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Review of LPI R&D Portfolio Balance

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Executive Summary

This report addresses MLA's need for an independent review of its 2013 LPI R&D investment portfolio, with special attention given to various dimensions of its portfolio balance. The review focuses on various dimensions of balance, the measuring and reporting of these portfolio dimensions, and how new research resources allocated over time determine the balance in the LPI investment portfolio.

Portfolio Balance Information and Reporting

The dimensions of balance for LPI addressed are defined and described. They include:

- Core funding area
- Outcome type
- R&D type
- Time to impact
- Risk levels
- Research disciplines

There has been intermittent reporting of some of these dimensions of portfolio balance in the past but such reporting was not regular nor had it covered all the six dimensions above. As a result, LPI proceeded to fill part of this gap by compiling time series information on core funding areas and R&D type for the five years ending 30th June 2013.

Results showed that the LPI expenditure for most core areas was on a clear upward trend from 2009. The only core area declining in expenditure was sustainability and environmental stewardship. For research type, trends over the five years showed an increase in the proportion of experimental development and capability building research expenditures and declines in strategic applied, adoption and commercialisation and strategic basic expenditure.

Despite data for only two dimensions being available, the compilation of these data and subsequent analyses demonstrate that it is possible to monitor and report some dimensions of balance in the LPI portfolio over time.

Literature Review on a Desirable Portfolio Balance

The most dominant portfolio management methods reported in the literature are financial methods that use various profitability and return metrics such as net present value, return on investment or payback period to rank and choose projects. However, companies that also pursue their business strategy in their R&D portfolio management have been found to be better performing than those who focus on financial methods alone. Scoring methods against qualitative criteria and some non-market valuation methods can also be used to rank and rate non-productivity outcome projects when selecting new investments to fund. Another finding was that when considering portfolio balance it is important to account for risk. Limited published literature could be found on how R&D organisations can or actually do divide their budgets between the usually longer-term and more risky strategic-basic and the less risky applied research.

Portfolio Balance Measuring and Reporting in other R&D Organisations

A review was conducted of approaches to portfolio balance and resource allocation used by the other Rural Research and Development Corporations (RDCs), a CSIRO Flagship and two State Departments of Primary Industries. The review covered the six dimensions of balance as well as tools and aids used for resource allocation and project selection. Some of the key findings from the RDCs were:

- Core areas are monitored and targeted across most RDCs.
- One RDC is targeting and monitoring balance across the dimensions of beneficiary

type, risk and time to benefits.
- Two RDCs are beginning to classify and monitor against dimensions of research type, risk and time to benefits.
- One RDC is intending to set targets for their portfolio according to time to benefits and risk.
- Monitoring benefits according to the triple bottom line was seen by some RDCs as necessary only from an evaluation perspective, rather than in setting targets or in annual reporting.

Key findings from the other R&D organisations were:
- There is no or very little targeted or specific top down allocation processes used by the three agencies.
- They all use mainly a bottom up approach guided by their priorities, goals and strategies that are largely set via government and industry.
- All three agencies recognised the value of knowing the characteristics of their portfolio and how it is changing.
- All three organisations do report their existing investment expenditure, at least by core area, by research type and to some extent by beneficiary (confined in some cases to industry split beneficiary rather than private/public or triple bottom line split). In some cases much of this reporting appears to be driven by obligations to provide input to other government organisations.
- In the case of one State Agency, it is clear that the data is used to maintain a desired balance across the portfolio and is used in resource allocation and project selection.

Past Investment Analyses of MLA

The economic evaluation of past investments can also inform some aspects of managing portfolio balance. This was demonstrated in this review via a re-analysis of a series of investment analyses (largely ex post) formerly undertaken by Agtrans Research for MLA in 2006.

Some findings from this re-analysis were:
- Experimental Development was the research type that delivered the largest benefit cost ratio (BCR).
- The risk reward analysis demonstrated how projects could be plotted to view balance, but would be more meaningful when applied to ex-ante analysis where more uncertainties are present.

Managing LPI Portfolio Balance

Four important elements of managing portfolio balance were considered. These were:
- A rigorous evaluation strategy at the project level is in place that ensures only the best projects are funded so that impacts of the R&D investment are maximised. While LPI has a rigorous process for scrutiny and assessment of the research proposals particularly in the productivity area, the transparency of the decision process is somewhat limited. Where necessarily subjective assessments are required, there is limited exposure of any of the decision criteria and formal processes used, such as scoring sheets.

- The portfolio should reflect the organisation's objectives, plans and strategies. However, it was not the purpose of this review to assess how well the current portfolio lines up against LPI business and corporate plans.

- Resource allocation and resulting outcomes and impacts should be in accord with funding of different contributors (both between sub-industries and across industry/public contributors). It is understood that the MLA resource allocation

process ensures that LPI funds are distributed to industries (e.g. sheepmeat, cattle, goats) in accord with the magnitude of levy collections from each source. While this seems straightforward for productivity research, there are also investments that serve multiple industry beneficiaries and also government funds that will be expended to seek community outcomes that also have differential impacts across industries.

Information on industry /public beneficiary type may be required by MLA to demonstrate it is delivering benefits to the community. The importance of this demonstration would largely depend on the government requirements. There are presently no requirements to target, report or monitor portfolio expenditure according to the triple bottom line expectation of impact. However it may prove useful to at least monitor expected LPI impacts in order to report such to the general public, stakeholders and government if required in the future.

- The resulting portfolio balance should be monitored and reported in order to inform management of the implications for the portfolio when changes in R&D priorities are being considered, or to ensure changes made to priorities are being implemented. The LPI practice appears to be less advanced than that of a number of other RDCs and the State Agencies. LPI can be considered currently to be in the low- to mid-range of monitoring and reporting activities across the various portfolio dimensions of core areas, research type, beneficiary type, time to benefits and risk–reward. It is apparent that LPI has a generally sound project selection process for deploying its research resources and its resulting portfolio is assumed to be consistent with its goals and strategies. While it could be argued that this is sufficient, in the interests of accountability and transparency, this may not be sufficient in future.

Resource Allocation to Community Benefit Areas

An important issue is allocating specific resources to produce community impacts (environmental and social) or choosing between projects delivering different proportions of industry versus community impacts. The implication of the LPI resource allocation process is that specific projects in the Integrity and Sustainability area do not compete for resources with projects in the Productivity area. The process therefore does not necessarily equate marginal returns of projects associated between the two boxes of resources.

Processes used by other RDCs for selection of projects to fund were found to involve some form of assessment against a set of criteria, and many used a combination of ex ante economic analyses and scoring or ranking processes.

A major argument for ranking and scoring against a set of criteria is, that while still subjective, it formalises the process and increases transparency. Any such process is contestable and scores are explicit and recorded. Whether such scoring is carried out by LPI staff or by a wider group, may depend on what other industry and peer review screening is involved in project development and selection.

A scoring approach could be augmented by a series of information sheets addressing each of the principal environmental and social outcome areas faced by LPI. Even if a formalised scoring system were not developed by LPI, such data sheets could still provide support in arguing the case for a project within the current LPI project selection process.

Key Actions for LPI to Consider

Key considerations for LPI are:

1. Develop the monitoring and reporting of a range of dimensions of portfolio balance.
2. Make greater use both of ex ante and ex post economic evaluation studies potentially to improve resource allocation and portfolio balance.

3. Increase the transparency of processes in resource allocation and project selection.
4. Develop a scoring model for new investments supported by fact sheets that assist scoring against environmental and social impacts.

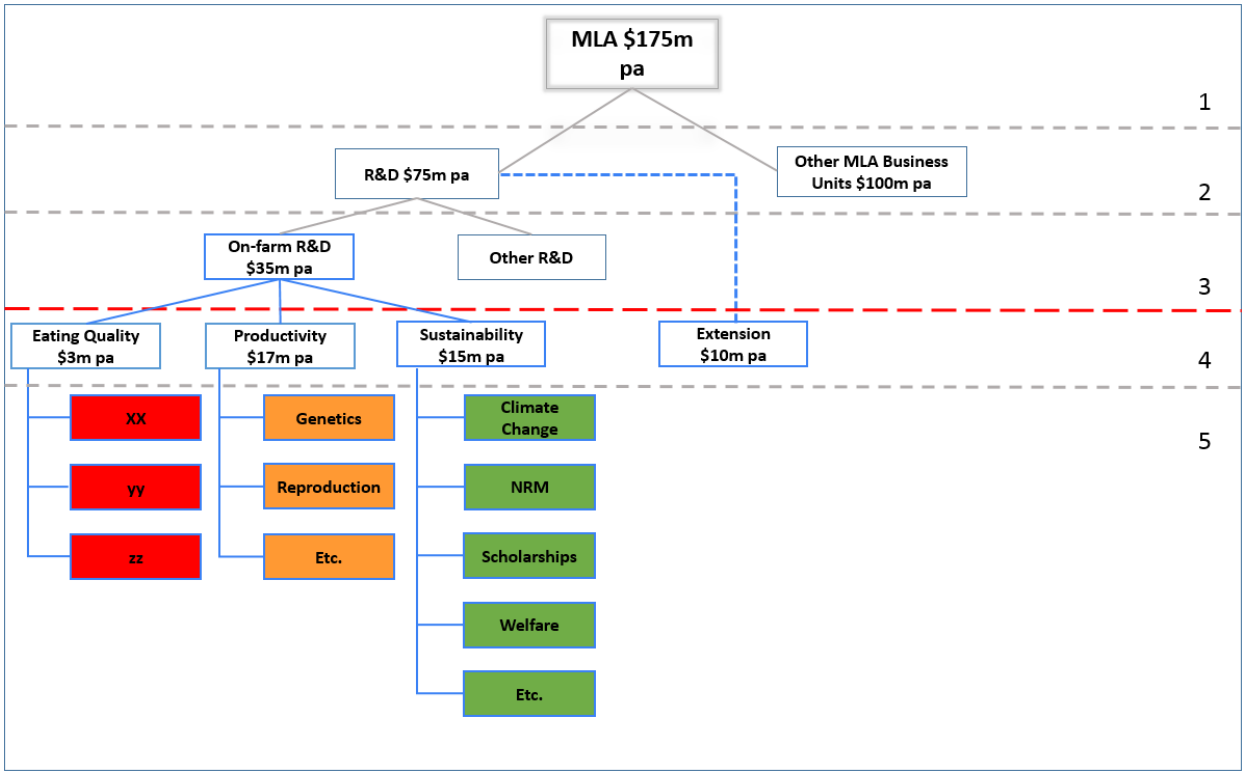
Section 1: Introduction

1.1 MLA Budgetary Allocations

MLA is charged with allocating industry and government resources to R, D & E activities to maximise benefit to levy payers and the community at large. Livestock Production Innovation (LPI) is the MLA entity responsible for managing MLA's investment in on-farm R&D as well as some goat and feedlot extension. Funding for mainstream extension is currently sourced from outside LPI but at times in the past has come directly from the LPI budget. MLA processing and marketing activities and budgetary allocations are managed by other MLA groups.

A brief overview of the distribution of resources including LPI allocations within the overall MLA framework is provided in Figure 1.1. The dollar figures displayed in Figure 1.1 are indicative of the proportional distribution of R&D funds in recent years and not presented as exact or authoritative estimates.

Figure 1.1: Research Areas and Indicative Budget Allocations for LPI



Source: Based on discussions with Banks and Alford, January 2013

The proportions of LPI investment at the fourth level in Figure 1.1 (e.g. eating quality, productivity, sustainability) have been relatively constant over the past few years. As far as can be ascertained, there have been no formal methods used to allocate funds between the areas listed at the fourth level.

Allocation at the fifth level (e.g. genetics, reproduction, welfare) have been relatively more variable in past years than at the 4th level; however these fifth level allocations also have remained fairly constant over time.

As allocation of funds at the fifth level is derived largely from a bottom up approach, the areas funded have some scope for change from year to year (e.g. under productivity, funds can be shifted slowly from genetics to reproduction or vice versa) and can be shifted via funding of new projects that may reflect the relative expected potential benefits at the project level. However it would be much more difficult for LPI managers to shift funding for some levy streams in the genetics area to say animal welfare or natural resource management or vice versa.

The identification of significant opportunities can be used to shift resources between R&D investment areas at the fifth level, but largely via a project or bottom up approach. Additional resources becoming available from some stakeholders for specific purposes (e.g. Government's Climate Change Research Program) can push more funds into certain projects and R&D areas more quickly. This has applied also at the 4th level and has been the major driver, along with Board decisions, of an expanded investment in sustainability investments in the past 15 years, at least up to 2011.

Scholarship investment is a part of the 'R&D capability for industry' core area of investment and is an attempt by MLA LPI to maintain human capacity in those areas deemed to be at risk of where shortfalls may be experienced via changing demand (e.g. due to an increasing demand for molecular biologists) or supply (e.g. due to ageing of personnel in specific disciplines).

In summary, as far as can be ascertained, LPI largely uses a bottom up approach to project selection. At least in the productivity area, project selection is aided by analysing projects in a financial sense to ensure they will potentially provide economic benefits; however, not all potential project investments can be represented in financial terms due to the presence of the difficult- to-value environmental and social benefits associated with some projects. In essence, the bottom up approach is largely effected via a subjective process at the fifth level, but with some inertia as to the shifting of resources at the fourth level.

Resource allocation is managed via a rigorous project selection process, particularly for the potential productivity oriented investments considered for funding. This project selection process and supporting tools that are used, together with their strengths and weaknesses, have been well described in Mullen (2012). However, apart from between the important core areas of productivity and perhaps eating quality and extension, there are few formalised processes available in the MLA tool set to equate expected average or marginal returns between all core areas. Research areas in the sustainability core area (level 5) provide the most difficult to assess both between themselves and against other research areas in level 4.

While the MLA resource allocation process for LPI is largely bottom up with regard to R&D subject areas, there are hints of a top down approach to funding between strategic initiatives and standard research categories (e.g. strategic basic, strategic applied) that may apply to LPI. Such shares across research types were set by the MLA Board in 2011 (Mullen, 2012, page 11). These percentage shares by research type are aspirational rather than firm targets. These aspirational targets are reported in Section 2.

The rate of change in any balance of the LPI portfolio across the various levels will be slow as only a proportion of the total budget can be allocated to new proposals in any year. Also, our understanding of the development of LPI balance across core areas in the recent past is that there have been some constraints on making deliberate or conscious allocation shifts between traditional levels of funding in core areas. This is most likely due to:

- An expanding MLA/LPI budget over time
- New sources of funding for investments with social and environmental investment becoming available (e.g. carbon and climate change) (Rob Banks, pers. comm., 2013).

LPI already has a rigorous process in place that allocates R, D & E resources in a manner that is aimed at maximising impacts, most obviously in projects and programs where financial benefits can be estimated. A simple view is that funds should be invested in those areas and activities that provide the highest payoffs and impacts to the red meat industry and the community. In reality, an efficient and effective allocation process is far more complex for several reasons explored later in this report. These reasons include various dimensions of portfolio balance such as the portfolio weighting to benefit different beneficiary types, the risk-reward balance, and whether some resource allocations are made in a top down sense instead of attempting to equate marginal returns in a bottom up sense.

1.2 Purpose

MLA sought an independent review of the balance in the current LPI investment portfolio. This review was to have emphasis on the balance and weights between:

(a) Productivity, environmental and social outcomes (Outcome type).
(b) Core areas of on-farm productivity, animal health and biosecurity, animal welfare, sustainability and environmental stewardship, optimising eating quality and R&D capability (Core areas of funding).
(c) Strategic Basic, Strategic Applied, Development, Capability Building and Adoption and Commercialisation (R&D type).
(d) Short, medium and long-term projects (Time to impact).
(e) Risk levels (High, medium and low).
(f) Research disciplines such as genetics, agronomy, animal health etc. (Disciplines).

It is recognised that some of the dimensions identified in items (a) to (f) are correlated or linked to some of the other dimensions. For example:

- the core area of animal welfare in dimension (b) addresses a social outcome in dimension (a).
- A high risk level in dimension (e) may be positively correlated with strategic-basic research in item (c).

LPI is seeking a method to:

- assess the present balance,
- justify the appropriateness of the present balance,
- provide options for monitoring and improving, if possible, the balance across the different dimensions,
- identify systems and tools to help make improved decisions affecting portfolio balance going forward.

The detailed terms of reference for the study are provided in Appendix 1.

1.3 Dimensions of Balance

Multiple Stakeholders and Outcome Type

LPI has to satisfy multiple groups of stakeholders as it receives funding from a range of industry levy payers as well as from government on behalf of the community. There are two major issues.

The first is that industry levies are collected on a commodity basis leading to the issue of industry equity in respective allocations, for example, between beef, sheep, and goats and within beef for example to grain fed versus grass fed.

The second is the balance between the pursuit of outcomes that primarily serve the industry versus those that impact most on the community (e.g. industry productivity versus predominantly off-farm environmental and social benefits). On this second issue, the difficulty faced is that it is not easy to measure the values of the public benefits (social and environmental) so that they can be compared with productivity gains that are more easily valued. A confounding sub-issue here is that many environmental and social sustainability benefits extend to both the public and industry, the latter via avoiding market access restrictions or inappropriate regulation.

Core Areas

Five of the LPI existing six core areas are for R&D funding (dimension b) are correlated with the three outcome types (dimension a). Three of the five fall into the industry productivity area (on-farm productivity, animal health and biosecurity, optimising eating quality), and two into the social and environmental outcome area (animal welfare, sustainability and environmental stewardship). The sixth core area (R&D capability) is associated with research efficiency and effectiveness. The principal difficulty with achieving balance here, at least with the latter half of these core areas is measurement/valuation to allow comparison of the different outcomes and impacts between industry and the wider community.

Type of Research

The three issues that determine the merits of the different types of research (and hence the balance across research types) are the time to delivering benefits, the magnitude of the benefits that may be delivered, and differences in the risk of benefits being delivered. These three drivers are discussed below.

Time to Benefits

Benefits to industry and the community usually occur in periods (usually years) after the research is completed (extension investment may be associated with shorter lags). In general (but not always), strategic –basic research may be associated with considerable time periods before impacts may be delivered, as opposed to the more applied research and/or extension investment. The difficulty faced is that if the balance of investment is strongly in favour of strategic research at any one time, there may be few benefits to deliver in the short term; this may be associated with dissatisfied levy payers and intergenerational equity issues.

Benefit Size
The size of the unit impact such as the gain per head or per ha is usually viewed as potentially greater (larger step changes) with new technologies being developed than with applied research that is perhaps shorter term but with smaller sized changes. If this view is accepted, then are the larger step changes ameliorated by the potentially longer time to delivery, potentially higher total costs, and potentially higher risks involved in strategic research? Is there an optimal balance between research types or between the constituent components of research types?

