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**Evaluating Reform of the New Zealand
Science, Research and Development System:
New Deal or Dud Hand?**

Siwan E. Lovett

Discussion Paper No. 42, September 1994

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Abstract:

New Zealand society has experienced a great amount of change in the last decade. These changes have principally been geared to reformation of the country's economy. A package of reforms, developed and implemented by both Labour and National Governments, has revolutionised the conduct of public service departments, as well as some parts of the private sector.

The philosophies which have guided those responsible for the new direction have been derived from schools of thought which had not traditionally been used to govern affairs of state in New Zealand. Public choice theory, transaction cost analysis and agency theory have provided the foundation from which ideas about the separation and purchasing of specific government functions have been based. The adoption of such ideologies has resulted in a public sector that bears little relation to the past.

This paper is concerned with an evaluation of the reforms, specifically as they relate to science, research and development in New Zealand. This sector has traditionally been sheltered from the vagaries of political and economic life and, as such, has been greatly affected by the recent reforms which have been imposed upon it. In undertaking an analysis of this kind, the reforms will be assessed on their theoretical basis, and then evaluated on their translation into practice.

Introduction: Setting the Scene

Science, research, and development in New Zealand have had a long history of government patronage. This history of patronage is shared with other countries, such as Australia and Canada, and may be understood as deriving from governmental concerns about the necessity for indigenous research and development rather than relying on discoveries from overseas (OECD: 1974). Government involvement led to a set of common problems experienced by all the above-mentioned countries. The expectation that government would provide support for research and development led to complacency in the private sector in all three countries. In addition, the strong primary production base that these countries were founded upon meant that "home-grown" industries have not tended to develop research institutions of their own. Rather, they allowed government to fund such investigations. The New Zealand experience provides a case study both of the way in which government has sought not only to reverse this private sector dependency, and also reform of the institutions which have undertaken public sector research and development.

In 1926 the New Zealand Department of Scientific and Industrial Research (DSIR) was established. The creation of this organisation represented the beginning of institutionalised government involvement in research and development. The DSIR was to remain the predominant research organisation in New Zealand for the next 60 years. Following the foundation of the DSIR other, smaller, research associations and specialist units within government departments began to emerge. There was considerable support for science during this time, with resources further increased throughout the 1940s and 1950s (Palmer 1993: 1).

However, the boom period for science in New Zealand was well and truly over by the end of the 1950s. The slowdown of the economy, combined with rising government deficits, saw fiscal cuts affect science primarily through decreases in personnel and organisational resources. This saw the momentum that had carried the sector so buoyantly in previous years slow, so that science returned to the bottom of the government priority list. It was not until the late 1960s

that steps were made to resurrect the science effort. This was engineered by the establishment of a National Research Advisory Council (NRAC). The NRAC was to advise government on the needs, planning and co-ordination of science, as well as on the creation of a ministerial portfolio for science (STAC 1988(a): 9).

The establishment of the NRAC, whilst viewed as a positive step towards raising the profile of science, did little to bring the sector's problems closer to resolution. The NRAC was largely frustrated in its attempts to gain government interest in the development of national science priorities towards which all research institutions could be oriented. Science was not an issue which concerned many voters and this resulted in a corresponding lack of interest in the area by politicians. It was not until the reforms of the 1980s, which encompassed all public sector functions, that science, research and development were specifically targeted for change. This period saw reforms, unlike any experienced elsewhere in the world, to be accomplished in New Zealand.

Part 1: New Right Reforms: Labour comes to power

The advent of a Labour government in 1984 marked the beginning of a period of change which saw New Zealand adopt a unique programme of reforms. The scene had been set in the early 1980s, as the Muldoon National government struggled with an economy that had deteriorated since 1975. Factors such as Britain's entry into the European Economic Community, as well as problems of increasing inflation, economic stagnation, balance of payments deficits and unemployment, paved the way for a new government with new ideas for solving the nation's problems (Duncan et al 1992: 5).

The attitude of the New Zealand population was also a major factor serving to promote change at this time. James discusses the demise of the 'prosperity consensus', which he believed had served to bind the population since European settlement (James 1992: 37).

Under this consensus the population were 'one people', initially being mostly of British descent, bound together in the common quest for a prosperous country. By 1984, however, this consensus no longer existed in a population which had become considerably more diverse ethnically and culturally. The traditional inhabitants of New Zealand, the Maori, were celebrating and promoting their identity as being very different from the more recent British and European settlers who made up 86 per cent of the population. By 1984, therefore, New Zealand was neither prosperous nor socially homogenous, and this meant that the country and its people were ready and willing to support promises of reform (James 1992: 95).

The fourth Labour government, inherited a depressed economy and a social order that was in need of direction. The ideological path that this government chose was characterised by the influence of rational economic philosophies and doctrines, notably public choice theory, agency theory and transaction cost analysis. The influence of these theories led to a blueprint for change which instigated reforms unprecedented in their scale and gravity. The theoretical underpinnings of these theories are, therefore, very important when attempting to understand the reforms that were developed during this period.

Public choice theory has been recognised as one of the most influential paradigms of the reform period in New Zealand. The theory is based on the belief that society is made up of individuals who seek to maximise their own self interest in every situation (McLean 1987:1). When this belief is applied to the overall functioning of a society, the market place is identified as the arena in which the bulk of transactions are efficiently made. Public choice advocates that the less intervention in the market place the better, as the market is the best mechanism for determining the success or failure of individuals and their companies (Self 1990: 25). Under such a model, those that fail are those businesses that are not competitive and, are therefore of no benefit to the economic development of the society. For this reason it is believed that economic transactions within the market should be as free from governmental intervention as possible. This enables individuals and the organisations they represent to make decisions in an environment which is conducive to maximising economic productivity.

This theory promoted the belief in more-market economic methods as the saviour of New Zealand and resulted in the country's government embarking on a programme of reform which was built upon ideas supporting the pre-eminence of markets and private regulatory systems (Bollard 1991: 2). This saw the implementation of a comprehensive programme of micro-economic reform, which was designed to remove all unnecessary barriers to competition. The abolition of a range of subsidies and tariffs, as well as deregulation and liberalisation of the economy, marked the beginning of the reform process. State control and intervention were reduced to the minimum level possible, which was a major change for a country previously rated as one of the most government intervened in the OECD (Easton 1993: 2). The programme came to be labelled "Rogernomics", due to its piloting by Roger Douglas, the Finance Minister at the time.

Corporatisation and Privatisation: The transformation of state-owned enterprises

Douglas argued that economic policy should be free from social and political considerations. His strategic plan required the removal of the state from the economy and the creation of an economic climate conducive to the domestic and international market-place (Kelsey 1993:18). This plan was outlined in the Treasury report *Economic Management* produced in 1984. This provided a programme for the full liberalisation of the economy.

The first phase of the reforms saw State-Owned Enterprises (SOE) transformed into commercially operated public corporations. The stated intention of the corporatisation process was to replace "mixed, inconsistent, discretionary, and sometimes non-monitorable objectives ... by clear consistent, commercial, measurable ones" (Duncan et al 1992: 24). The *State-Owned Enterprises Act (1986)* facilitated the process of transforming organisations which were identified as being suitable for corporatisation. Railways, radio and television, and government computing organisations, were all affected by the corporatisation policy (Kelsey 1993: 30).

These changes saw government departments and state agencies become responsible to their respective ministers for the provision of commercial services (Wistrich 1992: 120). As commercial bodies they were subject to the same rigours of the market place as any private sector company, and therefore had the same goals of making profits at the highest rate possible. Ministers in this new system were purchasing the services of their departments, and in keeping with commercial operational principles, contracts between government and senior management officials came to be used as the primary accountability mechanism.

Continued emphasis on change saw many of the organisations which had been corporatised subjected to further pressure to become privatised. Privatisation was more of a contentious issue than corporatisation. Dunleavy notes that there is a permanence about privatisation and the organisations which characterise the process, that leads to uncertainty about whether it is appropriate to transfer the provision of goods and services from the public sector into the private realm (1986: 13). Despite these concerns privatisation continued to be pushed by the New Zealand Treasury. Duncan believes that the motivation for the further sale of government organisations was to transfer assets to the private sector, thereby reducing the operational inefficiencies that were assumed to be inherent in bureaucratic organisations.

Another objective for corporatisation was that these "new" commercially-oriented organisations had to gain as much outside funding for their activities as possible. This goal could only mean a corresponding reduction in government expenditure, something that Treasury firmly favoured (Duncan et al 1992: 38).

The reforms described above redefined public and private sector activities through the utilisation of public choice theory and the market as a guide to economic and business decisions (Mascarenhas 1990: 83). However, the initial focus had essentially been on the structural reform of organisations. Changes to the internal management of organisations

was also targeted by reformers. This saw private sector operational and managerial principles enter the public service.

Bureaucrats under Siege: The reform of the public service

The reform of the public service occurred in two main, legislatively-defined, stages. The first phase was founded on the *State Sector Reform Act*, passed in 1988. This Act was primarily concerned with the development of a Senior Executive Service (SES), as well as the rules which were to govern this group's activities. The head of a government department, referred to as a chief executive, became responsible to the minister for the carrying out of specific functions. These functions, defined through consultation between minister and chief executive, served as the basis for a legally binding contract which both parties signed. In this way, chief executives and the departments they administered were commissioned to provide a service which the Minister, using monies appropriated from and accountable to Parliament, chose to purchase (West 1994: 1).

Considerable power was vested in the chief executive's position, with the minister rather than the State Services Commission appointing individuals to the position (Mascarenhas 1990: 84). Concomitant with the *State Sector Reform Act (1988)* and the new appointment responsibilities of the minister, was a move to broaden the personnel working within the public sector by hiring and contracting employees from the private sector (West 1994: 1). These changes considerably altered the employee profile of the public service at the managerial level.

