Australian Government
Australian Centre for
International Agricultural Research

Research Planning and Management for Foresters

ACIAR Training Manual

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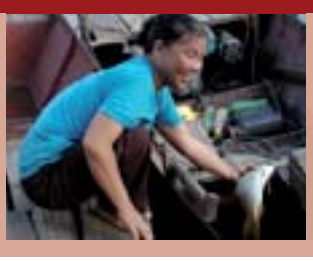

Research Management for Foresters

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Section 1
Knowing and understanding your context

1.1 Your external environment

External Influences

Many drivers of change in external environment
Political – government policy, regulations
Economic – business, international
Environmental - services, sustainability
Social and cultural – traditions, demographics
Technological - innovation
Cannot be predicted, but knowing about possibilities improves decision making

Government Policy

How will changes in government policy and priorities influence demand for research?
Implications for your organisation
Look ahead ten years
Most important policy issues (all areas)
Most uncertain issues (least predictable)
Consequences for forests, forest management, forest communities, industries
Policy opportunities and threats

Strategic Focus Topic

Agreed a strategic focus topic
Research and government policy
Research informing policy design
Research delivering policy objectives
Forest industries and communities
Time frame
Key areas (AROs)

Strategic Focus

Provides context and guidance
E.g., ARO identification
Not only forest policy
Poverty reduction
Environmental sustainability
Regional development
Integrated rural development
Health and education
other

Task 1

Agree strategic focus topic
Research- policy linkages
Identify influences over next 10 years
Assess importance and uncertainty
Agree key changes likely to shape strategic topic (critical uncertainties)
Provide external context for planning and priority setting

1.2 Your internal environment

Background

The purpose of this stage is to collate and assemble relevant background material that describes the structure of your group or organisation, the main areas of research, the sources of funding and recent performance information. In compiling this information and data, issues and patterns may emerge. These should be noted and listed.

For each area, as well as presenting relevant data, list any current and possible future issues, especially those expected within your planning horizon (e.g., the next ten years). This may include decisions to be made on projects/contracts and their funding, staff changes, asset replacement, and the like.

Having completed this stage all members of the group should have a common understanding of the current scope of the group's or organisation's activities and be aware of particular internal issues that may have a bearing on your future direction and performance in the future.

The key tool for this stage is an assessment of your organisation's strengths and weaknesses. At the same time, opportunities and threats in the external environment are assessed as well.

Some of this information and data will be compiled prior to the SWOT.

Step 1 Assemble Team data and information

For each of the following areas, note whether relevant data are available and note any relevant issues, especially current issues.

Area	Data	Issues
Staff		
Budget and finance		
Current Research Program - and commitments beyond current year		
Collaborators and Partners		
Main areas of work – what business are we in?		

Performing a SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis of your organisation

The SWOT workshop is essentially a brainstorming session, with each participant contributing. We use the nominal group technique, where each participant spends time alone writing down what they consider to be good and bad aspects of the organisation's business – the research program, the management of the research, linkages and collaborations, team dynamics, and so on. There are no boundaries. It is a time for each individual to have their say on what is working well, what is in need of improvement, what is frustrating and what is exciting and fulfilling.

Step 2 Individual ideas generation

Working alone for about 10 minutes, write down on a piece of paper what you consider to be good and bad about your organisation (focus to be agreed during the session), its program of activities, the work environment, its position in the government system and so on. Work quickly and freely. Write whatever comes into your head.

Step 3 Notes

Transcribe each individual idea to a PostIt Note. Only one idea per note, concisely and clearly expressed for your colleagues to see and understand.

Step 4 Trigger ideas

Write down any additional ideas that are triggered by the conversations during the first feedback session. These can be reported in subsequent feedback rounds.

Once the ideas and issues are exhausted, the next step is stand back as a group and consider the full set of ideas raised.

Step 5 Group perspective

Does this set of ideas and issues characterise the your organisation in all its important aspects? Is anything missing? Add more ideas to complete the picture. (note your personal response and then feed into group discussion)

The next step is to analyse the SWOT, component by component, commencing with strengths.

Analysis of Strengths

A strength is a favourable characteristic or feature of your organisation that sets you apart from your competitors and gives you a distinctive advantage. The thing to look for among the strengths is the organisation's distinctive competencies. A distinctive competency is an organisational strength that uniquely belongs to the organisation.

If it is not a unique strength or if others can readily copy it, then it is not a distinctive competency. It is distinctive competencies that establish the organisation's sustainable competitive advantage.

