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DEVOLUTION:

A THINK PIECE

A REPORT PREPARED FOR THE
MINISTRY OF RESEARCH, SCIENCE & TECHNOLOGY

BY

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EXECUTIVE SUMMARY

This paper has been prepared as an independent "think piece" for the Ministry of Research Science and Technology (MoRST). It is part of a reconsideration of the costs and benefits of the current contestable funding system.

The central issue being addressed by MoRST is whether the current contestable system may have lost some of its value with the suggestion that uncertainty and high compliance costs may have resulted in confused roles and a loss of skilled scientists.

The first section of this paper begins by considering the problem definition. Claimed negative impacts include high transaction costs, a bias towards a short-term revenue earning focus and an unnecessarily uncertain environment for career development.

The paper (P5) notes the context for the science reforms of the 80's and 90's including what is sometimes described as "provider capture". It qualifies this by pointing out that the claimed inefficiencies may also have been influenced by regalities over resource use, especially staffing.

In returning to the current context, it draws a distinction between purchasing research outputs and conventional purchase transactions; contracting for science outputs is characterised by uncertainty.

Recent work in Europe, as part of the European Research Area initiative, highlights the importance of the nature of the search regime, especially in newly emerging sciences. In a context in which the state of scientific knowledge is such that even trained evaluators are faced with a practical impossibility of deciding on the intrinsic merits of projects, then decision-makers should refer to the quality of proponents. In other words, there is a case that investment should be driven by the quality of institution rather than an attempt to assess the possible outcomes of competing projects where uncertainty prevails. In New Zealand this may mean rethinking the extent to which public choice theory has driven micro-management through a three-way policy adviser/purchaser/provider split within a conventional contracting framework. There is some support in the academic literature, and recent comment from the father of public choice theory, which supports this view.

There is also evidence that the reliance on a competitive model, and on financial performance as a key performance measure for research institutions, have undermined collaboration, including the freeflow of ideas, and biased research institutions towards the commercial/consultancy end of the spectrum.

This think piece accordingly concludes that there is substance in the problem definition and that the search for alternative means of funding capable of minimising the adverse impacts of the current system should be given high priority.

The next section considers MoRST's five objectives which should stem from any changes and discusses a shift to a different approach; relational contracting.

We suggest there should be a sixth objective, excellence in the areas that are significant for New Zealand.

The paper then discusses the nature of research organisations and their environment; Crown Research Institutes, Universities, and Research Associations not only have different structures; they face different incentives and different funding arrangements and accountabilities (with the universities' reliance on the Tertiary Education Commission, and access to the Performance Based Research Fund, being critical differentiating factors).

An alternative approach for funding is relational contracting; an approach which recognises that the purchaser and provider both have a common interest in building an ongoing relationship.

It can be developed at a project basis where it becomes a different approach to managing the purchase of a set of outputs. More significantly, in terms of the identified difficulties with the current contestable system, it becomes an organisational relationship. The funder's emphasis shifts from specific outputs to building organisational capability. It relies on building trust. Rather than negotiating individual contracts, the focus shifts to the strategic planning process and objectives of the provider – what capabilities is it seeking to build and why and how robust is its planning processes? The key relationships may be at a governance rather than (or as well as) at an operational level.

Such a shift would clearly have implications for current institutional arrangements for advice on science policy, for purchase activity and for monitoring.

The paper, on the material available, reaches the judgement that devolution appears the best option for addressing the identified problems. It notes also that there are risks with this that will need careful management.

Not all research organisations, or all major research funds, will be appropriate for devolution. As an example, establishing a relational contracting arrangement between a science funder and a university could create an immediate conflict both with existing funding and accountability arrangements in the tertiary sector, and with the internal structures of universities themselves.

The report makes the judgement that devolution should be limited to those organisations where relational contracting could be established at an organisational level (with a focus on the organisation's strategic direction, planning etc) and where the organisation has a demonstrated capability to be prepared to work in this way.

Of the various funds which come under Vote: Research, Science and Technology, the two which appear best suited for devolution are the Research for Industry and Environmental Research Output Classes – primarily because they are major sources of funding for organisations which should be able to adapt to a devolved approach. Other significant funds, such as the Health Research Fund, seem less appropriate because of the difficulties of devolving to universities within the approach this paper proposes (Otago and Auckland Universities between them are the major recipients from this fund).

Transition will need careful management. There will be "legacy" issues with existing multi-year contracts. We suggest that transitional funding be on the basis that:

- Eligible organisations receive, as of right, 80% of their base funding from the two output classes for a period of (say) three years.
- The amount of funding through the two output classes be increased by 20% of the aggregate base amount received by eligible organisations.

- Funds not allocated as of right – equivalent to 40% of the aggregate base – be allocated amongst eligible organisations based on their submissions on how they propose managing devolved funding.
- Remaining funds within the two output classes continue to be allocated on a contestable basis.
- The way be left open for additional organisations to come under the devolved funding regime if they can demonstrate that they meet the criteria and have the capability required.

INTRODUCTION

A key policy issue for the Ministry of Research, Science and Technology (MoRST) is creating a more stable funding environment -- reducing the instability caused by the contestable system, and implementing a greater level of devolved funding.

In order to complement and support the policy work which MoRST is undertaking, it has commissioned McKinlay Douglas Ltd (MDL) to prepare an independent "think piece". The terms of reference (ToR) require that the think piece:

- Tests the problem definition and the assumptions made in the Policy Development Context of the ToR. MoRST notes that the evidence is mainly anecdotal, although indications of high transaction costs and disaffection are real enough.
- Provides an independent and impartial analysis of the proposed policy objectives. As it is possible MoRST will devolve a significant amount of Vote RS&T, it is important to ensure MoRST is informed by an external view of the NZ system and the players within it.
- Informs MoRST thinking and provides ideas that may not necessarily arise during a policy process.
- Considers: if the proposed devolution solution is the most effective response; or if MoRST should be considering other options.
- Considers: which research organisations MoRST could devolve investment decisions to; criteria for devolving; which of the current funds could be devolved; at what proportion; and what positive and negative impacts could be expected across the system?

Amongst the requirements for the preparation of the think piece were that it:

- Not involve interviews or discussion with third parties.
- Be based primarily on MDL's existing knowledge of the New Zealand science system, supplemented by (primarily Internet-based) research on current trends impacting on science funding systems.

Consistent with the requirements of the terms of reference, MDL developed this think piece drawing on previous work which it had undertaken for MoRST, and material which could be accessed through the Internet.

The remainder of this report is divided into sections which respectively:

- Test the problem definition. This includes responding to the third item of the ToR, providing ideas that may not necessarily arise during a policy process.
- Provide an analysis of the proposed policy objectives. This includes a consideration of how a more trust based, relational approach to contracting with research organisations might operate.

- Considers if devolution is the most effective response or whether other options should be examined.

- Considers which research organisations investment could be devolved to including criteria, funds, proportion and possible impacts.

These tasks are undertaken within the constraints set by the ToR and the resources made available for this project.

THE PROBLEM DEFINITION

This section begins by outlining the main points of concern about the current contestable funding system. It supports this by drawing on views from the science community.

It then looks back to the drivers for the reforms of the 80's and 90's, raises the issue of contracting under conditions of uncertainty and considers current thinking in Europe on research funding. The impact of public choice theory is then examined briefly as is the claimed bias towards short-term research, and the present system's claimed encouragement of competitive rather than collaborative behaviour. This section then concludes that the problem definition is well based.

The background paper provided to MDL by MoRST, "A Stable Funding Environment", expresses the view that, as science providers have evolved, the current contestable system has lost some of its value. The paper states that "this is particularly true in areas of important strategic and environmental research, where a considerable element of uncertainty and high compliance costs may have resulted in confused roles and the loss of skilled scientists."

In essence the argument is that the transaction costs associated with the present contestable system are too high in relation to the benefits that contestability brings. Amongst the factors identified, some in the MoRST background paper and others in sources such as a considerable body of commentary from the New Zealand science community, are:

- The very high transaction costs associated with bidding into funding rounds, especially given the number and complexity of the different funding arrangements now in place -- a particular concern is the extent to which senior scientists have been distracted from "doing science" by the need to pursue funding.

- The diversion of resources into what many see as a top-heavy set of policy and administration arrangements including two separate stand-alone agencies, MoRST and the Foundation for Research, Science and Technology (FRST).

- A claimed bias towards short-term research undertaken to generate revenue as opposed to longer term knowledge generating research -- to put it another way too great a shift towards the applied end of the scale.

- A culture of competitive behaviour amongst institutions when the national interest would often be better served by collaborative/cooperative behaviour.

- The impact of uncertainty on career development.

That the transaction costs of the current system are high is not, in itself, evidence that they are too high. The crucial issue is whether the present system, and the costs it imposes, are a necessary condition for achieving the outcomes New Zealand seeks from

its science system. Any analysis of the problem definition must recognise that the costs cannot be considered in isolation but only in terms of the extent to which they are essential or not for the outcomes sought. There is a rough parallel with the well-known comment by Winston Churchill on democracy: "Democracy is the worst form of government except for all those others that have been tried."

A further point needs to be made. The "current contestable system" is not the only form of contestability which could have been used to impose competitive disciplines on the New Zealand science system. Rather, it has evolved from a very specific expression of contestability -- a strict separation between policy advice, purchase and provision supporting a process under which government departments and agencies receive their funding as the purchase price for outputs or groups of outputs in an approach intended to mimic, within the state sector, the arms length transactions typical within a private market.

A View From The Science Community

The New Zealand science community has been very active in documenting concerns about the current system both individually and through organisations such as the New Zealand Association of Scientists. Most recently, in May 2005, the Association released "There is a Better Way: Eight Recommendations on the Science System in New Zealand."

That discussion paper, whilst recognising the benefits that had resulted from the reforms of the 1980s and 1990s, was nonetheless highly critical of the current funding system (partly because the Association considers that government's total investment in science is inadequate). It identifies a number of features of the current system which it describes as highly dysfunctional and providing incentives that are inconsistent with a focus on New Zealand's requirements of its science system.

Similar sentiments were expressed in the so-called "open letter" to the Minister of Research, Science and Technology in October 2004.

