office to recognise the importance of, and provide financial support for, research into augmentative communication for children with special needs. Similarly, over the last decade McGlew has played an important role in establishing a debate about workplace health education in the UK. In both examples policy debate and research have evolved from top right to bottom left as shown in Figure 4.

Figure 4
Evolving locus between research contribution and policy discourse



The intellectual terrain of research exploitation is a product of the extent to which the policy debate is settled, and the degree of novelty in the research focus. As shown in Figure 2 the terrain is not evenly populated. In contrast to the linear model, which presumes that new knowledge may drive policy change, we find that the policy implications of research are 'mutually

constructed', but constructed in a context in which policy-players rather than academics are the key players. There may be tensions between the researcher's desire that their knowledge outputs will contribute to rethinking policy, and the policymakers' desire to narrow the range and stabilise policy options and seek support for preferred outcomes.

5 DISCUSSION: SOME POLICY IMPLICATIONS

In some situations there would seem to be stronger prospects of identifying a link between research and policy debates than in others. However it is often difficult to determine whether research drove or merely accompanied and legitimated change in policy. Policy change is shaped by a wide range of factors including the available resources, inter-relationships with and knock-on effects on other policies, compatibility with broad policy aims, and political feasibility so that the implications of research findings tend to be pursued or ignored for reasons which go well beyond the soundness of their scientific basis. Consequently attempts to attribute specific policy impacts to social science research may be misleading. First, the search for evidence of direct exploitation may lead to false negative findings and thus lead to underestimation of the utility and use of research. Second, the retrospective search by policy makers for evidence of linear impacts of research may lead them to valorise untypical cases and methods of proceeding. Indeed in many cases in which policymakers had flagged particular research findings the actual contribution of social science research to the decision often seemed very limited – mainly of providing support for and legitimising a course of action that the decision maker had already decided upon.

Third, and following on from this, many would argue that the most significant and valuable contribution of public-funded social science research is not to add weight to existing policy options, but to challenge current ways of thinking and pave the way for the emergence of new approaches. However this kind of transformation is likely to take place only in the longer term and to depend on the synthesis of many pieces of research (coupled perhaps with a growing perception amongst policy communities of tensions and problems with current approaches). It is therefore unlikely to be picked up by attempts to monitor the impacts or exploitation of research.

Expectations of demonstrable policy outcomes from discretely funded, short-term research projects (funded under the 'responsive' model) grossly underestimate the efforts necessary to disseminate findings and engage potential users which may continue well after the research grant has ceased. As one researcher, MacKenzie, observed,

> that the project was completed three years ago, and that the writing up is still going on, is significant. Clearly it is naive to think that you can just move into an area, conjure up your users, find out what they want, what they are interested in, put in your proposal … it's naive to think that you can do all of that within a single project. Engaging with users takes much longer to foster …

Longer-term and more programmatic research funding, for example through ESRC Programmes or ESRC Research Centres would of course provide a framework where these considerations could be incorporated into the ongoing development of the programme.[54] The ESRC has taken some steps towards a more explicit dissemination and exploitation process: Directors of ESRC Programmes have a budget for dissemination and networking; 'users' figure on advisory and steering panels. Nevertheless, funding councils might wish to consider whether the existing research funding model goes far enough, or is the most appropriate for a process that is messy, serendipitous, protracted, and network dependent.

6 CONCLUSIONS

The most important finding presented here is by no means novel: that the exploitation of social science research is virtually never a straightforward linear process. The dissemination of social science research findings does not guarantee exploitation of social science research. We noted in the introduction that funding bodies, conscious of their public accountability, want to be able to measure and promote research exploitation. Indeed, when set against a political agenda that aims for improved economic growth and social well-being, there is much to be said for more rigorous procedures for assessing the use and influence of social science and other research. However it is essential to avoid the mechanistic pursuit of narrow and inappropriate models of exploitation, and address the multiplicity of exploitation mechanisms and the diversity of audiences and concerns.

Complex and iterative, not linear and sequential. The continuing resort to linear models of research exploitation, by imposing unduly narrow views of who might utilise research and how, could, paradoxically, hamper attempts to

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[54] *ESRC Centres in particular offer resources for sustained dissemination and engagement. However this is a rather inflexible model which channels resources to a few large, long-term groupings. Much of the most exciting research comes from responsive mode funding*

improve the effective use of social science. For example, expectations that particular research findings will lead directly to particular policy changes are often undermined by unexpected outcomes: uses and users which were not expected at the outset are likely to emerge in the conduct of the research and its dissemination. Even providing a retrospective audit trail from a new policy or application back to specific research findings is often virtually impossible and always precarious. Assessment mechanisms must be aware of these complexities, lest they produce misleading and potentially damaging assessments of the value of social science.