Distinctive competencies must belong to the organisation or a unit within the organisation and not exclusively to a single member of staff. If the competency is embedded in an individual, then it is difficult to define that as a sustainable organisational competency. So for each strength it is necessary to ask this question:

Is the strength embedded in the organisation or unit, or is it exclusive to an individual staff member?

If the strength of competency belongs to the organisation or group, then the group's work potential (in terms of research output, earnings capacity, etc) can be sustained.

The following is a list of distinctive competencies, grouped into five areas:

Institutional knowledge (organisational based)
- Particular research capability
- Know-how
- Intellectual property
- Knowledge
- Customer knowledge (values)
- Shared values
- Internal networks

Embedded processes
- Leadership style and commitment
- Customer linkages
- Collaborations with other providers
- Relationships with government departments and agencies
- Internal communication systems, culture
- Staff commitment

Reputation and trust
- Brand name
- Size, position in market
- Resource base, skill base, past activities

Legal protection
- Patents, copyrights, etc
- Ownership of sites etc
- Agreements, etc

Activity specific assets
- Investments in position, market share, image
- Investment in sites, equipment, activities
- Capacity

Step 6 Analyse strengths for organisational distinctive competencies

What is unique about each particular strength? Why would others, competitors, be unable to emulate it?

To help with this assessment, list the organisation's or group's agreed strengths in the table on the following page and assess each accordingly. Indicate with a tick or a cross.

In some cases a distinctive competency may arise from the combination of two or more individual strengths. Explore the full set of strengths for distinctive competencies that may arise from systemic combinations, describe each and add to the list
.

Finally, test the vulnerability to competition of each strength – is the use-by-date OK or is likely to expire in the near future?

Assessment of Strengths – Distinctive competencies						
Strength	**Organisation based knowledge**	**Embedded Organisation process**	**Reputation**	**Legal protection**	**Assets**	**Vulnerable**
Y or N ?						
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						

Analysis of Weaknesses

A weakness is an unfavourable characteristic or feature of your organisation that makes it vulnerable to competitors and places it at a disadvantage. Some weaknesses are essentially symptoms of more significant matters in an organisation. The aim is to eventually address the cause of the weakness. This can be addressed later in the process, when strategies are determined.

Other weaknesses are failings relating to basic management of the organisation or group. These are operational weaknesses. They may include financial systems, personnel policies, succession planning, communications, reserves management, contract management, project selection processes. Good management of operational matters, while unlikely to generate a competitive advantage, has the benefit of ensuring that the organisation is well positioned. The absence of good operational practices adds to the stress of management and makes survival difficult.

A third category of weaknesses are structural weaknesses. These are areas where the organisation lacks a distinctive competency that would give it a competitive advantage. This involves assessing the organisation's position and performance in the market for research services relative to the competition. Structural weaknesses may indicate future strategic choices for the organisation – a structural weakness is a lack of strength which management intuitively feels the group or organisation should have. As such, they indicate areas of future or potential development.

Step 7 Analyse organisational weaknesses for potential development areas

Consider the list of weaknesses and classify each into one of the following categories:

Symptom Operational weakness Structural weakness

Weakness Assessment

Weakness	Symptom	Operational weakness	Structural weakness
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Analysis of Opportunities

Opportunity areas are potential investment or activity options. An opportunity is a favourable external situation or potential for growth, profit, advancement that could help your organisation or another research provider if appropriate action is taken. They should include existing areas as well as new areas. As the focus is the future, it is necessary to establish whether opportunities for existing activities and areas of investment will remain. You need to define opportunities as opportunity areas open to the organisation or group. By taking this approach, existing capabilities and the structure of the organisation should not limit the scope of opportunity identification.

Opportunities may be one of two main types:

- A portfolio opportunity
- A capability opportunity

A portfolio opportunity is an area of potential activity where the organisation's distinctive competency might enable it to develop profitable activity, or make profitable contributions to industry.

A capability opportunity is an area where the organsiation can develop a new capability that is relevant to future success. These potential development areas can be linked to structural weaknesses, which revealed potential areas for capacity development. Capability opportunities may include scientific capacity building.

Step 8 Analyse opportunities facing the organisation

Consider your list of opportunities and classify each into one of the following categories

Opportunity assessment

Opportunity area	Portfolio opportunity	Capability opportunity
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Analysis of Threats

A threat is an unfavourable external situation or force which could materially or professionally damage or undermine your organisation and others like yours, particularly if no protective action is taken.

In the analysis of threats look for any patterns and connections between individual threats. Differentiate each threat on the basis of whether it is an individual event or issue of short-term consequence only, a medium term and higher level issue or a longer term structural and fundamental issue that may change important aspects of the business environment.

