

Science and Technology Capabilities in New Zealand

March 2004: A Response to the Ministry of Research, Science and Technology's "I3 Discussion Paper" on Capabilities.

In January 2004, the Ministry of Research, Science and Technology (MoRST) wrote to stakeholders in the science system to invite feedback on a policy proposal paper which looked at ways to support Research, Science and Technology capability in New Zealand. This paper contains the views of the Council of the Royal Society of New Zealand.

Summary

We offer our own specific feedback about the overall debate, and then offer specific responses to the discussion paper's questions. We then recap the goals as we see them, and offer our own suggestions for an improved and simplified funding mechanism.

We have 3 conclusions:

1. We think that owners have the responsibility to support and foster capability. For Crown Research Institutes (CRIs) the Crown should show strong support for existing capabilities and developing and nurturing new ones.
2. Transitional arrangements ie. training and foresight are what count – Institutions should drop unwanted research programmes but not people. This is fundamental to supporting capability.
3. Non-Specific-Output Funding (NSOF) would be a practical instrument through which MoRST's suggested "Approach 1" (direct support for organisations) could support capability. NSOF should be enhanced by increasing the duration of support and (by using new funds) incrementally increasing the proportion of this fund. Ongoing evaluation will be required to determine if the increase is sufficient to meet the stated goals of the fund. NSOF has well-defined measures, an existing structure and increasing it would be transformational, greatly increasing support for capability (in its widest definition). Furthermore, it is linked to contestable funding without an increase in application costs or assessments. The benefits of minimal complexity with maximal benefits to capabilities seem to make this instrument an ideal mechanism for achieving the goal.

Introduction

The I³ challenge discussion document highlights the need for structural change of the science and technology (S&T) funding system and suggests strategies to improve the system, or to 'evolve' the system. We offer this feedback in a spirit of constructive criticism and hope that our thoughts will be given just consideration.

The Royal Society is encouraged that MoRST is taking this initiative. The steps being made to solve this through the I³ challenge are commendable. However, major changes in the structure, through slow evolution, or fast, could result in unintended consequences, if not handled properly.

Widespread changes that are not well implemented, not transparent to grass-roots scientists or not well understood could be the final straw that results in an exodus of our skilled S&T researchers. Implementation of any changes should occur in consultation with scientists, changes should be subtle but sufficient to achieve the desired results, with clear reasons and transparency.

We must admit that we found the document unclear in parts, and disjointed, and we thought that the questions asked were possibly incomplete, as many of the comments we wish to make do not answer the specific questions raised in the discussion document. We present some key concepts that we believe are missing from the debate, then discuss the given questions in the light of these concepts.

We agree that MoRST is responsible for policies relating to the funding system for S&T and that volatility is a problem in the current system. We have included some operational suggestions in this feedback, so that our ideas are not lost in the ether of generalizations. These operational suggestions are summarized at the end of this document. We would be pleased to discuss them with you.

We recognise that national capability is a larger issue than simply the capability funded through Vote RS&T. In particular, government might give strong consideration to how it can increase capability in end-user communities. However, we respond to this paper in light of MoRST's role and focus our the discussion to the areas where MoRST has immediate influence.

Key points missing from the debate

Transitions between ideas

MoRST's discussion has focused on capabilities. Capabilities exist for a purpose – to support the generation of new ideas, and the development of those ideas into scientific and commercial outcomes. Ideas are volatile and should be treated as such. Capabilities are not as changeable. Some necessary components of capabilities take time to develop. In particular, human resources take many years to develop and cannot be replaced or retrained quickly.

The role of the science management system is to make resources available to support ideas. When these ideas appear fruitful, we should transition resources towards them; when ideas decay, we should transition resources away from them. The transitional arrangements must allow the preservation, growth and redirection of human capital. At present, the transition between individual projects in the wholly contestable framework sets the pace for transitions in human resources. The mismatch in timescales between the development of new projects and the development of human resources is one of the prime causes of the low morale among CRI scientific staff.