Resilience of the rhetoric of linearity. Those practically involved in research and its exploitation are aware of the complex and often indirect ways in which social science may become incorporated into changed policies or strategies. Whilst criticisms of the linear model of research exploitation are now well-rehearsed and largely accepted within the community of researchers and research managers, government, funding bodies and private enterprise often continue to talk as though the linear model is a good reflection of the exploitation process. If the rhetorics of exploitation continue to be cast in linear terms across research policy bodies there is a danger that this reinforcement could have a detrimental, narrowing effect on the selection, conduct and dissemination of research.

Revisiting institutionalised arrangements. The existing research funding practices of Research funders and Higher Education Institutes (HEIs) are not necessarily well geared to the exigencies of effective research exploitation, regarding both the need for longer-term engagement for effective communication between researchers and decision-makers, and the crucial role that intermedaries play in this process.

Funding of research projects in the 'responsive mode' by the ESRC, and also by charities, firms and government is typically short-term and one-off[55]. This is out of step with the long time-scales necessary to build relationships and sustain research exploitation. One solution might be to fund more long term Research Programmes and Research Centres, which can provide continuity and support for engagement. There are, however, costs and other disadvantages (inertia, increased management costs, loss of competitive

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[55] *The Scottish Office funds some £130 Million of (science and social science) research p.a.. The recent SHEFC Consultation under its Review of Research Policy and Funding (SHEFC 2000b) proposes allocating some £1 Million p.a. for a Joint Research Development Funding Programme to pursue synergies with the research funded by the Scottish Office, recognising that sporadic Scottish Office funding may not be sufficient to maintain research capacity within the academic community.*

incentives) with these more centralised models of research management. Responsive mode funding in contrast tends to be more innovative, and is cheaper and more flexible.

A key question is whether we can find a way to achieve the benefits of managed and decentralised models. Some University departments and specialised research units have established dissemination mechanisms and built up expertise and reputations in the course of a series of research projects and have been able to sustain programmatic approaches to exploitation through responsive project funding. However in most cases this has not been achieved. This is something that might be addressed by the policies of higher education institutions and their constituent bodies - although we must remember here that many academics and their departments remain primarily focused upon individual scholarship, a model which is reinforced by existing incentives (eg promotion criteria or the Research Assessment Exercise, as we see below). Organisations sponsoring research could promote such a development by targeting their funds towards such centres of excellence. At the same time they may also need to consider how best to allocate their funding to sustain a healthy research community and promote diversity and exchange of ideas, since the same dilemma between centralisation and competition arises as with ESRC funding.

Another possibility would be for research funders to support mediating institutions with an emphasis on the exploitation of specific projects and, more important perhaps, effective use of the broad body of social science research in various areas[56.] Such institutions could also make social science more accessible to its general publics and to 'users seeking researchers', instead of the current exclusive emphasis on 'researchers seeking users'.

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[56] *In Scotland, SHEFC has developed novel funding mechanisms, including Research Development Grants, which could be seen as an instance of this. They support development of high quality research capacity in Scottish HEIs and emphasise commercialisation and dissemination of research particularly in areas relevant to the long-term needs of Scotland. Whilst RDGs were initially conceived tacitly in terms of science and engineering, a SHEFC RDG enabled the establishment of SUPRA – the Scottish Universities Policy Research and Advice network in the area of science, technology and environmental policy. (see www.ed.ac.uk/rcss/supra). This paved the way for a series of RDG funded centres in various areas of social science, including, to date: Transport Research, Environmental History and Policy, Interdisciplinary Research in Investment Science, Lifelong Learning, Rural Development Research, Socially Inclusive Services, and Families and Relationships.*

We have also argued that the exploitation of social science research depends critically on the networks in which researchers and users are embedded, and that the knowledge which users seek to discuss is often not the product of a specific project or the way it has been funded but is embodied in the person of the widely informed researcher. The most effective networks will be those which are:

- built up and sustained across HEIs and user organisations;
- over relatively lengthy periods of time;
- with fairly slow turnover of people;
- with a willingness and ability, perhaps trained ability, on the part of researchers to devote time to the dissemination and the application of their embodied knowledge;
- together with appropriate incentives for researchers to do so.