A more in-depth consideration of the concerns of the science community can be found in the special issue of New Zealand Science Review published in 2003 which brought together views from a number of different commentators with experience ranging from MoRST and FRST, to CRIs and other research institutions and the private sector. All recognised that there have been significant gains when the present day is contrasted with the pre-1987 situation. All argue that there is now a clear need for change with a particular emphasis on minimising transaction costs and providing greater stability for New Zealand's science system but without compromising the gains that have resulted from contestability.

These views are all consistent with the findings of various projects undertaken for MoRST by MDL over the past decade or so. We are in no doubt that the transaction costs associated with the present system are high. They include:

- The costs associated with maintaining two separate stand-alone agencies.
- The direct and indirect costs of contracting/bidding.
- The opportunity costs that result from research institutions pursuing short-term gain at the expense of investment in long-term research (identified by scientists as a direct result of the requirement that Crown Research Institutes be financially viable, a requirement interpreted as requiring that they earn their weighted average cost of capital).

- The impact on the present and future science workforce of the uncertainty seen as inherent in the current system -- essentially an issue of setting an appropriate context for maintaining/building capability.

In considering whether transaction costs are too high, it is useful to set the present system in context; specifically, to look back to the reforms of the 1980s and 1990s and understand why they were seen as necessary.

The Context for Reform

First, as is well-known, during the late 1980s and early 1990s New Zealand went through a major programme of public sector reform which affected the entire public sector. The overt rationale was a view of the nature of public institutions derived from public choice theory. This emphasised the importance of understanding the motivation of public officials and designing institutions, and institutional arrangements, to minimise the potential for misalignment of personal and institutional objectives. Specifically, public choice theory assumed that individuals were self-interested and opportunistic and that a major task of institutional design was to minimise the potential for these characteristics to undermine the achievement of organisational objectives. The measures, for public sector redesign, which public choice theory encouraged included separating out potentially conflicting functions such as the provision of policy advice and the implementation of the resultant decision (including the two separate elements of implementation; purchase and provision).

Consistent with this, an important objective of science restructuring was to separate out policy advice, purchase and provision (see point five at page 47 of "Science and Technology Review: a New Deal" the report of the Science and Technology Advisory Committee - hereafter referred to as the STAC Report). Much of what was regarded at the time as the relatively low productivity of government science was attributed to the fact that these three functions were combined in a single organisation, whether the Department of Scientific and Industrial Research or the other major government science entities such as the Ministry of Agriculture. What amounted to bulk funding of these organisations was seen as creating a situation in which senior managers were able to choose where and how funds were applied almost regardless of the national interest. The chosen solution was to ensure that the objectives for which research activity was undertaken would be determined on the advice of one group of officials, the role of purchasing research in support of those objectives would be managed by another and actual provision would be undertaken by providers separate from the policy and purchase functions.

Although many within science clearly thought that they had been singled out for attention, this was not the case. As Anthony Scott, the Executive Director of the Association of Crown Research Institutes, comments in his contribution to the special issue of New Zealand Science Review: " The New Zealand science system was merely another item on a reforming agenda applied to all and sundry, including core State functions (e.g. Justice, Social Welfare)."

It was widely believed, then and now, that the combination of bulk funding and the lack of effective external oversight of government's major science departments had resulted in very significant waste. Sean Devine in his contribution to the New Zealand Science Review special issue refers to “the elimination of useless research (about 20% -- 30% of that previously funded)".

If "useless research" on that scale is a natural consequence of bulk funding, and the alternative is the kind of detailed purchase system we now have, it would be hard to

argue that the associated transaction costs of the current system were too high -- it is extremely unlikely that they are of the order of 20% -- 30% of total funding.

A Qualifying Comment

However, that conclusion would be overly simplistic. First, it is important to recognise that the claimed waste in the previous system was not solely a function of bulk funding. It was also very much a consequence of the public-sector staffing arrangements of the time. Scientists were tenured public servants with strong statutory and other protections against dismissal. From a management perspective, these protections were a very significant barrier to managing the most important resource any science manager has, human capital. In practice, scientists who were either non-performers, or whose areas of research capability were no longer priorities for the organisation, could neither be dismissed nor reassigned to other work. From a resource allocation perspective, this problem was compounded by the need to apply relatively scarce operational funding in support of those scientists.

It is tempting to wonder what might have happened if, instead of seeing a major restructuring of government owned science as the necessary prerequisite to a better return on investment in research and development, government had given science managers the legislative and other discretions needed for better management of the science workforce.

Next, the significance of the fact that science was “merely another item on the reforming agenda”, to use Anthony Scott's words, should not be overlooked. Generally, public management reform was being driven by a purchaser/provider model. Government departments and other agencies were funded through purchase agreements between ministers and chief executives (parent departments and chief executives in the case of Crown entities) spelling out the required mix of goods and services which the department or agency would produce, and the payment that would be made for those goods and services. The intention was to impose on government provision, as near as could be done, the same disciplines as applied to firms operating in the private marketplace in the belief that this would encourage departments both to seek out least cost means of production and to focus on the requirements of the purchaser.

In that context, it was virtually inevitable that science reform would take place within the same framework as the reform of other major government activities. In essence, science was caught up in a "one size fits all" approach to the application of the principles of competitive markets within the public sector. There was simply no real prospect of science being treated separately with a "first principles" analysis of how best to apply competitive principles to science.

This was not just a matter of the views of public sector reformers being thrust upon the science sector. The authors of the STAC Report, in a chapter discussing "What Science?" had this to say:

> "Another way of looking at the issue is to see it as representing a shift from government acting as indiscriminate funder, to government acting as a discriminating purchaser…. This necessarily implies a competitive process. The only way in which the government (or an agent acting on its behalf) can identify those projects or programmes which best satisfies its objectives from amongst all the projects or programmes which might be available, is to rank the latter against each other and make a choice."

What that quotation illustrates is a view that the only way a discriminating purchaser might exercise choice is through the decisions it makes about the specific outputs

(project or programmes) it decides to purchase. This was entirely consistent with the pattern of public sector reform. However, as is discussed below, contracting for outputs is not the only way in which a discriminating purchaser might decide to exercise choice.

This takes us back to the question this section is addressing; is the problem definition - most especially that the transaction costs of the current system are excessive - correct? At the heart of this is an issue which has bedevilled science policy since the early 1990s; to what extent is it possible for government or an agent acting on its behalf to be an informed purchaser of science outputs?

Purchasing in Conditions of Uncertainty

In considering this, it is essential to recognise that the purchase of science outputs is significantly different from conventional purchase transactions. At the time that a contract for science outputs is negotiated, the output is seldom clearly defined and there may be a significant measure of uncertainty over whether the output will eventuate or, if it does, whether it will be appropriate to the purchaser's intentions. This is not simply the conventional problem of information asymmetry, with the provider having an information advantage that the purchaser cannot match. It is often the case of the provider itself being unable to predict what will result -- as is well-known, uncertainty pervades all stages of the process of research, development and finally commercialisation (or in the case of non-commercial outputs, their application).

It can be argued that the successive changes in New Zealand's science funding system, including the proliferation of funding instruments, is a direct consequence of the combination of uncertainty and the decision that New Zealand would get a better return from government investment in research and development by applying competitive disciplines to the allocation of funding.

If uncertainty is a dominant factor in the process of making investment decisions for research and development -- and there is a very significant amount of published material in science policy internationally which argues that it is -- then we need to consider whether the chosen means of imposing competitive discipline on science was the most appropriate one. Did the decision to impose a "more market" approach automatically mean moving to the purchase of science outputs or would some other approach have been preferable? Should we specifically recognise the uncertainty and design the purchase/funding process to treat this as a social fact rather than as a risk to eliminate through contracting practice, something which requires the purchaser and the provider to establish a much more collaborative relationship than is typical with arms length contracting.

A European View

There is an emerging theme within science policy debates in Europe which suggests a different approach. That theme starts with a focus on an issue which has not, as far as MDL is aware, received much consideration in New Zealand. The issue is the nature of the search regime within different science disciplines and fields.

The European Commission has established what is known as the PRIME Network of Excellence (PRIME stands for Policies for Research and Innovation in the Move towards the European Research Area). It is intended to address the major transformations that research and innovation policies are currently facing. The PRIME Network held its first annual conference at the University of Manchester in January 2005. Amongst the presentations were two papers from Andrea Bonaccorsi of the University of Pisa looking respectively at the nature of different search regimes in science and the implications for

institutional design (extracts from the two papers are included in the appendix to this paper).

To somewhat simplify the argument in the first paper, the case which is being made is that in many of the newly emerging sciences the process of search and discovery is fundamentally different from "normal" science. As the author expresses it, a search regime is a summary description of the pattern of growth of scientific knowledge and of the actual carrying out of scientific research. She demonstrates that the characteristics of search regimes vary significantly depending on the scientific field or discipline involved. The nature of some fields or disciplines is such that the search regime is operating within a reasonably well-defined and known area. New hypotheses may be generated but the context is such that it is comparatively easy for other scientists experienced in the field to assess the credibility of the hypothesis and the merits of its further exploration. In other fields or disciplines, including the newly emerging sciences in which New Zealand has a particular interest such as biotechnology and ICT, the situation is quite different. It may be impossible for even trained evaluators to choose between competing hypotheses.

In her second paper the author argues that, faced with the practical impossibility of deciding on the intrinsic merits of projects, decision makers instead refer to the intrinsic quality of proponents.

Here, what the author is contending is that excellence of institutions may be the best selection criterion for funding under conditions of uncertainty. Much of the analysis in the paper is a bibliometric comparison of institutional rankings within Europe and North America based on the premise that those scientists who are consistently amongst the most cited throughout their careers will be recognised as leaders in their field and in turn, the institutions for which they work will have the same standing. In an environment in which the labour market for scientists is competitive -- both in the sense that the market itself is open and that scientists have choice amongst institutions -- the best scientists will tend to work within the best institutions and in turn the best institutions will have a comparative advantage in attracting the best talent, including newly emerging scientists.

In essence, this work argues that the appropriate competitive discipline for determining which institutions should be funded is the competition for scientific talent rather than competition for project based funding. It is an approach which carries with it a number of necessary qualifications in a New Zealand context including the relatively small size of our science labour market (although that may be less of an issue than it first appears given that many scientists are effectively operating in an international rather than a New Zealand labour market when considering options for the development of their careers in science). It does draw attention to issues such as mobility amongst institutions, the nature of career development (including the impact of the structure of New Zealand science on the education of newly emerging scientists -- the extent to which much scientific research in New Zealand is undertaken outside universities) and in all likelihood the relative absence of the kind of indicators used to rank institutions in the papers just cited. Here it is important to emphasise that the use of bibliometric techniques to establish a ranking is critically dependent not simply on publications as such but on the status of the journals in which publications appear, and on the frequency with which the publications of individual scientists are cited.