Step 9 Analyse Threats facing the organisation

Consider the list of threats and classify each into one of the following categories

Threat Assessment

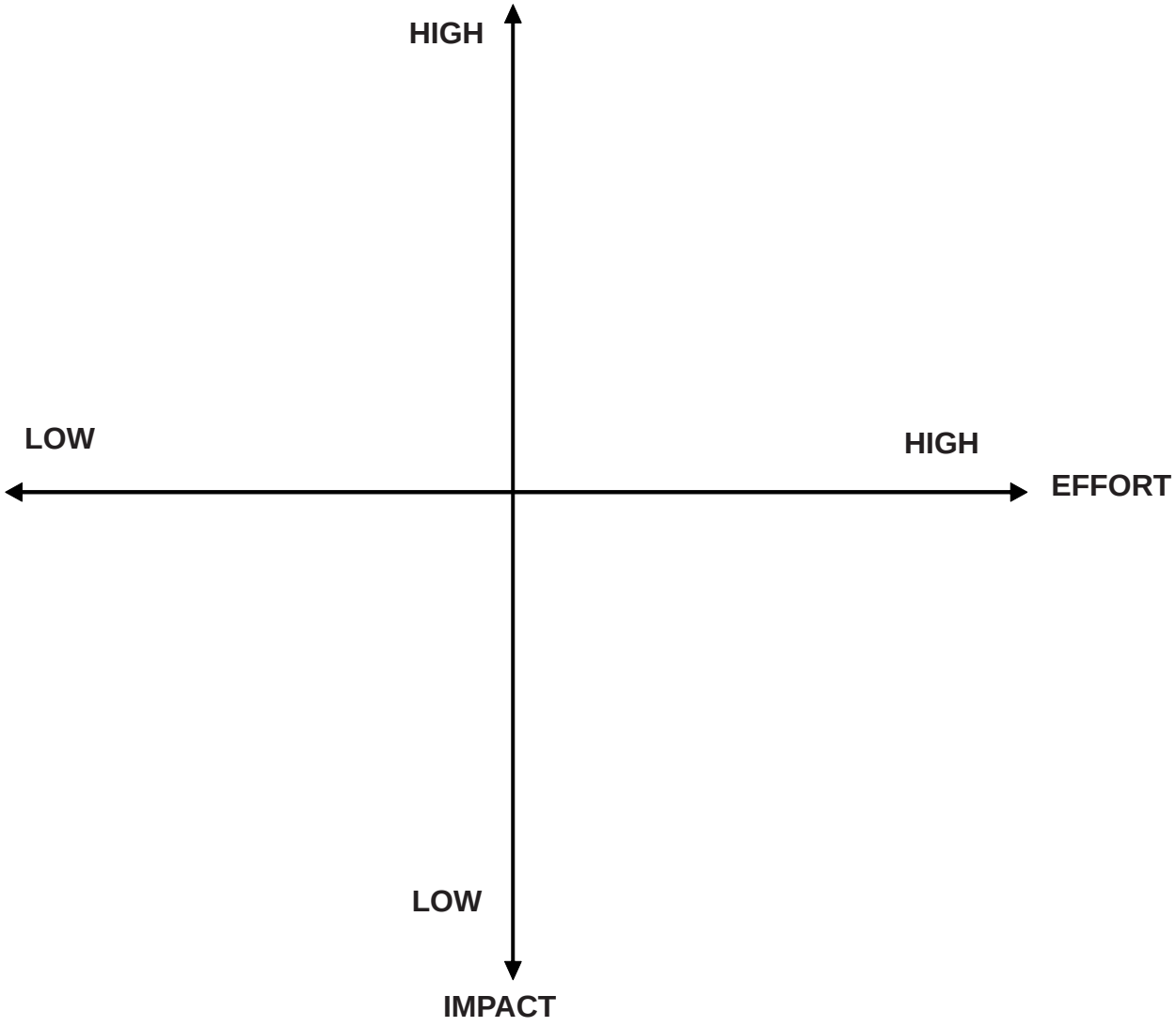
Threat	Short-term event, little impact	Medium-term issue, significant impact	Structural impact, major impact
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			

SWOT overview

From the SWOT analyses, the group should list all of the major areas or issues in need of attention and then attempt to prioritise them for action. This may involve some clustering or linking of issues and areas in terms of their nature and their impact on the activities and operations of your group or organisation.

Alternatively, you could agree on a set of criteria for ranking the areas and ideas. These could be impact (benefits, importance to the Team) and effort required to effect a change (costs, extent of change, ease of response or change). You could use the following matrix to plot your impact and effort assessments.

