How can research afford big capital items?

April 2004: Response to MoRST's discussion paper on large-scale research equipment

Introduction

In February 2004, the Ministry of Research, Science and Technology (MoRST) published a discussion paper to invite feedback on how New Zealand purchases national-scale research assets.

This paper contains feedback from the Royal Society of New Zealand in its capacities both as a purchase agent and as an academy of sciences for New Zealand.

The Royal Society is concerned that the large assets question is seen as a policy gap requiring additional policy tools. We believe that this gap arises from fundamental issues with the current funding mechanisms. While we aim to provide direct answers to the questions raised in the discussion document, we also discuss initially some points that seemed to be missing from the Ministry's discussion paper.

High quality infrastructure and suitable equipment are fundamental to attracting and retaining researchers, thus enhancing New Zealand's innovative capabilities. As with human capabilities, we see the funding of large assets as an important ownership responsibility. Support for both human capabilities and equipment needs to become regularised to enable ownership responsibilities to be properly articulated. The government is the owner of many of New Zealand's research institutions, but not the sole owner of all research capacity in the country. In Section A, we respond directly to the survey questionnaire, and in Section B we address some of the issues that we think are missing from the original discussion document.

This paper has been viewed and approved by the Council of the Royal Society.

SECTION A
MoRST Questions 1-3

The first questions deal with the key principles that describe large assets that are currently not supported by full-cost funding.

We agree largely with the decision tree. However, we think that the assumption that full-cost funding currently supports smaller equipment purchases is wrong. Therefore we get stuck at the first decision box, that asks "Is equipment purchase supported through full cost funding – Yes? – No?" We think there is another answer option, ie. "we don't know" and we will never definitely know under fully-funded short term contestable contracts, due to the nature of the whole funding system. There are several major points to make here, which we describe in detail in Section B.

We also think that the necessity for equipment to be "supported" is not strong enough. Equipment needs to be fully "enabled" as "support" could mean partial sponsorship, which does not necessarily fully enable the purchase of assets.

Regarding the "multi user or multi disciplinary" principle – this is not necessarily a criterion for large assets, although it is likely to be a consequence. It is possible that a large asset could be required for nationally important research that is provided by one group of researchers, in one specific discipline. This asset may not be fully enabled through "full-cost" funding, and could fall into the "large asset" category.

MoRST Questions 4-6

Similarly, question 4 asks about the definition that represents large-scale research equipment. Again, the "high number of users", while a common consequence, is not necessarily required to define large assets.

We agree with the other definitions of large scale research equipment.

MoRST Questions 7-9

We don't know the usefulness of a research equipment website, as New Zealand appears to be small enough for knowledge of large assets to filter through to users without a formalised system of transferring that knowledge. Yet, the idea has merit, and may be part of the solution to formalising the existing ad-hoc systems that exist. So, try it and see!

In section two of the discussion document, the specific questions relate to purchase of research equipment. The Royal Society does not perform research per se, yet we have interviewed several members and gathered general information on the problems that exist.

MoRST Questions 10-12

The full cost funding system has definitely affected members' ability to purchase large-scale assets through their respective organisations. The

failed attempts relate to an inability to get agreement among users to maintenance and depreciation charges, ownership, and initial cash provision (investment). Some successful purchases have occurred, following long delays and much discussion to get the necessary investment. However, these may subsequently turn out to be subsidised by Vote Education, as the full-cost system may not fully enable the purchase in the long term.

MoRST Questions 13-15

These points, above, also allude to barriers to an organisation's ability to collaboratively purchase large-scale equipment due to difficulties in getting agreements. The collaborations required, in general, to achieve much of New Zealand's research, are melded through long, risky processes that involve discussions, contracts, and often formation of new companies or research entities. The risks associated with purchase of large equipment are described in detail in Section B, so will not be further discussed here.

MoRST Questions 16-23 Access to research equipment owned by other organisations.