The work of the PRIME Network is one of a number of responses, some pan-European, some on the part of individual nationstates, seeking to address questions of performance and relevance of European research and development. A major factor has been the concern that European systems for research and development perform inherently less well than American systems.

A common theme is the view that European research has suffered from funding systems which have, in essence, bulk funded existing institutions without subjecting them to performance-based disciplines. Addressing this is seen as requiring a greater competitive element in science funding. A good overview of the nature of the debate, and the direction of change, can be found in the OECD Summary Report on Workshop "Science Funding in Transition -- Changing Paradigms and First Experiences of Implementation" (http://www.oecd.org/dataoecd/44/43/2506954.pdf).

National arrangements, across Europe, for science funding differ substantially one from another although, historically, there has been a tendency to place decisions on the funding of individual institutions with associations or other entities at least partly representative of those institutions themselves. Generally, the process of introducing an element of competition has not been one of major structural reform, as in New Zealand, but rather one of changing the brief of the oversight entities. Germany's Helmholz Association provides an example. It is an Association of some 15 individual institutes which play a major role in Germany's research sector. The process of reform has seen a shift away from institutional funding, with a strong element of "ownership" of entitlement, to programme funding. The funding process is managed by the Helmholz Association. From the description which the Association itself provides, there appears to be a strong element of what this report describes as a relational contracting, coupled with a focus on supporting long-term research and institutional capability. More information can be found on the Association's web site at http://www.helmholtz.de/Downloads/1_Wir_uber_uns/Profil/Overview_PoF.pdf.

The overarching impression from current developments in Europe is that the recognition of the need for a greater focus on relevance, outputs, performance etc has been coupled with a continuing stress on maintaining capability and building the confidence of researchers in the reform process (with an emphasis on the excellence of institutions broadly consistent with Andrea Bonaccorsi's work referred to above). This has been assisted by a related commitment to increasing investment in research, both generally and as part of the process of change, and by processes which have been designed to ensure strong oversight by people from the research community itself.

It is an approach which does recognise the insights from new public management but which appears also intended to mitigate against the more extreme impacts which arguably come from an overly rigorous application of a standard public choice theory approach.

The Role of Public Choice Theory

One question which a focus on the uncertainty inherent in the outputs of research raises, especially in the newly emerging sciences, is whether the underlying assumptions of public sector management, including the understanding of the nature of the principal/agent problem, have themselves had a negative impact. From this perspective, public choice theory is inherently based on distrust and this in turn impacts on the environment its application is intended to manage. This issue is explored in a recent working paper published by the ESRC Centre for Business Research at the University of Cambridge, "Theorising Corporate Governance: New Organisational Alternatives".

The paper is a consideration of the new institutional economics view of organisational structure including a critique drawn from recent literature of what is seen as the negative impact of this view of the nature of human beings in an organisational context. The following quotation sets out the essence of the argument:

> "Some, however, suggest that the refinement of contractual theories of the firm is inadequate, as many of their fundamental assumptions are so inaccurate that they

discredit the entire approach. For example Moran & Ghoshal (1996) strongly criticize Williamson's (1975, 1985) pessimistic assumptions about organizations as well as human behaviour and motivation:

> "[Economic] theories of today are dominated by a profoundly pessimistic view of organizations, concerned far more about the unintended consequences of organizing than about organizing for their intended purpose, and by an even more skeptical view of individual-organization interactions, grounded in the assumption that the human role in organizations is largely passive and frequently pathological... the all-pervasive concern for shirking, opportunism, and inertia in organizational economics (Moran and Ghoshal 1996: 70).
>
> "Moreover the normative implications of economic theories are perceived to be especially dangerous: Ghoshal and Moran (1996) criticize the fact that these theories create the conditions which encourage the type of behaviour they assume:
>
> "Social sciences carry a special responsibility because of the process of the double hermeneutic: its theories affect the agents who are its subject matter. By assuming the worst, this theory can bring out the worst in economic behavior. By assuming opportunism and establishing it as his base case, Williamson is blind to forces that work to confirm or discredit the validity of his assumptions ... In the process, his theory is likely to encourage the very behavior that it takes for granted and seeks so hard to control. (p.39)"

We are not aware of any objective research designed to test the proposition that, within the New Zealand science system, the application of a funding system based on public choice theory principles has had the impact which the quotation above suggests is a possibility. However, in much of the work that we have previously undertaken for MoRST, we have encountered attitudes amongst scientists consistent with a certain alienation from the institutional structures within which they work. It is possible that this may have been no more than the often observed phenomenon that scientists will owe their first loyalty to their science (including their research colleagues) and regard their current employer as simply a necessary means through which they are able to pursue their research objectives.

In New Zealand, part of the context for current issues in science funding may be the way that public choice theory has been applied in practice. The insights of agent/principal theory and transactions cost theory which underpin public choice theory were developed in the context of the classic private sector corporation with a division between ownership and management and then applied to other organisational structures. Virtually of necessity, it is inherent in the private sector corporation that the relationship between owners on the one hand and management on the other are arms length and mediated through carefully prescribed legal requirements (the constitution of the corporation; corporation law; securities law). There is no equivalent necessity for applying those same constraints to the relationship between public owners and public entities.

It can be argued that, by applying the insights of public choice theory as New Zealand did, it chose one possible option without considering whether there were other means of managing the presumed problems of self-interest and opportunism believed to characterise individuals whether in the public or the private sector. Little credence was given, for example, to the potential of the "public sector ethos"; the value system thought to underlie the commitment people were prepared to make to working in the public sector rather than exploring the possibly more remunerative opportunities available in the private sector. Indeed, rather than being seen as a means of mitigating the impacts of self-interest and opportunism, the "public sector ethos" was sometimes seen as simply a variant which dressed the self-interest of public servants, especially occupational groupings whose principal employer was the public sector, in the language of public interest.

Clearly views are now changing. There is a renewed interest in developing (reviving) the "public sector ethos". There are also signs of a realisation that perhaps the insights of public choice theory have been taken too far. In February 2003 James Buchanan, generally recognised as the father of public choice theory, delivered a public lecture on the theme of "What is Public Choice Theory?" (*a*t a seminar co-sponsored by the Center for Constructive Alternatives and the Ludwig von Mises Lecture Series*.)*. In the course of that lecture he had this to say:

> "Public choice, as an inclusive research programme, incorporates the presumption that persons do not readily become economic eunuchs as they shift from market to political participation. Those who respond predictably to ordinary incentives in the marketplace do not fail to respond at all when they act as citizens. The public choice theorist should, of course, acknowledge that the strength and predictive power of the strict economic model of behaviour is somewhat mitigated as the shift is made from private market to collective choice. Persons in political roles may, indeed, act to a degree in terms of what they consider to be the general interest. Such acknowledgment does not, however, in any way imply that the basic explanatory model loses all of its predictive potential, or that ordinary incentives no longer matter."

Other Factors

So far in considering the problem definition, we have concentrated on transaction costs, recognising that these are high and considering whether they are the necessary result of improving the performance of New Zealand's science system, or whether there are alternatives which should be considered. We have found that the overwhelming burden of comment is that transaction costs are too high, and that the chosen means of managing the New Zealand science system is generally too intrusive. This has been accompanied with argument which suggests that the New Zealand emphasis on outputs, and the associated application of micro-management, may be at least partly misplaced; that in conditions of uncertainty, there is a case for concentrating funding on excellent institutions rather than on attempting to purchase outputs which it is inherently difficult to define with any degree of certainty. We turn now to consider other elements of the problem definition; the claimed bias towards short-term research and the culture of competitive behaviour.

Short-term Research

At the time of the major science reforms, including the establishment of Crown Research Institutes, government was focused on the perceived need to change the incentives facing the research community. It had a particular interest in encouraging researchers to put more emphasis on relevance and the potential of commercialisation. One proxy for success with this objective was the ability of research organisations to earn an acceptable profit. The normal reasoning applied; if people/organisations were prepared to pay sufficient for the outputs of research organisations for them to generate a surplus, then you could assume that the research outputs were meeting or exceeding tests of value in a competitive market.

This approach was formalised in the Crown Research Institutes Act which requires that every Crown Research Institute shall, in fulfilling its purpose, operate in a financially responsible manner so that it maintains its financial viability. A Crown Research Institute is financially viable if "the activities of the Crown Research Institute generate, on the basis of generally accepted accounting principles, an adequate rate of return on

shareholders' funds; and the Crown Research Institute is operating as a successful going concern."

This requirement has been interpreted to mean that, year on year, a Crown Research Institute should earn its weighted average cost of capital. Such a requirement is inconsistent with the nature of long-term research for which returns are inherently unpredictable and may arise years into the future, if they do, rather than in neat twelvemonth packages to satisfy GAAP. The obvious strategy for a Crown Research Institute required to earn a profit on a regular basis is to move its activity towards the applied research/consultancy end of the spectrum. The annual reports, and disclosed funding sources, of Crown Research Institutes suggest strongly that this is exactly what has happened.

Placing such a sharp focus on annual profitability may have been appropriate as a means of signalling the need for a significant culture change when it was first introduced. However, including that requirement in legislation was only one and the most inflexible means of achieving the objective. It was also inherently short-term in focus when there were other and longer term means available of requiring Crown Research Institutes to focus on financial viability.

First, the government could have used the statement of intent process rather than legislation as a means of spelling out what was required in terms of financial viability. Secondly, the very fact that Crown Research Institutes were established as limited liability companies meant that their boards were subject to the normal statutory and common law duties imposed on directors which require them to be concerned with the company's viability.

It is difficult to see that the use of legislative means added anything of value which could not have been achieved through the other and more flexible processes available to government coupled with reliance on the legal duties imposed on directors. On the other hand it is clear that imposing this very specific requirement was interpreted within the New Zealand science community as a very major shift away from an emphasis on long-term research in the direction of what was little more than commercial consultancy. This view may have been an overreaction but it certainly existed, and almost certainly still does. It would make sense to remove the specific emphasis on shareholder returns and simply leave in place the first component of the requirement, that every Crown Research Institute shall, in fulfilling its purpose, operate in a financially responsible manner so that it maintains its financial viability.