Risk
The nature of R&D investment is that outcomes are uncertain and there is an element of risk in most investments. The risk of achieving no benefits from an investment is generally viewed as higher at the strategic–basic end of research types. However, the impact is generally viewed as being higher if strategic research eventually produces successful outcomes. The difficulty faced again is that if the balance of investment is strongly in favour of high risk investment and few eventually succeed, resources could be seen as being wasted with few benefits being delivered.

Maintaining Research Capability
Effective MLA funded R&D depends on maintaining research capability in various disciplines. Training is the major avenue to maintain the critical capabilities but some of this is captured also through normal project funding where experience is built via existing research. The balance of R&D investment in training and, specifically in the form of support (e.g. postgraduate scholarships, postdoctoral fellowships etc.) and the specific disciplines supported create questions for balance due to the difficulties in measuring impact of training (e.g. movement in and out of industries, ageing), and changing demand as new science emerges.

Section 2: Previous Snapshots of MLA Portfolio Balance

2.1 Introduction

Some estimates are available for the LPI balance across the six dimensions referred to in Section 1.3. However, these estimates refer to different periods (years) and no continuous time series was located at the start of this project. The available estimates are summarised in this section. Categories reported in some documents have been standardised to those used in this report.

2.2 Core Areas

Banks (pers. comm., 2013) reported a breakdown in funding to five core areas for southern R&D LPI projects for 2009/10 (Table 2.1). Banks (pers. comm., 2013) also reports investment across 7 core areas for LPI for 2012/13 (Table 2.2).

Table 2.1: Core Area Allocations for 2009/2010 (Southern LPI expenditure)

Productivity	Product Quality	NRM including climate	Supply Chain Efficiencies	Animal Welfare
55%	10%	24%	2%	7%

Table 2.2: Core Area Allocations for 2012/13 (LPI expenditure)

Annual Operating Plan Node	2012/13 budget ($m)	%
2.1 Eating Quality	0.875	2
3.1 On Farm Productivity	14.97	40
3.4 Animal Health	6.30	17
3.5 Producer Engagement	4.26	11
4.1 On Farm Sustainability	8.35	22
4.3 Animal Welfare	1.50	4
4.5 R&D Capability	1.16	3
TOTAL	**37.415**	**100**

2.3 Outcome Type

Banks (undated) has allocated the funding in the core areas for 2012/13 (in the table above) against financial, social and environmental outcomes. This was achieved by scoring each AOP Node across a 1-5 scale for each of the three outcome types and then fitting a regression equation to produce implicit weights for the portfolio as shown in Table 2.3:

Table 2.3: Core Area Allocations for 2012/13 (LPI expenditure)

Outcome Type	Implied portfolio weighting
Financial	55%
Social	6%
Environmental	39%

2.4 Type of Research

Banks (pers. comm., 2013) reported a breakdown in funding by type of research for southern R&D LPI projects for 2009/10 (Table 2.4).

Table 2.4: Type of Research Allocations for 2009/2010 (Southern LPI expenditure)

Strategic basic research	Strategic applied research	Development	Adoption and commercialisation	Capability building
5%	25%	26%	14%	19%

Mullen (2012, page 11) reports MLA goals for the portfolio balance across types of research (Table 2.5). Mullen reports that his understanding was that these budget shares were goals determined by the MLA Board (February 2011) and that the budget shares were derived by subjectively assessing how resources in each project are used. However, it is now understood that these goals were aspirational and represent a top down approach, potentially guided by Government guidelines and general stakeholder feedback (Rob Banks, pers.comm., 2013).

Table 2.5: Aspirational Goals for Research Type Allocations (MLA Board)

Strategic basic research (new knowledge)	Strategic applied research (proof of concept)	Development (market ready)	Adoption and commercialisation	Capability building
10%	30%	30%	17%	13%

2.5 Time to Benefits

Banks (pers. comm., 2013) reported a breakdown in funding by time to benefits for southern R&D LPI projects for 2009/10 (Table 2.6).

Table 2.6: Distribution of Time to Benefits for 2009/2010 (Southern LPI expenditure)

>7 years	3-7 years	0 to 3 years
32%	46%	23%

2.6 Risk

No compilations for LPI have been identified with regard to distribution of risk levels in the portfolio.

2.7 Disciplines Engaged

No compilations for LPI have been identified with regard to the distribution of disciplines currently engaged in MLA supported R&D, neither within R&D funding or for those being supported by scholarships or fellowships.

2.8 Conclusion

It is concluded from this brief review that there has been some reporting of some dimensions of LPI portfolio balance. However, such reporting

- has not covered all six dimensions,
- categories within those dimensions reported have not been consistent over time,
- some reporting appears to have been sporadic with no consistent monitoring process evident for any of the six dimensions.

Section 3: A Time Series of LPI Portfolio Information

3.1 Introduction

As a result of the patchiness of the readily available "balance" information as of January 2013, MLA proceeded to compile time series information on various dimensions of balance. MLA compiled annual data for each of the last four years up to June 2012 and included information from the 2012/2013 budget.

The resulting data set included information for LPI for each of the five years on:

- value of annual investment in each core area
- value of investment by research type

3.2 Methods

LPI funds were coded according to core areas, as well as sub-categories within core areas. This allowed for allocation of funds to one of the six core areas of eating quality, productivity, sustainability and environmental stewardship, capability, animal welfare and animal health and biosecurity. The "capability" core area was split in the analysis to demonstrate the differences in research capability and industry capability.

LPI core areas have changed over the five year time frame, for example 2012/2013 core areas did not include 'Science for the Future', a core area from 2009 to 2010. In these cases where inconsistencies exist, funds were grouped to be as consistent as possible with the current 2012/2013 core area categories.

Also, categorisation of research expenditure type was made by Banks and Alford for the years ending June 2009 to June 2013 according to the following definitions:

Strategic Basic Research: Provides a broad base of knowledge necessary for the future solution of recognised practical problems.

Strategic Applied Research: To determine new ways of achieving some specific and predetermined objectives – identifies a possible solution.

Experimental Development: Aims to produce new materials, products, devices, policies, behaviours or outlooks, or allow installing of new processes, systems or services, or modifications to existing new processes, systems or services.

Capability Building: Semi-formal and formal education.

Adoption and Commercialisation: Activities to facilitate adoption and/or commercialisation of specific products or services.

Total expenditure and proportion of expenditure over time were plotted in Excel according to categorisation of research type across all expenditure as well as expenditures within each core area. The graphs generated trends in the LPI portfolio. In addition, five year averages were provided for expenditure by research type and core area. Finally, the latest current balance according to 2012/2013 budgets was summarised.

3.3 Results

Core Areas

Figure 3.1 shows the LPI expenditure by core area, along with the total LPI expenditure over the five year period. LPI funds are on a clear upward trend from 2009. The only core area declining in expenditure is sustainability and environmental stewardship.

Figure 3.1: Total Expenditure by Core Area

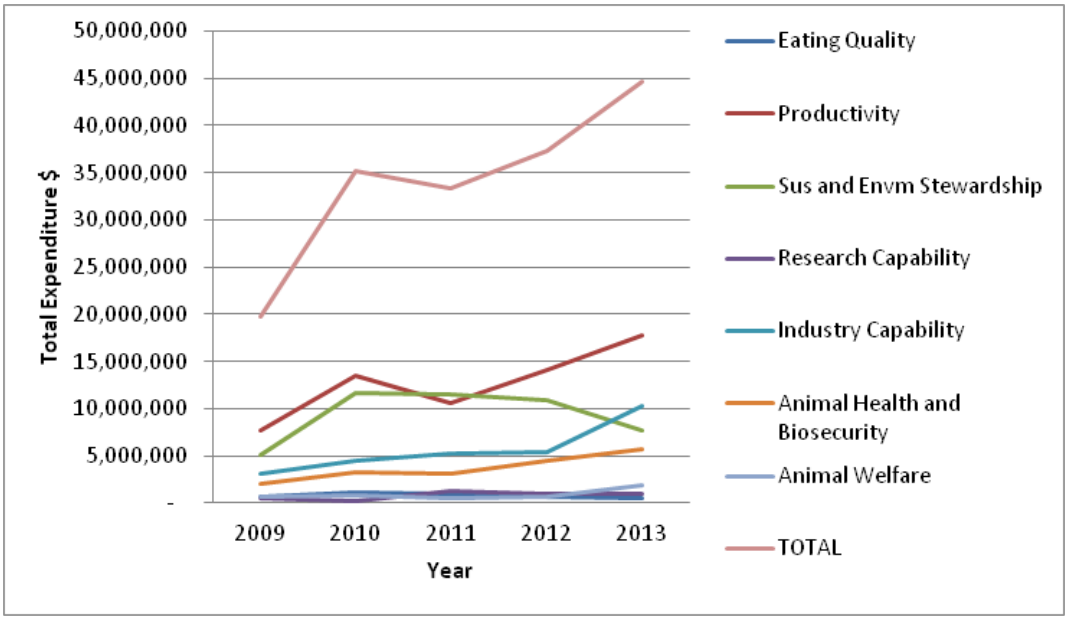
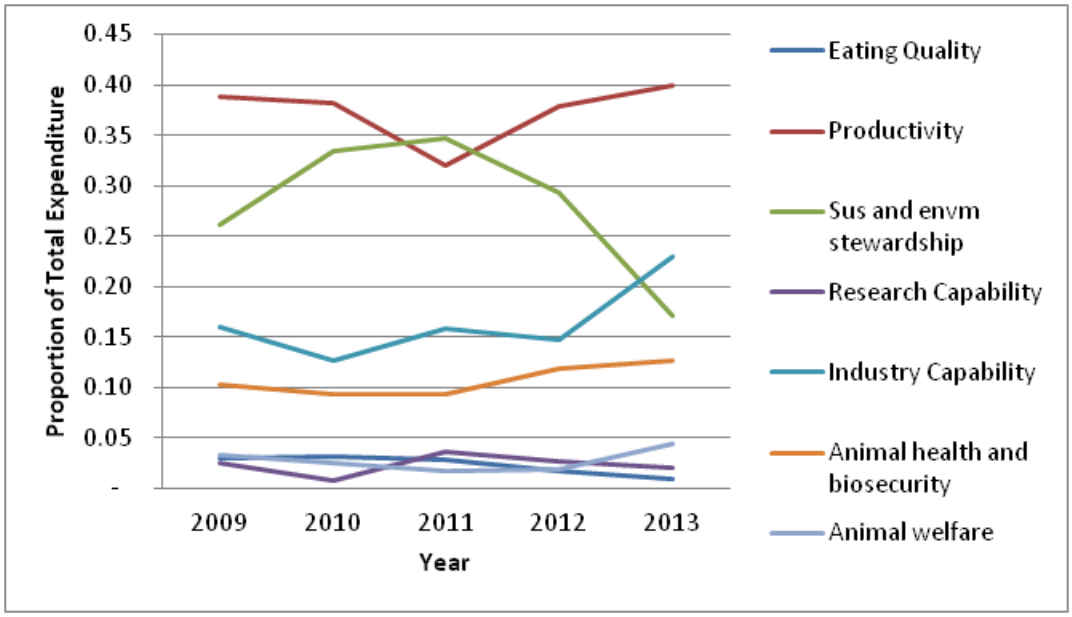


Figure 3.2 shows the core area expenditure as a proportion of total expenditure over time.

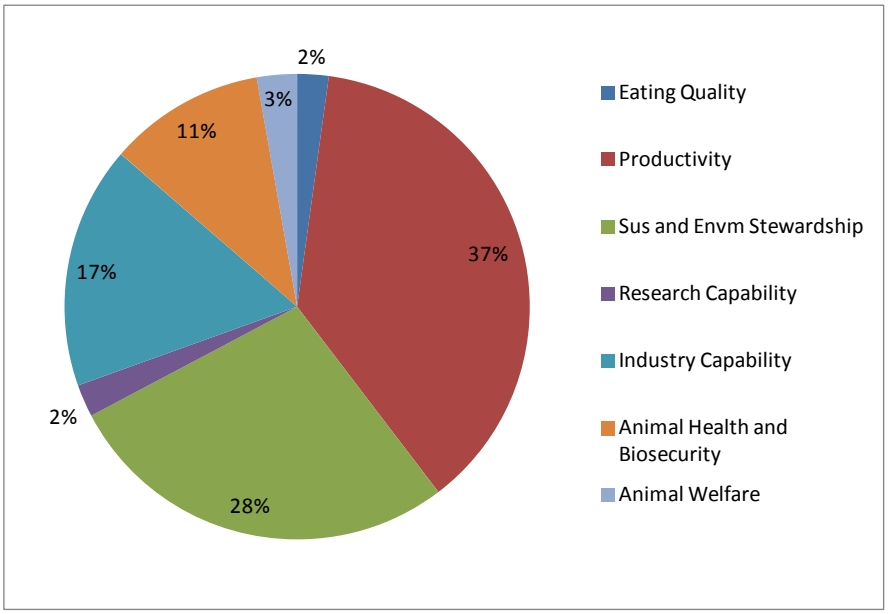
Figure 3.2: Core Area Expenditure as a Proportion of Total Expenditure



The most significant trend from this data is the decreasing expenditure in the sustainability and environmental stewardship core area. Expenditure in this core area has taken a significant drop since 2011. This drop has coincided with increased expenditure in the areas of productivity, animal health and biosecurity and animal welfare. Industry capability has also seen a significant increase from 2012 to 2013.

A five year average of expenditure by core areas is shown below in Figure 3.3.

Figure 3.3: Average Core Area Proportion of Expenditure 2009-2013



The LPI portfolio over the five year time frame has seen most resources allocated to the productivity and sustainability and environmental stewardship core areas; together these contributed 65% of expenditure.

The current portfolio balance of expenditure across core areas for 2012/2013 is shown in Table 3.1.

Table 3.1: Current (2012/13) Portfolio Balance by Core Area

Core Areas	**2012/13 budget $m**[1]	**%**
2.1 Eating Quality	0.45	1
3.1 On Farm Productivity	17.84	40
3.4 Animal Health and Biosecurity	5.66	13
3.5 Industry Capability	10.24	23
4.1 Sustainability and Environmental Stewardship	7.67	17
4.3 Animal Welfare	1.95	4
4.5 R&D Capability	0.91	2
TOTAL	**44.72**	**100**

1. Figures in table are based on data provided by MLA in March 2013. They vary from those provided in Section 2.2.

Research Type

Figure 3.4 shows LPI expenditure trends according to Research Type. Expenditure on all research types has followed the upward trend of total LPI funding.

Figure 3.4: Total Expenditure by Research Type

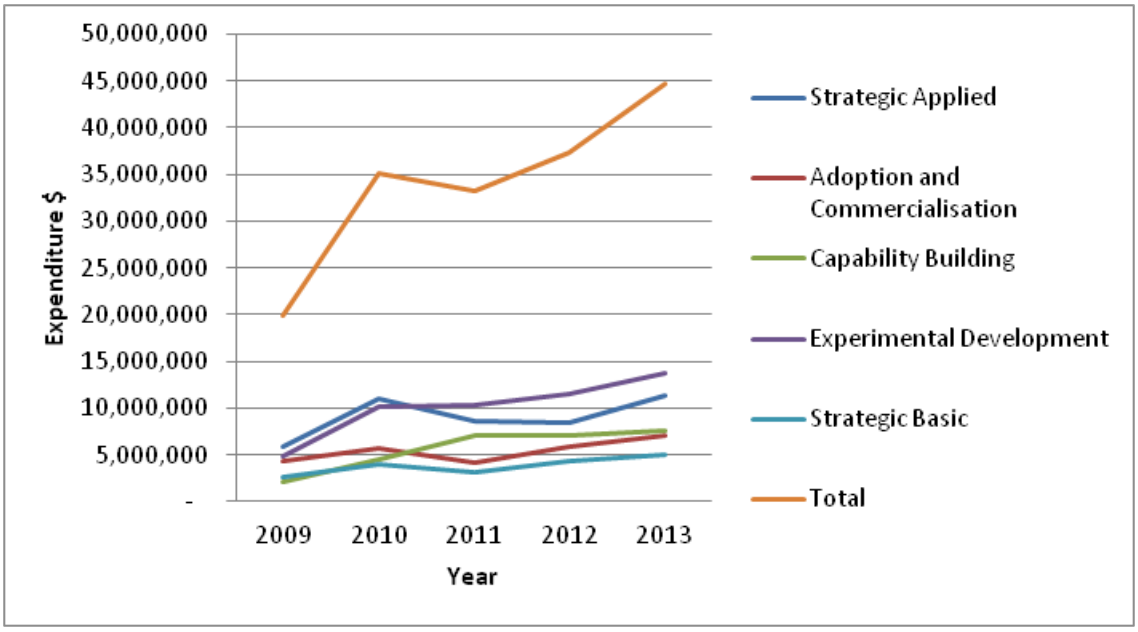
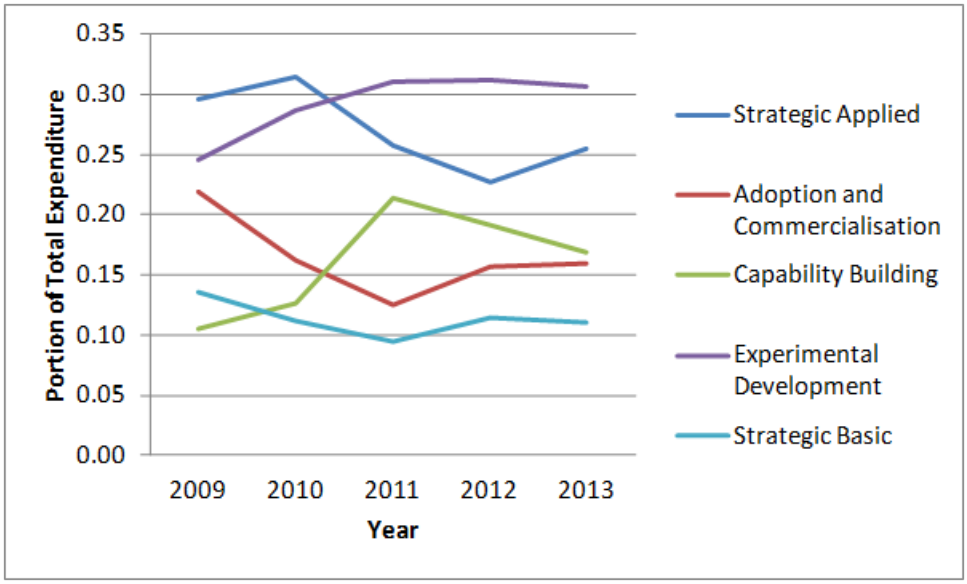


Figure 3.5 shows the proportion of research expenditure type each year for the years ending June 2009 to June 2013.