Hence there needs to be support for capabilities, including human resources, that is complementary to support for projects and programmes. This support should be less volatile, changing at a slower rate. This would provide for training, foresight and response to purchaser signals.

Ownership duties versus investment roles

Currently, government support for university capabilities is largely maintained through Vote Education and the PBRF supports good research. In contrast, CRI capabilities are supported with contestable funds, resulting in the investor being implicitly responsible for capabilities, rather than the owner.

We believe that responsibility for maintaining human resources should lie with the owner rather than the investor. Investors generally possess insufficient knowledge for human nurturing, whereas owners are more intimately aware of the needs, aspirations and potential of staff.

We see the need for an independent purchaser with a focus on strategic investment but that role is separate from managing the capabilities that will carry out the purchased research.

Responses to the context

The Royal Society believes there is room for improvement in the system. The difficulty in getting a clear agreement on options for change may suggest that the structure of the system is less important than the quality of management within the system. It could also suggest that few people have looked in sufficient detail at the system and at the proposals to change that system, or it could suggest that there exists a variety of evidence in favour of each of many different systems.

There is a lack of solid evidence about human resources problems in CRIs and throughout the New Zealand science system. For this reason, the Royal Society is carrying out its own human resources 'stock-take' study. In the meantime, our members report low morale with a perception that the knowledge workers, on whom the system depends, are being exploited. The instability of research careers may be more perceived than real; nevertheless the resulting low morale is very real and is an increasing threat to the stability of the system.

Responses to individual questions

While capability has many facets, by lumping these all together in one definition, the rest of the discussion document becomes ambiguous, ie. to which aspect of capability particular strategies are aimed. However, we agree that when talking about 'S&T capability', all these parts have to be considered.

With the broad definition of capability, it is hard to identify a capability and it is hard to know what national capabilities we will need.

The people with the clearest picture of current and emerging capabilities are those within the research organisations. They have the information advantage to identify the capabilities. Therefore they should be given the ability to direct resources to develop those capabilities.

If we want to address desired national capabilities, then a prerequisite is a clear statement of national RS&T priorities. There is currently no guidance on long term strategies. Any priority system developed will have to maintain a level of responsiveness to match changes in areas of strategic importance.

Question 2 – Managing volatility

MoRST's discussion paper asks if volatility can be managed through a funding system. We believe that the design of the funding system is indeed crucial to volatility. If evidence is uncovered to show that a research project is no longer valid, the work should be dropped. However, we must act to reduce the down-side of volatility. The transaction costs of changes in resource distribution will depend upon the rate of change. We believe that changes in funding should be gauged and paced to allow for not just an exit strategy, but a transition plan for the people involved. The mechanism to achieve this should still be based on performance. Currently this is based on the performance of individual projects, but these projects are embodied within research entities. It follows that long-term support for research entities should be based on overall performance of projects within those organisations.

However, the rate of change of resources within an organisation will depend upon the particular characteristics of those resources. Hence, the tools to manage resource changes within an organisation should rest in the hands of the management of that organisation.

There will be a trade-off between the flexibility of a 100% contestable investment system and the effect on transaction costs of excessively rapid changes. The funding mechanism should enable research entities to implement transition arrangements that allow preservation and development of human capital and other aspects of capability.

Question 3 – Key outcomes

MoRST's discussion paper posits five desirable outcomes: stronger user-provider linkages; allow organisations to evolve within the system; align ownership and investment goals; encourage creative risk-taking; and lastly, a system that is kept simple.

We believe that form follows function. So it is necessary first to get the aims and objectives correct for the system, including incentives, and the functionality of the system will follow.

We see the desired outcomes of any changes as:

- a) Clear goals, objectives and incentives for those who embody capability, namely the people with good ideas and the skills to take them forward.
- b) Simplification of the system on a conceptual level as well as a structural level.