The approach also seems at odds with what is the best available explanation of continuing government ownership of Crown Research Institutes. If they are simply to be providers of services in a competitive market, tasked with earning a return for shareholders, it is hard to make a case for continuing government ownership. Instead, if this case is to be made, it will be on the basis that continuing government ownership is seen as being the only means that will ensure the preservation/enhancement of research capabilities which the government believes are essential in the public interest.

The Culture of Competitive Behaviour

In respect of this, we simply note two points:

- It is inherent in any competitive market that participants will act to maximise their own benefit and this will include seeking to win market share from competitors. It follows from this that, in any competitive funding arrangement, the funder should expect to see competitive behaviour even if the consequence is a net social

disbenefit, so long as the successful competitor believes that it achieves a net benefit for itself.

- In all of the work which MDL has undertaken for MoRST which has involved discussion with Crown Research Institutes and other research organisations, it has been common for informants to comment adversely on the impacts of the competitive environment and refer to specific instances where they believe it has resulted in unnecessary duplication, loss of capability, high transaction costs, and the withholding of information that in a normal research environment would be shared between research organisations.

The Problem Definition: Conclusion

It seems clear from recent history that amongst the problems facing funders have been:

- Determining the relative merits of individual projects.
- "Unbundling" the nature of activity within multi-purpose institutions such as universities.
- Ensuring that commercialisation of research findings is optimised without overly biasing the activity of research institutions towards applied research and, for that matter, activities that are virtually indistinguishable from conventional consultancy.
- Maintaining research effort in areas that may be of long-term significance to New Zealand but with a low profile from a commercialisation perspective.
- Maintaining capability.

From the foregoing review of the various elements of the problem definition we conclude that it is well based and that the search for alternative means of funding capable of minimising the adverse impacts of the current system should be given high priority. This is not to argue that the arguments which gave rise to the present funding system were incorrect. Rather, it is to accept the desirability of exposing New Zealand's investment in research and development to competitive disciplines but to argue that the means of doing so should be consistent with other objectives, including the preservation/enhancement of desired research capability. Those means should also take full account of the uncertainty inherent in the research process, especially in the newly emerging sciences, when developing funding and contracting practices.

POLICY OBJECTIVES: TOWARDS A RELATIONAL APPROACH

Policy Objectives

In this section we both comment on MoRST's five key objectives and explore an alternative approach to contracting with research organisations.

The MoRST background paper " A Stable Funding Environment" sets out the following five key objectives which should stem from any changes:

- **Stronger and more sustainable connections between providers and users.** Stakeholder feedback indicates that one of the impacts of funding instability is that it is difficult to form long-term useful relationships and connections with other providers and users. The ability for organisations to form direct and substantial long-term relationships with users and be responsive to their needs is important.

- **Improved organisational arrangements within the system.** The aim is not to force, but to avoid creating barriers to changes in organisational arrangements within the system, where there are synergies to be obtained. This could include changes to the scope of cooperation and coordination between providers, as well as the evolution of current organisational entities.

- **Improved alignment of institutional expectations and purchasing.** There is scope to clearly articulate the outcomes the government wishes to achieve within a national RS&T framework to assist in aligning institutions' strategies with relevant strategic priorities in the purchasing system. The aim here is to achieve strategic alignment while institutions continue to operate as empowered and independent entities with a significant level of control over their activities.

- **Creative risk taking.** We need to encourage research organisations to take reasonable risks in new areas without being unduly penalised for doing so, or for trying and failing.

- **Less or at least no unnecessary increase in complexity.** Stakeholders have indicated a strong desire to simplify the system. The aim should be for necessary complexity only.

Those five outcomes sit under a proposed action to "devolve a significant amount of public good science funding to research organisations" (as we understand the term "research organisations" it encompasses any entity which believes that it has the capability to undertake research).

Considering Stability

The five outcomes, as a set, can be seen as the desiderata for an optimal funding system. For the purposes of this report they need to be seen in the context of the current funding system -- would their achievement represent a fundamental change or merely some fine tuning around the edges?

Part of the context for the current funding system is the government's overarching strategy as articulated in initiatives such as the Growth and Innovation Framework. Growing an Innovative New Zealand, the first substantive publication of the GIF initiative,

identified three priority areas for research and development; biotechnology, information and communications technology and creative industries. Each of these three are areas we would expect to be characterised by the impact of the forces of dynamism, diversity and complementarity described in the two papers by Andrea Bonaccorsi discussed in the previous section.

This implies a research environment which should be characterised by flexibility and which will also, at least at the micro level, include a high degree of instability because of the uncertainty inherent in individual projects. The need for continued development of New Zealand's science system suggests that this should be offset by a greater measure of stability at the organisational level.

The discussion in "A Stable Funding Environment", in contrast, places considerable weight on stability and appears to be arguing both that the New Zealand system of science funding has matured to a relatively stable state and that it is desirable to maintain this in the future.

Arguably, this is inherent in the five outcomes above. From our perspective, the process of setting the desired outcomes for a science funding system must begin with a clear-eyed understanding of what is expected of a science system, and the dynamics within which it operates. This includes drawing a distinction between what may indeed be the desirability of stability in a funding system, and flexibility, coupled with instability, in the research environment. In a way, this repeats the point made earlier in this paper that funding and contracting systems to be effective must be designed around the inherent uncertainty of the research endeavour.

In a sense, each of the five outcomes is almost a taken for granted in considering any organisational setting. It is hard to argue against outcomes such as achieving long-term relationships with other providers and with users, getting better alignment with the government's desired outcomes, or creating a climate in which research organisations feel able to take reasonable risks in new areas.

One concern we have, which we raise as a question rather than as a statement, is the extent to which the apparent relative stability described in "A Stable Funding Environment" is a function of underachievement. Could it be that one of the costs of the significant emphasis on achieving contestability through the purchase of defined outputs has been a relative loss both of excellence and of relevance to New Zealand's long-term goals as articulated, for example, in the GIF initiative? The need to be sufficiently specific to satisfy funders may be at odds with what is needed for leading-edge research in areas characterised by uncertainty.

Neville Jordan and Paul Atkinson, in their contribution to the New Zealand Science Review special issue (Development of Science Discoveries in the New Zealand Crown Research Institutes) argue that bibliometric analysis of the performance of the CRIs in terms of publications in refereed journals indicates a significant relative decline. The following extract sets out the nub of their findings:

> "A compilation of publication data collected from annual reports of the CRIs over 10 years, illustrates the point that international publication rates are relatively static in most CRIs. In analysing these data we do not treat CRIs differently, and we make reference to 'Key Non-financial Performance Indicators Generic to All CRIs' as set out in a policy statement by the Crown Company Monitoring Unit (CCMAU) which refers to "…standard measures of output used internationally…". A variety of things are listed but the most meaningful and comparable as a benchmark relating to science discovery, and actually reported, is international journal publication. With this in mind, we note that AgResearch Ltd over ten years showed an increment in total journal publications, but the numbers of papers in international journals indicating competitive science was near static ('flat') despite large revenue

> increases (56%) over this time. HortResearch Ltd did not report international publications separately for most of this time but showed a precipitous decline in totals, and at best a static result for international publications in the last three years again, despite reporting significant revenue increment (24%) over the 10 years. The publication output for Industrial Research Limited (IRL) was spiky but near static in totals, again with large revenue increment (54%); likewise for the Institute of Geological and Nuclear Sciences (IGNS) with revenue increment of 52% and also NIWA (127%) with a flat total of international publications in the last four years. It is clear the inflation adjusted revenue in the CRIs significantly increased whilst scientific output of international papers did not significantly increase. This is not a new analysis where publication rates of CRIs have been compared over time as a measure of research productivity, but we have attempted to define those in the international refereed literature and over a longer time span.
>
> "This is not a record of international accomplishment in science which might be expected of apparently healthily growing science institutions, growing as indicated by the reported revenues at the beginning and the end of the publication analysis Period. In explanation, it could be said that the reason for the flat rate of publication in international science journals is that CRI resources have been transferred into profit-making activities and, if this is correct, it is likely to be eroding the science base. It might also be that more commercially sensitive CRIs are withholding publication in lieu of patents and trade secrets. Patenting is not inconsistent with publication and should only throw in an 18 month lag before publication rates resumed at the base rate over these 10 years. If scientific productivity is disappearing into trade secrets, this would only indicate another set of problems in how to gauge New Zealand CRI science performance."

As can be seen from the last paragraph of the quotation, the authors felt it necessary to speculate on underlying causes, rather than feeling that they were able to be definitive. Nonetheless, the findings are concerning, especially when set in the context of the current discussion in Europe on the relative underperformance of European science when contrasted with American science -- with strong evidence of the linkage between publication, citation rates, and the performance of institutions.

Related to this is the concern expressed by a number of scientists at the fact that scientific excellence is no longer a criterion for funding within the main funds (although clearly it remains a criterion within the Marsden Fund).

We wonder whether one factor contributing to the relative decline in publication rates and, by inference, in the performance of internationally benchmarked research, is the absence until very recently of any explicit requirement for CRI boards, or universities, to focus on capability. This gap has now been addressed, respectively, by the requirement in the Crown Entities Act that the statement of intent should include how the board proposes to manage the organisational health and capability of the entity, and the introduction of the Performance Based Research Fund within the tertiary sector. How effective these will be in practice, and whether they will create their own adverse impacts, remains to be seen.

For the purposes of this report, we assume that MoRST takes it for granted that underlying the five desired outcomes is a sixth, excellence in the areas that are significant for New Zealand.

The Nature of Research Organisations

A further factor to consider, in assessing the relevance of the policy objectives, is both the disparate nature of research organisations and the way that they have changed over

time. As participants in the New Zealand science funding system, the three main categories of research organisations come with very different sets of incentives.

For Crown Research Institutes, access to government funding is crucial to their very survival. Accordingly, they have very strong incentives to ensure effective engagement with funders and to invest heavily in ensuring that they capture sufficient funding to support their business plans. Associated with this, they have incentives to restrict access by other players -- for example through their current arguments for increased core funding.