Company objectives and mission statements now direct agencies which had previously not been subjected to such economically-defined imperatives. Now the key defining element for any public service department is the contractual agreement between minister and executive, with performance based on financial profitability.

In order to facilitate fiscal evaluation, stage two of the public sector reform process involved the creation and passage of the *Public*

Finance Act (1989), which made performance indicators and their measurement through financial means an essential element of any government organisation's operations. The *Public Finance Act (1989)* introduced accrual accounting, operating statements, balance sheets and a host of other fiscal measures, all designed to enhance accountability as well as transparency, in the operations of government departments. This Act assumed that Cabinet defined strategic outcomes, and departments produced the outputs to deliver those outcomes. The *State Sector Reform Act (1988)* allowed the development of a contractual relationship between minister and chief executive, so that the Crown could purchase outputs through a specific purchase agreement. In effect, the *State Sector Reform Act (1988)* and the *Public Finance Act (1989)* served to link executive decisions to financial results (Scott & Gorringer, cited in Mascarenhas 1990: 85).

Transaction cost analysis and agency theory were influential in the changes to the public service outlined above (Boston et al 1991: 2). Both approaches are concerned with the relationship between principal and agent.

Agency theory rests on the notion that social and political life can be understood as a series of contracts into which a principal and an agent enter into exchanges with each other. In the New Zealand case these "exchanges", on the whole, have been economically defined. In such contracts, the agent undertakes to perform various tasks on behalf of the principal and, in exchange, the principal agrees to reward the agent in a mutually acceptable way (Boston et al 1991: 4). The individuals involved in such transactions are primarily concerned with their own welfare, an assumption which is also intrinsic to public choice theory. This self interest means that individuals will only enter into agreements which are of benefit to them. It follows therefore, that the transition of public sector departments into corporatised or privatised entities allows the contractual element of agency theory a free rein.

In New Zealand, this theory legitimated the development of the SES and the contracts which have become the basis for agency activity.

Transaction cost analysis builds on the ideas of agency and public choice theory. However, it is also concerned with recognising the importance of authority relationships within the structural context of organisations. This theory takes broad account of other social factors which may impinge on decision making within agencies (Boston et al 1991: 7). All firms, according to this theoretical position, aim to minimise the costs of transacting business (ie: their transaction costs). In order to try and combat the vagaries of the market place.

Transaction cost theorists argue that firms will attempt to vertically integrate their services as much as possible. This means that they may either try and take over their suppliers or, alternatively, try to take over their buyers, thereby creating a more certain operating environment for their organisations. This approach has been particularly important in New Zealand for evaluating the relative benefits of contracting services to government or to private sector agencies. This evaluation is done on the basis of the transaction costs associated with the provision of a particular service. The theory has also been useful in setting up the basis upon which efficiency and performance management criteria have been set.

When all three theories are brought together, the transformations of the public sector in New Zealand may be understood as being heavily influenced by rationalist economic theory. The "new managerialism" ethos, which characterised reforms in other countries such as Australia during this time, provides an umbrella under which these three approaches fit together.

However, whilst government rhetoric heralded the reform process as being one of the most progressive in the world, others were not so complimentary, particularly when the human cost of the changes was considered. These theories "changed the values upon which the public service was based, and as a result caused considerable anxiety and uncertainty within the workforce" (Mascarenhas 1990: 75). In order to fully appreciate the nature of the reforms and the rationale which served to guide them, an assessment of the changes in science, research and development will provide the opportunity to evaluate the application of these theories.

Part 2: Under the Reform Microscope: Changes to the management of science, research and development

The philosophies which drove the changes in New Zealand were based on freeing up economic and financial markets and the reduction of government expenditure (STAC(a) 1988: 8). When attention was turned to the area of science therefore, it was inevitable that government was concerned to reduce net funding levels in research and development. The desire to decrease financial support was due to the disproportion between public and private investment in research and development. The process resulted in a series of reforms designed to encourage industry to invest in research and development, as well as to make those public sector organisations responsible for science operate in a more commercial and economically profitable manner.

The NRAC, in response to the government intention to increase private sector investment in research and development, based its 1984 Science and Technology Plan - *The First Steps* - on the problems and issues which needed to be addressed in order for this investment redirection to be achieved. In this document, several broad statements were made regarding the need for improved sectoral investment in research, greater levels of innovation, and the better use of natural resources (NRAC 1984). These statements did not, however, contain any concrete plans for implementing or overcoming the identified deficiencies in the system. This lack of detail typified NRAC-produced documents and has been blamed, in part, for the Committee's overall lack of success in the promotion of science and research within both government and private sector realms.

The drive towards economic productivity required departments to obtain an increasing proportion of their operational funds from sources other than government. "User-pays" became the new precept governing departmental service provision. This push by government raised concerns in the scientific community concerning the effect such a policy would have on the quality of research. The pressure for a more focussed and economically driven research effort, as well as the necessity to retain their employment, meant that most research

personnel attempted to develop organisational strategies to comply with the government's policy focus.

In 1986 - following the "Science and Technology for Development Conference", which had been held in 1985 to facilitate communication between those sectors involved in science, research and development (STAC(a) 1988: 9) - the Beattie Report (entitled *The Key to Prosperity - Science and Technology*) was issued. It made recommendations designed to develop a national science and technology policy and a matching research effort (Davenport et al 1993: 3). In order to achieve this, a doubling of government expenditure in research and development was recommended in both the private and public sectors. Structural changes to the current system were also suggested, with the Report providing the blueprint for the establishment of an independent contestable funding mechanism, to which government laboratories and universities would bid for basic and strategic research project funding (Palmer 1994: 25).

Walker notes that, whilst the Beattie Report acknowledged that governments were increasingly feeling the need to "base decisions on the funding of research and development on a more quantitative understanding of the economic value of the results", reservations were expressed about the effect user-pays would have on science (Beattie Report, cited in Walker 1992: 7). Beattie cautioned that the arbitrary application of the user-pays principle could have serious negative effects, for example, favouring short term rather than strategic research in order to gain immediate financial benefits. In addition, because of its long term impacts, strategic research would be unlikely to be funded as such research does not secure readily observable rates of return. Other issues surrounding user-pays were also raised, such as the likely decrease in academic exchange between scientists due to their need to compete with each other, and the decline in collaborative research that would follow (Walker 1992 : 7).

Perhaps the most contentious of the Beattie Report's findings was its recommendations for government to double its investment in research, and to provide a 150 per cent tax rebate on private sector research and development. These recommendations were unacceptable

to a government committed to reducing expenditure and industry assistance. In addition, it was not regarded as appropriate to copy overseas schemes (in this case an Australian industry investment plan), an attitude which prevented a wider international scrutiny of possible options for reform. The Beattie Report was thus largely ignored by government.

Budget cuts, user-pays and a reduction in overall government investment represent the first stage of the science reforms (Walker 1992: 10). The influence of the *Public Finance Act (1989)*, which was designed to enable government to cost its "purchase" of science by output, meant that a range of new fiscal performance measures were introduced as the basis upon which the evaluation of activity was undertaken. Organisations subject to the pressures these changes imposed upon them responded in different ways. The DSIR, for example, reorganised its departments into ten strategic science activity areas as a basis for allocating research funds and for reporting on activities (Palmer 1994: 31). The breakdown of the organisation into ten distinct units was to allow the easy identification by potential customers of the services the department could provide, as well as focus organisational functions into strategic areas of activity. Other organisations attempted similar changes in efforts to maintain their viability within the new commercial context.

The NRAC was dissolved in 1986 and a new body, the Science and Technology Advisory Committee (STAC), formed to provide a greater level of scientific involvement and influence in the development and management of research and development policy. The STAC produced a number of documents and was more forthright than the NRAC had been, in some cases openly criticising government. One issue, in particular, pursued by the STAC was the large decline in national expenditure allocated to research and development. Research and development investment via government sources fell from 0.76 per cent of gross domestic product (GDP) in 1984 to 0.66 per cent of GDP in 1987, a drop of seven per cent in real terms. Although government had expected industry to pay for appropriate research and development, this had not occurred during the period under review. When compared with other OECD countries, New Zealand research and development expenditure

ranked seventeenth, with just one per cent of its GDP going towards science. Countries like Japan, Germany and the Netherlands spent around 2-3 per cent of GDP on research and development investment (STAC(a) 1988: 79). The STAC's criticisms were welcomed by the scientific community, whose environment had changed dramatically under the first round of reforms. Substantial reductions in government funding for science had accompanied the introduction of the user-pays policy and a new culture of contestability had come to permeate research and development. Through its actions, the STAC seemed to be providing a voice for science which had been lacking in preceding years.

A New Deal: Structural changes for science

In 1988 the STAC released *Science and Technology Review - A New Deal*, which addressed many of the issues brought up in the failed Beattie Report. *A New Deal* provided a plan for the reorganisation of science management in New Zealand. The key recommendations of the review were:

- Δ the separation of policy advice from the allocation of funds and from the performance of research;
- Δ the contestability of research findings based on scientific excellence, cost effectiveness and collaboration between researchers;
- Δ the establishment of national science and technology priorities based on wide government consultation; and
- Δ research agencies to have commercial powers and reduce the involvement of central government in fund allocation and management of research and development (STAC (b) 1988).

These recommendations received widespread Cabinet support and initiated a new regime for publicly-funded science and technology (Davenport et al 1993: 3). On the 11th of April 1989 Cabinet, building on the recommendations of the *New Deal*, announced operational and structural reforms designed to transform science, research and development.

These reforms involved the creation of:

- △ a Cabinet portfolio for Research, Science and Technology;
- △ a Cabinet committee with responsibility for Research, Science and Technology;
- △ a Ministry for Research, Science and Technology (MoRST) as a policy advisory department, as well as providing executive support to the Minister;
- △ a Foundation for Research, Science and Technology (FRST) as a statutory Crown agency to purchase science and technology, and;
- △ continued support for the role of the Royal Society of New Zealand.