We did not canvass our members specifically on this point, but our experience is that, generally, access to equipment is not a problem, unless the equipment does not exist. That is, once a purchase has been made, researchers are encouraged to use it (and pay for its use). The agreements usually are based on user charges that are simply invoiced to the user based on time, or units of use. Some equipment that used to be shared freely within an organisation, is now needing to be "charged out" to a budget code in formalised ways, to enable the depreciation and maintenance costs to be paid.

In response to the survey questionnaire, we would like to add that there is a major assumption that has been overlooked, and that is that the full-cost funding model should provide properly for asset purchase. In theory it might, however the reality is different. Therefore, Section B below points to specific issues that we think should be considered in developing the whole system.

SECTION B

Key points:

1. **Owner responsibilitie**s. We believe that owners (eg. The government as owner of Crown Research Institutes) must take a substantial share of the purchase risk. In some cases that may amount to all of the purchase risk. Too large a share of risk is currently devolved to institutions which have to rely upon contestable, future, and unknown, funding. The New

Zealand government, as owner of CRIs, currently possesses no instrument(s) by which it may exercise its ownership responsibilities in acquiring large assets. One possible route, as with maintenance of human capability, would be an instrument (and associated funding) directed via a re-visioned Crown Company Monitoring and Advisory Unit.

2. **Failure of full cost funding**. The current funding system fails to provide adequately for the purchase of large assets that may be required for desirable research in New Zealand's universities, public and private research organisations; this is due to:

- the lack of a process by which one may apply for the outright purchase of large assets,
- the cash flow anomalies resulting from disinvestment by purchasing agencies, that remove funding of depreciation for existing assets, and
- the inherent barriers to collaborative purchases due to competition for contestable funding that would pay for depreciation of multi-user large assets.

3. **The risk of asset purchas**e. The financial risks are borne by an organisation, while the government and purchase agencies fail to provide long-term signals that could inform on, or justify, the risk of investing in large assets.

4. **Maintenance**. Asset ownership responsibilities need to be accounted for fully, including maintenance costs of assets, which might include personnel, housing and maintenance contracts.

Concepts missing

Failures of the full-cost funding system

The discussion document makes a distinction between research equipment supported by full-cost funding and equipment not supported by that funding. Unsupported equipment seems to be equated with large-scale research equipment. The discussion paper then uses that distinction to consider the difficulties of purchasing in the current environment. The Royal Society disagrees with this on two points. Firstly, the assumption that full cost funding allows for the purchase of assets is not necessarily correct. Secondly, we believe that full-cost funding should, in theory, assist purchase of large-scale assets. Both of these issues arise due to the following reasons.

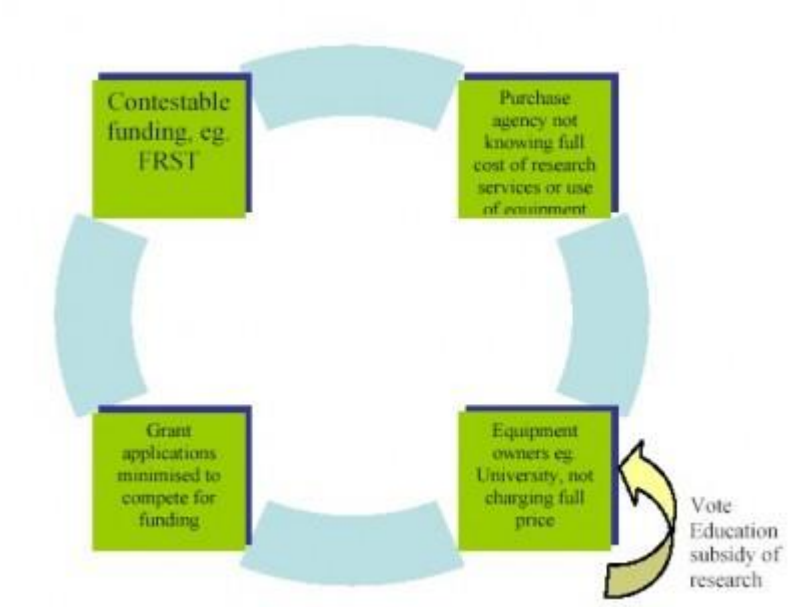
There is an inherent failure of the full cost funding system for large (and department-scale) asset purchases. The costs charged to users of research equipment do not necessarily cover the full costs of depreciation, maintenance, and capital costs over the time frame of the life of the equipment. This is due partly to the market forces that apply to charge-out rates for equipment use (ie. what users would bear, what they could pay overseas) and the lack of long term commitment of purchase agents to support particular areas of research that would use the equipment.