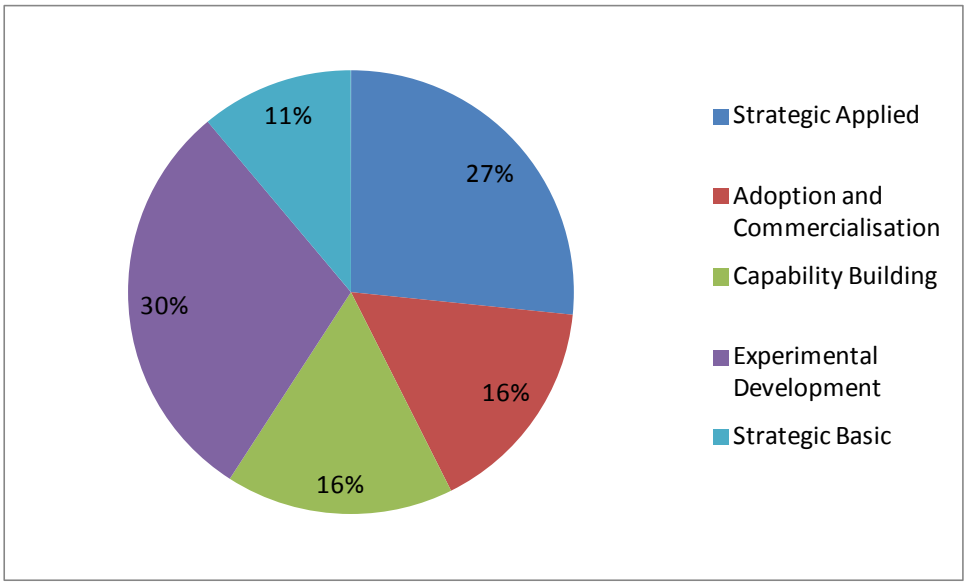
Figure 3.5: Research Type Expenditure as a Proportion of Total LPI Expenditure



Trends over this time period show an increase in the proportion of experimental development and capability building research expenditures and declines in strategic applied, adoption and commercialisation and strategic basic expenditure.

Figure 3.6 shows the average proportion for each research expenditure type for LPI over the five years. The portfolio has comprised predominantly strategic applied and experimental development expenditure, together contributing 57% of LPI expenditure. The smallest amount of expenditure is in strategic basic research at 11%.

Figure 3.6: Average Expenditure by Research Type 2009-2013



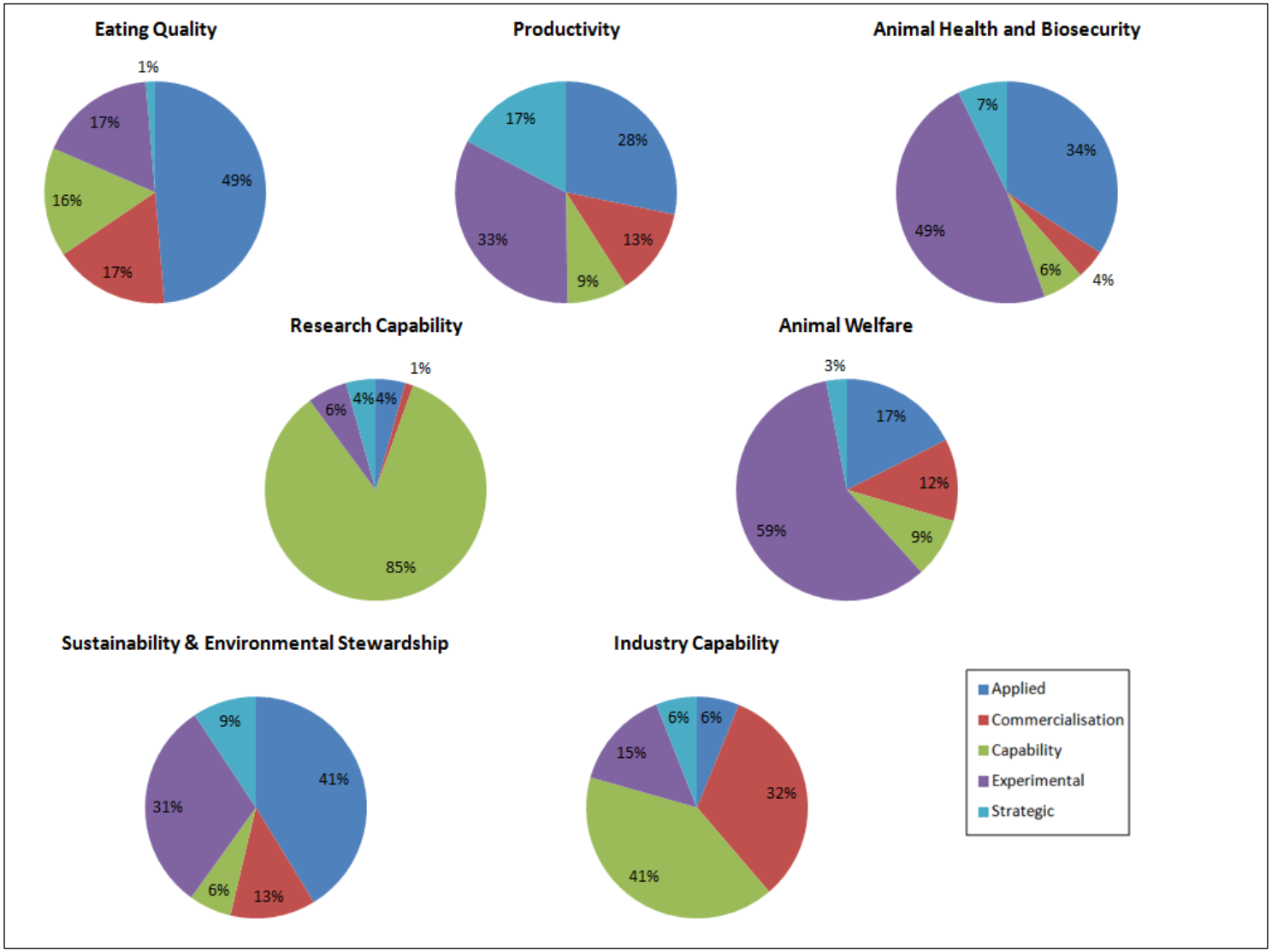
The current balance of research expenditure type according to 2012/2013 data is shown in Table 3.2.

Table 3.2: Current Portfolio Balance by Research Expenditure Type

Research Expenditure Type	**2012/13 budget $m**	**%**
Strategic Applied	11.36	25
Adoption and Commercialisation	7.12	16
Capability Building	7.57	17
Experimental Development	13.73	31
Strategic Basic	4.94	11
TOTAL	**44.72**	**100**

Figure 3.7 shows the current balance of research expenditure type within each core area for the 2012/2013 budgeted expenditure. With the exception of industry and research capability, it can be seen that applied and experimental research types make up the largest proportion of expenditure across all other core areas.

Figure 3.7: Current Research Expenditure Type in Core Areas 2012/2013 Budget



3.4 Conclusions

Data was not available at this time for all six dimensions of portfolio balance. Current and past portfolio balance was not reported for the portfolio dimensions of risk, time to benefits, beneficiary type and research disciplines. Despite this, the current analysis of the two dimensions, core areas and research type, can demonstrate how measurement might be undertaken across the other dimensions if so required.

The analysis has shown that LPI expenditure has increased over the five year period 2009-2013. Over this period the five year time frame has seen 65% of expenditure allocated to the productivity and sustainability and environmental stewardship core areas. Trends over the five years have shown a decreasing expenditure since 2011 in the sustainability and environmental stewardship core area. Increased expenditure has been evident in the core areas of productivity, animal health and biosecurity, and animal welfare and industry capability.

The portfolio has comprised predominantly strategic applied and experimental development expenditure, together contributing 57% of LPI expenditure. The smallest amount of expenditure is in strategic basic research at 11%.

In 2011 the MLA Board endorsed LPI portfolio goals of maintaining a balance of R&D expenditure across research types as follows:

Strategic basic: 10%
Strategic applied: 30%
Experimental Development: 30%
Capability Building: 13%
Adoption and Commercialisation: 17%

The analysis shows that research expenditure type is largely consistent with these goals both currently and for the past five years.

The compilation of these data and subsequent analyses demonstrate that it is possible to monitor and report some dimensions of balance in the LPI portfolio over time. How the balance information may be used and the categorisations of other dimensions of balance are addressed later in this report.

Section 4: Literature Review on Optimal R&D Portfolio Balance

Optimal R&D portfolio balance is a common and expressed challenge for R&D portfolio managers who seek to maximise returns while aligning their investments with a company's overall business strategy (Cooper et al 1999, 2001, Cáñez & Garfias 2006). R&D has been regarded by firms as a source of productivity and competitive advantage in the context of today's increasing technological complexity and shortened product/knowledge life cycles (Luo 2011, Cooper et al 2001).

R&D managers continue to report their dissatisfaction with currently-available R&D portfolio management models (Graves et al 2000). Many studies have been done on R&D portfolio management models (Graves et al 2000, Ringuest et al 2005, Cooper et al 2001, Cáñez & Garfias 2006, Dickinson et al 2001); these studies all suggest potential approaches of achieving an optimal balance for an R&D portfolio against a constrained budget. Though the tools and uses have changed over time, the basic need remains the same - companies must allocate a limited set of resources to projects in a way that balances risk, reward, and alignment with corporate strategy (Dickinson et al 2001). This review identifies optimal portfolio balancing methods discussed in the literature; presents some portfolio management case studies and identifies some issues associated with the current portfolio management approaches.

Some organisations view a portfolio as a top-down statement of aspirations while others see it as a bottom-up accumulation of available projects (van der Rohe 1998). Others such as Boeing Company (Dickinson et al 2001) and Meat and Livestock Australia (Rob Banks and Andrew Alford pers. comm., 2013) appear to opt for a hybrid approach where some top-down aspirational goals are coupled with a bottom-up approach to manage their portfolios.

4.1 The Methods

Different studies refer to different methods of attempting to strike a portfolio balance. These are mainly influenced by the assumed magnitude of returns, the associated risk, business strategy and sometimes the desire to maintain scientific capacity and a steady stream of new knowledge and technologies (Pannell 1999, Dickinson et al 2001). Some methods also seek to replace deteriorated research and keep productivity from declining below a benchmark (Sparger et al 2011).

To build a balanced portfolio it is essential to analyse existing and proposed projects in order to make decisions about which proposals should or should not be funded (Cáñez & Garfias 2006). Methods used in assessing and pursuing portfolio balance have been summarised into the following six categories by Verbano and Nosella (2010):

- *Mathematical methods:* (linear, non-linear, integer programming, goal and dynamic programming models), these optimise specific objective functions such as the benefit expected from a certain R&D portfolio affected by resource constraints.
- *Economic/financial methods:* (present value index, NPV, IRR, Expected NPV, etc.) these are normally not versatile and therefore modifications cannot be made to the course of action if any new information comes to light. The real options method is the only one that takes new data into account when applied to R&D project selection and evaluation.

- *Decision analysis:* (Analytic hierarchy, Process-AHP, Multi Attribute Utility Technique-MAUT, decision trees) in particular the AHP is a decision–making model that selects the best project by constructing a hierarchy with a tiered framework within which project alternatives are placed on the bottom level and objectives on respective higher levels. Decision trees are employed where the project is characterised by a sequence of decisions, where each decision is influenced by the outcome of the previous one. Decision trees are normally used as decision support in conjunction with other techniques.
- *Interactive methods:* (Delphi, Q-sort), these compare projects solely on the basis of subjective evaluations without using numeric logic or mathematical algorithms.
- *Scoring methods:* these establish a set of criteria that govern project selection, each method has its own technique which varies with sophistication; each project is given an aggregate score, which expresses the extent to which a set of criteria were met.
- *Strategic models:* These refer to models that take multiple strategic aspects into account during R&D project selection. The R&D projects are initially selected on the basis of their coherence with the identified strategies so as to reject any projects that do no concur with corporate strategy. When this phase is over, the projects are evaluated with one of the methods mentioned previously (NPV, scoring) in order to identify a portfolio of best projects.

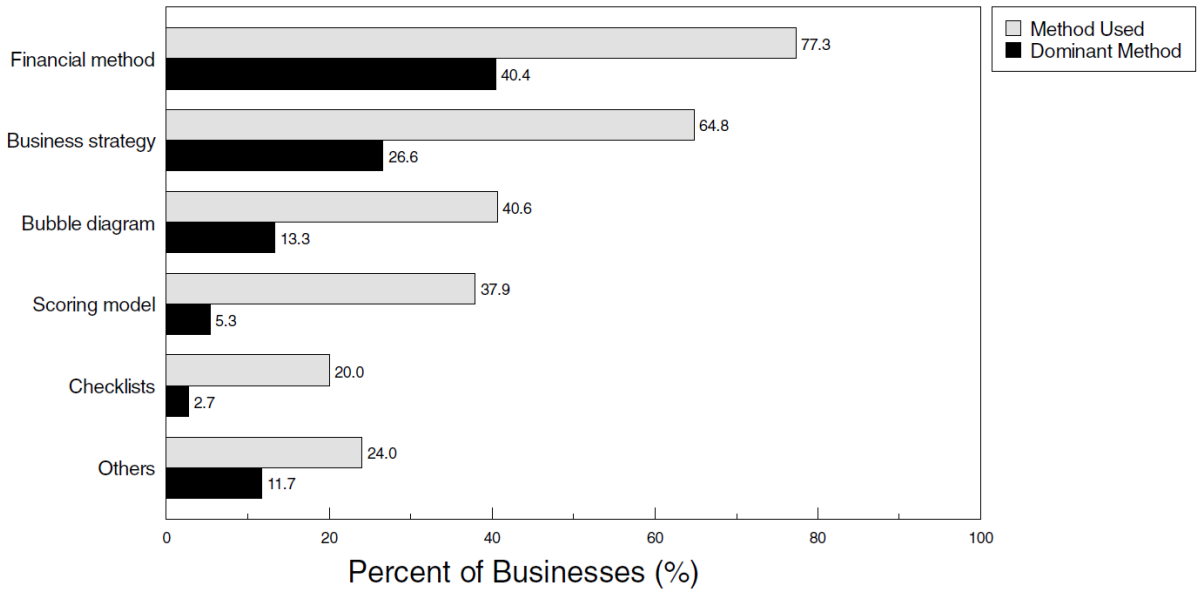
Many portfolio optimising models have been criticised in the past for their over reliance on financial/quantitative data that is not always available or even accurate (Dickinson et al 2001, Cáñez & Garfias 2006). After studying portfolio management by a sample of 205 North American firms; Cooper et al (2001) concluded that financial methods, although the most popular and rigorous, yield the worst results overall. Additionally, Cooper et al (2001) found that senior managers in the best performing companies consistently and significantly viewed portfolio management as much more important than managers in the worst performing companies.

Cooper et al (2001) found that by far the most dominant method for portfolio management were financial methods (Figure 4.1). As many businesses use multiple methods, the percentages in Figure 4.1 add up to well over 100%. The black bars show the dominant methods and add up to 100%. Portfolio management methods were categorised and described as follows:

- Financial methods: those that use various profitability and return metrics such as NPV, ROI or payback period to rank and choose.
- Business strategy: those allocating money across different types of projects according to the business's strategy, e.g. money is allocated across different types of projects and into different envelopes/boxes. Projects are then ranked within or rated within boxes.
- Bubble diagrams or portfolio maps: here projects are plotted on an *X-Y* plot (e.g. reward v. probability of technical success) or map and categorised according to the zone or quadrant they are in.
- Scoring models: Projects are rated or scored on a number of questions or criteria and the scores are added to yield a Total or Project Score which becomes a criterion used to make project selection and/or make decisions.
- Check lists: Projects are evaluated on a set of Yes/No questions. Each funded project must achieve all Yes answers or a certain number of Yes answers to proceed.
- Others: These tended to be hybrids or variants of the above methods (further scrutiny showed that most of these 'Other' methods were much like the business strategy method and a few were variants of the financial method).

Companies that pursued their business strategy in R&D portfolio management were found to be the better performing, had the right balance and number of projects for their budgets. The best performers tended to rely less on financial models and methods as the dominant portfolio tool, they focused on business strategy to allocate resources.

Figure 4.1: Popularity of portfolio methods employed by a sample of 205 firms undertaking R&D and product development



Source: (Cooper et al 2001)

While many methods and approaches have been found lacking in some sense, there is an agreement in literature that formalised portfolio management to achieve some form of balance can enhance performance and bring real benefits to R&D investment (Teller et al 2012).

4.2 Hybrid Methods and Non-Productivity Impacts

Cooper et al (2001) findings that best performing firms are those that rely less on data intensive financial methods gives credibility to pursue methods that are not as data intensive. Cáñez & Garfias (2006) concluded that in order to have a balance between short and long term R&D activities, it is important to consider both quantitative and qualitative criteria to analyse portfolios. This approach caters for firms to utilise business strategy methods that can be used to consider difficult to measure impacts such as social or environmental outcomes. Productivity projects will need not to compete with the social/environmental outcomes all the time. Scoring methods or non-market valuation techniques can also be used to rank and rate non-productivity impact projects in a portfolio. Mitchell et al (2010) states that in deciding whether to pursue projects with non-financial factors it is acceptable to call on managers to place a value on each project and compare those values. Projects can be scored on factors such as market growth rates, levels of competition, pressures, and impacts on industry image or social licence to operate.

Table 4.1 shows how some organisations or studies have used portfolio analysis to achieve a balanced R&D portfolio. Table 1 shows that companies tend to use a hybrid of criteria to optimise their portfolio balance e.g. Petrobas, a Brazilian energy company, scored projects on environmental impact as well as innovation and financial impact, among other things.

Table 4.1: Scoring Criteria Proposed by Different Organisations/Expert

Organisation/Expert	Criteria
PEMEX's Mexican Petroleum Institute	• Alignment with the strategic arenas • Business impact • NPV adjusted to risk • Time to market • Expected net profitability
Celanese	• Business strategy fit • Strategic leverage • Probability of technical success • Probability of commercial success • Reward to company
Exfo Engineering	• Strategic fit • Market potential • Financial analysis • R&D internal capabilities
CENPES-Petrobas	• Financial analysis • Applicability • Degree of interest • Probabilities of success • Environmental impact • Operational security • Innovation • Sustainability
Lucent/Bell Laboratories	• Benefit/cost ratio • Risk (optimistic, most likely and pessimistic scenarios) • Contribution of the project to strategic initiatives • Impact on market categories • Impact on intellectual property issues • Impact on the business unit
Robert G. Cooper, Scott J. Edgett and Elko J. Kleinschmidt	• Strategic alignment and importance • Product and competitive advantage • Market attractiveness • Leverage core competences • Technical feasibilities • Financial reward vs. Risk

Source: Adapted from Cáñez & Garfias (2006)

Projects with social and/or environmental outcomes can also be valued using non-market valuation techniques. Non-market valuations tend to use people's stated or revealed willingness to pay for something to derive an estimated monetary value of a project. An example of use of non-market valuation methods in agricultural R&D is, Mallawaarachchi and Quiggin (2001) in their "*Modelling socially optimal land allocations for sugar cane growing in North Queensland: A linked mathematical programming and choice modelling study*".