These changes brought together many of the recommendations and reviews that had accumulated over preceding years (Palmer 1994: 47). The reforms were consistent with the wider public sector reforms, through their incorporation of the policies and procedures outlined in the *State Sector Reform Act (1988)* and the *Public Finance Act (1989)*. The organisations created under these reforms were based upon the tripartite policy, funding and operations format, which had been used as a model by government to break up departmental functions within most portfolio areas. Accountability for service provision was built in through the contractual agreements which dictated the functions of every agency. The rationale behind such changes was that government now knew what it was getting back in return for its financial investment.

With this rationale guiding the changes, the development of MoRST and FRST represented the first step along the path of organisational reform for science. MoRST was created to provide advice on research, science and technology policy to the Minister and the Cabinet Committee responsible for that portfolio. In addition, it had a range of other functions relating to policy matters. The organisation had to provide executive support to the Minister; assist in the process of determining national priorities; provide strategic liaison and cohesion; develop audit and review procedures for Crown funded science and technology; raise public awareness about science; be active in

maintaining international science liaisons and cover all aspects of science education (Davenport et al 1993: 4).

As the agency informing the Minister of the research needs of New Zealand, the MoRST was also responsible for the dissemination of information concerning science, research and development at both the international and domestic level. These data then had to be translated into informed judgements about the areas to which government funding should be channelled.

The FRST was designed to handle all matters relating to the funding of science, research and development. The primary activity of the FRST was the management of the contestable pool of money for the purchasing of science and technology, called the Public Good Science Fund (PGSF). The PGSF was designed to be the most important element of the reformed science system. It represented the single largest source of research funding in New Zealand and became the primary means through which government invested in science (MoRST 1992: (i)). In its first year, FRST only allocated 20 per cent of the funding budget through the PGSF. However, rolling targets were set to increase this amount to 50 per cent within a couple of years. The PGSF was allocated on the basis of advice from MoRST about which areas in New Zealand required research and development. These categories of research were then published widely and research institutions submitted competitive bids for funds to conduct those projects. It was felt that the creation of FRST, as a body which would impartially allocate PGSF funds on the basis of inter-organisational competition, would greatly improve science, research and development in New Zealand.

The creation of the MoRST and the FRST meant the scientific community was initially uncertain about what to expect from these agencies, and how to go about gaining successful access to them. Much of the debate in the early months of 1990 revolved around the issue of what was public good science and what was not (Palmer 1994: 52). In economics a public good is one which is jointly consumed in a non-rival manner, and because of this, the marginal cost of adding an extra person to its consumption is close to zero. In other words, a public good is one which is not depleted by consumption (Maughan 1994). This definition

of a public good contrasted with the expectations of the research projects which were to be funded by the PGSF, and as such contradicted such a restricted economic interpretation of the concept. The strong government focus on returns meant that there was considerable pressure for research to return appropriate results. This meant that the product of research could be used (appropriated) by an individual or company. The uncertainty which surrounded the area meant that researchers were unclear about how to frame their bids for PGSF funding in the most competitive way.

The debate engendered by these concerns resulted in a Cabinet decision to define public good research, as against appropriate or operational research. Operational research was defined as research carried out by government departments in support of their own activities and funded from their own appropriations. Public good research was that which the FRST was now responsible for allocating funds to through the PGSF (Palmer 1994: 52). Further clarification was provided by the *Foundation for Research, Science and Technology Act (1990)*, which defined public good science as being involved in the purchase of outputs which were:

- Δ likely to increase knowledge or understanding of the physical, biological or social environment; or
- Δ likely to develop, maintain or increase research skills or scientific expertise that are of particular benefit to New Zealand; or
- Δ of benefit to New Zealand but were unlikely to be funded, or adequately funded from non-government sources.

Investment under such a definition covered the broad spectrum from basic through to applied research across a range of scientific disciplines. These definitions served to alleviate some of the concerns raised by the scientific community that the nature of public good research would change under the new arrangements.

The establishment of MoRST, FRST, and the Cabinet Committee for Research, Science and Technology, generated optimism about what seemed to be an increased emphasis on research and development by

government. In 1990 however, a general election saw the National Party assume government, leaving some doubt about what would happen to what was (at that stage) a half completed science system.

Completing the Equation: The creation of the Crown Research Institutes

The new National Party government promoted further reforms. Simon Upton, the new Minister for Science, Research and Development, was concerned to continue development of the New Zealand science system. This was to be achieved through the creation of Crown Research Institutes (CRIs). In July 1991, Upton launched the CRIs as being organisations which would "provide science outputs for the benefit of New Zealand and promote the application of research results and technology developments" (Upton 1991: 1). The CRIs were designed to fulfil the operations component of the functional split between policy (MoRST), funding (FRST) and operations (CRIs) activities, thereby completing the government blueprint for successful public sector reform.

The CRIs were to be free-standing research institutions, which were focused on a particular productive sector or natural resource. This resulted in ten CRIs being established in the following areas:

Primary Sector:

- △ New Zealand Pastoral Agriculture Research Institute Ltd (Ag. Research)
- △ The Horticulture and Food Research Institute of New Zealand Ltd (Horticultural Research)
- △ New Zealand Institute for Crop and Food Research Ltd (Crop and Food)
- △ New Zealand Forest Research Institute Ltd (FRI)

Secondary Sector:

- △ Industrial Research Ltd (IRL)

Tertiary Sector:

- △ Environmental Health and Forensic Services Ltd (EHFS)

△ New Zealand Institute for Social Research and Development Ltd
(SRD)

Resource Sector -Based:

- △ Manaaki Whenua Landcare Research New Zealand Ltd (Landcare)
- △ National Institute for Water and Atmospheric Research Ltd (NIWA)
- △ Institute of Geological and Nuclear Sciences (IGNS)

The separation of research areas in this way was expected to provide the best possible system for covering all of New Zealand's sectoral needs. Each CRI was set up as a company, operating under its own legislation through an amalgam composed from the *CRI Act (1992)*, the *Companies Act (1955)*, and aspects of the *Public Finance Act (1989)*. The CRIs had a Board of between five and nine Directors, elected by the two equal shareholders of the Institutes, the Minister for CRIs and the Minister for Finance. This meant that the CRIs were wholly crown-owned enterprises (CCMAU 1993: 3). A hierarchy of accountability existed within the CRIs, with the chief executive of each being directly accountable to its shareholding Minister.

The work which these organisations were to accomplish was outlined as follows:

"Their work will be vertically integrated. They will have a broad focus across a range of science and technology, but will avoid overlap with other CRIs. They will be nationally based with regional centres. Their purpose will be to work for the benefit of New Zealand, establishing research capabilities, carrying out scientific and technological research, and providing services."

(Ministerial Science Task Group 1991: 3)

The CRIs were, therefore, charged with the responsibility for meeting New Zealand's research needs whilst, at the same time, maintaining their individual financial viability. The emphasis on vertical integration referred to the CRIs' conducting projects which ranged along a spectrum from basic through to applied research. In colloquial terms, the CRIs were designed to be capable of looking at any

project from "DNA to the dinner plate". New Zealand, it was argued, "needed to achieve higher levels of exports based less on commodities and more on higher value-added products, with better product differentiation, better design, more sophisticated marketing and well-established brand names" (MoRST 1992: 1). This range of requirements meant that CRIs had to be able to conduct research in whichever area a particular sector required, as well as being able to pursue private sector contracts, thereby enhancing their financial flexibility and reducing the need for government expenditure.

The CRIs were created through an amalgamation of personnel and departmental resources. The DSIR, MAF Technology, Forest Research Institute, New Zealand Meteorological Service and the research branch of Environmental Health, were believed to be "constrained by their departmental framework", according to Upton (Upton in Ministerial Science Task Group 1991: 4). By meshing these five organisations into ten commercially-independent research institutes, it was believed that the science, research and development system in New Zealand would be considerably enhanced. Consideration had previously been given to maintaining the old organisations; however, institutional bickering and tensions prevented constructive solutions being developed. This led reformers to believe the best way to deal with the sector was to create an entirely new system, thereby dissolving previous organisations and hopefully transcending petty inter-agency politics.

The establishment of the CRIs saw the completion of the structural reformation of the science system in New Zealand. The first round of reforms had concentrated on policy advice and funding. The CRIs served to provide the link between funding, policy, and the actual realisation of those objectives through research activity. The active role government played in the reform process cannot be understated. Both Labour and National governments were committed to change and this commitment saw the establishment of MoRST, FRST and the CRIs take just four years to accomplish. The principle of government ownership over the process was further clarified, and made legally stronger through the passage of the *Crown Research Institutes Act (1992)* (Palmer 1994: 63). This Act gave a statutory commitment by government to maintain the science infrastructure, a commitment that

gained bipartisan support in New Zealand. This support meant that the FRST would be managing a PGSF with a guaranteed minimum level of funds for the next five years, regardless of party politics.

The Last Details: The priority-setting process

The move to make further changes to the system came in the wake of the first test of the new arrangements in 1990, when they encountered a number of difficulties primarily related to the bidding and funding allocation processes. In light of these problems, Minister Upton commissioned a review of the 1990 bidding process in order to cope with the areas of greatest concern.

In their report, the 1991 Science Funding Review Panel (SFRP) identified several areas which needed to be improved for the system to operate as intended. Criticisms ranged from the lay-out of the application forms to the discretionary power of the FRST in the allocation of funds.