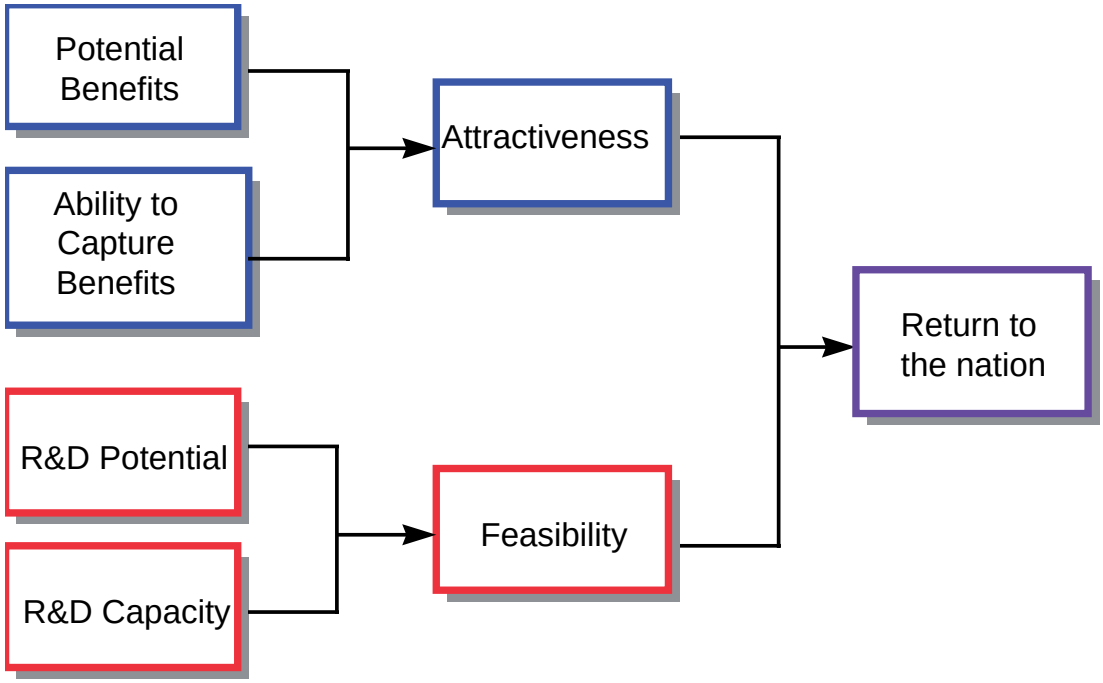
These SWOT data will prove to be of value in subsequent stages of the planning process, especially the strategy development stage. In fact, they will help define the strategic agenda for the organisation and provide valuable background and context for the scenario learning stage. The SWOT generates a data base for use in all subsequent stage of the workshop.



Section 2
Research Priority Setting

2.1 The Research Priorities Framework

The research priorities process is based on a conceptual framework developed by CSIRO in Australia in the early 1990s. The framework comprises four criteria which provide indications of the relative attractiveness and feasibility of research for a set of defined areas of research opportunity which capture relevant industry and community segments. Attractiveness addresses relevant aspects in the external or 'business' environment such as market conditions and prospects, social trends and prospects, political factors, and the economic situation and outlook. Feasibility addresses aspects relevant to the research environment, including science and technology capacity trends and prospects, research resources, facilities, networks and other research providers. The framework is presented below.

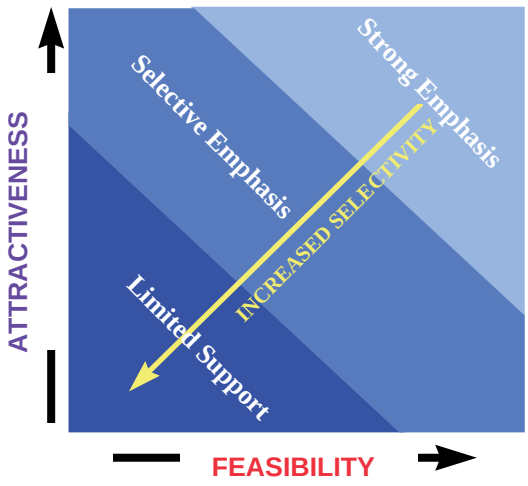


Attractiveness is a measure of the likely benefits to industry and society from successful scientific and technical advances in the industries and sectors relevant to the area of research opportunity.

Feasibility is a measure of the research organisation's competitive position in the delivery of scientific and technical progress within the area of research opportunity for the nation.

An area of research opportunity encompasses an industry, sector, social or environmental objective to which research is applied. The set of agreed areas of research opportunity are the focus of the priority assessment exercise.