One approach which may be used in estimation of non-market benefits of research projects is the benefit transfer methodology (Chudleigh et al, 2012). In essence, this means transfer of estimated benefits from an original study to a new study. Benefit transfer is used where cost or time does not permit a specific research study to derive an estimate of benefits for the new site or new project. However this is not always done given the infancy and sometimes lacklustre acceptance of non-market valuation results.

4.3 Portfolio/Project Interdependencies

Many of the common, formal and quantitative methods found in literature tend to treat individual projects as independent and are suitable when projects are evaluated in a common funding period (Dickinson et al 2001). This is not always the case as many projects are dependent on work already done or yet to be done, so there is always a link between past and future investment. Projects tend to share their resources and knowledge to diffuse good practices and learn from each other (Martinsuo, 2012). Such sharing can benefit the entire portfolio as synergies and capability can be exploited and costs can be minimised. Terwiesch and Ulrich (2008) argued that a project should not be evaluated in isolation, because without supporting projects in the portfolio the project may have a limited impact over time; and the value is not just from the individual project but the whole portfolio. Boeing Company made noble attempts to account for project interdependencies, multiple funding cycles in their optimal portfolio balances while covering risk/reward, timing and strategic objectives but this proved to be complicated and data became difficult to interpret (Dickinson et al 2001). Dickinson et al therefore proposed use of a dependency matrix, which quantifies the interdependences between projects, and a nonlinear, integer program model to optimise project selection. The model also balanced risk, business strategies/objectives and the cost and benefit of the entire portfolio. This model had the capability to rapidly quantify and evaluate small changes to the portfolio once an optimum strategy is identified (Dickinson et al 2001). When presented with the optimisation model, Boeing's portfolio management board saw it as a faster method of comparing alternate portfolios (Dickinson et al 2001). However, like other mathematical models, detailed, validated and rigorous data is required for this method to be used with any degree of confidence.

4.4 Risk

R&D related risks can be categorised as technology risk and market risk (Luo, 2011). Technology risk is the uncertainty about the project's success in achieving the desired objectives whereas market risk can be described as the uncertainty of the project's market value/impact.

Graves et al (2000) suggested a simple yet theoretically rigorous method for designing optimal R&D portfolios that minimise risk for a given level of return; this used linear programming in excel. The only assumption is that the decision maker is risk-averse. An optimal portfolio according to this study is one that minimises risk for a given level of return. Later on Ringuest and Graves (2005) proposed yet another "simpler version of a rigorous method for generating portfolios that minimise risk for a given level of return". Unlike the Graves et al (2000) paper, this study replaces linear programming with a simple decision tree. The weakness of both these proposed methods and those proposed by other studies is that the methods cannot be used to assess and manage a portfolio that includes

social/environmental benefit and other non-financial return projects. Many organisations today do undertake projects that do not have explicit financial returns. Also many methods cover risk as part of project selection or portfolio assessment but due to other factors such as customer request and cost changes, risk can impact portfolio balance between portfolio analysis events or after project approvals (Martinsuo, 2012). This therefore requires a continuous check of how risk is changing and taking appropriate action to maintain an optimal R&D portfolio balance. Probability of success (against returns) charts are commonly used to visualise the risk and associated pay-offs (Terwiesch and Ulrich, 2008). Acceptable risk levels should be judged against anticipated reward. Ringuest and Graves 2005 suggest a risk-reward plot and screening a group a projects to find those preferred by risk-averse decision makers.

4.5 Strategic-basic and Applied Research

The Australian Bureau of Statistics (1998) defines types of research as follows:

- Pure basic research is experimental and theoretical work undertaken to acquire new knowledge without looking for long term benefits other than the advancement of knowledge.
- Strategic-basic research is experimental and theoretical work undertaken to acquire new knowledge directed into specified broad areas in the expectation of useful discoveries. It provides the broad base of knowledge necessary for the solution of recognised practical problems.
- Applied research is original work undertaken primarily to acquire new knowledge with a specific application in view. It is undertaken either to determine possible uses for the findings of basic research or to determine new ways of achieving some specific and predetermined objectives.
- Experimental development is systematic work, using existing knowledge gained from research or practical experience that is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

The two types relevant to this review are the strategic-basic and applied research. Strategic-basic research is associated with long-term investments whereas applied research is associated with relatively short-term investments.

There appears to be limited published literature on how R&D organisations can or actually divide their budgets between strategic-basic and applied research. Two examples include studies done by Pannell (1999) and Cáñez & Garfias (2006), these are discussed later on. However there is abundance of literature arguing that there is a need for a good balance of the two (Czarnitzki and Thorwarth 2012, Grilliches 1986, Piesse and Thirtle 2010, Mansfield 1980). Companies either have these in grey literature or they pursue their own goals and fund both types of research intuitively. Some studies to estimate how much is actually spent on different types of research are sometimes undertaken e.g. Huffman and Evenson (1993, 2008) and Cáñez & Garfias (2006).

Pannell (1999) estimated the mean optimal level for strategic-basic research to be 23%, (with the remainder being allocated to applied research). Pannell's attempt to calculate the optimal balance between strategic-basic and applied research is based on a simplified modelling framework informed by a study of literature on how strategic-basic research contributes to socio-economic objectives and its links to applied research and technology. The framework is then implemented as a numerical model, using hypothesised parameter values to explore and illustrate the potential behaviour. Applied knowledge is conceptualised as being constrained by a maximum level depending on the stock of basic knowledge, whereas basic knowledge is not similarly constrained by applied knowledge. This means that

in any period, applied research has a diminishing marginal product of applied knowledge, whereas basic research has a constant marginal product of basic knowledge. It also means the impact of basic research on production of applied knowledge includes substantial lags. The mathematical model was solved for 100 years in five year periods with the objective of maximising the NPV of investment in basic and applied research.

The assumptions used to get the 23% are theoretically convincing but clearly not exhaustive. The study intelligibly states that the numerical results are not empirically accurate. This may be a reason why there seems to be no Australian organisation (to the knowledge of authors) that has adopted the numerical results of the Pannell (1999) study. This 23% is also heavily reliant on the assumptions on: strategic-basic research having a certain impact on productivity of applied research, the intrinsic value of basic knowledge and the rate of obsolescence of basic knowledge. All these three parameters are bound to change with time, cannot necessarily be generalised across industries or research areas, time periods and the different business environments and strategies.

Huffman and Evenson (2008) found that the US federal and state institutions spent 31.3% of agriculture research budget on basic research for the year 1997; this proportion was higher for livestock basic research as a proportion of total livestock budget at 46%. Type of research was defined by discipline e.g. a researcher who had title of plant physiologist or an area of work of plant physiology was classified in the plant sciences basic research category.

The Mexican Petroleum Institute (a research arm of PEMEX a Mexican state owned petroleum company) had a policy on project type that stated that 20% of the resources were to be allocated to basic research while 80% were to be assigned to applied research and technology acquisition. A snap shot analysis of 83 on-going projects found that 21 (or 25%) were on basic research and they accounted for 40% of the assigned resources, (Cáñez & Garfias, 2006). After a rigorous portfolio analysis using the scoring criteria outlined in Table 4.1, it was deemed more efficient to assign 25% of resources to basic research and 75% to applied research and technology acquisition. This case study highlights the need to have a resource allocation policy in place and to have monitoring and evaluation processes to ensure that the policy is followed and that the optimal balance is pursued in a diligent manner.

4.6 Summary

In summary this literature review has highlighted that there is no one way of deciding on an optimal balance of investment between different types of short, medium and long term research. By far the most dominant portfolio management methods are financial methods that use various profitability and return metrics such as NPV, ROI or payback period to rank and choose projects. However, companies that pursue their business strategy in their R&D portfolio management have been found to be better performing, have the right balance and number of projects for their budgets.

So as to have a good balance between short and long term R&D activities, it is important to consider both quantitative and qualitative criteria to analyse and balance a R&D portfolio. This allows managers to utilise business strategy methods which can also consider difficult to measure impacts such as social or environmental outcomes. Scoring methods and some non-market valuation methods can also be used to rank and rate non-productivity outcome projects in a portfolio.

It is also important for projects not to be evaluated in isolation because without supporting projects in a portfolio the project may have a limited impact over time and the value is not just from the individual project but the whole portfolio. There should be some form of accounting for interdependencies between projects.

When optimising a portfolio balance it is important to account for risk. As projects progress, it is beneficial to continuously monitor how risk is changing and to take appropriate action to maintain the optimal balance through time.

There appears to be limited published literature on how R&D organisations can or actually divide their budgets between strategic-basic and applied research. Two examples are studies done by Pannell (1999) and Cáñez & Garfias (2006). Pannell (2010) estimated the mean optimal level of for strategic-basic to be 23%. This estimate was derived by using a simplified modelling framework informed by a study of literature on how strategic-basic research contributes to socio-economic objectives and its links to applied research and technology. Assumptions and parameters used in the model are neither universal nor fixed and they are bound to change with time, across industries, time periods and the different business environment and strategies. The Mexican Petroleum Institute (IMP) had a policy of investing 20% in basic research with the remainder going to applied research and technology acquisitions. A study of their on-going projects revealed that they were spending 40% of resources on basic research while the optimal balance would be to assign only 25% of the budget to basic research. Therefore there is a need to have a resource allocation policy in place and to have monitoring and evaluation processes to ensure the policy is followed and that the optimal balance is pursued in a diligent manner.

Section 5: Managing and Reporting Balance in Rural Research and Development Corporations

5.1 Introduction

A review was conducted of approaches to portfolio balance and allocation used by the other Rural Research and Development Corporations (RDCs).This was to assist in gauging the appropriateness of the LPI approach and balance through comparisons with similar rural research bodies. The review covered the six dimensions of balance and tools and aids used for resource allocation and project selection.

5.2 Approach

The review involved collating information from the RDCs via their published documents (e.g. strategic plans, annual reports) as well as eliciting further information from a questionnaire sent by email to each RDC. Questionnaires were constructed specifically for each RDC based on the information already publicly available.

Information was pursued on six dimensions of portfolio balance including core areas of investment, time to benefits, research type, beneficiary type, risk and research capacity. Information was also pursued on analysis/aids used for project selection. The following RDCs were approached.

Australian Egg Corporation Limited
Australian Pork Limited
Australian Wool Innovation
Cotton Research and Development Corporation
Dairy Australia
Fisheries Research and Development Corporation
Forestry and Wood Products Association
Grains Research and Development Corporation
Grape and Wine Research and Development Corporation
Horticulture Australia Limited
Rural Industries Research and Development Corporation
Sugar Research and Development Corporation

LiveCorp and the Australian Meat Processor Corporation were not included due to the relationships and sometimes shared funding with Meat and Livestock Australia.
After collecting information, personnel were contacted from each RDC to verify findings and provide comment further on their processes for portfolio balance. The responses were aggregated so that specific RDCs could not be identified.

5.3 Results

Of the 12 RDCs surveyed and contacted, six responded to the survey. The results following are split into two parts. The first part presents the information from publicly available documents for the six RDCs that did not respond to the survey. The second part reports information from the six RDCs that did verify and expand on the publicly available information as sought from the questionnaire.

5.3.1 Findings from RDCs not Responding

It should be noted that the following relies only on publicly available information from the six RDCs that did not respond to the survey. Hence, there could be some portfolio balance practices undertaken by these RDCs that have not been reported publicly.

Core Areas
Three of the six RDCs specify target expenditure against core areas (sometimes referred to as goals, programs or objectives). These specifications are outlined in either Five Year Strategic Plans or Annual Operating Plans. Individual projects are classified and expenditure is monitored according to the core areas. The other three RDCs did not directly target some core areas, but monitored and targeted expenditure at a higher level, for example a strategic priority relating to research was allocated 54% of the budget. However this expenditure was not divided any further between core research areas. These three RDCs had marketing responsibilities in addition to a research role.

Research Expenditure Type
The RDCs did not appear to classify or target expenditure according to research types.

Beneficiary Type
Reporting of beneficiary type in a triple bottom line context occurs largely within evaluation reporting. Specific targeting of the portfolio balance according to industry, environment and social beneficiaries was not evident for four of the RDCs, although one of the six did make reference to an intuitive consideration of a balance between productivity and sustainability. One RDC targets beneficiary types via its core areas that were structured in a triple bottom line context.

Time to Benefits
For five of the RDCs, expenditure according to time to benefits is not monitored or targeted. One RDC stated it encouraged a balance between short and long-term projects for industries within its portfolio.

Risk
For five of the RDCs, expenditure according to risk was not targeted or monitored. One RDC considered the risk of not achieving outcomes intuitively when investing in new projects.

Research Capacity
Research capacity was addressed by all six RDCs within core areas, or via higher strategic priorities. Scholarships were provided to maintain skills within the respective industries or address foreseen gaps, however capacity building for specific research disciplines beyond the provision of scholarships did not appear to be taken into account when funding new research projects.

Analysis/aids used for project selection
Processes for selection of projects to fund were found to involve mostly some form of assessment against a set of criteria. Ex-ante benefit cost analysis was a feature of only one RDC's project selection process. The remainder of the RDCs used criteria in a benefit cost framework to determine future investments. The criteria used for project selection included the following but note that each RDC used only a subset of this collective list:

- potential benefits
- likelihood of success
- clearness of objectives
- potential level of overall impact
- stakeholder support
- environmental impact
- project design
- pathway to adoption
- supply capacity
- adequacy of funding
- exposure to external events

- alignment with strategic priorities
- feasibility of proposed work
- how outcomes will add value relevant to industry
- skills and capacity of the research team

The extent to which projects are assessed quantitatively against criteria is unknown.

5.3.2 Findings from RDCs Responding

The results of the six RDCs that responded to the survey are shown below.

Core Areas

All but one of the 6 responding RDCs classify expenditure according to assigned core areas. The process for determining the amount of funding allocated to the core areas is largely a consultative process with industry, committees, the RDC Board and core area investment managers. Categories of core areas for investment were found to change over time, generally according to a five year strategic plan. Set allocations (%) are generally provided as targets for funding to core areas. This may be at the start of a five year investment plan and can act as a rough map for how investment should be allocated, or change yearly.

The one RDC that was found to not report core areas for research had marketing responsibilities and allocated funding according to a higher level budget, for example 'On-farm research' was allocated 30%, but core areas within on-farm research were not given explicit allocations.

Research expenditure type

Two of the six responding RDCs were found to report and monitor research expenditure type from year to year, however only one of the two target specific research type proportions. Another RDC has put processes in place to begin classifying individual project investment according to research expenditure type and suggested that targeting of portfolio balance according to research type may emerge over time from this classification as information on current balance becomes apparent. One RDC responded that a balance between different types of research was considered intuitively in portfolio planning or reviews, but not monitored or targeted explicitly. Weighting of research, development and extension are being proposed in another RDC's draft strategic plan for its on-farm core research areas. Finally one RDC sets broad aspirational targets for research expenditure but has not monitored the portfolio to see whether these targets are being met.

Beneficiary type

To some degree, beneficiary type in a triple bottom line context is reported at least qualitatively by RDCs as part of CRRDC evaluation guidelines. Five of the six responding RDCs did not set targets according to beneficiary types in a triple bottom line context.

One RDC did determine the planned balance of beneficiary type in the five year strategic plan. This balance was being monitored each year and compared with a planned balance. When a project contributed to more than one beneficiary type, the expenditure was reported on the basis of the primary benefit. Monitoring beneficiary type was seen by some of the responding RDCs as primarily for reporting purposes rather than a dimension to plan or target. Beneficiary types in the context of different industries within an RDC portfolio were not explored.

Time to Benefits

Only one RDC provided explicit planned expenditure according to time to benefits. These planned expenditures are outlined in the strategic plan according to the following classifications; short term (delivery of benefits in less than two years), medium term (delivery

of benefits in two to five years) and long term (delivery of benefits in more than five years). Another RDC has planned desirable levels of delivery of benefits in its new draft strategic plan. This planned allocation encompasses its complete portfolio which includes on-farm research, off-farm research and marketing.

Two other responding RDCs are currently beginning processes to monitor expenditure according to time to benefits. One provided definitions of how projects were categorised in the context of the duration of projects. These categorisations were: less than a year, one to three years, three to five years and five plus years. This RDC highlighted that the nature of issues dictate the length of investment. An intuitive consideration of balance was previously used in an attempt to ensure delivery of a pipeline of benefits.

The remaining RDCs responded that they employed an intuitive consideration of balance of the time to benefits dimension or saw that it was incorporated into ex-ante benefit cost analyses conducted of prospective investments.

Risk

The respondent RDCs had a variety of processes to manage risk. However with the exception of two RDCs, there was no targeting of a specific balance across high, medium and low risk investments. Risk was taken into account across the RDCs when deciding on investments through mitigation strategies, likelihood impact matrixes, risk reward analysis and ex-ante analysis. One RDC has begun to monitor portfolio expenditure according to different levels of risk beginning in 2012-2013, however no targeting is planned as yet.

Of the two RDCs planning targets for risk portfolio balance, one has done so against its five year strategic plan and another has set desirable levels of risk expenditure in the draft of its new strategic plan.

Research Capacity

As with the non-responding RDCs, research capacity was consistently addressed within a core area or higher strategic priority. Any existing or foreseen capacity gaps are addressed through the type of scholarships offered for specific discipline areas. Research skills were maintained beyond the provision of scholarships through capacity building components in research projects in three of the six responding RDCs.

One RDC monitors the balance between undergraduate, postgraduate, post doctorate and fellowship support as part of a ‘health check’ within each one of its wider research priority areas. Another RDC is moving towards targeting investment in the research capacity dimension. To date this RDC had seen the funding of PhDs to be based primarily on attempting to maintain a balance between future capacity, commitment to training, succession and R&D project priority. The funding of different scholarships, with some allowance for flexibility, is usually targeted at four to six new PhDs every year and 1 post doctorate. The undergraduate program is still in its building phase. This RDC is also considering capacity building for specific research disciplines when funding new research projects other than scholarships. The RDC has conducted a capability audit and overseen their sector plan with an innovation network. Investing for succession in research capacity has begun and expected to be a more targeted feature in its next strategic plan.