It was the assessment and allocation process that caused the most concern (SFRP 1991). The allocation process had been described by the STEP, in *A New Deal* (1988), as being the most important element in the system. It was this component, and its interaction with other parts of the system, that would, in the STEP's opinion, determine the success or failure of the overall reforms (STEP 1988):

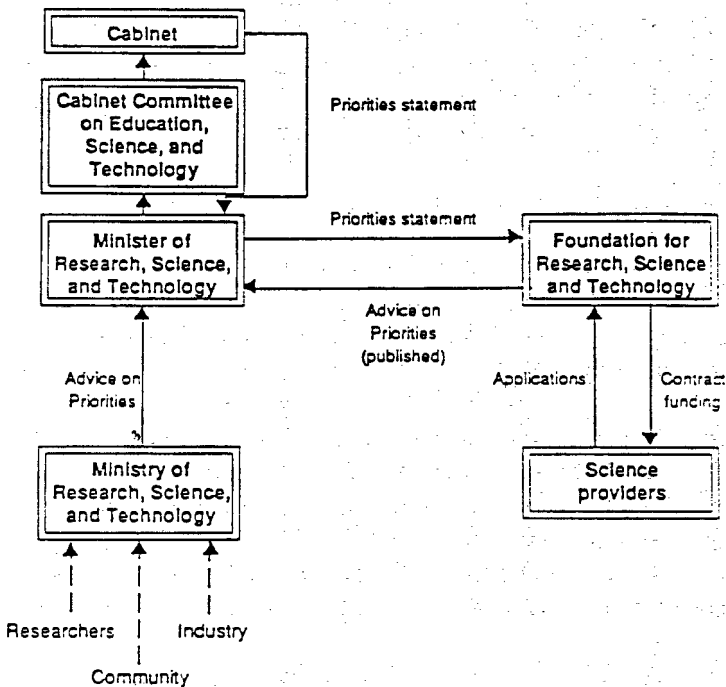
“the allocative issue is the key issue in the restructuring of government support for science and technology. The success or failure of the restructuring will be directly dependent on how the allocative process is structured and operates”.

The success of the allocation system therefore, was contingent upon the classification of research priorities meeting national economic needs. The classification process involved MoRST, in consultation with those within and outside the research community, identifying the areas where research would be of most benefit to New Zealand. The MoRST used the priorities it identified to create output

classifications, which were then submitted to the Cabinet Committee on Education, Science and Technology to determine the levels of funding which would be allocated to each output category.

The SFRP discovered that confusion existed amongst the research providers about the way in which these new arrangements for research were to operate. This confusion was despite the clear delineation of roles and responsibilities that characterised the new organisations that had been created in the system. Figure 1 illustrates the new interrelationships between the organisations as a result of the reforms.

Figure 1: Relationships Between Organisations



Source: Report of the Science Funding Review Panel, 1991, Appendix F, 50.

The SFRP inquiry discovered a widespread ignorance of these organisational relationships and the processes which were to govern the new system's operation. Few providers interviewed had anything at all to do with the MoRST in the identification and development of national research priorities. The SFRP found this worrying, as it indicated a damaging lack of consultation between scientists and the MoRST (SFRP 1991: 26). Clarification and the dissemination of more information about how the new system was to operate was recommended by the SFRP as being an urgent priority if these problems were to be avoided in forthcoming bidding rounds.

Further difficulties were also highlighted by the SFRP through their emphasis on the "lack of clarity, bordering on confusion, as to what is Public Good Science, and what is not" (SFRP 1991: 29). This confusion was despite the *Foundation Act (1990)*, which clearly defined what public good science covered. The SFRP stated that the confusion amongst providers was essentially due to the difference:

- △ between science as an element of our culture, and science and technology as a tool for economic growth; and
- △ between the role of science and technology as a contributor to economic growth and the issue of who should fund that contribution (SFRP 1991: 29).

This confusion translated into providers being unsure as to what should and should not be funded from the PGSF. The issue came up in almost every interview and discussion that the SFRP undertook. The difficulty for providers was the balance between the necessity for research to be appropriable and for it also to be for the wider public good, as defined in the *Foundation Act. (1990)*.

In an effort to try and clarify the misunderstandings about the definition of public good research, the SFRP recommended that scientists should focus upon provisions of the *Foundation Act (1990)* defining Public Good Science outputs as those "that may be of benefit to New Zealand, but are unlikely to be funded, or adequately funded, from

non-government sources" and also listed elements of research as encompassing development activities.

It was hoped that placing emphasis on these principles would assist providers in the submission of bids, as well as increase the scope of projects to include a spectrum from production through to processing technologies. The first round of bids had been criticised for funding projects which were predominantly concerned with fundamental science, rather than applied, research. This was considered to be a somewhat conservative approach for a system which purported to be concerned with the promotion of economically-beneficial research (SFRP 1991: 30).

The SFRP noted that the configuration of the research projects funded in the 1990/91 round were those that were able to meet accountability requirements, strict time frames and had the organisational back-up to conduct the projects submitted. In order for projects to meet such criteria they were necessarily low risk, and also low on rates of return, although those returns were to a large extent guaranteed. The SFRP recommended that, in light of this, the next bidding round should move beyond this risk averse stratagem to fund research which would be dealing with value-adding and associated post-harvest technologies (SFRP 1991: 27).

The bids refereeing and assessment process was also highlighted by the SFRP as being an matter requiring attention. Criticisms encompassed the standard of refereeing; the competence of referees in making judgements outside their field of expertise; the methods used to select referees; and the problems of conflicts of interest, with referees reviewing applications in output categories where they were also bidders.

The small pool of scientists and experts in New Zealand able to review bids meant that there was at least a potential conflict of interest, if not very little chance of referees' being totally objective, particularly in situations of resource scarcity. These problems had existed in the previous science system; however, the reforms meant that due to the loss of any agency automatically funding appropriations

from government, failure to gain funds for research projects had severe consequences in terms of employment and the viability of scientific organisations.

Further critiques related to the overall lack of consistency in the referee reports in terms of style, length and the criteria used for assessment. The return of hand-written referees' reports led, in some cases, to the identification of referees supposedly protected by anonymity. Referees' comments on the process reported difficulties in properly reviewing and assessing applications due to lack of sufficient information and of being faced with requests to referee a large number of applications within a period of a few days. This area was clearly identified as one which required further refinement for it be a successful part of the overall system.

In the SFRP Report's concluding statements it was suggested that the development of national science priorities would be of great benefit to the system, providing an overarching direction and purpose which was currently lacking. National science policies, the SFRP argued, would bridge the gap between the statement of the Government's socio-economic outcomes for science, and how these outcomes were to be achieved through the purchase of public good science outputs. Public good science it was argued, needed to be purchased with reference to a longer term vision for science, research and development and its role in the progress of New Zealand.

The SFRP report proved to be crucial to the reform process and led to further changes to the system. In response to its findings, a Science and Technology Expert Panel (STEP) was set up in 1992 to produce a strategic overview of the directions the new system should take in the development of national research priorities.

In August 1992 this Panel made its final recommendations to Minister Upton. These were largely concerned with pursuing research that would add value to the quality of primary products. STEP proposed that research investment should utilise existing economic strengths and concentrate its resources in areas where they had been successful in the past (MoRST 1992: 4). In recognition of the SFRP's

recommendations concerning the need for national science directions, priorities were to be developed which would help to orientate science and research to the future and immediate needs of New Zealand. As such, these identified priorities would serve as the basis upon which funds from the PGSF would be allocated.

The emphasis placed on priority-setting led to the development of a framework within which the process could operate. There were three main elements in this framework; a directions statement, an output classification system, and criteria upon which decisions could be based about the allocation of research funds.

The directions statement outlined the areas to which research should be directed in order to best meet the needs of New Zealand. The MoRST played a major role in the development of the statement, with research themes created outlining the key sectors and areas which required investment in the form of research projects. These themes were fairly broad, to enable an overall direction for science, research and development to be achieved. The directions statement was not something which was designed to be static, rather, it was to be a dynamic document. As such, the research directions for New Zealand were able to be flexible in response to changing needs and as opportunities and problems arose.

The development of themes was followed by the classification of research into output categories within the PGSF (Davenport et al 1993: 6).

Output categories were, under this new process, to be defined on the basis of the purpose and value of research in any particular area. The output categories were designed to cover four broad areas: economic, social/cultural, environmental and miscellaneous. Research projects relevant to these categories were then identified and divided within the thematic framework. In the first round of bidding for funds from the PGSF there were forty output categories developed. This number has since tended to fluctuate, with the number for 1994 being reduced to twenty-six.

The criteria upon which research projects were to be chosen, and the identification of the organisations which would be responsible for their accomplishment, made up the final component of the decision-support framework. The idea behind such a framework was to provide an objective list of factors which were to be considered when decisions were made about the funding or otherwise of research projects. Five factors were developed, and these were divided as follows:

Supply Side:

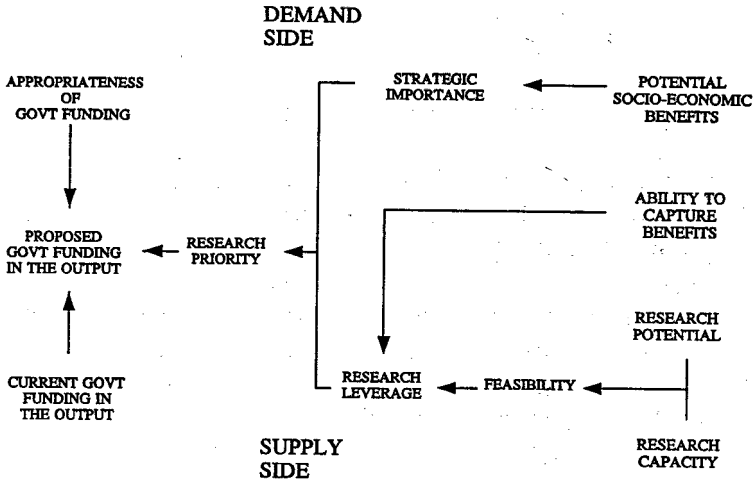
- Δ *research capacity* - whether the resources are available for a particular project, or that could be made available to support current and future research;
- Δ *research potential* - related to the fertility of research in the output class in achieving results, and in generating new opportunities and avenues of exploration;
- Δ *ability to capture research benefits* - referred to the ability of the users of research to take up the results.