For universities, in contrast, access to government funding through sources other than the Ministry of Education/Tertiary Education Commission is in the nature of icing on the cake -- an additional and at least initially discretionary source of funding outside their core funding (given that they have now had access to this funding for nearly a decade, it is likely that at least in some universities, this is now treated as equivalent to core funding). So far as their incentives go, they are to encourage government to keep funding as open as reasonably possible so as to enhance their ability to compete funds away from other providers. They have a related set of incentives to ensure that the government continues to deny access to PBRF funding for institutions outside the tertiary sector even though these may be quite extensively involved both in the type of research typically supported by PBRF and in supporting the education/training of graduate students.

Research Associations are different again. As MDL concluded in a report which it prepared for MoRST in 2003, research associations are not so much a separate category with a number of common characteristics, as a set of unique organisations each with its own defining characteristics. As an example, there is a world of difference between the Cawthron Institute and the New Zealand Fertiliser Manufacturers Research Association. The former has many of the features of a Crown Research Institute with its commitment to undertaking research with a mix of public good and commercial characteristics. The latter is essentially a joint venture between two private sector manufacturers as a means of carrying out research which has generic implications for the fertiliser industry but is not so commercially sensitive that the individual firms believe they need to keep the research findings in house.

In some respects, also, research associations are stalking horses for commercial firms in the sector which they serve. They have the natural incentive for any private sector entity of shifting as much of their costs, as possible, on to the taxpayer.

Another factor which needs to be considered, and which is somewhat at odds with the apparent assumption of stability underlying the background paper, is the extent to which institutions in the science sector have changed, and continue to change over time. In this respect, it is instructive to go back to "Crown Research Institutes: Research Companies for New Zealand" the report of the ministerial science task group released in June 1991 which preceded the establishment of CRIs. That report had this to say about the nature of CRIs:

> "Each of these 10 Institutes is focused on a productive sector or a grouping of natural resources. Their work will be vertically integrated. They will have a broad focus across a range of science and technology, but avoid overlap with other CRIs."

The reality is that much of the activity of individual CRIs overlaps with that of others. One of the criticisms of the current funding system is the excessive competition that has resulted from this and, as a consequence, the lack of the level of collaboration/cooperation that critics see as essential.

This was partly a consequence of the fact that, in practice, it proved impossible to achieve the kind of pure separation which the report of the ministerial science task group

envisaged. However, it also reflects the changing nature of science; the fact that in the new emerging sciences, there are significant complementarities across what might have previously been seen as discrete areas of research.

Towards a Relational Contracting Approach

The outcomes outlined in the background paper, and the proposed action to achieve them, reflect a concern to move away from micromanagement through competitive bidding for funding to an approach which places more emphasis on the capability of individual research organisations to identify projects/programmes with the potential to contribute to the government's desired outcomes. The background paper postulates that "a greater level of trust could be placed in providers, allowing them to make detailed research investment decisions where they have the greatest information advantage."

This would be complemented by an approach to funding that "should be related to components of an organisation's research strategies or business plans, with the relevant milestones and other details being negotiated between research organisations and the funding and investment agencies. Accountability should be provided for through an appropriate mix of joint planning, negotiation, competition, monitoring and evaluation."

This approach explicitly recognises that it is the research organisations which have the information advantage. Rather than a potentially adversarial relationship with them through a competitive process in which less informed purchasers attempt to corral researchers, the preferred approach is to work with researchers but within a framework which incentivises them to use their information advantage in the common interest.

Relational contracting has developed as a means of managing uncertainty. If the intended subject of a contractual relationship can be clearly and explicitly defined ex ante, and neither party has any informational advantage over the other, then conventional output based contracting will be efficient to achieve each party's objectives. The greater the degree of uncertainty, the less this will be the case.

When contracting under conditions of uncertainty, a purchaser can rely on a combination of "best efforts" at specifying the outputs required combined with provisions in the contract to permit some adjustment of contract outputs, or of payment, if the outputs do not meet the purchaser's expectations. This might include quite extensive arbitration/mediation provisions. This approach will often be supported by the at least implicit understanding that performance which meets the purchaser's expectations will be rewarded with further purchases and performance which does not will be penalised by placing further business elsewhere.

In a market with a range of potential providers each of whom may be able to meet the purchaser's requirements, a purchaser may be prepared to rely on conventional contracting even under conditions of uncertainty for reasons including:

- An expectation that the provider will recognise the implications for repeat business if its performance does not satisfy the purchaser.
- It may appear more efficient to rely on market disciplines and the formal terms of the contract than to attempt to work more closely with the provider to minimise the consequences of uncertainty.

In other circumstances, conventional contracting may not be sufficient to meet the purchaser's needs. These include:

- The purchaser has an interest in building up the provider's capability. This gives the purchaser an interest not just in the output as such, but in the provider's internal processes and how both the contract with the purchaser and the way it is managed contribute to capability development (including the ability of the provider to attract and retain key personnel).

- The purchaser believes that relying on conventional contracting methodology will not provide sufficient protection against the risks associated with uncertainty. Accordingly, it wishes to have a close working relationship with the provider so that it is privy to developments in the supply process not just at the formal level of what may be required of a reporting process under the contract, but at the informal level at which the provider and its staff are prepared to share their views about what is actually happening with producing the required outputs, possible developments, risks and opportunities.

- The provider may have collateral requirements of the purchaser. Specifically, it may want to have a relationship such that it can commit to the investments associated with producing the contracted outputs in the knowledge that the purchaser will not take a "black letter" approach to the contract but will work with the provider in understanding and managing the consequences of uncertainty.

Relational contracting is an approach which recognises that the purchaser and provider both have a common interest in building an ongoing relationship. The current contract, whatever it may be, is not seen in isolation, but as a step in an ongoing process.

It takes a significantly different approach to the leverage which each party would normally expect to achieve through any information advantage it holds. In a traditional contracting relationship, a party which holds an information advantage will use that as a means of extracting a benefit from the other party. In a relational contracting arrangement, the information advantage is something which is "put on the table" for the contracting parties to share as part of the process of optimising the outcomes for each of them.

In a science funding context, this would have research organisations taking an open book approach with the funder but would also have the funder doing the same with any research organisation with which it deals. Relational contracting is trust based. As such, it is possible only if each party can have confidence that the other party has shared with it all the critical information it holds in respect of the proposed contracting arrangement.

How this is done may differ depending on the nature of the research organisation involved and the significance of the funding concerned for the research organisation. If the funding is a relatively insignificant in terms of the organisation's overall budget, or is dealing with only a part of the total range of activity which the organisation undertakes, then relational contracting may be expressed primarily at an operational level -- with the equivalent of an account manager in the funder, and a programme manager in the organisation, representing the key relational level.

If the funding is a relatively major part of the research organisation's budget, or the funder has what could be described as strategic objectives for the funding related to the development of the capability of the research organisation itself, then the relationship may need to be at a much more senior level. Since the primary responsibility for strategy rests with the governing body of an organisation (whether funder or provider) then the key relationship would need to be between the respective governing bodies, or at the very least closely monitored by them (the practicalities of the operation of Crown entities and similar bodies may suggest that the primary relationship, in this situation, would be between the respective chief executives but with direct accountability to boards).

For Crown Research Institutes, a shift to devolved funding would be a major and positive change in their operating environment. It would result in a very significant component of their total revenue coming to them under different conditions than now apply with a significantly greater degree of freedom at the micromanagement level. It would also carry with it an implication -- indeed an obligation -- that the different approach would be reflected in, and responsive to, the CRI's strategic direction as expressed in documents such as its strategic plan and its statement of corporate intent.

For universities, the situation would be very different. Although public good science funding is obviously attractive to universities, it is a relatively small proportion of their total revenue. It is probably unrealistic to expect that they would change, in any significant way, their approach to managing their business in order to accommodate this. An additional factor in this is their primary accountability to the Tertiary Education Commission as their principal funder. One possible option for addressing this issue is for the contract relationship to be between the funder and a university controlled entity which would have responsibility, within the university, for managing the relationship. Uniservices Ltd, the University of Auckland's research arm is an example. We would, however, expect this approach to run into very significant obstacles within the universities themselves as it would conflict with the current semi-autonomous status of a number of different elements of the typical university and could also be seen as a challenge to the principle of academic freedom.

Research associations would be in much the same situation as Crown Research Institutes. The potential for significant devolved funding would be a major attractor and almost certainly an incentive for them to work closely with the funder in ensuring that their planning, resource allocation, monitoring and evaluation processes met the funder's requirements.

As a final point on the nature of relational contracting, it is important to stress that there will be significant differences depending on the objectives both of the funder and of the research organisation. If the relationship is being built around a particular activity or programme, then both may be focused simply on that programme, the people involved in working directly with it, and the issues that will arise as any findings are taken through the development and application (commercialisation) stages. The relational contracting approach may be expressed in ways such as greater collaboration/openness around matters such as the robustness of the underlying hypothesis, the research organisation's project management, any problems or difficulties that the organisation may encounter during the project, its proposals for further development/commercialisation and similar matters essentially of an operational nature.

If the purpose of relational contracting is to change the operating environment for the research organisation itself then a different approach will be required. The funder's interest will shift from a specific activity or programme to the organisation itself. Its focus will be on the quality of the organisation's strategic planning. What goals is it setting for the organisation? What assumptions underpin the strategic plan? How robust are they? What understanding has the organisation displayed of how its environment may change over time, including the implications for the relevance of the research which it proposes to undertake? In practice, relational contracting at this level will require the funder to work closely with and have the confidence of the research organisation at a strategic planning level -- rather than the organisation reporting its key corporate documents to the funder, the funder will be part of the organisation's planning processes.

MDL has considerable familiarity with this approach to relational contracting in another sector of activity which has equivalent issues of uncertainty and multi-causality; the funding of economic development agencies. This sector is beginning to adopt an intervention logic approach to contracting. Rather than simply specifying outputs, which has been the traditional approach, the focus is now on the desired outcomes. The process which underpins contracting is one of spelling out the underlying rationale and

supporting evidence for the chosen activity, the expected milestones, the endpoint and how that will be recognised, and the monitoring and reporting arrangements which will support that. This is coupled with the funder itself setting out what it regards as the desired outcomes from economic development activity and the role which it will play in supporting the EDA as provider. In some instances, the principal funder will take an active part working with the EDA in the development of its strategic and business plans -- not in a micro-management sense but rather as a means of ensuring both alignment between the objectives of the funder and the EDA, and of building confidence and trust which will enable the two to work together effectively over the longer term.