Analysis/aids used for project selection

Ex-ante benefit cost analysis is a formal part of the project selection process for two of the six responding RDCs. Another has used a series of formal models including the Rendell McGuckian model, the Innovar project scorer and a Price Waterhouse Cooper project evaluation tool.

One RDC combines ex-ante benefit cost analysis and a ranking process. Benefit cost analysis is carried out on selected projects. This RDC brings together issues facing the industries in its sector and ranks them according to importance to core areas and to stakeholders. These issues are then explored further to determine what projects should be funded. The projects to address the determined issues are then discussed and ranked by staff and broad based experts including scientists and industry personnel.

The final two RDCs use scoring of projects against a set of criteria. The criteria used are strategic fit, likely impact from investing or not investing, whether market failure exists, short or long term need, risk of not achieving outcomes and the likely adoption pathway. The extent to which projects were assessed quantitatively against these criteria is unknown. One RDC notes that its process is mainly intuitive, however a subjective scoring system against the criteria is used to produce a single score. The score is used as a check that projects are within a "ballpark" and can be used with recommendations to support or not support a project.

Allocations

Four responding RDCs provided explicit percentage ranges of expenditure for how they were targeting or monitoring against dimensions of portfolio balance. A summary of these results is provided in Table 5.1. This covers the dimensions of research type, time to benefits, risk and beneficiary type, however no single RDC was targeting or monitoring balance across all these dimensions. Percentages of expenditure by core areas were not included in Table 5.1 due to the diversity and commodity specific nature of core areas. As some RDCs asked to remain anonymous in this review, the four RDCs are labelled as A, B, C and D in Table 5.1.

Table 5.1:Summary of Allocations or Planned Allocations for Portfolio Dimensions

Research Expenditure Type			
RDC	***Allocation Type***	***Category***	***Allocation***
RDC A	Actual 2012/2013 budget allocation	Applied Commercial Demonstration and extension Experimental Development Strategic basic Training and Development	36% <1% <1% 57% 4% 3%
RDC B	Planned allocation over 2012-2017	Research Development Extension	40% 40% 20%
Time to Benefits			
RDC	***Allocation Type***	***Category***	***Allocation***
RDC C	Planned allocation over 2012-2016	Short (delivery in less than 2 years) Medium (delivery in 2 to 5 years) Long (delivery in more than five years)	43% 48% 9%
RDC A	Actual 2012/2013 budget allocation	Less than 1 year 1 to 3 years 3 to 5 years	Not provided 43% 36%

		5+ years	Not provided
RDC D	Draft planned allocation over 2014-2016	Short Medium Long	38% 42% 21%
Risk			
RDC	***Allocation Type***	***Category***	***Allocation***
RDC C	Planned allocation over 2012-2016	Low Medium High	40% 47% 13%
RDC D	Draft planned allocation over 2014-2016	Low Medium High	42% 47% 11%
Beneficiary Type			
RDC	***Allocation Type***	***Category***	***Allocation***
RDC C	Planned allocation over 2012-2016	Industry Social Environmental	66% 20% 14%

5.4 Summary of Findings

From publicly available information only the key findings were:

- Targeting or monitoring of portfolio balance is generally not being pursued by the six RDCs across the six dimensions beyond core areas and to some degree by beneficiary types.
- A balance across two of the dimensions, risk and time to benefits, is considered intuitively by at least one of the RDCs.
- Evidence of targeting or monitoring of portfolio balance by research type could not be found.
- Limited ex-ante benefit cost analysis is being used for project selection.
- Assessment of potential projects for funding is largely in a benefit cost analysis framework, but no explicit scoring process is reported publicly as being used.
- These findings from the non-responding RDCs are from publicly available documentation. It is acknowledged that some processes for targeting and /or reporting balance within a portfolio may not be publicly reported but may form part of an internal process.

Key findings from the six responding RDCs were:

- Core areas are monitored and targeted across the six RDCs, however sometimes at a higher level such as ‘On-farm research’ instead of more direct research areas such as ‘Improving Crop Yield’.
- One RDC is targeting and monitoring balance across the dimensions of beneficiary type, risk and time to benefits.
- Two RDC’s are beginning to classify and monitor against dimensions of research type, risk and time to benefits.
- One RDC is intending to set targets for their portfolio according to time to benefits and risk.
- The definitions and categorisation of time to benefits and research type vary between RDCs.
- Monitoring benefits according to the triple bottom line was seen by some RDCs as necessary only from an evaluation perspective, rather than in setting targets or in

annual reporting.

- Research capacity is being pursued not only through scholarships but also through capacity components at the project level by at least one RDC.

Section 6: Managing and Reporting Balance in Selected Agricultural Research Agencies

6.1 Introduction

Several non-RDC research agencies were contacted to assess how balance is managed where government rather than industry is the core funding base. These R&D entities were the CSIRO Sustainable Agriculture Flagship Program, the Department of Primary Industries Victoria (now the Department of Environment and Primary Industries) and the Department of Agriculture Fisheries and Forestry Queensland.

6.2 Approach

Five agencies were contacted by telephone and each agency was sent a one page set of questions. The three organisations that responded expressed strong interest in the subject matter and all three supplied significant written responses about their resource allocation process and how they managed portfolio balance. A personal visit also was made to the CSIRO Flagship office and discussions held with Brian Keating (Director).

6.3 CSIRO Sustainable Agriculture Flagship (SAF)

Core investment areas

SAF targets investment in capability areas through a planning process; this process is linked with its impact planning and evaluation processes.

Most of the SAF budget is tied to funders' requirements so there is little scope for top down planning or specifying targets across core investment areas (Brian Keating, pers. comm., 2013). About 15% of the budget is reserved for strategic directions funds. From this 15% the Flagship commits to high risk, blue sky research that helps to inform discussions and future work with impact partners. The 15% is guided strongly by knowledge of pathway to impact.

SAF generates annual reports of expenditure in capability areas. More recently, SAF has commenced coding projects by impact pathways. The portfolio balance is managed to deliver national impacts and benefits via the SAF goals of increasing productivity by 50 per cent and reducing carbon emissions intensity by at least 50 per cent by 2030 (Paul Barnett, pers. comm., 2013).

Research type

Due to the diverse nature of the many impact pathways SAF pursues, there is considered no optimal proportion of blue sky, strategic or applied research. The type of research that is required is considered different for each impact pathway. The more limited strategic funds (the 15%) are invested across the range of research types in alignment with impact pathway aspirations.

For the bulk of the portfolio, a major limitation on research type is the extent to which SAF resources are tied to undertaking research determined by its research partners where most research is of an applied nature.

Beneficiary type

The Flagship's goal includes reference to economic, environmental and social beneficiaries. The economic aspects of increased productivity are only considered to be met satisfactorily on the condition that environmental and social aspects are also met. As a result of SAF impact planning and coding of projects to impact pathways, they are able to manage the balance and type of investment in each of the triple bottom line areas.

Time to benefits
Measures of time to benefits are not specified in advance. The pipeline of impacts is subjected to annual analysis to determine the most appropriate investment that will accelerate progress towards the desired effects across the triple bottom line.

Risk level
Risk-reward spread is not specified in advance. Risk tolerance is more often set by the SAF research partners. There is more control over strategic funds but these are often used to undertake basic research to 'de-risk' a research area such that it would be more attractive to external investment.

In summary:

- The influence of the operating environment on the overall portfolio balance for SAF is significant.
- Only about 15% of the SAF budget is discretionary with the remainder in line with external funding.
- Resource allocation for all expenditure is influenced to some extent by SAF attempting to align its investment with that of partners according to SAF's long-term impact pathways. These pathways have been developed to meet the SAF goals of increasing productivity and reducing carbon emissions intensity.

6.4 Department of Agriculture, Fisheries and Forestry Queensland (DAFFQ)

DAFFQ's response was specifically tailored to the animal industry research area.

Core investment areas
DAFFQ does not specify ahead target percentages of its R&D budget for each investment area. Rather the allocation is dependent on intuition, likelihood of breakthroughs, current state-of-play with industry needs and priorities and the priorities of the Government of the day. DAFFQ support the National RD&E Framework where it has major roles in beef and in tropical-subtropical fisheries and aquaculture.

In the last two years areas of RD&E have been allocated to four categories based on a number of criteria. The categories are: "Must Fund", Should Fund" "Could Fund" and "Low Priority". This process identifies the areas the group will cut at the next budget savings task, with cuts having been made consistently over the past 12 years.

A long-term goal of DAFFQ is to *Double Queensland's Food production by 2040*. This is increasing the focus of research towards productivity (e.g. increasing R&D in animal health, nutrition, reproduction, etc). Correspondingly the investment in climate change R&D and environmental sustainability will decrease. In the animal science area, DAFFQ maps out the broad directions for each industry by six discipline areas similar to those core areas similar to those held by MLA (animal health, genetics, animal welfare, environmental sustainability etc).

DAFFQ do monitor and report actual expenditure every year in each investment area by categorising each project's expenditure by its contribution to each core area as well as to a range of other categories. Data has been reported each year since 2003/04 to the Queensland Chief Scientist, and to the Australian Bureau of Statistics since 1998/99 under their mandatory biennial collection of research and expenditure data. Reports to the Queensland Chief Scientist included the investment against (i) QPIF's Innovation Platforms (Evolutionary, Revolutionary and Tactical Research), (ii) the Queensland Government's R&D Priorities, (iii) ABS *Type of Activity* (Pure-Basic, Strategic-Basic, Applied Research and Experimental Development), (iv) ABS Fields of Research and (v) ABS Socio Economic Objective.

This required project leaders and project officers to categorise projects across the relevant fields. While there is a reasonable effort put into reporting on R&D expenditure, there is currently not a lot of analysis of these reports to provide guidance as to what the R&D portfolio should look like. As mentioned earlier, intuition and gut-feel in response to industry and government priorities dictates the shape of the R&D portfolio.

From 2004 to 2008, DAFFQ operated an internal purchaser-provider model for agricultural RD&E. The purchaser was a group known as the "R&D Strategy Group". The provider was Agriculture, Food and Fibre Sciences. The R&D Strategy Group was staffed with senior research officers and agricultural economists. The group conducted a rolling program of economic assessments of projects and programs. Projects and programs were developed or curtailed based on these assessments.

The R&D Strategy Group monitored expenditure under QPIF's *Innovation Platforms* and did re-direct R&D funds towards more revolutionary research. At times this was controversial, as programs losing funds lacked the mechanisms to reduce expenditure rapidly when needed e.g. the tools to quickly close research facilities or quickly reduce/shift staff were not available.

When QPIF was merged with several other Departments to form DEEDI in March 2009, the purchaser-provider model ceased. During a review of DEEDI's R&D portfolio management conducted in December 2011, many research managers commented favourably on the value of the R&D Strategy Group's independent oversight on the R&D portfolio and the rolling program of economic assessments (Peter Johnston, pers. comm., 2013).

DAFFQ is one of five Queensland Government departments trialling a new approach to budget development known as Zero Based Budgeting in partnership with Queensland Treasury. This approach involves describing the services provided by a business area and accurately costing that service. Services are ranked from most important to least. Animal Science has described its R&D portfolio as a suite of 32 services and described each in detail.

Research type
DAFFQ does not specify ahead the proportion of expenditure it strives to achieve across research types. As mentioned above, R&D expenditure is categorised and reported each year by research type. This has been reported each year 2003/04 to the Queensland Chief Scientist, and to the Australian Bureau of Statistics since 1998/99 under their mandatory biennial collection of research and expenditure data.

Beneficiary type
DAFFQ does not specify ahead the proportion of expenditure targeted at specific beneficiary groups. However, within Animal Science at least, the proportion of R&D allocated to each of the broad livestock industries in Queensland (beef, sheep, dairy, pigs, etc) is monitored with regards to its alignment with the relative gross values of production (GVP) for each industry. Consideration is also given to the relative maturity of the industry and the make-up of the industry.

Expenditures are categorised and reported by beneficiary type each year since 2003/04 to the Queensland Chief Scientist, and to the Australian Bureau of Statistics since 1998/99 under the mandatory biennial collection of research and expenditure data. Reporting and categorising to the Queensland Chief Scientist does not include triple bottom line categories or private versus public benefits.

Time to benefits
The proportion of DAFFQ expenditure targeted at different 'expected time from initial investment to first benefit' periods is not specified nor is it categorised or reported retrospectively.

Risk level
There are no targets involved regarding risk management and there is no reporting by risk category or risk reward.

In summary:

(i) There is very little top down planning towards a targeted/specific portfolio balance across any of the six dimensions.
(ii) Resource allocation between different core areas is driven by both Queensland government priorities and industry priorities, opportunities on offer, the GVP of each industry, intuition, the Department's skills base and the strength of their collaborations.
(iii) Both Queensland Government and industry priorities are currently pushing the balance of investment towards productivity.
(iv) DAFFQ monitors and reports actual expenditure every year across a range of balance dimensions including core areas, research type and industry type; reporting against triple bottom line or against private versus public benefits does not occur.
(v) Despite a considerable amount of data being collated annually on the R&D portfolio, it is not clear how this data is used for adjusting or improving the portfolio.
(vi) There are no targets set or any retrospective reporting for time to benefits or risk –reward.

6.5 Department of Environment and Primary Industries Victoria (DEPI)

Core investment areas
DEPI do not specify ahead target percentages for each core investment area. However, DEPI is well aware of the spread of current investment across each investment area and how it needs to shift resources according to its strategy based on State Government priorities and the national primary industries RD&E strategies (NPIRDEF).

The most recent Agriculture RD&E plan (DPI strategy 2013-17) reflects the Victorian Government's priority for productivity and market access. Industry co-investment is recognised as a key driver in productivity research in that DEPI will reduce its investment in productivity and market access areas if the DEPI investment significantly exceeds industry co-investment.

DEPI Agriculture R&D investment has been categorised into various core areas for some time (with NPIRDEF Industry and cross-sector strategies added recently). Annual monitoring of the portfolio can track whether the shifts proposed in their four-year strategy are actually happening as a consequence of the annual project selection and review process. It is notable that the project selection strategy in place includes portfolio balance as one of its seven criteria.

Research type
Data on research type is assembled each year and has been monitored over many years.

Beneficiary type
The DEPI strategy defines the proportion of expenditure targeted at specific beneficiary groups in general terms but does not specify target proportions. DEPI uses industry level data (e.g. measuring the impact of 30 years of dairy RD&E), program level case studies, and project level evaluation and monitoring processes to guide these proportions.

Most investments aim to achieve multiple benefits across the triple bottom line. This, combined with a general lack of consistency in definitions makes data analysis and target setting difficult using the triple bottom line categories.

In 2013 DEPI is analysing the balance of co-investment from "other government" and "industry" bodies with the aim of determining whether the relative levels of government and industry are appropriate. It will apply a "beneficiaries and funders approach" to test whether co-investment from industry and government are in balance with respect to public and private benefits. To do this it compares DEPI funding with project co-investment from industry (RDCs, CRCs and agribusiness companies) and other government departments (Chris Langford, pers. comm., 2013).

Time to benefits
Adoption timelines vary according to specific industry problems and technology solutions. However, time to first adoption is covered in DEPI's ex-ante project evaluation processes; also, time to adoption is minimised by consideration of route to market issues during project planning and selection.

DEPI assume that the majority of its R&D investments will have an impact on agricultural productivity and competitiveness in the medium to long term. Where there is considered less of a market failure in short- term low- risk projects with shorter times to first benefit, the industry beneficiaries are expected to fund the majority of the investments.

Risk level
DEPI does not specify ahead (1-5 years) the desired proportion of expenditure by risk category at the organisational level. Also, DEPI does not categorise or report expenditure by risk category. However, each Executive Director and their senior team develops their own risk/reward profile which they use to develop their portfolio of projects and their overall approach to science and innovation.

In summary:

(i) Resource allocation between different core areas is strategy driven by the national R&D priorities, Victorian government priorities and the extent of industry funding.
(ii) DEPI investment has been categorised into various core areas for some time; annual monitoring tracks whether the shifts proposed in their strategy are actually happening as a consequence of the annual project selection and review process. It is notable that the project selection strategy in place includes portfolio balance as one of its seven criteria.
(iii) The DEPI strategy defines the proportion of expenditure targeted at specific beneficiary groups in general terms but does not specify target proportions.
(iv) DEPI aims to identify the net socioeconomic benefits in both quantitative and qualitative terms. Benefits by triple bottom line types are not quantified separately due to a general lack of consistency in definitions, the interactions between private and public benefits, and the difficulties associated with confidently valuing social and environmental benefits in dollar terms.

(v) In 2013 DEPI is analysing all its agriculture RD&E investment data to include all co-investment from non-DEPI sources in order to determine whether the relative levels of government and industry are in balance with respect to public and private benefits.

(vi) There are no targets set or any retrospective reporting for time to benefits or risk –reward. However, time to adoption is minimised wherever possible.

(vii) The risk profiles of R&D programs are not managed at a DEPI Group level but are managed by each Executive Director according to their own risk/reward profile that they use to develop their portfolio of key projects.

6.6 Conclusions

- There is no or very little targeted or specific top down allocation processes used by the three agencies.
- They all use mainly a bottom up approach guided by their priorities, goals and strategies that are largely set via government and industry.
- All three agencies recognised the value of knowing the characteristics of their portfolio and how it is changing.
- SAF takes the environment into account when pursuing productivity gains but also focuses specifically on greenhouse gas mitigation via agricultural systems as its main public impact goal.
- All three organisations do report their existing investment expenditure, at least by core area, by research type and to some extent by beneficiary (confined in some cases to industry split beneficiary rather than private/public or triple bottom line split). In some cases much of the reporting appears to be driven by obligations to provide input to other government organisations.
- In the case of DEPI, it is clear that the data is used to maintain a desired balance across the portfolio and is used in resource allocation and project selection.
- The application of categorisation of beneficiaries (industry/community) is necessarily subjective.

Section 7: Informing Portfolio Balance from Past Investment Analyses of MLA

7.1 Learning from Past Evaluations

As reported earlier, ex ante economic evaluation of prospective investments is used by some research organisations, albeit selectively to inform investment decisions. Ex post analyses have been used in the past few years by the RDCs under the auspices of the CRRDC and the Commonwealth Government for the purpose of demonstrating accountability to stakeholders.

However, the economic evaluation of past investments can also inform some aspects of managing portfolio balance. The following provides an indicative analysis.

7.2 The 2006 LPI Analyses

In 2006 Agtrans Research undertook a series of economic analyses for LPI. The rationale for these analyses was that MLA required some measure as to how well their R&D investment portfolio was performing. The initiative was to provide accountability to MLA investors (industry and government) that investments were being made wisely and were retuning financial/economic gain to industry and the wider society. Another principal requirement was the provision of information in a triple bottom line format on the range and nature of benefits being produced.