Demand Side:

- Δ *potential socio-economic benefits* - concerned with the strategic importance of the potential social and economic benefits of research, and the significance of these benefits in terms of the outcomes identified in the directions statement;
- Δ *the appropriateness of Crown funding* - identified the extent to which it was appropriate for government to be funding research in a particular output class in terms of the existence or otherwise of market failure in the funding of that research, and the extent to which the benefits of the research could be captured by identifiable groups or individuals. Other considerations were whether the research was needed to meet international or domestic commitments. (Davenport et al 1993: 6)

Figure 2 below illustrates how these five factors interacted in the process of decision making, to secure the optimum result in the determination of output resource allocation.

Figure 2: Model for Determining Crown Funding by Output



Source: Doig, M., 1993, Establishing Science Priorities for New Zealand, Ministry of Research, Science and Technology, November, 9.

It was believed attention to these factors would lead to the best possible decisions being made about the allocation of funds. They were also intended to assist in rectifying some of the problems the SFRP had earlier identified with the refereeing and allocation processes. Further refinements to the priority-setting process involved the employment of consultants to develop research strategies for each of the Output classifications dividing the PGSF (for example, there is a Research Strategy wholly concerned with Output 29 - Environmental Protection). These research strategies have been designed to improve clarification about Output categories and the types of research which would be located under their auspices. These new "research strategy" documents will be available for the next bidding round and should assist in helping to rectify the previous problems.

The STEP recommendations paid close attention to the problems identified by the SFRP, and attempted to deal with those deficiencies. The combination of research directions, output classifications and a decision framework to support them, provided a comprehensive and rigorous priority setting process. With this final component in place, the reform of science, research and development was believed to be complete in structural, managerial and operational terms.

Part 3: Letting the Dust Settle: The reforms reviewed

The research and development reforms have been in operation since 1993, marking the beginning of a new era for science and technology in New Zealand. The arrangements for managing research and development are based on a logic which is both rational and plausible. Government is actively involved in purchasing a specific product, which is determined by experts analysing New Zealand's research needs. The organisations which are successful in gaining funds to conduct a project are selected on the basis of competitive merit and, as such, are by definition the best for the job. Increased accountability within research institutions and between managers and shareholders, means that there is no longer the danger of scientists determining research directions to meet their 'pet' project areas. Overall, the system should provide the New Zealand taxpayer with the knowledge and information that will enhance competitiveness and economic payoffs.

However, questions are being raised in the wake of the reforms about whether public choice theory, transaction cost analysis and agency theory are appropriate bases for reform. Is science and research merely a commodity like any other? Can a public good be subject to market place determinants of success or is that a contradiction in terms? What of the human factor? Can good science be conducted within a competitive environment where the dollar return is the main measure of success?

The following discussion is concerned with an assessment of the system as it is currently operating in New Zealand. As such, any issues,

problems and difficulties will be studied in an attempt to highlight positive and negative aspects of the new arrangements for research and development. It would, therefore, seem pertinent to begin such an evaluation with the employees who must work within the new framework.

Rhetoric and Reality: Scientists and researchers under the reforms

The group most affected by the changes to New Zealand's research and development system have been the scientists and researchers. They have experienced changes which have not only transformed the organisations within which they work but have also altered the context for the conduct of scientific inquiry. A commercial mode of operation has required scientists to become proficient in "selling" their services, in most cases to management rather than to the general public. Commercialisation also has changed the discourse used within organisations, so that researchers must now present their work in a manner that fits within economically-defined parameters. For many employees, change of this magnitude has not been easy to manage.

Shorland describes the environment in which scientists must now operate as one where the predominant activity is "fire-fighting". By this he means that a new managerial regime has been ... "built up arbitrarily by the reformers, with no reference as to where it came from, no justification for its choice, and perhaps worst of all, one which does not even address the errors of the past" (Shorland 1991:81). Such an environment has meant that scientists are constantly on guard, removed from the process, and readying themselves to "fight" the next "fire". There seems to be a large gap between the rhetoric of government:

"The scientific community and user groups have seized the chance to have a say in this process. The accumulated intellectual horsepower that has gone into this process must surely assure New Zealand of a system that will deliver benefits to both scientists and users of their work." (Upton 1991: 6)

and feelings by employees that they were largely irrelevant in the reform process. Rather than being a process in which opinions and participation was actively sought, it was one in which scientists felt removed from decision making:

“Over the last few years the administration of New Zealand science policy has appeared to be arbitrary, secretive, and without clearly defined national priorities.” (Sissons et al 1989: 2)

This discrepancy has meant that instead of a cohesive and collaborative scientific community, researchers perceive the environment in which they work as being uncertain, competitive and unstable, without security for employees. In discussions with Public Sector Association (PSA) representatives it was confirmed that the nature of the reforms and the manner in which decisions and their subsequent implementation had been made, was a process with little employee involvement (PSA 1994). It was revealed that, although there was some employee representation on a few of the decision-making panels, this was largely felt to be tokenistic. One senior scientist asked to participate on one of the priority-setting panels reported that the decisions had in effect already been made and, as a result, they were merely used to validate pre-determined outcomes (PSA 1994).

Working conditions, career structures and general employee attitudes towards the research and development environment have all suffered under the new system. The individual, rather than the group, has come to be emphasised, making the development of a corporate culture quite difficult to achieve (Tapper 1994). This has also been reflected in the choice of most employees to come under individual rather than collective contracts. This is the management preferred option and one which confirms the emphasis on the individual rather than the group.

A survey of members of the New Zealand Association of Scientists (NZAS) in September 1991, inquired of the impact of the reforms on those workers within the research and development system. The findings revealed a high level of dissatisfaction and scepticism about the new arrangements for research. An overall lack of confidence was

discovered, with several sets of problems identified as being caused by the reforms. The reforms had reduced efficiency; flexibility, and objectivity; produced a mismatch between a centralised policy and funding section and a decentralised operations function; and had reduced collegial collaboration. Generally the respondents saw the system as less fair, one in which priorities were set without consultation. The reforms had created staffing recruitment and retention problems and made science managers' tasks more difficult (SciNet 1991: 1).

These responses indicate that there were strong negative opinions about the new system in 1991. Positive responses to questions about the reforms were limited, with the following considered beneficial for research and development:

- △ increased accountability (but not in the control of research);
- △ the competitive funding arrangements were seen as producing some positive benefits (although they were unlisted);
- △ greater transparency in the system was supported;
- △ the introduction of other research organisations into the competitive funding pool was supported (SciNet 1991: 1).

Although these positive aspects were identified they were qualified by concerns with the need for further change if the system was to improve, especially that scientists should be involved in the decision-making process.

When asked about whether the new system was having an effect on science and technology careers in New Zealand, the survey gained a response rate which was 100 per cent affirmative. Concerns existed about the low morale of some researchers and the lack of stability which seemed to be inherent in the system. Predictions were made that future scientists would be driven off-shore in the pursuit of better employment prospects. Perhaps the most disturbing of the responses was the statement that under this new system there was "more pressure to fudge results in order to meet the demands of an outcome-oriented management regime" (SciNet 1991: 5). Such an outcome would be in no one's interests but the mere fact of it being mentioned served

to demonstrate some researchers' perception of the gravity of the situation.

One of the main issues which arose as a result of the reforms was that scientists felt they were no longer responsible for making decisions about how the organisations they worked within were to operate. The philosophies which provided the basis for the reforms in New Zealand were derived from economic theory and this is not appropriate for the management of science and scientists (Spriggs & Pritchard 1989: 185). Spriggs & Pritchard went on to justify this assertion by stating that:

“Economics, at present, is too limited to be useful for the rational management of research, or for the construction of a thoughtful science policy.” (Spriggs & Pritchard 1989: 185)

Research is being placed within financial metaphors, with its governing philosophies concerned with management by financial objectives. However, the general practice of managing private business operations, let alone science agencies, through capital budgeting frameworks and other financial instruments has been subjected to criticism of its focus on short-term profits (Spriggs & Pritchard 1989: 188). It is certainly the case that the emphasis on returns from research involves scientists determining which projects to bid for on the basis of the outputs they may return. With this rationale governing decision making it is the short-term, low risk, profit-generating project that is chosen. This was demonstrated in the results of the first bidding round (SFRP 1991). To choose otherwise would be to risk a loss of funding.

Easton makes the point that whilst some research can be operated under such commercial conditions - for example, in the pharmaceutical industry - it is also clear that much cannot, particularly research which falls into the 'fundamental science' category. “All science does not have a commercial purpose, some could be pursued in order to further knowledge and open minds to new possibilities” (Easton 1989: 36). This type of scientific exploration has not gained as much financial support, particularly since the SFRP and STEP recommendations in 1992 calling

for more applied research to be undertaken. There has been a swing against fundamental research in subsequent funding rounds, with the new pressures on researchers resulting in their chasing short term money as a survival imperative (Sissons et al 1989: 6). The question of whether the research that is being pursued is the "best", in terms of its overall benefit to the New Zealand community, is not a factor which seems to be considered in this new equation.

Competition has also impacted upon the nature of relationships between and within institutions. As was mentioned earlier, tensions between MAF and DSIR in particular had existed in the previous science framework, and were considered to be so entrenched that a totally new system was required. However, it appears that new arrangements are also being criticised for not limiting communication and knowledge sharing between the CRIs (Tapper 1994). The divisions which existed between the old MAF and DSIR, are being repeated; however this time it is the CRIs that are becoming isolated from each other.

This situation is due to an anomaly faced by those who operate within the system. If the CRIs are to be commercially competitive there are few incentives for a sharing of knowledge, as it is that knowledge that provides the competitive advantage for the organisation. Competitiveness is justified on the basis that it provides efficient and effective services which can produce results. However, Sissons et al believe that it is a myth that maximising competition necessarily results in maximising accountability. If anything, competition is likely to reduce accountability as it promotes secrecy (1989: 6). As secrecy increases between, for example, laboratories, duplication becomes much harder to detect, thereby reducing efficiency.