However, there are factors working against the sustainability of such networks. In the existing model - whereby research is funded as a series of discrete activities - the widespread employment of research staff on short-term contracts induces a number of costs which may often be overlooked: the loss of trained researchers when a project is completed; the loss of embodied knowledge that goes with them when they leave the project; and the loss of potential benefits to society from the failure to apply these ideas. These costs are immeasurable. But if they were factored in, the current model of responsive research funding might seem less attractive.

Increasingly, teaching staff are also on short-term contacts. The pressures thus placed on them are not conducive to networking with users or devoting time to ensuring their work is exploited, as opposed to published in academic journals. Moreover, the Research Assessment Exercise (RAE), by which the Higher Education Funding Councils support research and scholarship within HEIs, encourages academic publication and gives little weight to exploitation activities. This problem has been recognised by the Funding Councils and is one focus of their current reviews (HEC02/00, SHEFC 2000a). RAE seems likely to be continued for the time being, given its positive impact on research performances, but to be fine-tuned to give greater weight to the 'third mission' of HEIs: of consultancy and research exploitation, as well as teaching and research. There is a double bind here in that our audit shows how immensely difficult it is to trace directly and unequivocally an audit trail of exploitation. Thus even if the RAE were to shift ground and give more credit for exploitation it is far from clear how methods simple enough to be used in the RAE could be developed.

We need to think creatively about how to encourage engagement between researchers and users, including the formation of networks and the development of embodied knowledge which have proved critical to the ways in which social science knowledge actually comes to be used. The challenge is to find ways to institutionalise relationships without setting them in concrete. In meeting this challenge, government, funding bodies, and research active institutions must not underestimate the importance of supporting sustained effort in relationship building. Research policy needs to grapple with this tension between encouraging continuity and the quality benefits of competitiveness and diversity. Institutional policy support should remain reflexive and sensitive to a range of practices that can cater for the various potentially contradictory requirements, for example between research excellence and exploitation, particularly since the most appropriate approaches are likely to vary between different research and policy settings, undermining the idea of a single model of best practice. Encouragingly, the Scottish Higher Education Funding Council has been very aware of many of these points (SHEFC 2000a).

Whilst changes in researcher behaviour and research policy are already underway, our study flags the crucial influence of policymakers and other research users - the main gatekeepers for exploitation - in terms of being open to findings and insights emerging from research. This study was conducted in the run-up to devolution, prior to the establishment of the Scottish Parliament and Government and their associated policymaking structures. This has led to the renewal, expansion and elaboration of the research and advisory structures that existed previously with the Scottish Office and its constituent departments (for example the Scottish Office Central Research Unit), as well as wholly new types of institution such as the Scottish Parliament Information Centre (SPICe) which provides research, information and documentation services to the Scottish Parliament. These fora offer greater opportunities for institutional linkages, the formation of networks and other interactions[57]. The

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[57] *Intermediaries, such as expert advisers, are still likely to be important in translating between the body of academic research findings and particular policy debates. The run-up to devolution has seen an expansion of discussions between policymakers and expert advisers and has opened up new spaces and avenues of contact, bringing greater open-ness for academic-policy relations. There has also been a growth in political Party researchers and in lobbyists. Given the importance of embedded knowledge, actual migration of experts may also be important. Recent Scottish Office recruitment adverts for research and advisory posts flagged the possibility of secondments, raising the possibility of greater exchanges between academia and government, more in line with Continental practice.*

existence of the Scottish Parliament, and its specialist committees (which unlike Westminster can initiate legislation and debate), opens up yet wider channels for interaction and debate. These initiatives within the Scottish policy structures may prove more important in bridging the worlds of research and policy than the HEI initiatives discussed above on the research side. Indeed Scottish devolution, with its emphasis on a more open culture and methods of working, may pave the way for a closer and more constructive relationship between research and policy.

Scotland approaches the 'Knowledge Age' with some advantages, including a culture in which knowledge and education have traditionally been valued, and a strong existing research base. Scotland attains around a third more research income per capita than the rest of the UK mainly from research funding councils and charities which operate at the UK level, and, increasingly, from European agencies (SHEFC 2000a). However, well-tuned policies will be needed to ensure that this small nation can continue to stay in the forefront of an increasingly competitive global research market, as well as ensuring that this knowledge is effectively exploited.

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