The following paragraphs describe in more detail the nature of these failures.

Market failure due to the incomes of the user base

The charge-out rates of a piece of research equipment under full-cost funding should reflect some balance between the cost of the use of the equipment and the equilibrium market price that users are willing to pay, the difference being taken as profit and the costs including a contribution towards equipment replacement.

In reality, the system is dysfunctional as the user base rarely has sufficient income to pay fully for the costs of asset use. The pricing levels are set based on beliefs about "what the market will bear". This pricing information is fed back to purchase agents. To keep grant applications competitive, applications for funds use these pricing levels. This results in grants at levels below the true costs, and grants that do not enable equipment replacement. The diagram below indicates the cause and effect of the reality of the current contestable system.



The market demand for services from large-scale equipment is severely dysfunctional, with users unable or unwilling to pay market rates and service providers unwilling to ask for market rates. Effectively, equipment purchases are made via subsidies from one source or another, eg. education subsidies, alternative commercial revenue, or windfalls that resulted in unexpected investment ability. These subsidies or investments are separate from the charges applied to users of the equipment in the full-cost funding system.

Market failure due to overseas competition

Many of the research services provided by large-scale assets in New Zealand are marketed successfully around the world. New Zealand has been competitive in attracting international business due to our inherent cost-effectiveness. This external funding has been vital in allowing some of our research assets to continue as long as they have. However, the international market rate for these services does not provide for full-cost funding. The majority of our international competitors receive substantial subsidies for services provided to their own national researchers, as well as economies of scale not available to New Zealand providers. This greatly distorts the international market prices for these services. Hence New Zealand providers are forced by the international market to price their services at lower than the on-going cost of providing those services. Due to the size of New Zealand it is often necessary to supplement local income off an asset with international income, to ensure the asset is used maximally, and provide additional revenue to partially support maintenance and depreciation costs. However, this international income does not necessarily cover full-costs, indicating the failure of the market for large asset use, due to our position in the world context.

The potential for loss of national capability

Where international capabilities can provide services at lower costs than New Zealand national assets, a case can be made that international assets should be used in preference to national assets. However, this is antithetic to the desire for local innovative capacity.

In addition, many services cannot be transplanted internationally in this manner. One example would be the analysis of delicate biological samples in large-scale research facilities. This capability, which may underpin the biotechnology research at the heart of the Government's Growth and Innovation Framework, is inherently localised. It is not practical to perform such work overseas, due to the nature of the work and due to regulatory systems, eg. export permit requirements for biological products. Thus if New Zealand failed to invest in such a national facility, then it may not be able to partake in research in that field. This would greatly limit our ability to benefit from international research in that field. Maintaining innovative capacity in New Zealand is a primary goal of national research investment.

Inappropriateness of the market model due to the small size of the New Zealand market

Large assets are in many cases discrete, in the sense that half of an electron microscope is no use at all. If the New Zealand market for services of an asset is not large enough to fully utilise that asset, then the

operators of that asset will have to either increase their charges to New Zealand users or look elsewhere for income. If the charge rates for use of an asset were deemed to be too high, then there would be a lack of initial buy-in or commitment from other users, and the business case for the purchase would fail. This would result in no asset purchase, and a loss, or lack, of capability.

Similarly, a country like New Zealand may be too small to produce a large number of research service providers. For example, there are only two accelerators in the country, run by one group providing isotope analysis services. With these small numbers, the market force of supply and demand is limited in its ability to set prices and create efficiency in the usage of large assets, as currently happens with smaller assets and services such as DNA sequencing (where there are several service providers and a large number of users).