The issues which have been raised in this section are those that related to findings in 1991. It could well be the case that the system has now been in place long enough to alleviate some of the concerns that were raised in the SciNet survey. However, it is clear that the scientific community did not feel involved in the decision making as it related to the reforms and this has had a detrimental effect on relations between these individuals and the reformers. Some would argue that the criticisms put forward by the scientific community are

just "sour grapes". There has always been a perception of scientists being far removed from the general community, conducting research in their own areas of interest and only occasionally coming down from their "ivory towers". However, the level and range of disquiet about the reforms discussed above does not appear merely to reflect a few isolated individual concerns.

In a review - conducted by the management consultancy firm, Price Waterhouse - of the processes used by the CRI Implementation Steering Committee in its creation of the Institutes, it was noted that one of the main lessons to be learnt from the process was the "need to keep all staff fully informed on the process, the reasons for delays, and the status, or expected timing of key decisions" (Price Waterhouse 1993: 2). The lack of involvement by scientists in the process has therefore, to a certain extent been acknowledged by reformers. It is important for the future success of the system, that any further changes be accomplished with the active participation of employees. This involvement is necessary if the mistakes of earlier reforms are to be avoided.

The Umpiring of Research: Refereeing under review

The refereeing process continues to pose problems for scientists. Despite the SFRP Report (1991) highlighting deficiencies in the area, there has not been any change in the method by which bids are assessed. In the new, highly-competitive, environment within which research is conducted researchers have been placed under considerable pressure, often reviewing bids which may well be competing against their own applications for the same money (SFRP 1991: 31). The small pool of scientists available to assess bids has created a situation in which expertise is compromised. In one such instance a Masters student had reviewed their Supervisor's bid, a seemingly ridiculous scenario (Parry 1994).

There is no impartial reviewer in New Zealand as the universities also bid for PGSF funds. At the moment they are limited to \$10.7 million of the overall pool. However, over the next two years they are

to gain complete access to the PGSF (PSA 1994: 2). This is causing a great deal of worry in the CRIs, as universities - although supposed to bid on a fully-funded basis - in reality will always be able to undercut a CRI bid, as their staff salaries are covered separately. This represents a significant difference between the two types of organisations and serves to validate the CRIs' concern. On the whole, university bids are better rated than the CRIs, as indicated by their success in obtaining funds. The strength of their bids has meant that some CRIs are attempting to create collaborative links with universities in order to maintain their viability once those institutions secure unrestricted entry to the PGSF (Townesley 1994). Sykes notes that, whilst this appears to be a good idea, in practice it often translates to the CRI bid being "tacked" onto the bottom of a university application, in the hope that it will enhance the credibility of the bid. However, there is a growing realisation within universities, that they are very competitive bidders in comparison with the CRIs and do not need to collaborate in order to gain research monies (Sykes 1994). The possibility that some CRIs may close as a result of not being able to attract funds may well result from the universities' entrance into the pool, though the reforms' supporters would argue that such casualties obviously mean that those CRIs are failing as competitive research organisations and must bear the consequent costs.

The issues which surround the refereeing process have led to calls for a rethink of the current procedures. Suggestions for improving the process have involved a reviewing procedure which would actually occur after the funds have been allocated. McWha believes that it would be more beneficial, not to mention efficient, if a team of scrutineers assessed projects on site, through a rigorous review process (McWha 1994). There would be many advantages in this type of review, not least in the time saved by scientists on assessing applications. Whilst it would still be necessary to have an initial assessment process it could be on the basis of specific criteria and could involve the development of expert panels dealing with all the bids that related to a particular output category. Such a panel could assess bids on the basis of criteria agreed to by all those involved in the decision-making. The post-funding review would follow the Panel's allocative decisions and

pick up any problems with the particular research in hand. Continued funding could then be made on the basis of that review.

Proposals like the one outlined above have been suggested as being able to rectify the current procedures, which are not only time-consuming but are inherently flawed as an objective system of peer review. There is too much at stake for scientists in the new environment to expect total impartiality to override higher priorities such as maintaining the organisation's viability, not to mention the individual's employment status. It is hoped that the level of disquiet concerning the process as it currently stands will lead to a review of the refereeing system. This would seem to be a necessary step if the credibility of the funding process is to be maintained.

The Longer Term View: Moving beyond short-term gains

"More, Better, Relevant Research" has been the catchcry used by the MoRST in its role as the primary body responsible for advising the Minister and Cabinet on the research needs of New Zealand. However, the translation of these priorities into PGSF output classifications has encountered criticism, particularly in the most recent 1992/93 bidding round. In the wake of the SFRP (1991) and STEP (1992) reports, which highlighted the need for research to be conducted in areas which were directly related to improving economic strength and applied research, the output classifications have swung away from generic research into specific and somewhat narrow areas of investigation. The MAF notes that "the shift of funding emphasis away from generic animal and plant science, which underpins productivity improvements in the production of primary produce, is of some concern" (MAF 1993: x).

The reason behind the decrease in broad-banded, generic research may lie in the STEP (1992) recommendations which highlighted the need for more specificity in output classifications. STEP recognised that the PGSF would not be significantly increased in the short term and so needed to be closely targeted (STEP 1992: 4). It was believed that the PGSF would be distributed much more effectively this way. It is certainly the case that, in terms of meeting the requirements for

research to be output-oriented, it is much easier to gain positive results by undertaking projects which are smaller in scale and hence more easily managed. Generic research does not have such characteristics, tending to be more widely spread over a range of discipline areas rather than just one. Sykes claims that the increasing focus on short-term, applied research will eventually threaten the maintenance of basic, core competencies. He points to the fact that, under the new output classifications, there is really no category in the PGSF which is designed to meet objectives which relate to this broader research spectrum (Sykes 1994). The loss of multi-disciplinary research would be of great detriment to the New Zealand research community, not to mention the general public, as the translation of research results into outcomes necessarily involves a combination of both social and scientific expertise.

Arguments for a better balance between fundamental and applied research have also focused on the lack of long term funds available in the PGSF. Definitions of long term research are those projects which have a time-frame of three years. This is a comparatively short time period for what is commonly referred to as "blue skies" research.

At present there is little provision for such pioneering work to be done. Although the universities have traditionally conducted such research, with the entrance of these institutions into the PGSF they will be competing for the same projects as the CRIs and will no longer have the direct government appropriations they may have allocated for this type of high risk research. Tapper makes the point that, under the new system, a distinction may be drawn between research and science. Science, he argues, is about creating and testing hypotheses, whereas research is about useful information, and its usefulness may or may not relate to proving or disproving a hypothesis. In New Zealand, good research is being done but good science supposedly is not (Tapper 1994). Good research in New Zealand is defined as "research that produces commercial results", it is not necessarily research that is going to further the general knowledge base. This is a real problem because it is often from fundamental science that the real finds are made, often by chance, and bearing little relation to the original intent of the project.

For organisations which are concerned with genuine public goods, there are real fears that the new environment of user-pays and competition will threaten the funds directed into their area. The President of the Royal Forest and Bird Protection Society of New Zealand made the following comments in an invited response seeking opinions about the reforms:

"It seems clear that the government's "user-pays" policy applied to scientific research will adversely impact more on ecological and systematic research applied to New Zealand's indigenous biota and nature conservation than in any other field of scientific endeavour. This is because the potential beneficiaries of such research, our native plants and animals, and the habitats and ecosystems that support them, are in no position to raise the necessary funds...the temptation to get the greatest return for the scarce research dollar will inevitably mean that short term contracts designed to yield quick answers will displace long term research studies that provide invaluable perspective." (Mark 1989: 25)

It is a too early to assess whether Mark's fears - expressed in 1989 prior to the actual implementation of the changes - will be realised. In a FRST statement on Long-Term Science Priorities, recognition was given to the importance of maintaining research into areas which may not necessarily be profit-generating in fiscal terms:

"the social sciences and environmental sciences powerfully contribute to New Zealand's social, cultural and environmental well-being as well as contributing to economic objectives." (FRST 1992: 4)

Given the strong economic imperatives which exist, there is still concern that not enough pure public good research will be done. There is provision for such research in an output category called the Non-Specific Output Category (NSOF). Bids for this category can range across any discipline or project area and the environmental research, referred to in the quote above, would be expected to gain funds in this category. There was approximately \$30 million allocated to this output

in 1993/93, and the last bidding round saw the category swamped with applications, making decisions concerning what should or should not be funded extremely difficult.

There has been some evidence in reports produced by the FRST that there is a commitment to increase time frames for research projects from three to five years. Laurie Hammond, Executive Director of the FRST, stated that he was intending to get the PGSF funding 60-70 per cent of funds on "long term" (ie: three years) research in the future (Hammond 1994). In addition, the development of long term national priorities in line with these extended time frames has been highlighted as an area which is important and requires ongoing development. Whilst these moves are considered positive, it is the translation of such ideas into action and, more importantly, the allocation of money into these types of projects, that will be the real proof of the commitment to extend research time frames.

At present, scientists are faced with bidding rounds conducted annually, despite funding for a project being allocated over a two year time frame. It is possible that funding could be discontinued half way through a project. This is not conducive to the development of a secure and productive research community, with some describing it as causing research to be conducted on "shifting sands" (Tapper 1994). It remains to be seen whether the desire for short term gain will be checked sufficiently for longer term research to be undertaken, and resources allocated to achieving those ends.

Closing the Gap: Extension, technology transfer & the producer

In the Horticulture and Food Research Institute (Hort+Research) Research Report for 1993 it was recognised that research was a wasted investment unless there was an interactive link between scientists and growers. The report went on to say that, with the changes to the Ministry of Agriculture and Fisheries Advisory Services Division, science lost what had been its primary technology transfer mechanism (Hort+Research 1993: 7). The loss of technology transfer has been one of the major criticisms against the reforms and some feel it is

hindering the CRIs in their quest to become successful market place competitors.