There are useful lessons for science funding from this experience because of the parallel between economic development and research and development. Both activities are undertaken in a context of high uncertainty, multi-causality, and relatively weak strategic planning.

This latter point is especially significant. Inherent in a shift to long-term relational contracting is a need for much more effective strategic planning. In MDL's experience, much of New Zealand strategic planning, especially in the public sector, is either business planning by a different name -- in other words essentially a multi-year extrapolation of current activity relatively uninformed by any understanding of how the organisation's environment might change over time -- or a set of aspirational statements effectively detached from the operational goals and realities needed for their realisation.

Relational contracting will require the funder to have a very clear idea of what the long-term objectives are for science funding. This will include an understanding of the strengths and weaknesses of the New Zealand economy, of key sectors such as education and of the likely future trends that will impact on New Zealand. An obvious example is demographic change, not just within New Zealand as currently extrapolated from our own data but the probable impact of demographic change elsewhere, for example the expectation that between now and 2025 the labour force within the area of the European Union will decline by 21 million and the population aged 65 or over will increase by 40 million, or the 2003 estimate by the European Commission that Europe will require an additional 700,000 researchers by 2010, over and above those needed to replace those retiring from the workforce, in order to meet its research goals.

Similarly, it will require research organisations themselves to have clear long-term goals, and a strategic thinking approach which enables the organisation to identify and implement the strategies needed to realise those goals. In practice, if relational contracting becomes a reality then, at least in the case of those research organisations which receive a major part of their funding in this way, strategic planning is likely to become the focal point of the relationship with each party privy to and influencing the development of the other party's strategic planning -- as is beginning to become the case with those economic development agencies that are adopting an intervention logic approach to planning activity and negotiating with their main funder.

Shifting to Relational Contracting: Some Objectives and Implications

It seems reasonable to assume that, under a relational contracting approach, the government's expectations of the New Zealand science system would include maintaining/developing capability in disciplines/fields that are expected to be critical for New Zealand's future; enhancing the linkages between science and end users and increasing both the proportion and the absolute amount of investment in research and development provided by the private sector (this may be better expressed as provided by non-government funders). Objectives of that kind remain merely aspirational unless they are translated into specific goals and the goals themselves are consistent in the

sense that the goal or goals for one objective do not create perverse incentives impacting on the achievement of the goal or goals for another objective.

Take capability as an example. It would not be sufficient for the funder to state that it required funding recipients to focus on building their research capability. There would need to be some understanding not just of the disciplines/fields involved but also of what was actually meant by capability. Would it be defined in terms of the formal qualifications of research staff with, for example, an increasing proportion of research staff with doctoral qualifications? Would it be in terms of increased investment by the funding recipient in the further development of staff capability -- for example an in-house investment in postdoctoral training? Would it be in terms of publication and citation rates? Would it be in terms of effectiveness in applying research findings (including commercialisation)?

For its part, the funding recipient will also be expected to have its own capability objectives and goals and these would be influenced not just by the views of the funder but by requirements such as the statement of intent for a Crown owned entity, or the Performance Based Research Fund. As part of its own strategic planning, the recipient should also have a clear understanding of what it means to be a capable research organisation within the disciplines/fields in which it expects to be active coupled with specific actions intended to achieve/maintain that status.

There is potential for conflict amongst different objective/goals, especially given the obviously limited resources available. If capability is defined in terms of publication and citation rates what does this mean in terms of separate goals for commercialisation and for building strong linkages with end users?

It may simply mean that the funder needs to have confidence that the funding recipient is able to manage these separate and potentially conflicting objectives and goals. In support of this suggestion, there is some evidence that scientists themselves are responsive to financial incentives so that, for example, the way in which royalties from scientific discovery are shared can have a positive impact on both research and commercialisation activity.

In November 2003 the Federal Reserve Bank of San Francisco launched the Centre for the Study of Innovation and Productivity with a conference on Technology, Innovation and Public Policy. Below is an extract from the conference paper "Incentives and Invention in Universities" (the paper is available as National Bureau of Economic Research working paper 9727):

> “This paper makes two main empirical contributions. First, we show that academic research and inventive activity respond to monetary incentives. This finding is important because it means that the design of intellectual property rights, and other forms of incentives, in academic institutions can have real effects on economic growth and productivity. Second, we show that the response to incentives is much larger in private universities than in public ones. Controlling for a variety of other determinants, including university size, quality and R&D funding, universities with higher royalty shares generate higher levels of license income. In private universities, the incentive effect is strong enough to produce a ‘Laffer effect’, where raising the inventor’s royalty share would increase the license revenue actually retained by the university.
>
> “A number of recent studies have found that private universities are more ‘efficient’, as measured in terms of scientific publications and various outcomes of technology transfer activity. Beyond these differences in the level of efficiency, in this paper we show that scientists at private universities are more responsive to royalty incentives. In this context, we also show that technology licensing offices are more productive in private universities suggesting that private institutions have

> more effective, commercially-oriented technology transfer activity. These findings imply that private ownership is important in the university sector. Why this is so remains an open question. Case study and survey evidence indicate that organizational structure and objectives in TLO's vary across universities (Feldman, Feller and Burton, 2001; Thursby and Thursby, 2001). Understanding how those differences — and others such as internal incentives and institutional culture — are linked to university ownership type and how they affect performance is an important topic for future research, but beyond the scope of this paper."

This is yet another area in which understanding is still relatively limited. There is simply insufficient research information available internationally to allow a definitive statement that an optimal policy for sharing the returns on intellectual property will have a positive impact both on research and on commercialisation. From work such as the paper just cited what we do have is an emerging hypothesis.

A shift to a devolved funding approach based on relational contracting will encounter a number of such areas where both the funder and the funding recipient will be somewhere near the bottom of a relatively steep learning curve about what will actually work in practice. What this emphasises is the importance of continued information sharing, and of a preparedness to take a long view rather than divert from the proposed course at the first sign of any difficulty -- in essence, for both the funder and the funding recipient there will be a need to be comfortable with an understanding that the early years of devolved funding will have about them some of the characteristics of what is sometimes euphemistically described as "learning by doing".

In practical terms, this probably means that the funder will need to have in place the equivalent of a relationship manager for each significant funding recipient and that the relationship manager's task will be one of working closely with the governing body and senior management of the funding recipient. The working relationship will need to have a particular emphasis on the nature and quality of the funding recipient's strategic planning and its relationship to the funder's objectives and goals.

There is another issue that will need careful consideration. In MDL's experience a greater focus on strategic planning, and the goals, objectives and activities which result, may have quite a significant impact within any given organisation. It is not uncommon for that much closer focus to raise very real questions about the appropriateness of the current mix and nature of activity. As an example, articulating a clear linkage from a strategy through goals and objectives to activities may demonstrate that one or more activities should be abandoned or substantially changed.

Accordingly, there is the potential that a shift to devolved funding will, at least during the implementation stage, add to instability. Given the clear expectations within the New Zealand science community regarding the impact of devolved funding, implementation management will need rather more care, and understanding of the impact on research staff, than has sometimes been the case with public sector reform.

Handling this well probably matters more in a change of this kind than in most public sector reforms. The reason is that any change is intended to promote greater stability and a relationship of trust between the funder and funding recipients. If research staff see the change as yet another destabilising and career threatening factor, then a major barrier will have been raised to the achievement of the intended outcome.

There is one other aspect of relational contracting that merits comment, even though this report is not required to consider matters of implementation. This is the implications for MoRST and FRST if relational contracting became the norm. At the moment, MoRST's primary focus is on policy advice for the government on the nature of the New Zealand science system, including its strategic direction. FRST, for its part, is the government's principal purchase agent.

A shift to relational contracting, especially at the organisational as opposed to the programme/activity level, would almost certainly require a different set of skills, at least on the purchase side. There would be a shift from what is primarily an output purchase and monitoring role towards more of a combination of a relationship management and strategic capability. It is possible this could see the role of FRST beginning to look more like the role of MoRST, raising the question of whether two organisations remained necessary.

A greater emphasis on relational contracting at an organisational level would also imply a more significant role (or perhaps government placing more significance on the role) of the board members of research organisations. This could suggest a reassessment of the respective roles of the Crown Company Monitoring and Advisory Unit and MoRST.

None of these comments on the roles of these three agencies should be seen as a definitive in their intent. Rather, the purpose is simply to highlight the need to consider how the roles and capabilities of those agencies would contribute to achieving government's objectives under a different approach to funding.

DEVOLUTION VERSUS OTHER OPTIONS

As part of the brief for this report we are required to consider if devolution is the most effective response or whether other options should be examined.

The first point to make is that a number of the concerns which have been raised about the current funding system could, on the face of them, be addressed individually. For example, as suggested above (page 11) the impact on CRIs of the requirement in the Crown Research Institutes Act that “every Crown Research Institute shall, in fulfilling its purpose, operate in a financially responsible manner so that it maintains its financial viability” could be modified.

It is doubtful that such an approach would address the essence of the concern which lies behind the interest in devolution. The concern is not simply with formalistic issues such as the financial viability test. It is much more about who holds the decision right over the activity that research organisations undertake. Amongst other things, that concern needs to be seen in the context of the "efficient purchaser" orientation that governs public sector spending decisions. There is a clear concern amongst working scientists that the micromanagement which results from this substitutes the judgment of non-scientists for that of scientists.

From this perspective, simply tinkering with the rules will not address the problem. Rather, there is a need to deal directly with issues such as the decision right, and the culture of the decision-making process.

This is not to argue that scientists, within research organisations, should be made autonomous with funding to meet their needs. It is to argue that an effective answer to the problem definition needs to ensure that decisions on investment in research adequately reflect the knowledge, understanding and objectives of the scientists who will undertake the research. The trick is to balance the government's strategic objectives for research and development with creating a supportive decision environment.

We are limited in considering whether other options should be explored in addition to devolution by factors including:

- The stipulation that preparation of this think piece not involve interviews or discussions with third parties.

- The resources made available for completion of this project.

- The fact that the overwhelming majority of the evidence available through the sources that we were able to access, including MoRST's documents, articles and commentary in the public domain, and our previous work, all point in a single direction; the need to address the adverse impacts on the research environment of the particular form of contestability on which science funding has been based.