The presence of fully amortised or stranded assets further distorts this market. These assets can potentially charge only marginal costs.

Risks borne by research providers

A purchase agent can lower the priority of research that uses a particular piece of large equipment. This reduces or stops the revenue associated with that equipment, meaning that forecast full-cost funding is at risk.

In many cases, the scientific merit of owning an asset is greater than the financial business case; for example universities may invest in an asset in the hope that it will increase future post-graduate student numbers as a result of improved scientific capabilities. Such increases in revenue may occur in the distant future (ie. more than 6 to 10 years later) and so the asset purchase is described as having "strategic" value. However, the reality of such forecasts depend on many other things, such as the student fees structure (eg. competition with other universities), changes in immigration policies for students, long term changes in numbers of students studying science, secondary education policies, strength of international economies etc. When a university makes a large asset purchase solely for its long-term strategic value, the risk of owning that asset is huge, and is borne solely by the university, without any signals from government to provide the necessary long-term commitment to the policies that would support the purchase of such equipment, eg. promoting science at secondary school, positive immigration policies for students, post-graduate student support etc.

Similarly, strategic decisions made by Crown-owned research institutes that subsequently fail due to changes in government policy directions or the business market place, may put at risk their cash flow. Such failed asset investments, while providing for scientific capabilities in the short term thus enabling stronger research opportunities, may, in fact, risk

their future ability to invest in commercial opportunities due to changes in their cash flow situation.

Transaction costs and divestment add to the risk of large asset investment

Large assets are less flexible than smaller assets, as purchasing and divestment systems, increased requirements for oversight and due diligence, and smaller markets for those assets lead to higher transaction costs. This also adds to the burden of large asset purchasing – not only does the investigator have to provide a solid business case for the purchase (to justify the cash flow implications for the organisation), but they must do this in a vacuum of systems that provide for these higher transaction costs.

The fact that such transaction costs must be borne by the research provider or investigator without any commitment to long-term funding by purchase agents, exacerbates the lack of ability to develop business plans for large asset purchases, and puts at risk the cash-flow of national research organisations. A mismatch between strategic signals and the results of certain contestable funding instruments limits the information available to asset managers on the income to be obtained from their assets.

In addition, it is necessary to have a system that allows for transition arrangements or exit strategies for large-assets. Currently, the existence of "stranded assets" ie. those from which no revenue is earned, and which cannot be sold, reduces the ability to purchase large assets, by reducing the organisation's cash-flow situation.

Risks associated with large assets are exacerbated by the research priority setting system

National research priorities, which are imposed from above onto research providers, are changeable over time. Yet research providers have to take on the risk of purchasing large assets, with no certainty of the income from those assets. If the rate of change of national priorities matched the rate of change of large assets, using a directions-setting framework that was sustainable; and if purchase agencies were to stick to the signals that were given for long-term research priorities, then research providers could make more realistic business cases for the purchase of large assets (as well as other aspects of research capability investment).

Risks associated with large assets are exacerbated by financial systems

The cash flow required for asset purchase is often possible through a research organisation's balance sheet, although some organisations are better placed (are more asset rich, or have stronger cash flow) than others. The tendency to borrow in order to provide the cash for initial purchases does not appear to be widespread in New Zealand's Crown-owned research institutes and universities. However, if borrowing were required, it is unlikely that favourable borrowing terms would be available in the New Zealand cash market. That is, interest rates are high, adding to the depreciation and maintenance costs of large assets that must be provided through contestable funding. In addition, lenders in the NZ cash market for large equipment are risk-averse, preferring more secure clients such as farmers.

Large assets versus medium-scale assets

Large-scale research equipment that is of national importance and with a wide user base is currently purchased through negotiations among users and commitment to a business case for that purchase. However, such negotiations can reveal a lack of confidence in the purchase of a large asset, due to its risk profile, and alternative, cheaper, less strategically beneficial and less appropriate assets may be bought to get maximal buy-in of users. The inability of users to trust (or forecast) the research revenue streams long-term, therefore reduces the scientific capabilities of New Zealand collaborations.