Prior to the reforms MAF ran an Agriculture Extension Service as part of its Advisory Division. This service was one which was accepted and used by growers, as it provided advice and served as an information point from which knowledge about new technologies and techniques could be obtained. The service was free to consumers and was seen as furthering the national interest by helping primary producers keep abreast of world developments in their industry. The reforms to research and development saw this service discontinued and, eventually, reshaped into Agriculture New Zealand, which commenced business with 132 consultants in July 1992. This organisation has a commercial focus, with a client base which is moving from individual growers and farmers to a growing number of larger agribusiness and local government organisations (Gardner & Parker 1993: 1). The restructuring of the extension service in this way has had two main effects. Firstly, the withdrawal of government support to New Zealand farming has reduced farm incomes and, secondly, the 'user-pays' philosophy has meant that the (old) extension officers, who have managed to keep their jobs, are now required to operate in a commercial mode (Walker 1990: 24).

"Commercialisation necessitates a focus on the purchase and sale of goods and services, and sees employment and function defined by a series of contracts in which identifiable outputs are to be delivered to clients for negotiated inputs" (Walker 1990:25). This new philosophy saw the reforms alter the MAF Agricultural Advisory Services into something totally different to its predecessor. The organisational management and administrative practices, work, clients, services and culture have all changed. Performing work specifically for government (and, hence the taxpayer), is now done under sufferance as it does not return the same dividends that work for the private sector provides. This fairly radical change has not been easy for those who were employed in the original MAF. The attrition rate for consultants has been high because successful revenue earners have left the organisation to work for themselves; for others, the stress has been too great and they have resigned (Walker 1990: 27).

In a 1993 survey conducted amongst practising agriculture consultants, it was revealed that the amount of time spent on extension work (which is defined as the transfer of information/technology to the farming community for which no fee was charged) was less than 20 per cent. The only consultants where this differed was for a group of Dairy Board employees. These consultants registered 95 per cent of their work as being involved in extension. For the producers outside the dairy industry, therefore, technology transfer has become something of the past. As was noted by one of the consultants in the survey:

“With the demise of the Government funded MAF consultancy service, there is now a large group of farmers not being serviced because they are not prepared to pay.” (Gardner & Parker 1993: 7)

The fact that farmers are not prepared to pay for the services provided by agencies such as Agriculture New Zealand, is owing to the lack of value that most farmers place on research and development. The Dairy industry, through its development and continued support of the New Zealand Dairy Research Institute (DRINZ), has catered for the needs of its producers. Meat and Sheep Producer Boards have also set up research organisations to deal with the specific needs of their industry. The Meat Industry Research Institute of New Zealand (MIRINZ), and the Wool Research Organisation of New Zealand (WRONZ), have been established for some time. However, as tends to happen in producer-run organisations such as these, in hard times it is budget cuts to research that are the first to be made. This is a further demonstration of the attitudinal problem towards the value of research which exists amongst farmers.

The new environment is one in which government is no longer prepared to fund research for farmers who are not putting anything back into the system. In the Foundation for Research Science and Technology 1993 Report, it was stated that:

"Industries that do not maintain or increase their research and development contributions will see 'public good' science funds move from their sector to other sectors"

This statement has led to shifts in funding priorities, because government is only willing to help those industries that help themselves. For example, in the latest output classification round, investment in dairy related research was increased in recognition of the high level of industry resources directed towards that area. At the same time support for the sheep industry decreased, in line with what was perceived as a lack of industry investment. The MAF warned that this policy may, in the long-term, affect the national appropriateness of the research that is being undertaken (MAF 1993: 66).

It is clear that the Government's uncompromising approach is producing results. For example, the arable farmers in New Zealand have agreed to the establishment of a Foundation for Arable Research (FAR). In an unprecedented move, a referendum of those involved in the sector agreed to such an institution being created in recognition of the fact that, without some investment in research and development, arable farming would be without any government support. In a recent publication by the establishing committee of the FAR, it was stated that:

"Changes to Government funding policies will have a major effect on arable research programmes as Government insists on the private sector making a realistic contribution to match Government's science spending. With the exception of herbage seeds and wheat, arable farmers have contributed little to the research that supports their industry. Government has made it clear that unless we reverse this situation current Crown funding will progressively reduce". (FAR 1993: 1)

The document goes on to say that, without investment in research and development, arable farmers will not be able to remain competitive in the world market place. The recently amended *Commodities Levy Act (1993)* has enabled the FAR to be funded through a levy on arable crops, at rates set by the farmers themselves. An elected Board will ensure

that all regions are represented, as well as act as the interface between research and grower. In this way the projects that are chosen for funding will only be done so in direct line with farmer-determined needs (English 1994).

The development of the FAR is a positive outcome for what was an unwavering approach by government in dealing with a sector which for so long has received patronage and support in the form of subsidies and public assistance. The FAR, at this stage, represents the only group, since the reforms, to mobilise support for greater farmer input into research and development. Hodd notes that for the majority of primary producers research is not a top priority, and the current expense of securing investment in research programs is not an option for the average farmer (Hodd 1994). However, the decline in the availability of free extension services may force producers to follow the lead the FAR has taken in the progressive management of their industry's research needs.

The loss of technology transfer, and the skills and knowledge of those that were employed in the government provision of such a service, has led to arguments that the reforms to research and development started at the wrong end of the system:

"Making the most of the best currently available technologies and practices was the last item on the agenda of the science reforms rather than the first as should have been the case."
(MAF 1993: 69)

Rather than capitalising on the strengths that were already in the system, new practices and structures were developed which actually served to negate the expertise that was already present. The shift from an organisation which had a strong belief in its role of providing a national service, to the new profit-based consultancies of the nineties, resulted in a loss of personnel and experience in the extension services.

It is interesting to note that concerns were raised in the survey (discussed above) about where consultants were going to be trained now that the MAF had been dissolved? The survey discovered that the

majority of private consultants had initially been employed in the public service. It was also feared that, although there are currently too many consultants in the market place (another result of the exodus from the public service), in another 10 years there would be a shortage of people with sufficient knowledge about New Zealand agriculture to successfully help those organisations that could pay for their services.

Organisations, rather than the individual farmer, are now the identified consumers for consultancy services. For most consultants a desirable client profile was to have a few large organisations who would employ them on a continuous basis, rather than servicing the individual farmer who was, in reality, too small in the new market place to pay for agricultural extension and technology transfer expertise (Gardner & Parker 1993: 18). This finding would lend further support to the development of organisations such as the FAR, who represent a group rather than any individual farmer.

Technology transfer is certainly an issue that the CRIs are concerned with addressing, as it makes little sense to be undertaking research which cannot be communicated to potential consumers. The MAF's criticisms concerning the initial lack of attention paid to the area are correct, however, for most CRIs the development of technology transfer mechanisms is now a top priority. Without this part of their organisation operational, their attempts to be competitive in the market place would seem to be somewhat futile. What is certain is that the technology transfer services that are developed will not be for-free, with consumers expected to pay for the competitive information and advice that these agencies will hopefully be in a position to provide.

For the primary producer, therefore, the reforms have ushered in a "brave new world". The loss of tariffs and subsidies, the opening up of markets and other micro-economic measures, have been coupled with a decrease in government support in research and development and the extension services which flowed from these. The new environment necessitates exclusion in terms of client base, otherwise the benefits of the research will not be profitable. The farmer must, therefore, have sufficient resources to pay for research and development. It would seem logical to promote the further mobilisation of producer groups to

form research organisations of their own, as without this they will have little individual access to new technologies.

Whether there will be an increase in the number of producer research organisations remains to be seen. A fundamental attitude change on the part of many farmers seems necessary for there to be much likelihood of other groups following the FAR's lead. However, the loss of extension services, and the fact that technology transfer is now becoming a competitive part of service provision, may mean that producers will become less complacent about participating financially and intellectually in the research and development system.

Public Good or Public Loss? Intellectual property rights

Under the terms of the *Foundation Act (1990)*, intellectual property is owned by whichever organisation the PGSF selects to conduct a particular research project. The bids which are the most successful in gaining PGSF funds are those that either have a proportion of private sector investment or can guarantee the production of marketable results. By definition, a competitive market place means exclusion as, without it, the product is not going to be competed for or purchased. Further, a company jointly investing in a research project with a CRI, is unlikely to do so if they are not going to get exclusive rights over the results; without this guarantee what other motivation is there for financing research? That is why the decision was made that whichever agency was successful in gaining a particular PGSF project, would then retain the intellectual property rights over their results.

This decision would seem logical if the CRIs are to be successful in gaining private sector investment. However, this means that there are no guarantees that the New Zealand taxpayer will get anything back from the PGSF. Intellectual property is a commodity, and, as such, it can be traded and shared internationally. In order to ensure their viability, many of the CRIs are conducting projects with overseas backers. For a reasonably small investment these overseas companies are able to access research agencies which - by virtue of their ability to get private sector investment - get the rest of their funds from the

PGSF (Kettle 1994). The results of that research, although in large part funded by the New Zealand taxpayer, then move offshore, with the overseas company gaining disproportionately from its investment.

This anomaly - where a foreign enterprise can appropriate the profit from public research investment - is one which has not been addressed by those involved in the management of the new system. There is a clause in the PGSF that states that any research which produces a "windfall" would have to put a certain percentage of that back into the fund. However there would be many ways around this and, the contracts which are signed between CRI and private sector investors are not likely to be challenged by a government which is pro-commercial development.

Singing the Same Tune? MoRST, FRST and the CRIs.

The reforms in New Zealand have been based upon a philosophy which was concerned to make the operations of government as transparent and accountable as possible. This rationale produced a tripartite split between policy advice (outcomes and priorities), funding (purchasing of outputs), and operations (the delivery of those outputs) (West (b) 1994: 17).