Fifty randomly selected individual projects funded by MLA from July 2001 to June 2006 were evaluated. Benefits for each of the 50 projects were described and summarised in a triple bottom line format (economic, environmental and social).

Thirty of the 50 projects were subjected to a benefit-cost analysis with the remainder evaluated qualitatively. As some projects had been grouped together for the purpose of estimating the value of benefits, there are 24 rather than 30 individual quantitative analyses in the report.

Industry economic benefits were identified in all analyses and were valued in all 24 quantitative analyses. Environmental benefits were identified in 30 of the analyses. No valuation of environmental benefits was applied but in many cases the economic benefits valued also captured an environmental or resource condition benefit (e.g. reduced soil loss from earlier destocking). A total of 30 of the analyses identified social benefits arising from the investments. As with the environmental benefits, no social benefits were valued in the 24 benefit-cost analyses.

7.3 Extension of the 2006 Analyses

As part of the current project, it was thought possible to extend the 2006 analyses to include portfolio balance information. This was to service two objectives:

(i) to provide earlier portfolio balance information for LPI compared to that provided in Section 3, with regard to core areas, research type, beneficiary type, time to benefits and risk

(ii) to ascertain any relationships between the variables in (i) and between the variables and estimated investment performance.

The total value of MLA funding for the 50 randomly selected projects was $12.3m, which was 26% of the total population of relevant projects of $48.2 M across 361 projects (nominal terms) funded over the five year period ending June 2006. So the projects analysed were a reasonable proportion of the LPI portfolio.

As the sample of 50 projects was drawn randomly, the sample was considered representative of the LPI investment over the period. Hence any portfolio balance information extracted also can be considered representative of investment over this period.

Portfolio information already available from the 24 investments included:

- Investment criteria by 5 levy payer groups (N Beef, S Beef, Sheepmeat, Feedlots and Live Exports).
- Investment criteria by core area of research (N Beef, S Beef, Sheepmeat, Feedlots, Live Exports, Strategic Science, Adoption and Capacity, Environment and Animal Health and Welfare).
- Time from first year of investment to estimated first year of benefits.

Additional information that was extracted in the current review includes:

- Risk reward profile by setting all output and outcome probabilities within each of the 24 quantitative analysis equal to 100%. As most projects were completed, only 5 projects had probabilities embedded from which could be derived some measures of risk–reward. Most of the probabilities referred to outcome uncertainties rather than output uncertainties.
- Research type by categorising each of the 50 projects into strategic-basic, strategic-applied, experimental development, scientific capacity building and extension.
- Beneficiary type by allocating the benefits from each of the 50 project investments to specific percentages of total impact across industry, environmental and social beneficiaries. This allocation was subjectively derived by a team of two in Agtrans.

7.4 Analysis of the 2006 Extended Data Set

Figures 7.1, 7.2 and 7.3 provide a snapshot of how expenditure was allocated in the projects according to core areas, research type and beneficiary type.

Figure 7.1: Proportion of Total MLA Expenditure by Core Area

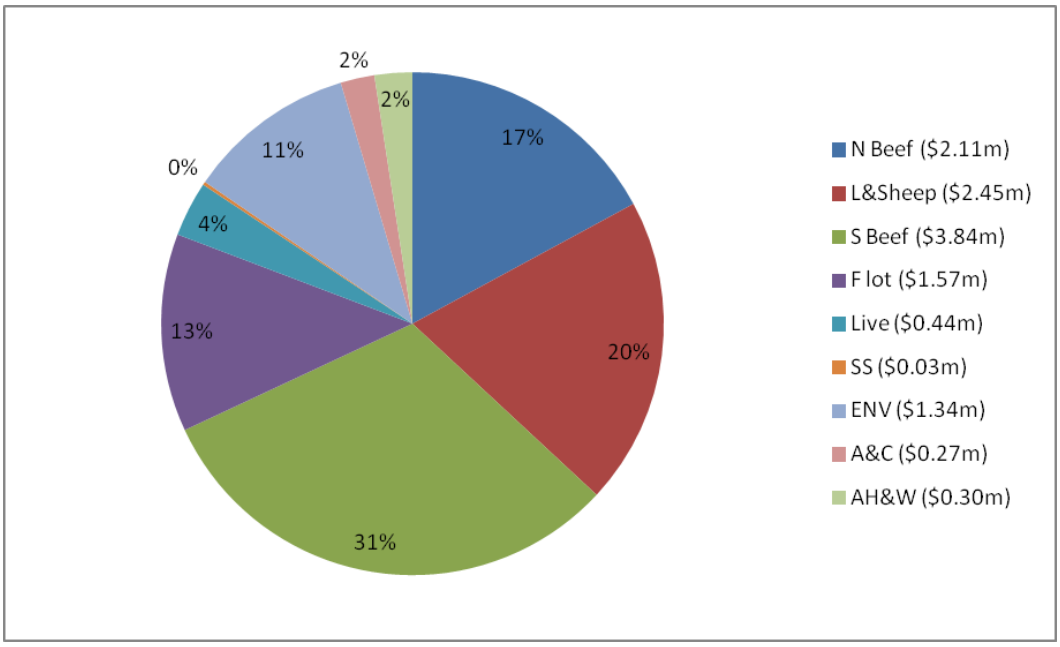


Figure 7.2: Proportion of Total MLA Expenditure by Research Type

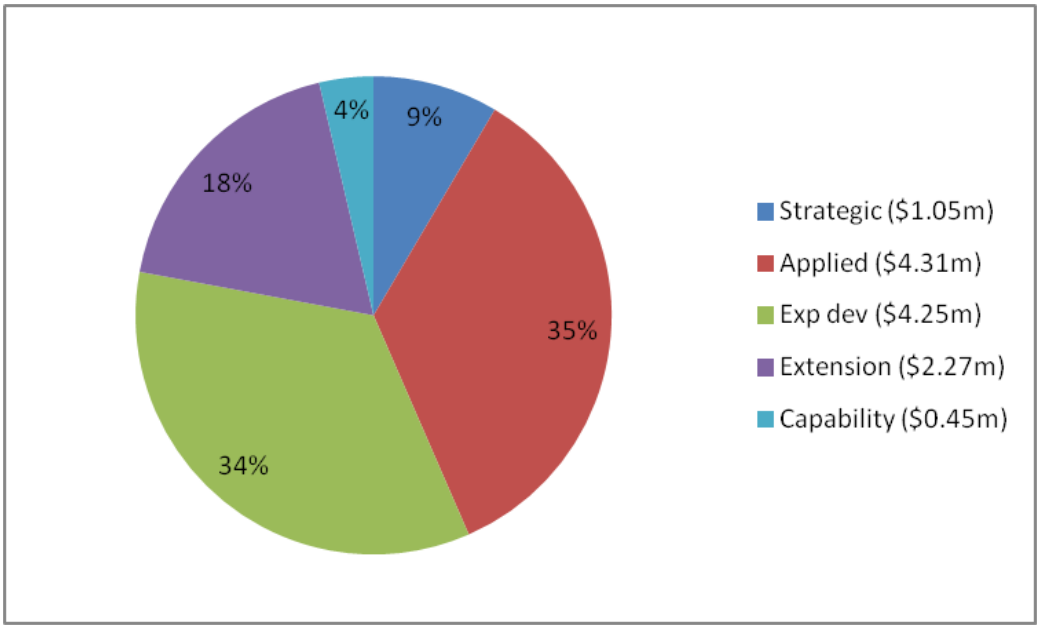
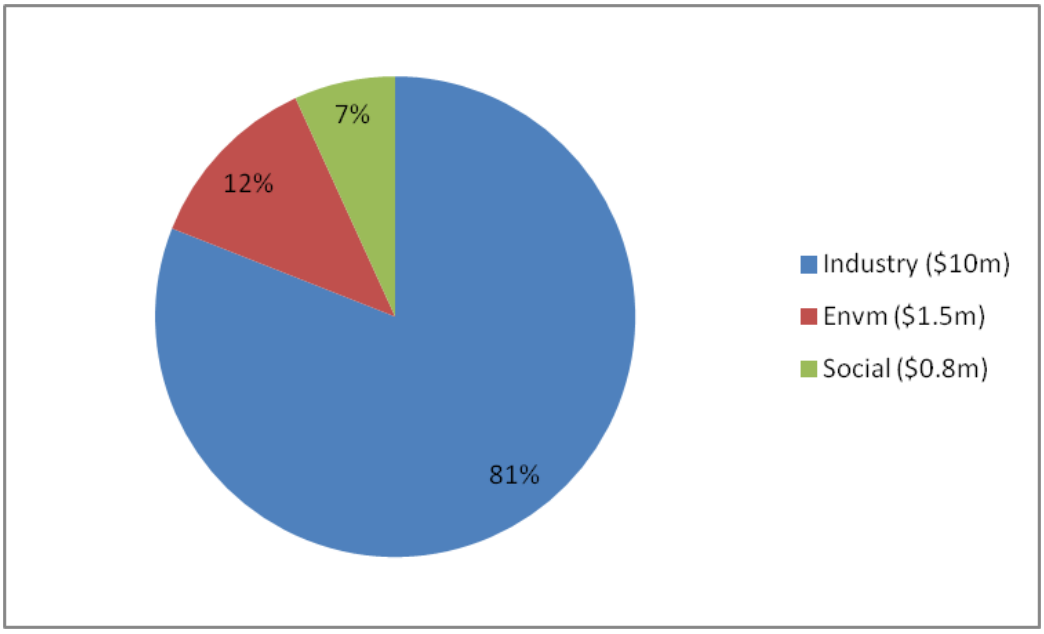


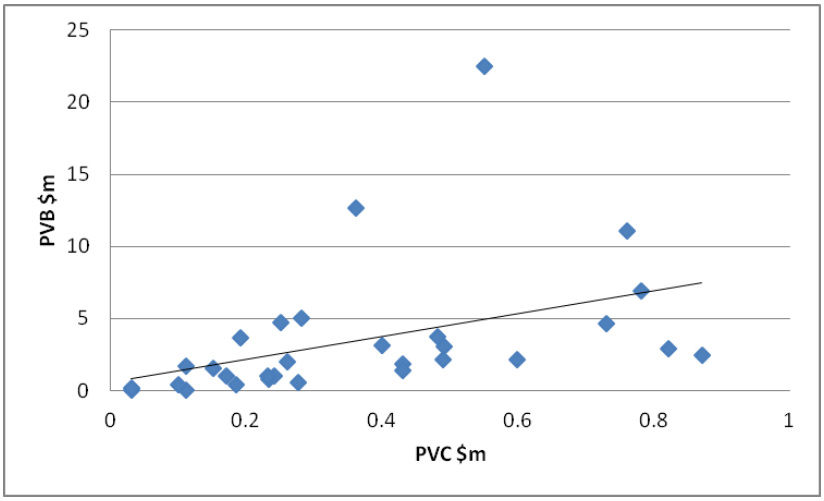
Figure 7.3: Proportion of Total Expenditure by Beneficiary Type



As Figures 7.1 to 7.3 demonstrate, expenditure has been allocated predominantly to the then current core areas of northern beef, lamb and sheep and southern beef. A majority of the research undertaken has been applied or experimental development in nature and the beneficiary of this research was mostly industry, within a triple bottom line context.

Analysis of the data according to investment criteria allowed for some relationships to be tested. For example, as expected there appeared to be a relationship between the size of the investment and the value of the benefits estimated (Figure 7.4). Regression analysis suggested that the relationship was statistically significant (t=2.42, p=0.02), and showed an r-squared value of 0.17.

Figure 7.4: Present Value of Benefits (PVB) by Present Value of Costs (PVC)



The benefit cost ratios for 21 investments (MLA investment only) in relation to its PVC are shown in Figures 7.5.

Figure 7.5: Benefit Cost Ratio by Present Value of Costs

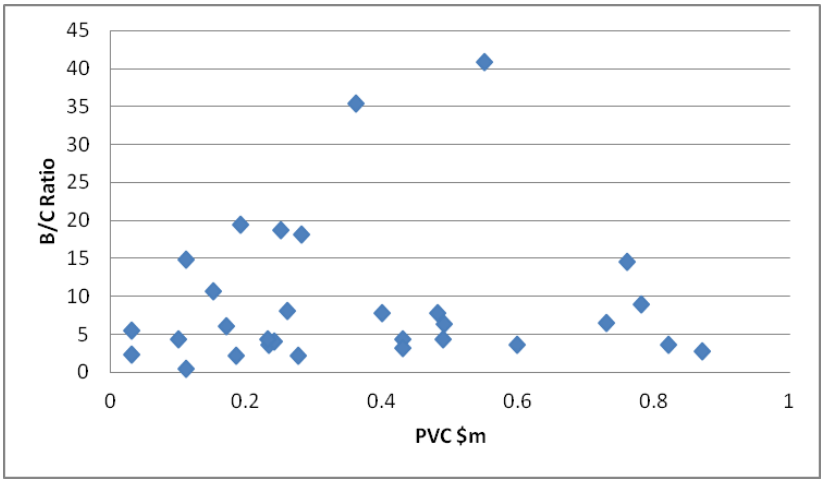
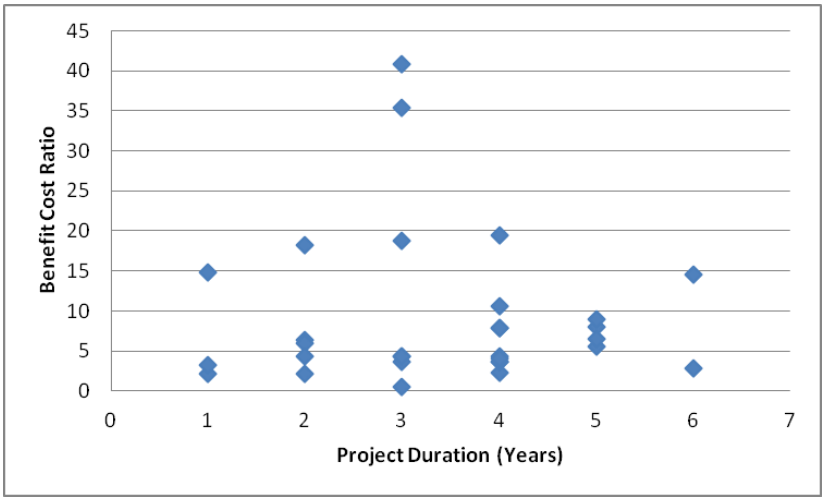


Figure 7.5 suggests no clear relationship between PVC and rate of return.

The duration of each project was also recorded, which allowed for some analysis on the relationship between the length of a project and expected returns. There appeared to be no clear relationship between length of the project and benefit cost ratio as shown in Figure 7.6.

Figure 7.6: Benefit Cost Ratio by Project Duration



The period between the year of first investment and the year of first benefits was also available in the benefit cost analyses. As Figures 7.7 and 7.8 demonstrate, there are no clear relationship between time to benefits and the rate of return. A regression analysis also indicated no significant statistical relationships.

Figure 7.7: Benefit Cost Ratio by Time to First Benefits

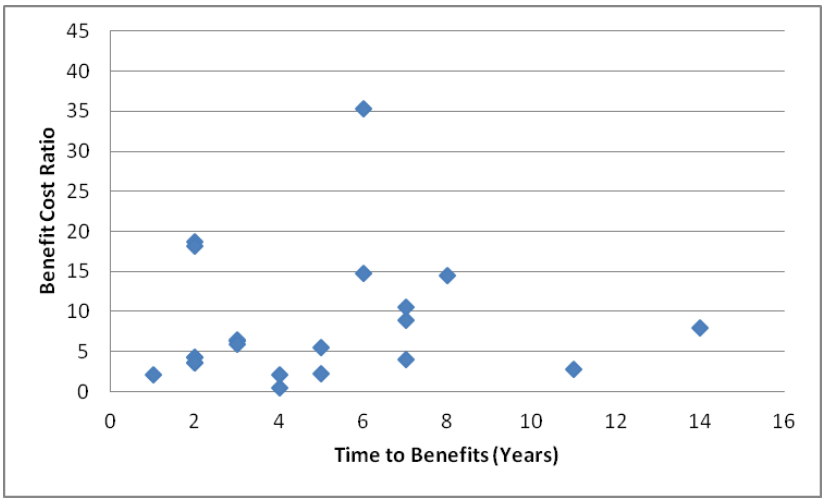


Figure 7.8: Internal Rate of Return by Time to First Benefits

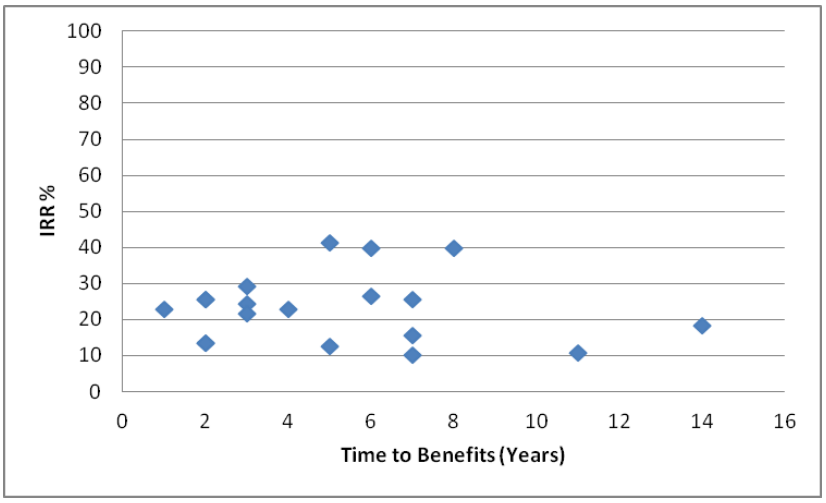


Figure 7.9 demonstrates each project by its research type composition by time to benefits in years. Projects that were strategic in nature took the longest number of years to deliver benefits. Projects with applied research showed longer periods to deliver benefits and experimental development research was associated with projects that deliver benefits across a range of periods under seven years. Projects with extension research generally delivered benefits in shorter periods than experimental development.