Difficulties exist where substantial pieces of equipment are used for a large fraction of the work of a single department. Equipment of this type is supposedly supported through full-cost funding. However, in practise there are a number of issues that limit the ability of University departments to purchase, operate and maintain equipment of this level. Due to the substantial cash flow required for purchasing large assets, and their inherent risks, university departments may effectively compete with one another for asset purchases. This also occurs within other businesses, such as CRIs. When putting forward the business cases for various purchases, such interdepartmental competition may result in the business case of the 'most likely to be funded' equipment to be put before the 'most scientifically meritable' purchase. This can put constraints on the scientific capabilities of a particular research group.

Many of these issues are common to the provision of both substantial and national assets and should be considered.

Maintenance costs

Most large-scale research assets have significant operating costs, even when they are not in active research use. These costs can be hourly, such as the requirement to keep pumping an ultra-high vacuum system

between work duties, or longer term, such as a research vessel docked between expeditions. While depreciation costs are accounted for through international accounting standards, maintenance costs can be dealt with more subjectively, resulting in potential 'shirking' of responsibilities to adequately budget long-term for the maintenance of such equipment. This may, long term, result in an inability of the full-cost contestable funding system to adequately provide for these costs. For example, if staff required to man a piece of equipment were employed on an hourly basis, then accountants could cost the charge-out rates accordingly. But in reality staff are employed either permanently or on short-term contracts with a pre-set weekly number of hours, and so accounting for the charge out rates in case of low-usage of the equipment becomes difficult. This is especially so if disinvestment occurs in a particular lab or research area, resulting in a loss of equipment users.

Where organisations are asset-rich, for historical reasons, the maintenance of these assets can eat severely into the cash reserves in times of low usage.

When competing for large asset funding, business cases can be made more attractive by an investigator if maintenance costs are underestimated. This further risks the cash flow situation of the organisation that invests in large assets.

In summary, maintenance costs are charged to research projects at reasonable rates, but do not necessarily reflect the whole cost of the equipment, due to the inability to determine long-term usage, with short-term contestable funding instruments.

Conclusions

Various pathways exist for the funding of a large asset. At one end of the scale, the owner may take all of the risk, and not only buy the asset, but cover all its operating costs, and make it available free to users. At the other end, users may be required to club together, shoulder all the risk, and make their own arrangements to ensure that income to cover the purchase is available from grants, sales, or subscriptions.

Middle options involve risk-sharing, for example an the owner covering all capital costs and users covering operating, or by several owners partnering with each other to buy the asset.

We believe that owners (eg. The government as owner of Crown Research Institutes) must take a substantial share of the purchase risk. In some cases that may amount to all the purchase risk. Too large a share of risk is currently devolved to institutions which have to rely upon contestable, future, and unknown, funding. The New Zealand government, as owner of

CRIs, currently possesses no instrument(s) by which it may exercise its ownership responsibilities in acquiring large assets. One possible route, as with maintenance of human capability, would be an instrument (and associated funding) directed via a re-visioned Crown Company Monitoring and Advisory Unit.

Full Cost funding

Accessing large assets enables research capability, maintaining innovative capacity in New Zealand. Access means hiring, leasing, purchasing or sharing large equipment. The business case for each option is usually given by the investigator to the research providing organisation, and investments are provided via cash flows from internal asset depreciation. However, the depreciation and maintenance costs are not fully enabled by the current "full cost" funding system, due to various aspects of market failure in the charging of costs to users of equipment.

We suggest that there are three significant solutions to the current anomaly with "full cost" funding. The first two are complimentary and troublesome if not introduced together.

1. accurate full-cost charging rates
2. grant applications to reflect accurate full cost rates
3. the Government-as-owner taking on risk, where the Government causes that risk, rather than devolving all risks associated with asset purchases to providers. This means investing in large assets as well as support for stranded assets
4. over and above these improvements to the full cost funding system, there needs to be new investment to provide the capabilities the government seeks to acquire and support, to provoke increased innovation and growth for New Zealand.