Another factor is also relevant; what could be described as the general "reform fatigue" which affects much of the public sector. We would be reluctant to consider any alternative which involves significant organisational change unless it appeared absolutely necessary. We make this statement as we believe there is now sufficient evidence to suggest that the costs of structural reform are considerably greater than was understood when the public sector reform process first began.

That said, there are elements of the New Zealand science system which may be contributing to the concerns underlying the problem definition which would be worth exploring further. They include:

- Whether New Zealand can afford to maintain two separate systems of publicly owned entities substantially committed to public good research -- universities and CRIs -- especially with funding systems which at least superficially appear likely to create obstacles to close cooperation between the two systems.

- Associated with this first issue, the relatively small-scale of New Zealand's research institutions. Small-scale has the potential to impact in a number of ways including the ability to develop strong career paths internally, access to investment/equipment, and the capability of senior management and boards.

The most substantive non-government re-examination of the New Zealand science system in recent years is the work of the Science Enterprises Group (made up of senior representatives of Crown Research Institutes, research associations and universities). In November 2004 the group released "a Framework for Research and Development Investment in New Zealand", a paper which is described as presenting the considered views of science enterprise leaders on what the group sees as the two main tasks to address if a compelling case is to be made for additional private and public sector investment in research and development. The paper described the tasks as "to demonstrate that science and technology research contributes towards desirable outcomes for the nation; and second, that New Zealand's scarce resources in science investment are used to maximum effect."

The paper puts forward a set of principles which should underpin investment in research and development, proposes a set of investment categories, processes and agencies, considers capability issues and the distribution of investment and both proposes a set of investment agency structures, including areas of responsibility, and comments on the implications for policy and advice.

Although it presents an apparently comprehensive overview, it does so from what could be described as an "ideal type" perspective rather than from a real-world assessment of the current issues confronting the New Zealand science system, including the impact of different means of allocating funding to research and development. Of importance from the perspective of this paper, it does not address the implications of contracting under conditions of uncertainty. Thus, even in its most "blue skies" category, *Discovery,* the paper proposes that "research proposals are evaluated in terms of their intrinsic scientific or technological merits, as determined by peer groups" and "decision processes are fully contestable, and establish priorities for funding based on peer review of the intrinsic merits of proposals."

The fact that the paper does not address the issues of contracting (funding) under conditions of uncertainty and in particular does not address the issues raised by research such as the work of Andrea Bonaccorsi cited above, can be seen as reflecting its emphasis on structure - the institutions responsible for policy-making, funding, and undertaking research - rather than on the dynamics of funding and research as such. It does mean that the paper is of limited value in considering the question of devolution as a response to the challenge of how to manage contracting under conditions of uncertainty. This comment should not be seen as a criticism, so much as a recognition of what the SEG paper does and does not set out to do.

We do not expect a shift to devolution, on a relational contracting basis, to be an instant solution to the problems facing New Zealand's science system. As signalled in the previous section of this report, there are real risks that will need to be managed. However, after assessing the problem definition against the information available to us, we conclude that devolution represents the best option for addressing the identified problems.

WHICH RESEARCH ORGANISATIONS?

In this section of the report we consider which research organisations could be the recipients of devolved funding including which funds, criteria, proportion and possible impacts.

For the purposes of discussion we divide research organisations into four separate categories; Crown Research Institutes, universities, research associations (for a description of this category see the MDL report for MoRST "Dynamics of the Structures and Governance of Research Associations) and other -- primarily private sector firms.

The starting point for the selection of research organisations needs to be the objective of the devolution initiative; is it simply to reduce transaction costs? Is it intended to support the achievement of government's overarching objectives for research and development?

If it is the latter, then the first step needs to be determining what those objectives might be in a devolved funding environment. If, as an example, emphasis is placed on building capable research organisations, then priority might be given to organisations selected in terms of both the nature of their core business and of their scale.

In practice, there are bound to be multiple objectives including reinforcing technology transfer, improving our knowledge of New Zealand's natural environment and underpinning the government's objectives for economic growth -- which clearly implies some kind of judgment about choosing amongst different sectors (disciplines/fields in science).

As has been discussed above (pages 19 and 20), relational contracting can operate at two different levels; at the organisational level where the focus is on building the capability of the organisation itself and at a programme/activity level where the focus is on changing the way in which the funder works with providers on a project basis. The question of which organisations should be the recipients of devolved funding is one which needs to be answered at the organisational level rather than the programme/activity level. To put it another way, relational contracting at the programme/activity level is an approach which could be applied across the board regardless of the nature of the recipient or of the proportion of its funding which comes from government sources -- the funder's interest is in the outputs from a specific project rather than in the impact on the organisation as a whole. This comment needs to be qualified by the recognition that some programmes, which in one sense are very clearly project based, may also have an interest in changing the culture/capability of the recipient. Technology for Business Growth provides an example. In contrast, relational contracting at the organisational level is concerned with the capability of the organisation itself and the processes it uses to determine what research it undertakes, why, and how the results are applied.

Selecting Research Organisations

If the purpose of devolution is to address the issues identified in the problem definition, then the focus should necessarily be on providing organisations with the flexibility required to develop their research capability, including the career environment for research staff, and minimise the transaction costs associated with obtaining and allocating funding to specific programmes/ areas of activity Specifically, devolution should be to organisations that are able to integrate this into their strategic

planning/thinking and demonstrate that there are reasonable grounds for believing they will achieve the benefits expected from devolution, including the development of capability, and who are prepared to work within a relational contracting framework.

All CRIs should qualify. Devolution to universities, or to university related research entities, may need more consideration. Clearly, the ability to access funding from the two funding areas being considered for devolution has become important for the university sector (the areas are the Research for Industry and Environmental Research Output Classes). Withdrawing access is unlikely to be a sensible option. On the other hand, it is hard to see how devolution of the approximate equivalent of what individual universities currently receive from FRST managed funds could be accompanied with a relational contracting approach at an organisational level. Reasons include the relatively small-scale as compared with the university's total revenues, and the separate strategic and operational planning framework for tertiary institutions managed by the Tertiary Education Commission. Considerations such as this might make it desirable that any devolution to the university sector be to a separate stand-alone research arm (such as Uniservices Ltd), or at least to a separate business unit with its own management and strategic planning capability, though we doubt whether imposing this option would be welcomed by universities because of the internal management issues it would raise.

Research associations present different issues again. As already noted, they are highly diverse ranging from the Cawthron Institute which in many respects is similar to a CRI, to the New Zealand Fertiliser Manufacturers Research Association which is essentially a partnership between two private firms. Eligibility could be decided on a case-by-case basis determined by the extent to which any particular research association could demonstrate that it was committed to the objectives of the devolved funding strategy and had the capability and organisational characteristics required.

A similar approach could be taken with private sector firms. To put it another way, the selection criteria should be focused on the demonstrated potential of the funding recipient to meet the objectives of the devolution programme, rather than on the ownership, and formal structure, of the funding recipient.

Which Funds?

The two funding areas which have been identified by MoRST as a priority for devolution, the Research for Industry and Environmental Research Output Classes, are the two which have been of greatest significance to those organisations which have been most heavily impacted by the matters highlighted in the problem definition (Crown Research Institutes). This of itself makes them a logical starting point.

Another factor to consider is the multiplicity of funds through which government provides support for research and development. A number of these funds are specifically targeted towards the private sector, seeking to encourage greater engagement with research and development -- for example Technology for Business Growth. We would not attach a high priority to changing the way in which those are allocated -- and if we did we would probably argue that the context in which to consider change is the government's economic development strategy, rather than its research and development strategy (although, as noted above, there may be merit in applying a relational contracting approach to individual contracts).

We would also leave aside, for the moment at least, those funds which are targeted to high performing individuals and funding intended to encourage original research, specifically the Marsden Fund. We would also see devolution as less of a priority for the New Economy Research Fund primarily because of its emphasis on basic research and hence the fact that it can be seen as targeted more towards universities where the scope

for devolution as a means of changing the organisation's operating environment (both because of issues of scale and of framework) appears less immediately promising. Instead, we suggest that considering the possibility of a shift towards devolution for the New Economy Research Fund be deferred until MoRST has been able to assess the experience of devolution within other funds.

One other fund, of relatively significant size, does merit consideration from a devolution perspective; the Health Research Fund. Although that fund is open to and receives applications from a number of different providers, in practice the majority of its funding is received by two institutions, the universities of Auckland and Otago. On the face of it this would suggest that devolution may be worth considering, as much as anything as a means of increasing alignment between the objectives of the Health Research Council and the strategic planning and research activities of the two universities.

To make an assessment of whether there does appear to be a strong case for including the Health Research Fund within any devolution initiative, we undertook a brief analysis of the new contracts let by the Health Research Council in the year ending 30th of June 2004. The total value of new contracts (a number of which were multi-year) was approximately $55.15 million. Of this total, $33.04 million or 60% was awarded to the University of Otago and $17.43 million or 31.6% to the University of Auckland. The two universities thus captured 91.6% of all new contract funding awarded in that year.

Given the preponderance of funding going to the two universities, it could almost be suggested that the Health Research Council is simply a conduit for funding to the country's two medical schools. Options such as devolution, or of bringing the funding under the umbrella of university funding generally might seem worth considering. However, a closer examination of what is actually happening produces a different picture.

The funding awarded Otago University was made up of 24 separate contracts with 16 different departments, faculties or institutes within the university. In Auckland's case, there were 20 contracts with 15 different departments, faculties or institutes. To put this another way, there was in fact a much higher degree of contestability than appears from the percentage of total funding which the two universities received. Although universities may, for legal purposes, and sometimes in the eyes of policymakers, be seen as single entities, in practice they are much more akin to a federation of semi-autonomous bodies. This is reinforced by the traditional emphasis on academic freedom (a value which is still enshrined in the Education Act 1989).

This brief overview of health research highlights a point which is worth keeping in mind when considering a shift to devolution. Each separate fund and the objectives it serves needs to be considered in its own terms, and any changes made only on the basis of a good understanding not just of the objectives of the fund itself, but of the organisational and cultural environment within which the fund actually operates.

In practice, we would support the judgment in the background paper that priority for change should be given to the Research for Industry and Environmental Research Output Classes. Both are of a sufficient scale to enable the development of an approach to devolution which could have a meaningful impact on the activities of all four categories of research organisation. Concentrating on those two funds should provide a more than sufficient opportunity to develop the practice of devolution with the judgment on incorporating other funds to be made later, based on experience with the initial two.