Looking more broadly than MoRST's discussion paper, we place high priority in the two areas of connections and risk taking. However we think

that getting the aims, objectives and incentives right will make the system more functional, naturally simplifying it. Within the scope of MoRST's paper, we see the priorities as:

1. Creative risk taking
2. CRI ownership expectations aligned with investment priorities
3. Less complexity
4. Strong sustainable connections
5. Enable evolution of organisations

Stronger and more sustainable connections between providers and users need to be developed to maximise the benefits of capability development. However, the instruments to manage volatility that are proposed in MoRST's current discussion paper should not be regarded as the prime instruments to strengthen user-provider connections. A more effective instrument might be to change fund application rules. For example, effectively, only research providers can currently apply for contestable research funds such as PGSF and NERF. If users could lead the applications for certain funds such as "Research for Industry" (RFI), or its equivalent in the social and environmental fields, then the providers would have further reason to link in with users' requirements.

The alignment of users' expectations of research providers would be contingent upon users understanding what research can offer them and upon their ability to specify the research they desire. This understanding and ability to communicate needs, will take time to develop and therefore a gradual roll-out of system change is more desirable than a sudden alteration in this aspect of the system.

Currently, there exist barriers to collaborations among scientists based on perceptions of being unable to 'share', eg. the NSOF pot of money for CRIs versus the Vote Education (including PBRF) pot for universities (and no special pot for private research entities). The time required for negotiations among collaborators over IP ownership, the necessity of splitting budget contributions, and the unwillingness to share due to the competitive nature of the funding system all place barriers in the way of collaborations between CRIs and universities.

New Zealand's 100% contestable system penalises failure and it still appears to penalise risk-taking. The contestable investment system can do more to reward those research organisations which build a balanced portfolio of risk. Individual failures should not have an overriding effect on the research capability of organisations or parts of organisations. The management of risk portfolios within an organisation should be left to those who have the most information about the risks within that portfolio, namely the managers within that organisation.

Question 4 – Principles

Well-defined principles should be orthogonal and thus we make no attempt to rank MoRST's suggested set. "Principle" may be too grand a word to apply here. "Operating Principles" might be less grandiose.

Devolution is not a principle; it is an answer to a question. The principle is that decisions should be made where the information advantage lies.

Contestability may be a means to an end, or an end in itself.

Accountability and feasibility are principles and cannot be disagreed with.

We would add that another key principle is that: **the system should be responsive to evidence of performance of the system** (how well it is achieving its goals) ie. a feedback loop should be integrated in the system for evidence-based continual improvement. This may require improved evaluation or just improved response systems to conclusions arising from evaluation.

We agree that MoRST's other principles of effective governance and long-term/short-term balance are useful.

Question 5 – Options for supporting strategic capabilities

Briefly, MoRST suggests two options. Approach 1 is direct support for organisations; Approach 2 is direct support for capabilities.

Approach 1

We agree that research organisations embody capability. They have the best information about those capabilities. Therefore they are best placed to manage that capability, and they should be given the resources to support that capability. This would be in addition to the existing contestable funding that they receive to carry out particular research projects. Approach 1 is better due to its simplicity and the ability to alter existing funding instruments to achieve the strategy.

Human, infrastructure and relationship parts of 'capability' are supported in universities by Vote Education, while Crown-owned research organisations have no comparable institutional support. Accordingly, a possibility for examination would be that Approach 1 were implemented to support capabilities in all research entities that are successful in winning government funding through contestable means. This would alleviate the dichotomy between CRIs and universities, but the pros and cons need careful examination.

Some credit should be given to the scientists and managers within CRIs to be responsible with institutional funds, rather than enforcing levels of accountability that effectively produce another form of contestable funding. It leaves management of capability, in its broadest sense, up to the research providers, as they are best placed to develop internal capabilities. Linking the fund to contestable funding levels would obviate the need for additional performance parameters, as they would naturally focus on developing their research capabilities. Providers in the past may have wanted to commit long term to development of their human capital, yet they have not had the mechanism to do so. Therefore the “performance expectations” can be specified via the “agreed ownership expectations” as, broadly, *to develop research capability*.