The overall focus is the return to the nation from investment in research. The return is higher, the higher the attractiveness and the higher the feasibility. As attractiveness and feasibility decline, so too does the return to the nation, while selectivity among research projects increases, as shown in the diagram adjacent.



Stakeholders are those individuals or groups of people who have a stake in, or can have a major impact on, the performance of the organisation as well as groups dependent to some degree on the organisation for the realisation of their personal or organisation goals.

Data and Evaluation Sheets are summary records of key industry and research issues, trends and prospects relevant to the industries, sectors and strategic goals represented by each area of research opportunity. Data and Evaluation sheets are prepared for each area of research opportunity by experts and analysts from the research organisation. They are provided to workshop participants prior to the workshop to aid their initial assessments.

The magnitude of attractiveness and feasibility cannot be measured directly for all areas of research opportunity. Therefore, indicators are used to guide assessment. Assessments are made by selected individuals representing the industry or area of research opportunity from an external (attractiveness) perspective and individuals representing an internal or organisation (feasibility) perspective. These individuals are the organisation's key stakeholders.

Stakeholder representatives come together in a workshop to discuss and review priority assessments that each of them made independently prior to the workshop, using information prepared by the organisation (data and evaluation sheets) as well as their own knowledge and experience of the various areas of research opportunity. Each stakeholder uses a simple scoring method to assess the four criteria for each of the agreed areas of research opportunity. The group's average criterion scores for each area of research opportunity provide the basis of the attractiveness-feasibility screen and the subsequent discussion.

Criterion definitions and relevant indicators are presented below. These aid workshop participants in making assessments. These indicators are among the data presented in the area of research opportunity data sheets. The area of research opportunity data and evaluation sheets are prepared by experts from the research organisation.

Lessons learnt from applying the Research Priorities Framework in different organisations and countries

Several lessons have been learnt from the experiences of applying the original CSIRO attractiveness-feasibility priorities framework in various research organisations within Australia and in other parts of the world over the pasty decade. Like many processes or methods the framework is not a 'one size fits all' approach but must be adapted to align with the situation and needs of the organisation, group or country where it is being applied.

Adaptation of the framework may involve variations to the selection of appropriate priorities criteria and the definition or description of criteria. Variations to the original CSIRO framework for use by your organisation are outlined here.

R&D potential

The original CSIRO priorities framework was designed in line with the types of research and development conducted in the Organisation. CSIRO is a significant contributor to the advance of scientific knowledge in many fields. Therefore, it made sense to include R&D Potential as one of the underlying criteria.

Experience gained from applying the original priorities framework in other countries and research organisations revealed that the importance of generating new scientific knowledge is of lower importance than in CSIRO. In these organisations and countries there greater importance is attached to applying and/or adapting existing technologies and knowledge to improving productivity, enhancing community livelihoods and/or sustaining the environmental resources. This is the case in Indonesia and with FORDA.

The priorities framework has been modified to include scientific knowledge benefits among the potential benefits, together with economic, social and environmental benefits.

Capacity to deliver

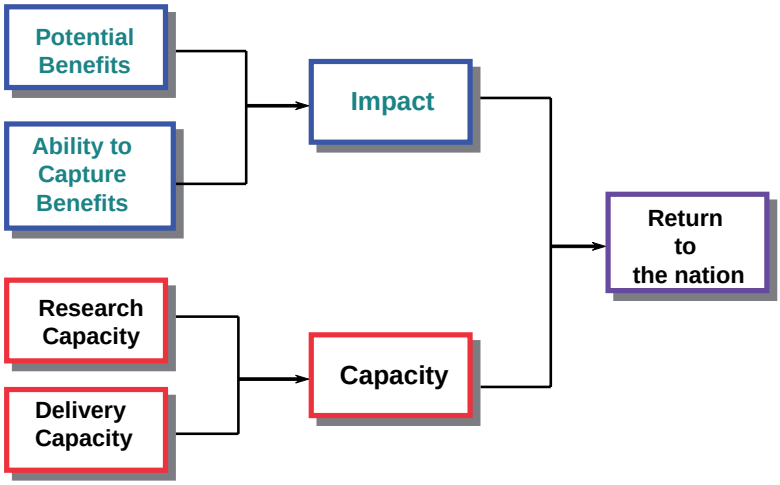
Successful research and successful research organisations have capacity to deliver the outputs of their research that is equal to their capacity to do the research. The importance of adoption and technology transfer needs to separately assessed within the priorities framework to give research organisations an indication of their capacity to deliver or transfer research results as well as their capacity to do the research. The original priorities framework included research and delivery capacity in the R&D Capacity criterion. The framework proposed for your organisation redefines Feasibility as Capacity with component criteria of Research Capacity and Delivery Capacity.