Figure 7.9: Research Type and Years to First Benefits

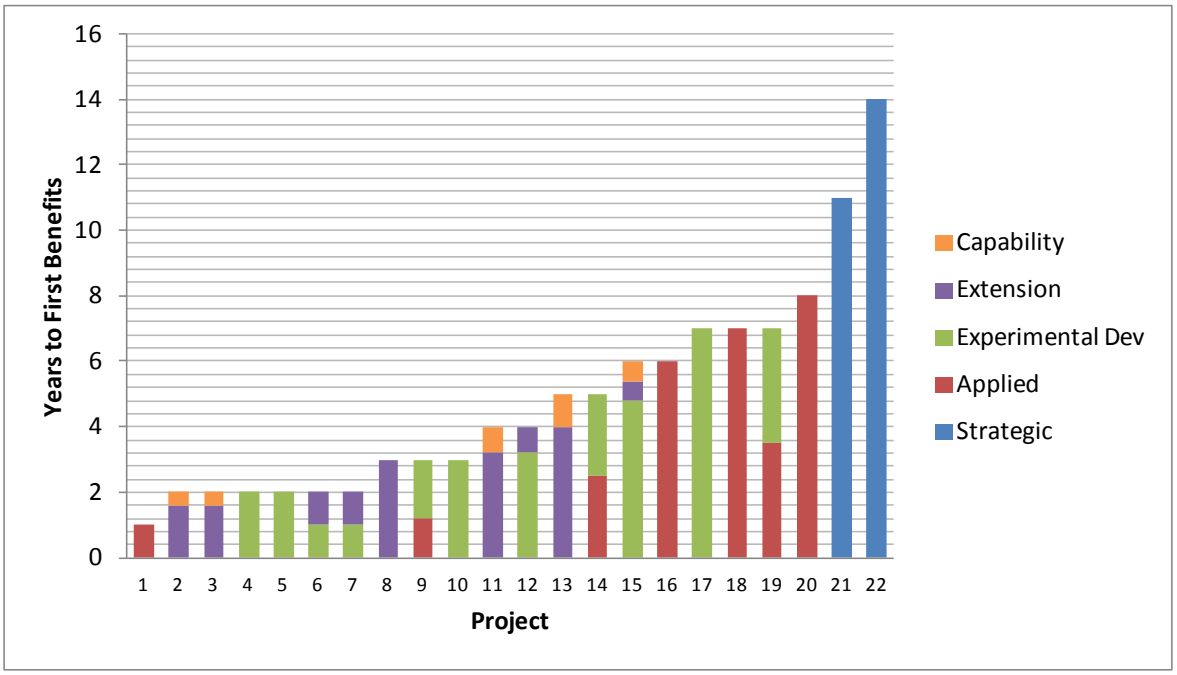
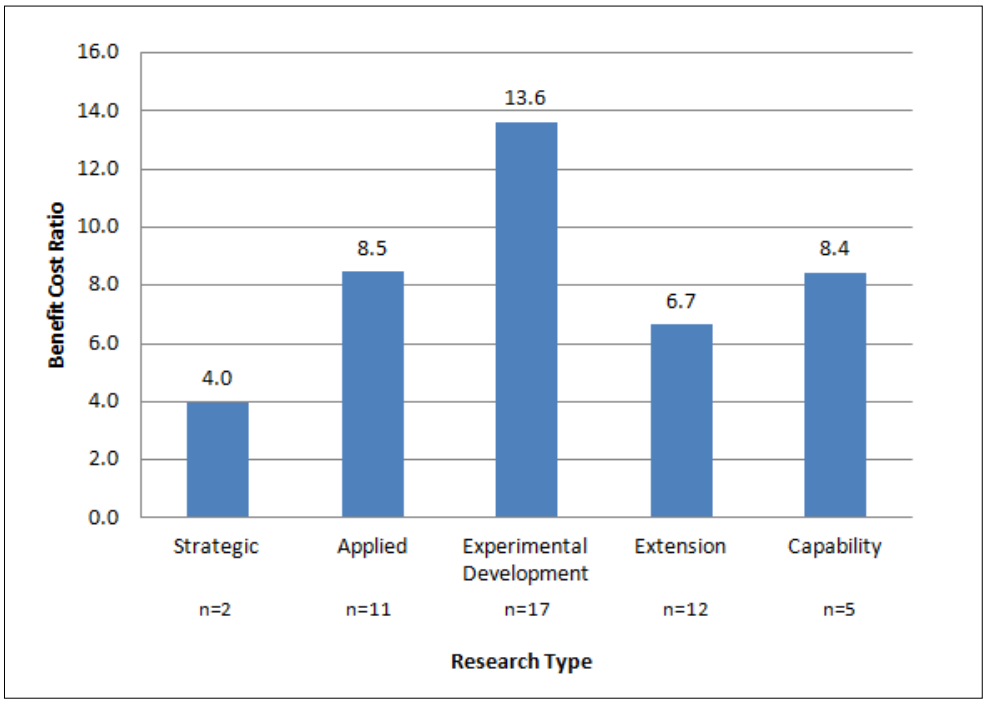


Figure 7.10 shows the benefit cost ratio of projects by different research types. This was generated by weighting the proportion of research type by the PVB and PVC of each quantified project. The weighted PVB and PVC were aggregated for each research type and a BCR produced. As Figure 7.10 demonstrates, the highest returns are from experimental development projects. However, it should be noted that a majority of projects within the sample were classified as experimental development. The number of projects contributing to each research category is noted by n.

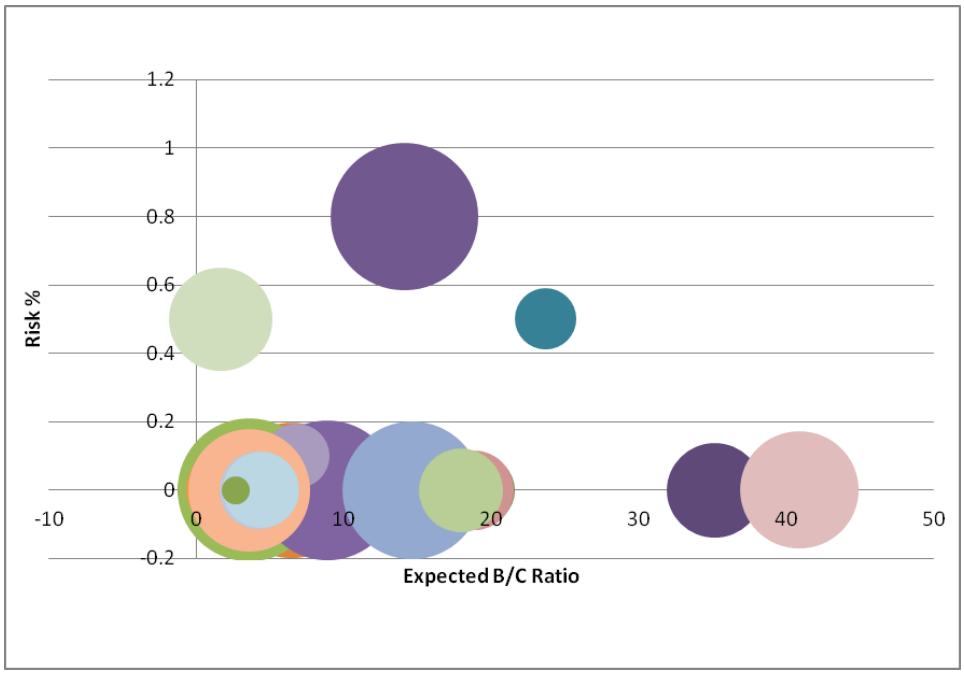
Figure 7.10: Benefit Cost Ratio by Project Research Type



The extended analysis also allowed for a risk reward graph to be generated. The risk free benefit cost ratio on the x axis in Figure 7.11 is generated by dividing the PVB before risk by PVC. The size of the bubbles represents the size of investment (PVC). As previously mentioned, only a few of the case studies allowed a risk free PVB to be estimated due to their mainly ex post nature.

Although most of the investments lie on the zero risk axis due to their ex post nature, one of the investments was shown to have an extremely high benefit cost ratio once risk was removed. This was a highly strategic project which was assigned a low probability of success (high risk) in the original quantitative analysis. Without allowing for risk, the B/C ratio for this project would have been 266 to 1. This outlier has been excluded from Figure 7.11. The most desirable projects according to the graph should be those that lie to the right on the risk free B/C ratio axis and have a low degree of risk.

Figure 7.11: Risk Reward versus Investment Size



7.5 Conclusion

Although constrained somewhat by the size of the sample, this analysis does provide a demonstration of how portfolio balance data may be used when combined with investment analysis. As could be expected, a majority of expenditure was allocated to core areas that represent major industry groups and the primary beneficiary type of this research was industry.

The type of research undertaken was reasonably consistent with the time series data in Section 3, with the highest allocation to experimental development and applied research. Relationships could not be established between investment criteria and both duration of projects and time to benefits. This suggests that, for this sample at least, long and short term projects may not deliver significantly different returns on investment.

Plotting of the relationship between research type and time to benefits confirmed what would be expected, with applied and more strategic projects taking longer periods to deliver benefits. A weighting of PVC and PVB by proportion of research type for individual projects allowed for a benefit cost ratio for each type of research to be generated. Experimental Development was the research type that delivered the largest benefit cost ratio (BCR).

However, care should be taken when making comparisons between the research types and their BCRs considering the number of projects within the sample quantified. The risk reward analysis demonstrated how projects could be plotted to view balance, but would be more meaningful when applied to ex-ante analysis where more uncertainties are present.

The further analysis of ex post data has shown that some portfolio balance information can be extracted from such studies. While the analysis of the 2006 evaluation data does not reveal any key relationships that can be used to suggest balance changes, such analyses may offer evidence that changes may or may not be appropriate.

Section 8: An Assessment of MLA Portfolio Balance

8.1 What is an Appropriate Balance?

The question has been asked "whether the current LPI portfolio balance and the process by which it is determined appropriate"? The term appropriate can be interpreted in different ways:

1. Is the portfolio optimal? This implies that there may be an optimal solution to the balance of individual characteristics of an investment R&D portfolio or for the overall balance between dimensions. Given the changing nature of a wide range of issues facing LPI, the uncertainty of research outcomes, and other factors, the opinion of the authors is that is not particularly helpful to attempt to simplify to such an extent by seeking an optimum. In fact, it may be impractical or endless to pursue such a solution unless the goals or objectives of LPI are defined in quantitative terms.
2. Is the portfolio justifiable? This interpretation places emphasis on the process by which resources are allocated (e.g. the pursuit of efficiency and effectiveness of the portfolio investment) and therefore reflects how the balance has been developed.
3. Does the portfolio reflect the objectives and strategies of LPI and MLA? This interpretation places some emphasis on process but more importantly on the portfolio alignment with corporate and business unit plans, that in turn should capture industry and government priorities.

The following assessment places most emphasis on the process as well as the alignment of the portfolio with plans and strategies and therefore is most focused on the second and third interpretations above.

8.2 Towards Best Practice: Principles Emanating from this Review

There is probably not one set of R&D management practices that is "best" across all organisations. Given that caveat, the elements of a desirable process for managing portfolio balance to ensure appropriateness, efficiency and effectiveness are identified here from the literature review (Section 4) and from selected processes used by other RDCs and the research organisations making input to this study. Four important elements are listed here and each is discussed in turn:

1. A rigorous evaluation strategy at the project level is in place that ensures only the best projects are funded so that impacts of the R&D investment are maximised.
2. The portfolio should reflect the organisation's objectives, plans and strategies.
3. Resource allocation and resulting outcomes and impacts should be in accord with funding of different contributors.
4. The resulting portfolio balance should be monitored and reported in order to inform management of the implications for the portfolio when changes in R&D priorities are being considered, or to ensure changes made to priorities are being implemented.

8.3 Project Evaluation and Resource Allocation

The foregoing literature review (Section 4) found that the most dominant resource allocation methods for R&D are financial methods that use various profitability and rate of return measures to rank and choose projects. The simplest version of this is to select those projects that maximise total financial benefits from a given R&D budget.

However, companies that pursue non-financial methods such as pursing their business strategies within their R&D management have been found to be better performing than those that rely on financial methods alone. While the literature review was focused on companies, there appear no apparent reasons why this finding would not apply to a broader category of commodity research organisations (such as RDCs).

These non-financial methods could include:

- Allocating resources into different boxes according to the organisation's strategies and then ranking or rating projects within the boxes.
- Scoring models or check lists using criteria or answers to a list of questions that include the strategies and priorities of the organisation.

From what we can gather, LPI largely follows a classical financial method of resource allocation with the aid of the Rendell McGuckian (RM) model, but does not use formal scoring or transparent check-list systems.

The RM model is sometimes supplemented with full financial cost benefit analyses (CBAs). While the RM model is a strong productivity modelling sieve, it does not take into account non-market goods or community benefits that do not have dollar values. It is understood these are taken into account subjectively in the earlier stages of project development and in the peer review process undertaken by managers in LPI.

Mullen (2012) has provided a detailed review of R&D activities and processes undertaken in LPI to evaluate program and project proposals. Mullen observed from the peer review process that research proposals were being assessed and resources allocated "in a way consistent with strong outcomes for industry and the community". However, Mullen considered the process "not particularly transparent".

"It seems to me that because of the inadequacies of the proposals and the Items for Discussion (IFDs), external parties using only this documentation would be unlikely to replicate the resource allocation decisions of LPI closely. One step to increasing transparency would be to develop a template for proposals and IFDs which more consistently addressed the 18 questions so that a third party could see a clear plausible path between research activities and industry and community outcomes" (Mullen, 2012).

Other relevant issues here are:

1. Some of the sub-areas in the sustainability area may contain income sources where the resulting resource has to be expended in that particular area (e.g. carbon related issues). In this regard it could be concluded that projects in this area are provided by MLA funding on the basis of servicing government priorities that are reflected in the MLA Corporate Plan, rather than subjected to a rigorous financial or threat analysis.
2. Extension comes under the auspices of LPI but is currently funded from sources outside the LPI budget; this is probably because it covers extending both R&D outputs from both on farm and processing R&D and marketing. How project selection for extension projects is carried out is not commented on here.

In summary, it is considered that while LPI has a rigorous process for scrutiny and assessment of the research proposals, the transparency of the decision process is somewhat limited. Where necessarily subjective assessments are required, there is limited exposure of any of the decision criteria and formal processes used, such as scoring sheets.

8.4 Reflecting the Organisation's Strategies

It is axiomatic that the portfolio of investment should be aligned with strategic plans or business plans. If these plans contain specific or indicative targets for any dimensions of balance, then it follows that monitoring the balance appears necessary with regard to good management, accountability and reporting to stakeholders. If the plans do not specify targets, it still would be helpful to management to know the expenditure in each core area, and across other dimensions as well.

It is not the purpose of this review to assess how well the current portfolio lines up against

LPI business plans (as far as can be ascertained, the LPI portfolio is well aligned with its business plans and with the MLA Corporate Plan 2010-2015). Core areas within the LPI portfolio have business plans containing key initiatives and key performance indicators. The business plan key initiatives form part of the overall Corporate plan's strategic imperatives (together with marketing and off-farm research imperatives). Progress against key milestones is reported annually (MLA, 2012).

Also, it is likely to be important to measure and report on how the LPI portfolio reflects the National RD&E Framework for beef, sheepmeat etc, the National R&D Strategies and the Government's Rural R&D Strategies.

In support of the alignment with strategies, Mullen (2012) makes a useful comment about appropriate balance:
"LPI allocates research resources against a set of strategies derived from the goals of MLA and its stakeholders. Questions about portfolio balance are questions about whether the LPI budget is allocated across this set of strategies (and/or across the research programs that underlie them) in an appropriate manner. Other dimensions of balance might include balance between types of research – basic v applied for example – or between administrative units but balance between strategies seems to me to be the most sensible question related to the efficiency with which LPI uses research resources. Balance between strategies is also amenable to some form of portfolio analysis" (Mullen, page 33).

8.5 Stakeholder Funding Requirements and Beneficiary Distribution

8.5.1 Specific Industry Beneficiaries

It is understood that the MLA resource allocation process ensures that LPI funds are distributed to industries (e.g. sheepmeat, cattle, goats) in accord with the magnitude of levy collections from each source. While this seems straightforward for productivity research, there are also investments that serve multiple industry beneficiaries and also government funds that will be expended to seek community outcomes that also have differential impacts across industries.

As the process is not fully understood by the authors and it does not appear transparent, it could be improved by a formal process of monitoring and reporting to demonstrate the congruence between investment by industry type (beef, sheepmeat etc) and beneficiaries of the investments. If this process is not already undertaken, it would be relatively simple to implement with the proportion of expenditure from each project assigned across the industry beneficiary groups.

8.5.2 Industry/Community Beneficiary

We have been asked to:
"*Propose a suitable means of assessing the weighting of the R&D portfolio across productivity, environmental and social outcome parameters, and compare with other RDCs, or other industry approaches".*

Setting Targets

The setting targets across the triple bottom line (TBL) is not practiced by LPI nor is any monitoring or reporting of the beneficiary split across this dimension. An exception may be in reporting economic evaluation investment analyses where triple bottom line categorisation of benefits may be included. From what we could ascertain, only two RDCs set targets across the TBL.

It could be argued that it would be appropriate to set targets (other than aspirational) across the TBL only when it is required by government or in statutory funding agreements. This is a complex issue as any targets would be dependent on various arguments and rationales for government funding of rural research.

Monitoring and Reporting Across Triple Bottom Line

Such information may be required by MLA to demonstrate it is delivering benefits to the community. The importance of this demonstration would largely depend on the requirements from government associated with its support for matching the industry levies for R&D. There are presently no requirements to target, report or monitor expenditure according to the triple bottom line expectation of impact. However it may prove useful to at least monitor expected LPI impacts in order to report such to the general public, stakeholders and government if required. It is recognised that any classifications would need to be carried out subjectively.

Section 7 of the current report (the 2006 LPI investment analysis of 50 randomly selected projects) was based on analyses that contained TBL reporting at project level. This was extended in the current study by assessing the proportion of each of the TBL impacts for each project. These proportions were applied to the investment costs for each project resulting in an assessment of 81% delivering industry impacts, 12% delivering environmental impacts and 7% for social impacts. While this was a subjective process, it gave results that appeared at least sensible.

This result can be contrasted with the snapshot reported in Section 2.3 where Banks reported 6% social and 39% environmental. While the social impact weight appeared consistent between the two estimates, the estimates for environmental were quite different (12% and 39%). This may illustrate difference in methods and/or inconsistence in definitions of environmental versus productivity splits. For example, projects that directly or indirectly address NRM have both an environmental and productivity dimension.

Rather than estimating the proportion of impacts, another possibility for monitoring would be to subjectively rate the TBL impacts as "significant", "some" and "minor" for any given project or group of projects. This approach has been used frequently by Agtrans Research in the past by applying a subjective impact rating system (three star, two star, one star) for any identified benefits whether they be industry, social or environmental. The aggregate number of stars across a set of projects provides an indicative measure of the distribution of impacts.

Practices in other RDCs

Only two RDCs plan total expenditure according to the triple bottom line. RDCs are obliged to report at least qualitatively in evaluations, but otherwise regularly reporting at a project level across the triple bottom line was not found to be conducted for the whole portfolio.

As opposed to monitoring and reporting the industry/community impacts, Section 9 addresses processes for allocating resources and selecting between projects where community impacts are paramount.