Approach 2

Approach 2 would need a central agency (eg. FRST) to be capable of identifying and assessing capabilities nationally. It would require the agency to compare national capabilities against national needs, and the rates at which different capabilities could be modified. Support for new capabilities would require the agency to identify capabilities before their qualities are known, through some kind of foresight, or crystal ball. It would require capabilities to be legal entities. While all of the above are highly desirable, they are difficult, even dangerous, to concentrate in one agency. Approach 2 would therefore be demanding and unlikely to work from an operational point of view.

Even if an operational approach could be developed from Option 2, we see it as becoming another straight contestable fund, with a complicated application process and complex assessment process. This approach will not achieve the goal of simplifying the system, with priorities set at policy level (MoRST) that may only address limited types of research (eg. a list of national priorities) and there is a risk that some nationally important areas of research will be forgotten, or prioritised so low that they do not achieve support. There is the potential to ‘lose’ important capability and this approach may not necessarily achieve the goals desired. The national priority list would have to be quite broad for CRIs to have any discretion with this funding. This approach is rather incoherent and we don’t see what it would contribute to the stated goals of supporting capability and managing volatility.

The Hybrid Approach

The hybrid approach, with the levels of funding split in a more complex way over the four levels shown in MoRST’s paper (Institutional Support; Funding to meet Key Outcomes; Project-based Contestable Funding; and Commercial Funding from Other Sources), may reduce the amount of institutional support to a level where it loses its benefits to the system. Considering the entry and exit costs of using contestable funding, we

think the institutional support needs to be stronger than it is currently, and implementation of a hybrid approach would not show leadership in supporting capability, but confusion.

Goals of the ideal funding instrument

The funding mechanism to support and develop capabilities should be required to:

1. support capability in all its components, complementarily to supporting projects and programmes
2. support ownership duties rather than investor expectations
3. promote the investigation of new ideas
4. manage rates of change in resource allocation and the shock of step changes
5. allow research organisation managers to decide upon varied rates of change for the various aspects of their organisations
6. provide effective feedback loops for the system to be responsive to performance
7. provide clear goals and incentives for managers of capability
8. be feasible to implement
9. reduce transaction costs and bureaucratic costs
10. reward research organisation managers for developing a balanced risk portfolio
11. support flexibility in organisational arrangements
12. be accountable (performance-based)

The goals of the new funding mechanism would be simply to nurture capabilities, including human capital.

How NSOF fits with these requirements

We propose that an enhancement to the NSOF fund could meet all the requirements.

NSOF already comes with a built-in mechanism for distributing funds, namely the Foundation for Research, Science and Technology's current contestable process. This provides an independent and broadly-based review of performance. The investment is still 100% contestable.

NSOF is already used as a means to directly enhance capabilities in Public Good science at CRIs. NSOF is already used to alleviate the shock of step changes in funding.

It is low in transaction and running costs. It has a built-in feedback loop, in which the income from NSOF is still allocated based on the current funding competition. Hence research organisations receive clear indications of their performance. They receive this indication in the year of the contestable funding award, ie. even before they receive NSOF funds.

NSOF is already implemented, hence we know that it is feasible. The operational management is already in place, so transaction costs will not increase greatly and accountability issues have already been decided upon.

Areas where NSOF can be extended to better match these requirements

Size

If NSOF is linked to contestable government funding, then it remains a performance based funding instrument. NSOF, however, is currently too small to make an effective contribution to sustaining and growing capabilities.

We do not know today how much the system needs to effectively maintain its capability. The investment should be large enough to support human resources and new ideas. We can say that it is not sufficient at present.

Crown Research Institutes currently receive NSOF at 10% of last year's PGST² funding. We suggest that the value of NSOF grants should be incrementally increased. After each increase in the fund, evaluation will be required to determine if this increase is sufficient to meet the stated goals of the fund.