The revised Capacity criterion aligns with concerns about how effective its research is linked with the policy process. It will be possible for each area of research opportunity to assess those elements that comprise the ability to effectively and efficiently deliver to and influence important policy and public management decisions. This will be reflected in the selection of indicators for the criterion.

Capacity is measured as the sum of Research Capacity and Delivery Capacity. An organisation may decide to apply weights to the Capacity criteria in line with needs, or they may be equally weighted. An average Capacity score can be estimated for the determination of overall priorities in association with the Impact score.

Attractiveness

The original Attractiveness criterion still comprises Potential Benefits, with the addition of scientific knowledge benefits, and Ability to capture, which measures the capacity of users to adopt the outputs of research for a particular area of research opportunity. While the revision to the Potential Benefits criterion is only minor it represents a change to the original CSIRO framework. Therefore, a new title is used, Impact, in place of Attractiveness. Impact is measured as the product of Potential Benefits and Ability to Capture. The following diagram illustrates the Impact-Capacity Priorities Framework.



2.2 The Priorities Criteria

The following is an outline of the priorities criteria as applied to the assessment of research priorities for an R&D organisation. The focus is industries and other stakeholder groups benefiting from the development and application of advances in scientific research.

Impact

Impact is a measure of the likely benefits to industry, society and the environment from successful scientific and technical advance.

Impact is measured as the product of:

- Potential Benefits
- Ability to Capture

Potential benefits:

The maximum additional benefits (economic, social, environmental and knowledge) for the country from (additional) investment in research and development for the area of research opportunity (ARO).

Consider:

1. Assume that research is successfully completed, regardless of its specific nature, and successfully adopted, despite any constraints which may be apparent. These are relevant to the other criteria.
2. Account only the marginal or additional benefits due to research investment. Compare future sector outcomes (level of benefits) for a with research scenario and a without research scenario. The without scenario is a continuation of current input-output patterns. The with research scenario indicates the change in value of production and in other benefit areas from an increase in R&D for the areas of relevance.
3. Consider all research contributions, not only those from your organisation's research. Account for contributions from existing scientific knowledge and from knowledge likely to emerge in the next 3 to 5 years (planning period) which is relevant to the area of research and the industries/sectors which will benefit.

Ability to capture:

The likelihood of the country capturing the estimated potential benefits from successful R&D.

Consider:

1. Assume that research is successfully completed.
2. Account for factors in the external environment that may enhance or constrain adoption of new technology or other outcomes of scientific research.
3. Most relevant conditions for uptake are those likely to prevail in the future when research outputs are delivered to the market. Therefore, assess changes in factors likely to influence future adoption rates and levels.

Capacity

Capacity is a measure of a research organisation's competitive position in the delivery of scientific and technical progress for the nation's industry, environment and community.

Capacity is measured as the product of

- Research Capacity
- Delivery Capacity.

Research Capacity

The ability of the research organisation to competently and competitively conduct the research required to produce improvements for the area of research opportunity

Consider:

1. Capacity includes resources, skills, competencies, facilities and equipment owned by the organisation as well as those available through collaborations and partnerships with other researchers and research organisations and from in-kind contributions of stakeholders and customers.
2. Cost of research is relevant here.
3. Your organisation's competitive strengths in the fields relevant to the needs of the area of research opportunity

Delivery Capacity

The ability of the research organisation to efficiently and effectively deliver research outputs to the satisfaction of users and other beneficiaries.

Consider:

1. The quantity and quality of in-house communication and knowledge and technology transfer or extension skills and experience
2. Existing partnerships or alignments with agencies to transfer research results to users
3. Relationships and other arrangements with user communities
4. Knowledge and technology transfer strategy
5. Research delivery skills of project leader and other key staff – customer relations, market and industry knowledge, negotiation and communication skills, established links, past record