8.6 Monitoring and Reporting Balance

The fourth element considered important by the authors in best practice portfolio balance management is monitoring and reporting the balance. The LPI practice appears to be less advanced than that of a number of other RDCs and the State Agencies. LPI can be considered currently to be in the low- to mid-range of monitoring and reporting activities across the various portfolio dimensions of core areas, research type, beneficiary type, time to benefits and risk–reward.

It is apparent that LPI has a sound project selection process for deploying its research resources and its resulting portfolio is assumed to be consistent with its goals and strategies. While it could be argued that this is sufficient, in the interests of accountability and transparency, this may not be sufficient in future.

The balance dimensions of research type, time to benefits, risk reward and research capability are explored further below. Core areas will not be elaborated on because it is evident that the balance data is available in LPI, but just has not been monitored or reported consistently over time. Sections 3 and 7 demonstrated that mapping trends over time and thus monitoring balance for this dimension may be achieved quite easily. At present, the balance of the LPI portfolio is not reported by core area in publicly available MLA annual reports, but rather at a higher level of all MLA activities (inclusive of marketing and off-farm research). The other dimension of portfolio balance not discussed below, beneficiary types, has been discussed in Section 8.5.

8.6.1 Type of Research

The MLA Board recently has established research type expenditure aspirational targets. However, at least up until this study, it appears that research expenditure type has not been monitored or reported, or, if it has, it has been only for meeting requirements for government reporting in economic evaluation analyses.

A general hypothesis for balancing strategic and applied/adoption investments is that the former is more risky, takes longer to deliver benefits, and produces significant step changes if successful. Section 7 supports the first two relationships but not necessarily the third. The 2006 historical analysis of LPI investments showed no relationship between strategic research and higher benefit cost ratios; in fact, the converse was exhibited. However, there were only two of 30 projects classified as strategic, so the sample was small. Furthermore, one of the two strategic projects was risky and the investment criteria reflected the high risk. If the risk factors were removed, that one strategic project gave far higher returns than any other project in the 30.

Our conclusion is there is not likely to be a standard or optimal proportion of funds invested across an entire portfolio as individual issues may well be suited to different research types at any one point in time.

Further, there does not appear to have been many LPI supported discrete investments that have driven significant step changes in beef and lamb productivity in the past 10-15 years. But whether this is a function of failure of strategic research initiatives or insufficient resources invested in strategic or transformational R&D is unknown. Most productivity advances appear to have been incremental in nature.

8.6.2 Time to Benefits (Maintaining Outcome Streams)

Maintaining continuous outcome and benefit streams to producers is important to levy payers for two reasons. First, being able to deliver a stream of benefits over time is important to retain confidence of levy payers that R&D investment is delivering. Second, the preservation of intergenerational equity between levy payers needs to be addressed so that there is at least some connection between a producer paying a levy and being able to identify with some benefits being captured by that producer.

The maintenance of continuous outcome streams is connected to type of research, time to benefits and risk. Based on the analysis of the 50 randomly sampled projects in 2006, MLA does maintain outcome streams over time. This is largely due to the range of issues covered by a mixture of research types.

Estimates of the period from the first year of investment to the first year of benefits are not currently reported for LPI expenditure. However, it would seem reasonably simple to provide if a description of the pathway to adoption is specified for all projects. The reporting of more detailed information on benefit streams across the portfolio would be difficult to achieve, unless significantly more ex post evaluation was carried out.

8.6.3 Risk-reward

LPI incorporates stop/go points in projects in addition to project management strategies to manage risk in investments (Andrew Alford, pers. comm., 2013). Setting targets for desirable risk levels may not be appropriate for LPI. Monitoring and reporting the level of risk subjectively is considered to be more important in portfolio management. However, quantitative risk-reward assessment can only be achieved by expanding the range of ex-ante evaluation analyses.

8.6.4 Maintaining Scientific Capability

Scientific capability is obviously a key requirement for efficient and effective R&D investment. Most RDCs address the maintenance of research capacity as a core area or a strategic priority. Specific disciplinary gaps identified are often addressed via the type of scholarships or fellowships offered. Building or maintaining specific capabilities is also addressed via components in research projects.

MLA appears to pursue a similar approach. The issue is really one of disciplinary auditing and planning of how to address current and future capability needs, rather than an issue associated with portfolio balance. There is no simple answer to the weighting between investment in R,D&E versus that in capability building, or between different avenues of capability investment that may be available.

One possibility may be that capability may be better built via R&D projects that have been through a selection process rather than via stand-alone PhD scholarships, all other things being equal. This principle is not necessarily supported by evidence but could be supported or rejected by information on recruitment ease, performance and impact, loss of scholarship-trained personnel to other industries/overseas etc. Also, the need for increasing capacity in areas likely to become important in the future may require different strategies as there may be fewer current projects in which they may play a role. It is possible to value investment in correcting gaps in capability by valuing an increase in the effectiveness of R&D, however this would require a number of assumptions to be made, many of which would be uncertain.

Section 9: Resource Allocation to Community Benefit Areas

9.1 Introduction

With regard to the distribution of expenditure and/or impacts to the three triple bottom line categories, some attention has been given in this report to monitoring and reporting (Section 8.5.2). An associated issue is allocating specific resources to produce community impacts (environmental and social) or choosing between projects delivering different proportions of industry versus community impacts.

Also mentioned earlier was that financial guidance tools such as the Rendell McGuckian model cannot be applied to valuing social and environmental benefits. LPI recently restructured its research expenditure into two strategic imperatives entitled “Increasing Productivity” and “Supporting Industry Integrity and Sustainability” (I&S). There is a top down allocation of MLA funds to these two imperatives.

The I&S area does contain a number of sub-areas that are associated with productivity (e.g. weeds, pests, and natural resource management areas such as soil erosion). This means that the two imperatives do not clearly represent productivity versus community benefits. The top down process that drives the allocation to these two boxes of resources has not been determined but it is understood that the process is consistent with MLA objectives and funding sources and allocates resources from a range of sources to a range of MLA activities via a two dimensional matrix (MLA, 2012).

The implication of this process is that specific projects in the I&S area may not compete for resources with projects in the productivity area. The process therefore does not necessarily equate marginal returns of projects associated between the two boxes of resources, even though both boxes contain productivity elements. Furthermore, the top down allocation between the two boxes of resources is not transparent. It is understood that this split is largely historical but it is presumed it does still reflect stakeholder goals and allocates resources according to funding sources. Whether there is a process whereby changes in priorities can shift this two-box allocation is uncertain.

Given a fixed level of resources for integrity /sustainability, the next question is how are projects, for example, in the animal welfare area compared to those that support biodiversity or other natural resource management improvements.

9.2 Tools Used by Other RDCs

Most other RDCs do not use a top down approach to allocating between productivity projects and projects where there are significant community impacts. As reported in Section 3, processes for selection of projects to fund were found to involve mostly some form of assessment against a set of criteria, and many used a combination of ex ante economic analyses and scoring or ranking processes. Ex-ante cost benefit analysis (CBA) was a feature of three of the 12 RDCs in their selection process and it is presumed that these CBA processes were not used for valuing the community impacts. In general, CBA was used selectively.

Some RDCs used ranking and/or a set of criteria to select future investments and these were applied to all projects irrespective of the type of impacts. These criteria differed among the RDCs. Some RDCs applied ranking by both staff and broad based experts including scientists and industry personnel. Where project scoring was used, criteria included (among other variables) strategic fit, extent of impact, extent of market failure, risk of not achieving outcomes and the likely adoption pathway

A major argument for ranking and scoring against a set of criteria is, that while still subjective, it formalises the process and increases transparency. Any such process is contestable and scores are explicit and recorded. Whether such scoring is carried out by LPI staff or by a wider group, may depend on what other peer review screening is involved in project selection.

9.3 Valuation of Social and Environmental Benefits

Even with ex post CBAs, there has been limited valuation of benefits in environmental and social categories by the RDCs. For example, in a recent study by Agtrans Research of a range of cost benefit analyses (CBAs) of agricultural research investments (including those by RDCs), only 61 social outcomes were valued for CBA purposes out of a total of 526 social outcomes identified. It is likely that major reasons for not valuing were insufficient linkage evidence and the judgement that it was not worth the effort given the resources available. It is also generally recognised that many social outcomes are actually spillovers from industry outcomes.

Further, a number of the social benefits valued in some CBAs are not entirely legitimate as they sometimes overlap with industry benefits (consumer benefits can already be included in industry benefits via economic surplus calculations) or employ community employment and income benefits relying on multipliers from farm productivity or farm income gains. Such benefits should not be included in such CBA analyses carried out within national boundaries (due to resource displacement issues).

Any social benefit categorisation is furry around the edges. An attempt at categorisation is shown below in Table 9.1. These categories have been adapted from earlier work in 2012 for the Department of Primary Industries Victoria and would be suitable as an initial check list for LPI.

These categories were not defined specifically to address livestock-oriented research but rather agricultural research in general. The relevance of meat and livestock production to each of these categories of outcomes could be examined and adapted to identify issues relevant to a LPI context.

Table 9.1: Social Benefit Categorisation for Agricultural Research

Social Benefit Category	Description
Increased community capacity	Wider community and its individual members (including primary industries) ability to adapt (prepare, respond and make decisions) to changes in agricultural conditions through education, training, planning, technical and financial skills, innovation, networking and policy.
Increased social equity and reduced conflict	Covers improvements in understanding of issues among and between industry and community groups, protection of indigenous knowledge and cultural practices.
Improved health (including mental health) and safety for industry workers and farm families	Covers reduced stress, anxiety, injuries, morbidity and deaths in the workplace, along the value chain, as well as families living on farms.
Improvements in animal welfare	Covers reduced deaths, morbidity and suffering for farm, companion and pest animals.
Increased, or avoided loss of, amenity	Covers avoided costs of degradation or improvements in air quality, water quality (boating and swimming), landscapes,

	recreational fishing and other recreational activities/facilities.
Increased scientific knowledge and research capacity	Covers scientific knowledge that has broad relevance to the wider community as well as innovative capacity, scientific leadership, education and training for researchers.

A similar check list could be developed for environmental benefits.

While there are existing valuation methods via benefit transfer from existing willingness to pay studies and potential for development of standard values for some community outcomes, it is generally held that at this point in time a comprehensive valuation of social and environmental benefits within a portfolio is too difficult, costly and not sufficiently reliable.

Some projects not conducive to the RM model are currently addressed by their own specific ex ante CBA. It is suggested that further CBAs could be undertaken on some selected projects in the I&S area where there may be existing credible estimates of available social and environmental benefits (e.g. soil loss, weeds, biosecurity improvements).

9.4 Scoring or Ranking

If valuation in dollar terms is generally excluded, the next best alternative may be to undertake a scoring or ranking approach to all projects with a template where each project is scored against a set of predetermined and stated criteria. Criteria could be established reflecting a benefit cost framework with questions including those addressing impacts or benefits, the proportion of the industry or industries targeted, the pathway to adoption, added costs along the adoption pathway, expected maximum level of and first year of producer adoption, probabilities of output and outcome success etc.

Many of these criteria are most likely addressed in the current LPI resource allocation system. While the RM model covers many of these criteria for productivity outcomes, something more is required to support scoring for the environmental and social outcomes. Such an approach would not only provide a mechanism for selecting between projects with mainstream community benefits, but also between community orientated and productivity elements and would accommodate those projects with spillovers both ways. In summary, the process would necessarily be subjective and probably mimic to some degree the current process. The main advantage is that the process would be transparent and incorporate social and environmental benefits. The most difficult aspect would be the scoring (e.g. on a scale of 1 to 5) for environmental and social impacts.

One aid to a scoring approach could be for LPI to produce a series of information sheets addressing each of the principal environmental and social outcome areas. Such data sheets could cover aspects such as scope, current impact on both industry and society, opportunities for improvement, and R&D needs. The sheets could include data on the magnitude of the issue (e.g. the cost of eutrophication in Australian waterways, the cost of farm accidents to society, the various estimates that have been made on the value of biodiversity, the value of erosion and soil loss).

Even if a formalised scoring system were not developed by LPI, such data sheets could still provide support in arguing the case for a project within the current LPI allocation process. This would be by providing evidence of the magnitude of the issue, opportunities to deliver impacts and the likely adoption pathways. In some cases it may be clear from the sheets that there is no LPI role for R&D investment or in extension.

Such information may be required by MLA to demonstrate it is delivering benefits to the community. The importance of this demonstration would largely depend on the requirements from government associated with its support for matching the industry levies for R&D.

It is understood that some initiatives have already been undertaken in LPI to strengthen evidence for supporting projects associated with non-market benefits. Also, the idea has been mooted that the "cost to industry" of a range of issues may be a useful starting point; these would include the costs of potential regulation and loss of market access.

Section 10: Options for LPI

10.1 Monitoring and Reporting Balance

The most important change for LPI to consider is to commit to a process of monitoring and regular reporting the balance of its portfolio. The major argument for this approach is that the R&D portfolio balance cannot be improved if knowledge of the existing balance is not available. Further, arguments for LPI developing a consistent monitoring and reporting system would be:

- It is becoming more commonplace among other Australian RDCs and State agencies.
- DAFF (2012) in response to the Productivity Commission Report has signalled that the RDCs may need to do this in the interest of efficacy, accountability and effectiveness:
  "The government will require that RDCs be able to demonstrate a mix of investment projects (short, medium and long-term) and their associated risk profile (low, medium and high) and to report against them. This expectation will be reflected in RDC SFAs." and
  "invest in an R&D portfolio that appropriately balances long-term and short-term, high-risk and low-risk, and strategic and adaptive research needs"
- It can be helpful in ascertaining if the portfolio reflects changes in strategies and priorities made at a higher level.

The dimensions to monitor and report could cover core area and sub-areas, research type, time to benefits, risk-reward, and beneficiary type including industry subsector and potentially regional distributions of potential impact.

If this option is considered there are associated activities involved to assist effective and efficient categorisation. Some to be addressed would include:

- Definitions of categories and guidelines for their use.
- Depending on who and how many are involved in carrying out the categorisation, there may well be a need for preliminary testing and standardising the application of the categorisation system.

An increasing economic evaluation effort (both ex ante and ex post) at project level could boost the usefulness of the monitoring and reporting activity. For example, it could be helpful if LPI could aggregate the results of its RM models for new projects into meaningful groups (sub-areas within productivity) and/or historical CBAs. This would allow success measures such as investment criteria to be compared with various dimensions of balance to elicit potentially useful relationships and strengthen reporting. Undertaking CBAs that include valuation of non-market impacts for selected projects also could be considered.

The performance of past area and sub-area investments from past economic evaluation studies could act as a guide for future investment. In 2004 CIE recommended an integrated selection/evaluation system for MLA incorporating both market and non-market values, but it is understood the system was never implemented.

10.2 Increase the Transparency of Resource Allocation within LPI

The Commonwealth Government (DAFF, 2012) has indicated
"it will implement changes to the RDC model to increase accountability and transparency to stakeholders. The changes are intended to provide clarity to levy payers on rural R&D expenditure, and provide confidence to stakeholders that the investment is being well spent".

In summary, the government will
"require RDCs to publicly release the minutes of board meetings and outcomes of project selection processes".

Based on DAFF intentions and the earlier arguments in this report based on efficiency, LPI needs to consider increasing transparency in its resource allocation process. This applies to the allocation between the two strategic imperatives (involving a wider MLA process), as well as to projects within each imperative.

Both allocation processes need greater emphasis on structures that encourage resources to be allocated so that the marginal value of the last project in each area is roughly equated. The non-market values in environmental and social impacts make this extremely difficult, but a potentially improved process appears feasible.

10.3 Development of a Scoring Model for Project Selection

One possibility for improving transparency would be the development of a scoring model that could be applied to all potential LPI investments. Some of the characteristics of a scoring model could be:

- Development of projects via consultation as currently exists
- Preliminary screening ensures all projects coming forward reflect MLA goals, strategies, and imperatives
- Scoring model to be based on a set of criteria
- Criteria address both market and non-market impacts
- Availability of data sheets to assist with scoring
- RM and other CBA models to assist with screening and provide input to the scoring model

If the scoring option is considered there are other activities and elements that need to be considered in its development. Some of these would be:

- Development of the information sheets
- Consideration of who does the scoring
- The specification of the scoring criteria

Section 11: Conclusions and Considerations

Key findings in this report include:

1. LPI resource allocation and project selection methods are generally rigorous and are likely to result in investments that are efficient and effective in the pursuit of the higher order objectives set by MLA and the priority areas defined by MLA.
2. While the objectives and areas of research are defined in the MLA Corporate Plan, Business Plans etc, the transparency of processes for resource allocation are relatively weak.
3. Apart from the use of some tools (e.g. Rendell McGuckian model and KPIs) we could not find where the resource allocation process, including how tradeoffs are made, is described in a practical sense.
4. LPI monitoring and reporting of its portfolio balance is not advanced compared to some RDCs and compared to the two state agencies making input to the study.
5. The LPI monitoring and reporting of portfolio balance could be improved by a greater commitment to categorising and reporting across a range of dimensions as suggested in the options section of this report.
6. The current portfolio balance resulting is generally appropriate to goals and imperatives stated but can be improved largely by more standardised and regular reporting of the portfolio.
7. As with other research organisations, allocation of expenditure to projects with significant social and environmental outcomes is recognised as difficult due to the inability in most situations to confidently value the relative outcomes; this applies to the tradeoffs between projects with productivity and environmental/social impacts, as well as between projects with predominantly environmental/social impacts.

Key considerations for LPI are:

1. Develop the monitoring and reporting of portfolio balance.
2. Make greater use both of ex ante and ex post economic evaluation studies potentially to improve resource allocation and portfolio balance.
3. Increase the transparency of process in resource allocation and project selection.
4. Develop a scoring model supported by fact sheets that assist scoring against environmental and social impacts.

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Appendix 1: Terms of Reference

MLA is seeking an independent review of the current LPI R&D investment portfolio. This will require the reviewer to:

1. Propose a suitable means of assessing the weighting of the R&D portfolio across productivity, environmental and social outcome parameters, and compare with other RDCs, or other industry approaches.
2. Using the recommended approach, assess and report on the current portfolio balance, and define the most appropriate balance of projects across core areas, timeframes and if possible research disciplines, taking account of productivity, environmental and social outcomes. Further this assessment should address issues including:
    a. risk in R&D portfolios;
    b. the potential benefits and risks of longer-term, “blue-sky” research; and
    c. concerns about maintenance of scientific capability.

    The analysis should be informed where possible by evidence of past success in a) developing new knowledge and tools, and b) achieving adoption and hence industry change.
3. Provide recommendations on the balance of short, medium and long term projects to provide an ongoing pipeline of innovative R&D outputs.