Time

Currently, NSOF only provides a single year of funding after a contestably-won project grant. The contestable grants provide a signal to the research organisation managers about their performance and capability. However, one year may not provide sufficient time for a response to that signal. We suggest linking to the rolling average of the past three years funding, to allow managers a greater time to effect major transitions.

With NSOF linked to contestable funding, this means that poor ideas will decrease funding over a longer time frame than at present. This lessens the damage from individually failed ideas, thus making the research providers less risk-averse.

Extent

NSOF is currently available to CRIs only. New Zealand's research capabilities are embodied within a range of organisations, taking in CRIs, universities, consortia, and private research enterprises. If an organisation has the ability to repeatedly win contestable project funding from the Government through Vote Research, then it probably embodies a capability that the Government may wish to support. Hence there is a case to be examined that an enhanced NSOF should be made available to all who gain contestable funding, along with a process to report on its use. This would extend the reach of NSOF without adding extra funding instruments and the clarity of a single approach should reduce perceived barriers to collaboration between different kinds of organisations.

However, the effects are complex, and sometimes conflicting:

- If the purpose of the extended NSOF is solely to support capabilities, then this may clash with the role of the PBRF. This exists to support research in universities and the interaction between an extended NSOF and the PBRF would need to be considered.
- Subcontracting of research is another issue which may need addressing. Principal investigators may be awarded a contestable grant but they may not embody all of the capabilities that are utilised in the project.
- Private institutions may embody some national capability but they are outside public ownership. For these institutions, their NSOF funding would still be entirely dependent upon the performance of their contestable grant applications. This provides an incentive for them to use the NSOF funding in developing their nationally-important research capability. However, oversight and communication of expectations should be provided to them by MoRST.

We do believe, however, that the case warrants examination. If NSOF were extended to organisations other than CRIs, then its size should be increased to reflect this change.

Ownership

Currently, we see the Foundation for Research, Science and Technology (FRST) as increasingly a *de facto* manager of human resources in CRIs, whereas it is our opinion that this is the responsibility of the owner. Investors are traditionally not responsible for human capability, whereas owners are responsible for developing staff. Since CRIs are entirely owned

by government, we suggest that the Minister could provide the NSOF support for CRIs, for example via CCMAU. This could be done by moving NSOF from FRST to CCMAU, although this conceptual clarity might be offset by an increase in transactions costs for this move.

Potentially, CCMAU could explicitly give institutes the goal of developing human capital as well as financial capital.

In summary, we propose that NSOF be invested, still on a contestable basis, but with the results of the contest distributed over time, allowing a research organisation to predict its income over a broader period. This eases transitions whilst still providing signals about appropriate directions for research. It also finally gives the Crown-owned entities a mechanism for implementing long term human capability development.

Conclusions

We have three main points to make, the first two are key points missing from the debate, and the third is our recommendation for a solution to the capability support issue:

- We think that owners have the responsibility to support and foster capability, ie. for CRIs the Crown should show strong support for existing capabilities and developing new ones.
- Transitional arrangements ie. training, foresight, reinvesting capital assets, are what count. In particular we can quickly change technologies, but we cannot quickly develop highly skilled people.
- NSOF would be a logical and practical instrument through which Approach 1 could evolve support for capability, by increasing the proportion. NSOF has well-defined measures, an existing structure and simply increasing it would be transformational, greatly increasing support for capability (in its widest definition), with minimal upset or tinkering that may backlash on research capacity. The benefits of minimal complexity with maximal benefits to capabilities make this instrument a practical mechanism for achieving the goal.

Finally, if the funds for this new investment mechanism are taken from current funding, then the contestable funds will be insufficient, and will not be able to provide the priority signals that indicate the directions of research. The best that can be achieved will be the mapping of current research into the new structure, with devolvement to the providers of management of research directions. There may be some gains from increasing the system efficiency, but the new mechanism will not develop substantially new capabilities without new money.