Potential Benefits - key indicators

Potential Benefits are higher:		Indicators (measurement)	Assessment		
			LOW	**MED**	**HIGH**
1.	The larger the size of the industry (area of research opportunity), as measured by industry gross product (value added) and expressed as a share of gross domestic product (or industry gross product)	GDP; Industry gross product (GP) or value added, %GDP	Industry GP < y%	Industry. GP between y & x	Industry. GP > x%
2.	The faster the expected growth of the industry's gross product - linked to domestic and overseas demand growth (includes growth in exports and import replacement)	Industry GP growth forecasts	<GDP annual growth	=GDP annual growth	>GDP annual growth
3.	The greater the proportional reduction in industry (area of research opportunity) costs induced by research	Examples of unit cost reduction % reduction			
4.	The higher the R&D intensity - Area of research opportunity R&D expenditure expressed as a ratio to GDP or Industry Gross Product. R&D intensity is an indicator of the expectation of high returns from R&D expenditure.	Area of research opportunity R&D expenditure; GDP & area/ industry GP R&D intensity	> Country R&D intensity	= Country R&D intensity	< Country R&D intensity
5.	The greater the positive environmental impact:	*Largely judgment, with some supporting data*			
	- soil and water quantity & quality	Impact on water quality & quantity			
	- biodiversity	Impact - species diversity			
	- air quality	Impact on air quality			
	- waste reduction	- Resource efficiency impact - Value of recycled material			
	- amenity & recreation	Estimates of value or contribution			
6.	The greater the spillover benefits to other sectors and industries	Links to other sectors - intensity and spread of linkages - linear and cross linkages			
7.	The greater the contribution to the stock of knowledge	Numbers of quality scientific publications			

Not all areas of research opportunity deliver benefits in all categories. This table provides a guide of use in the assessment of each area of research opportunity. In some cases hard data are provided, while in others assessment is based on individual judgment. In making the assessment, it is worth keeping a record of the arguments used to support the assessment as well as any questions that may arise. These can be considered further in the workshop discussions on research priorities. Scoring sheets can be designed to accommodate this.

Ability to Capture - key indicators

Ability to Capture is higher:		Indicators (measurement)	Assessment		
			LOW	**MED**	**HIGH**
1.	The higher the R&D intensity	Area of research opportunity R&D expenditure; GDP & Industry GP The country's R&D intensity	>National R&D intensity	=National R&D intensity	<National R&D intensity
2.	The more competitive the industry or area of research opportunity in terms of: - the industry concentration ratio - Country's share of international trade	*Domestically:* Degree of industry concentration *Internationally:* The country's share of global trade			
3.	The higher the domestic rate of adoption	Historical adoption rates for the area of research opportunity or industry and expected future rates of adoption	<30%	30-60%	>60%
4.	The sooner the reduction in unit costs is realised	Speed and ease of adoption	>5 yrs	1 to 5 yrs	< 1 yr
5.	The lower the costs of adoption, including the direct cost of technology and the indirect costs of adopting new technology	Typical costs for new technologies, including costs of integrating into existing operations			
6.	The lower the level of government regulation or policy which may restrict the industry or sector.	Government policies and industry regulations which may limit industry development and the uptake of research outputs. Note possible future changes			
7.	The greater the level of specific government support for the industry or sector	Govt. policies and programs which actively support the development of the area of research opportunity or industry. Note possible future changes			
8.	The higher the level of innovation in the industry or area of research opportunity	Survey data for industries			

The most relevant conditions influencing adoption of research outputs are those likely to be prevailing in the future. Given that these may differ from current conditions, possible changes in factors that influence uptake and outcomes for an area of research opportunity or industry should be assessed. The time horizon chosen depends on the typical gestation period for R&D, which could be in the range of 1 to 5 years depending on the type of research. Therefore, for indicators of ability to capture, relevant data and information are often about future, not present or past conditions.

Research Capacity - key indicators

Research Capacity is higher:		Indicators (measurement)	Assessment		
			LOW	MED	HIGH
1.	The higher the organisation's international status in research fields relevant to the area of research opportunity, reflecting quality and breadth of skills and experience	Publications by the organisation's scientists Citations by their scientists (Impact) International conference invitations			
2.	The greater the organisation's ability to assemble and lead competitive teams of researchers	Number of existing collaborative arrangements for the area of research opportunity relative to total for the organisation			
3.	The higher the organisation's share of total R&D expenditure for the area of research opportunity	Share of total organisational expenditure on R&D			
4.	The lower the unit cost and/or project cost of the organisation's research, compared with that of its competitors	National comparison of research costs - for key items - unit labour cost, project labour costs			
5.	The higher the quality of the organisation's research infrastructure and equipment	Value of assets Age of assets			
6.	The higher the quality and efficiency of support staff and systems	Ratio of support costs to total costs for the organisation (compare to national figure or other suitable benchmark)			

For R&D capacity the focus is on the organisation's skills, experiences, and competencies as well as the quality of infrastructure equipment and services. The organisation's competitive position is the key indicator, requiring knowledge of competitors' performance in similar areas. Competitors can be from elsewhere in the same institution, depending on its structure, or national and international. Who else is providing or could provide similar research services in the same markets or to the same customers as your organisation? How does your organisation shape up to the competition?