As discussed above, the justification for such a split was that when these three functions are all in the one organisation they tend to create blurred lines of accountability, leading to inefficiency (Winsley 1994). However, there are strong arguments which counter the separation of activity in this way. Ham & Hill point out that artificial functional boundaries can be so created and that this can result in an decrease, rather than an increase, in efficiency (Ham & Hill 1984: 13). In discussions with observers of the new science system it became evident that the arbitrary separation of functions as they have occurred in New Zealand has led to communication difficulties and a lack of understanding about the roles and responsibilities of each institution in the research and development framework.

The question of whether it is possible to separate, arbitrarily, the policy process into three identifiable units of operation is one which has been debated in international public administration circles. The New Zealand experience appears to add support to those in the debate who argue it is impossible to divide and categorise the policy process in this way.

Policy formulation, implementation and evaluation may be likened to a seamless web, where the differentiation of function and activity is virtually impossible. It is an accepted fact that, even when a policy or priority is formed, the process of implementing it may turn it into something very different. Problems are not always easily defined and there are many impediments to coordination and implementation. The subjectivity and variability of perceptions as they relate to the definition of a problem, interpretation of the policy designed to rectify that problem, and the outcomes which are then sought, are ones that are currently bedevilling the New Zealand science, research and development model. As was mentioned earlier, although accountability exists between chief executives and their respective shareholders, there is no such system for ensuring responsibility between the organisations. As a result, each of the agencies is meeting the requirements laid down in their individual contracts without ensuring that the viability of the system as a whole is maintained.

The interlinkages and roles of the MoRST, the FRST and the CRIs seems logical and organisationally efficient. However there are concerns that the MoRST is progressively becoming more and more marginalised, as the FRST plays a much greater role in the decision-making as it relates to the determination of priorities. The CCMAU, the government-created monitoring unit is also adding to the increasingly complex web of relationships that seem to be developing between organisations within the system.

Communication is not reported as being a primary activity in the current arrangements, it being left up to individuals within their respective agencies to decide whether or not to contact others. Overlaying these problems is an environment of contestability and competition which is not conducive to the development of strong inter-

organisational links, particularly as they relate to interaction between the CRIs. Formal accountability may exist between the chief executives of the agencies and their ministers, but it does not exist between the agencies, a failing which is having detrimental results.

The FRST has been accused by some of taking over the process, implying that its original discrete functions of the purchasing and funding of specific research outcomes are, in fact, being supplemented by decision-making as it relates to the policy advice and operations part of the research and development system (Kelly 1994). This is not an unexpected development, as it is impossible to divorce the activities which characterise policy, funding and policy implementation into discrete organisational entities. In undertaking a greater role in other policy areas, the FRST is unwittingly denying the basis upon which it has been organisationally founded. As the MAF points out:

“The tension which exists between MoRST and FRST is due largely to the policy delivery split. Any move by MoRST, such as the establishment of priority themes or National Science Steering Committees (NSSC), has the potential to limit the flexibility of the Foundation, and appears to be viewed by the Foundation as an imposition.” (MAF 1993:66)

These criticisms need to be addressed if the system is to retain its credibility as being organisationally effective and efficient. The CRIs are also claimed by the MAF to be facing difficulties:

“CRI's do not have any core funding. They operate as science contractors with much of the research being based on single year funding, as determined by the success of their bids to undertake research. Some discretion is given to the CRI's by allocating an amount equal to 10% of the funding they attract through the bidding system in a particular financial year. This funding forms the NSOF output category, and can theoretically be used for whatever they see fit. CRI's are expected to be viable businesses and return a dividend to government while at the same time maintaining core competencies in the sciences.....in essence, the CRI's have

been given responsibilities, but not the resources to allow them to undertake research and generate the data they need to meet those responsibilities." (MAF 1993: 62)

This quote, taken from the MAF's 1993 post-election briefing to the Minister, highlights the anomalies of the system faced by the CRIs. The CRIs, although treated as "normal" science companies, are still charged with carriage of the brief of a crown science organisation in that the research they conduct is supposed to meet public good requirements. As discussed above, the structures as they currently exist means that pure public good research is not a viable proposition for CRIs and their staff.

Another difficulty faced by the CRIs, is that they are decentralised and regionally-based and yet must be responsible to a policy and funding core which is applied and centralist in orientation (Lancashire 1994). This "mismatch" causes difficulties in the selection and determination of projects. It is often the case that farmers' problems are regionally-based, rather than being concerns which can be applied across a broad national spectrum. The promotion of industry involvement through such programmes as the Technology for Business Growth Scheme, is contributing to the need for farmers to mobilise and form organisations of their own. Increased investment by the private sector is also encouraged by government through the development of partnerships. The leverage which these investors are likely to gain over the CRIs will mean that there will be a further move away from pure public good research (PSA 1994: 5).

The encouragement of industry is a priority for government. However, the PSA, makes the point that in 1994 private sector funding still only represented 34 per cent of the total research investment with the OECD average standing at 55 per cent. They attributed the increase of private sector investment in other countries as being partly owing to the tax incentives that are common throughout the world (PSA 1994: 5). For example, in Australia a 150 per cent tax rebate is provided for companies investing in research and development. The PSA suggests that a 200 per cent tax rebate be introduced in New Zealand, as without it they do not believe private sector investment will increase. It

remains to be seen whether the government will act on such suggestions.

Conclusion: New Deal or Dud Hand?

This paper has taken a "snapshot" of a system that must be recognised as still being in its infancy. The criticisms that have been levelled at the new arrangements represent a combination of impressions gained by the author, as well as from a series of interviews with key personnel from as many of the organisations involved in the changes as possible. The combination of these primary and secondary source materials have provided an overall assessment of why the reforms occurred, who was responsible for their implementation, which methods were used to accomplish those changes and how the people that work within the system have been affected by the reform process.

The reform process which has been accomplished in New Zealand has revolutionised the conduct of scientific inquiry. The scale of the reforms are such that a considerable amount of interest has been generated in them within the international research community. This interest is probably because of the fact that the reforms in New Zealand changed the discourse within which research and development was to be understood. The goals of the restructuring were concerned with increasing private sector investment and ownership of research and development, as well as making those public sector organisations concerned with making scientific investigation more efficient and effective. The reforms which were chosen involved the separation of activity into discrete and specific functional agencies, with strong accountability and reporting requirements, legislatively regulated to ensure that the organisations so created maintained their obligations and met the goals to which they were oriented. The result is a system of agencies which are based on private sector managerial and structural principles and operating within a competitive and profit-maximising environment.

There can be no doubt that the changes made to the research and development system have significantly altered the institutions and the working environments within which employees in the sector must now function. Discussion above has highlighted the human cost of the reforms, with many employees feeling alienated from those managing the process. The reforms were accomplished with such speed that employees were unable, or unwilling, to mobilise until after the changes had been accomplished.

Was it necessary for the reform process to be conducted in such a unilateral manner? It has been suggested that if the reforms had taken longer to develop and implement the changes would not have been so dramatic and employees would have had considerably more involvement in the process. This would mean that delays would have hindered the transition to a new system. It has been argued that New Zealand could not afford such impediments. The choices were justified on the basis that they were concerned with maintaining the long term viability of a sector which, for too long, had been shielded from the realities of the competitive market place. Government could no longer afford to carry the burden of a research effort that attracted little private sector investment and conducted projects that were not necessarily designed to improve the economic situation of New Zealand's industrial and primary producer sectors.

However, if New Zealand is to maintain the current system it is clear that further changes are required and that the scientific community must be involved in such decision-making. I have highlighted some of the problems which exist within the new system, and there does appear to be efforts being made to address most of these deficiencies. A primary issue remains about how the CRIs are going to balance their quest for economic survival, with their public good science obligations. There can be no doubt that researchers are focusing on short term-low risk projects which contradict government assurances about long-term visions and directions for New Zealand science. The question needs to be asked as to whether the quality of research has improved or declined under the new system, and whether the projects that are being chosen are the "best" for the New Zealand public interest.

The will for further change does appear to be present within those most affected by the changes - the researchers and scientists. For these individuals, further reform would address the anomalies, and hopefully provide a more stable environment within which to work. This commitment, gratifying for the New Zealand government, could be a result of recognition within the research and development community that the reforms were necessary if their sector was to survive the economic downturn that the government was seeking to redress. The context of the reforms was such that drastic action was deemed to be necessary to avert a national economic crisis. Although the methods and process used to achieve reforms were arbitrary, there is no doubt that the primary goals of the reformers to achieve a more sustainable and market-oriented research effort has been attained. The value of that research remains an issue which, as yet, does not seem to have been considered fully.

The New Zealand government made the choices which they felt were necessary to convert a dependent research and development effort into a competitive and financially viable system. Although doubts remain as to whether the CRIs, in particular, will be able to meet the objectives of the reforms, it may well be the case that New Zealand has pioneered the development of new publicly-funded research and development regimes, as well as having successfully begun engaging private sector investment in the promotion of indigenous scientific investigation. Problems exist in relation to the short term nature of the projects that are currently gaining funds from the PGSF; however, this could be a transitory situation. It is not inconceivable that, if the CRIs become successful and profitable, research and development competitors, the funds gained from outside sources could maintain the organisations financially and government funds - via the PGSF - could once again be directed into "blue skies" research.

It remains to be seen whether New Zealand's decision-makers will listen to the criticisms that exist and act upon them. Those in control of the system need to be aware of the issues which are being raised, as ignorance of them could jeopardise the very system they created. Overall, the system is based on a rationale that is logical, consistent

and theoretically able to achieve the results that it has been created to obtain. However, the nature of the process, the high human costs, and the anomalies which serve to counter the rationale that the system is for the "public good", leave feelings of unease about whether the research that will be conducted will benefit New Zealand as a whole, or merely serve to line the pockets of a few international and domestic clients. Ultimately time will tell whether science, research and development has been dealt a new deal or a dud hand, by those in New Zealand responsible for making the rules and controlling the game.

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