Criteria for Devolving

The criteria for devolution should be tied back to the overarching objectives for research and development. We have already noted the possibility that, as devolution is

implemented, those objectives may be refined reflecting the feedback that comes from the process of moving from strategic objectives to goals and activities. For purposes of discussion, we assume that the long-term objectives will be along lines such as:

- Developing the capability of New Zealand's research institutions.
- Improving the linkages between researchers and end users.
- Supporting sectors/industries that offer above-average growth prospects.

The criteria should include demonstrated capability in areas relevant to the long-term objectives including strategic planning/thinking, the ability to "drop-down" to specific goals/activities, research excellence in disciplines/fields relevant for the government's strategic objectives, competence in, or at the very least a credible commitment to, working with end users and organisational soundness (governance; systems; financial viability).

It may also be desirable to set criteria in terms of the ownership and development of intellectual property developed with the assistance of devolved funding. This might be done purely in terms of the public funder requiring that research supported with public monies be, as far as possible, publicly available. It might be in terms of the research organisation developing an intellectual property strategy designed to incentivise research staff (refer to the extract above at page 22 from Incentives and Invention in Universities and the subsequent discussion).

Finally, the criteria should include a demonstrated preparedness to work with the funder in a relational contracting mode as that term is used in this report.

Proportion

The first point to make is that there is a significant "legacy" issue. Both of the funds being considered for devolution have a number of long-term funding commitments. Those would need to remain in place although there could be a good case for shifting the contracting and monitoring arrangements for those commitments into a relational contracting mode. Next, not all of either fund should be devolved -- on the criteria for devolution above, it is likely that MoRST would decide to devolve only that funding currently allocated to Crown Research Institutes.

Proportion -- the funding that each research organisation currently being funded through either or both of these funds receives under the new arrangements -- will be crucial. Associated with this is the virtual certainty that it will be impossible to develop a set of ex ante decision rules for the allocation of funding under a devolved approach, if these were to involve any significant reallocation of funding as between current recipients. The ability to do that will be dependent on experience -- we expect rules for reallocation to evolve as research organisations demonstrate their capability under the new regime.

That said, the funder will need a set of principles to govern the initial devolution. We would suggest that an important criterion for these is to minimise uncertainty and, in particular, make it clear that one objective of the change is to provide greater stability for research scientists (subject to performance, which under the new regime may become primarily a matter for the employer, constrained by its need to demonstrate it is meeting the funder's expectations).

In MDL's view, it will be worth making some financial investment in ensuring the success of the change. Against that background, we would suggest that the issue of proportion is

approached on the following lines (the suggestions are indicative rather than recommendatory):

- The amount of funding available from the two funds for those research organisations eligible for devolved funding be increased by 20%.

- Each eligible research organisation currently being funded through one or both funds be given a commitment to a minimum of 80% of its current funding level for the next (say) three years.

- The remaining funding -- equivalent to 40% of the funds currently available through the two funds to eligible research organisations -- be allocated to them based on their submissions on how they propose managing devolved funding in order to meet the government's objectives for investment in research and development.

The purpose of this approach is to ensure that, through the implementation phase, every research organisation currently dependent on one or both of the funds to be devolved has a reasonable assurance that it will be a winner from the immediate reallocation. Proper application of relational contracting principles should ensure that those organisations not really capable of adapting to, and providing government with superior returns from, the new environment should ultimately lose funding.

As a final comment on any shift to devolution, note that the suggested approach to initial funding might need to be fine tuned to take into account the nature of existing commitments.

It can be expected that organisations which have been or expect to be in receipt of funding from either of the two funds, but which are not included amongst those organisations initially eligible for devolution, will want to be included especially if the transition to devolution involves an increase in funding. This should be seen as an incentive for those organisations to demonstrate how they would add value under devolution. If MoRST decides to proceed with devolution to selected organisations as suggested in this paper, then it should at the same time make it clear to other potential recipients of devolved funding the conditions under which it would be prepared to include them, and put in place the resources (mainly people) needed to work with other potential recipients to determine whether they should be included within the devolution approach.

Finally, it should be made clear that a shift to devolution of funding within the Research for Industry and Environmental Research Output Classes should not imply that the only organisations eligible for funding from those should be organisations which qualify for devolution. Access to this funding should remain available on a contestable basis to new entrants and to existing teams/organisations for whom devolution is not considered appropriate -- which could include a number of research associations and university based researchers.

Impacts

Properly managed, a shift to devolution accompanied by relational contracting as described in this report, should enable a much better alignment between the activities/outcomes of research organisations, and the government's objectives for investment in research and development. That will require particular attention to the more difficult aspects of relational contracting which we expect to be the strategic thinking/planning which underpins the choices research organisations make.

On the negative side, our main concern is with the impact on current and future research staff. The work which MDL has done for MoRST over the years has repeatedly brought out the same concerns about morale, career development and organisational health that have led to the devolution proposal itself. It is essential that any implementation be both designed and managed to minimise any further negative impact and, as soon as possible, enable the rebuilding of morale, and the confidence of present and future researchers in the New Zealand science system.

CONCLUDING REMARKS

From time to time, work undertaken for MoRST, including but not restricted to projects for which MDL has been responsible, has had to consider the public policy rationale for government ownership of CRIs. As far as we are aware, whenever this has been done, the answer has been to preserve a critical mass of expertise regarded as important for New Zealand's future development.

To put this another way, the rationale has been the need for capability. There has been a recognition that capability does not arise in isolation but can only be developed and maintained in the international context which characterises the science community.

Despite that, capability has not until very recently been seen as a specific objective. As other commentators have noted, the combination of the financial viability provisions of the Crown Research Institutes Act with CCMAU's role as monitor has placed an emphasis on financial viability rather than on research capability. That is now changing with the new emphasis on capability and on the development of non-financial performance indicators.

This report has drawn on a recent European research which has sought to address the relatively inferior performance of European scientific research as compared with American scientific research. The hypothesis which ongoing work is clearly testing is that the crucial difference is the capability of institutions -- and that capability is a determining factor in the ability to attract and retain excellent scientists.

We conclude this report with a recommendation that MoRST monitor this line of research and consider its implications for New Zealand -- both in the longer term and in the development of performance indicators for Crown Research Institutes.

Finally we note that the same issue may also apply to universities which themselves have only recently come under a regime requiring them to demonstrate the capabilities of their research performance (the Performance Based Research Fund).

APPENDIX

This appendix set out quotations from the two papers by Andrea Bonaccorsi referred to in the body of the main paper. The purpose of including the quotations is to give the reader an introduction to the arguments in her own words.

The following quotation is from the introduction to the first of those two papers, Search Regimes and the Industrial Dynamics of Science:

> "Three dimensions capture the essence of relevant distinctions: the *rate of growth*, the *degree of diversity*, the *level of complementarity*. By combining these three dimensions one is able to characterize rather carefully several *search regimes*.
>
> "A search regime is a summary description of the pattern of growth of scientific knowledge and of the actual carrying out of scientific research. A regime is not a scientific field or discipline as such. Rather, it is a *consistent set of dynamic properties of the search process* in a field. Fields and disciplines may be characterized by a particular regime for a long period, but may also be subject to a sudden and rapid regime change. By looking at abstract regimes we leave open the question on what is the typical regime a discipline or field is in (although in our examples we will inevitably talk of concrete disciplines and fields). Also, there is the possibility that established disciplines exhibit different search regimes in different areas.
>
> "Therefore we are not advocating a taxonomy of scientific disciplines (which would be a meaningless task), but propose that, at an appropriate abstract level, there are robust structural and dynamic properties of search that have an empirically recognizable counterpart.
>
> "The characterization of a search regime answers some basic questions about the dynamics of search: How rapid is the production of new scientific knowledge? How many different directions does scientific research take? Which resources are utilized in research? Although there are many other possible questions, we will show that these simple ones are theoretically powerful. The characterization of search regimes is a parsimonious way to take into account differences *internal* to science without falling into phenomenological exercises. The economic, institutional and policy implications are far reaching."

This next quotation is from her second paper, "Better Policies versus Better Institutions in European Science":

> "Diversity and divergence require a sharp increase in the exploration and evaluation capabilities for both scientists and policy makers.
>
> "For scientists, this means increasing dramatically the ability to explore in different directions and evaluate the merits of proliferating hypotheses. Institutional systems in which doctoral education and postdoctoral research training are based on competitive principles and better organized perform better in this respect. Doctoral and postdoctoral research are the best institution for exploring in different directions, at a reasonable cost, in a relatively short time frame, under conditions of high growth and divergence. In competitive systems, doctoral students become risk takers and collectively pursue several divergent research directions in parallel. Also,

if a grant system allows post-doctoral researchers to create the required complementarities (e.g. creating a laboratory, hiring research assistants), then it is possible to capitalize on exploration, validating the hypotheses and sometimes creating entirely new fields. Clearly postgraduate systems in which students are encouraged to pursue the research directions already envisaged by supervisors and post-docs do not have autonomy in organizing research have far less exploration and evaluation capabilities.

"For policy makers, it is important to note that institutions with a consistent tradition of calling for *independent bodies* for evaluating research (both ex ante and ex post) have some advantages.

"However, even trained evaluators find it difficult to come up with decisive arguments in selecting research projects. Faced with the practical impossibility to decide on intrinsic merits of projects, decision makers refer to the *intrinsic quality of proponents*. They look for signals of quality of proponents, which are better approximated by their past curriculum and the reputational rent of their institutions. Affiliations are a powerful signal of quality. The reason is that affiliation is the final outcome of a long selection process, in which the quality of a scientist has been repeatedly evaluated under conditions of impartiality and competition over his life cycle. Top quality institutions are not important because they are large (as several policy makers believe), but are important because of the underlying competitive selection process. This is an important reason why being in the upper tail of scientific quality is important. When new fields are created, there is no way to know in advance about the relative merits of proliferating and sometimes competing hypotheses, as proposed by new entering scientists. The only way is to be sure that they have survived the best possible selection process. The larger is diversity and the stronger is divergence in the search regime, the higher the importance of selection processes. Therefore in the comparison between Europe and US, it is not the same thing to have the same total amount of publications and to have the same share of highly cited scientists."

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