In some cases it may not be possible to differentiate between areas of research opportunity for some indicators, such as for 5 and 6 above. In such cases the average can be used.

Delivery Capacity - key indicators

Delivery Capacity is higher:		Indicators and Data (measurement)	Assessment		
			LOW	**MED**	**HIGH**
1.	The higher the quality and quantity of specialised communication and technology transfer staff and infrastructure available				
2.	The greater the number of partnerships and alliances with agencies who are specialists in knowledge and technology transfer and extension				
3.	The stronger the relationships between researchers and relevant stakeholder groups				
4.	If a knowledge and technology transfer strategy exists				
5.	The higher the level of knowledge of users' needs and level of satisfaction in delivering to them				

Delivery Capacity complements Research Capacity. The focus is on the organisations skills, facilities, networks and partnerships that support the efficient and effective delivery of research outputs to user groups. The organisation's competitiveness in delivery in these areas relative to other research organisations or providers of knowledge and new technology is critical to its performance. It is important to identify other providers of new knowledge and technology and how they perform relative to your organisation.

For some areas of research opportunity specific technology transfer activities and strategies may be in place, while for others they may be covered by an overall organisational strategy.

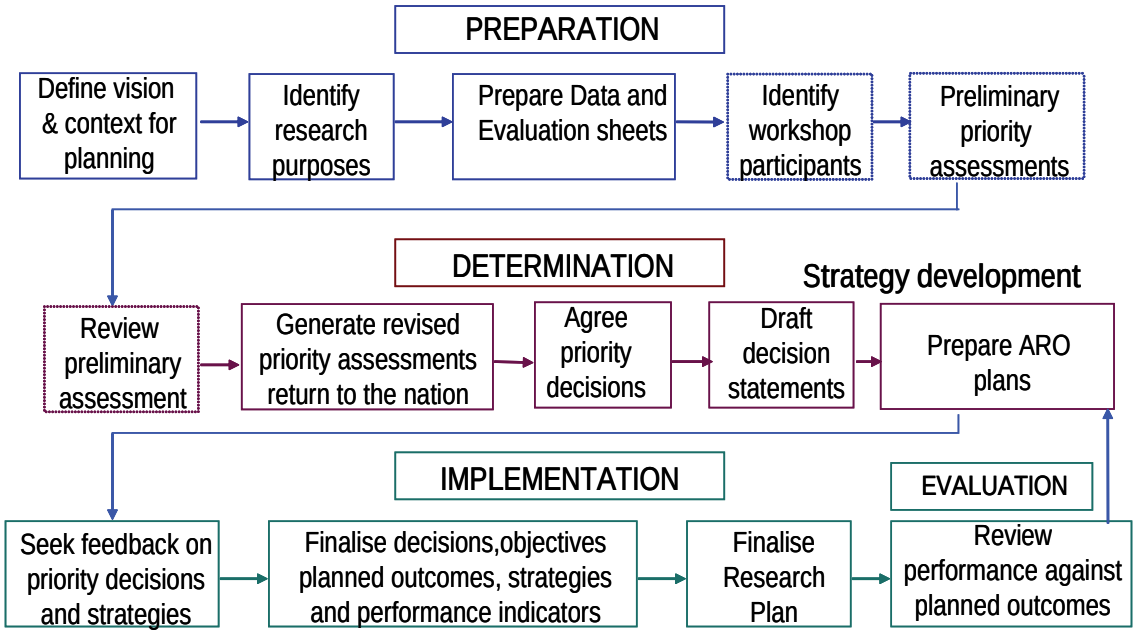
2.3 Implementing the Priorities Process

Introduction

There are four main stages in the priority setting process. These are:

- Preparation
- Determination
- Implementation
- Evaluation and review

The component steps within each stage are indicated in the diagram below. Priority setting needs to be implemented in the context of the organisation's strategic planning process. Priority setting alone is unlikely to be sufficient. The planning process provides important strategic direction and context in which priorities can be set. These are linked to external driving forces in the policy, economic, social and technology environments. 'Priority setting is the final phase of the research planning process' (Contant 2001, p.183)



Preparation

Vision

The driving force behind research priority determination is the organisation's strategic vision. In the absence of a strategic vision, a process must be put in place to agree a suitable vision. There are various approaches to developing a vision, ranging from that where the Chief Executive declares his or her vision for the organisation, to that developed using a process involving all staff in the organisation. Important aspects to note are that a vision must:

- focus on the organisation's strategic competitive advantages
- articulate what and where the organisation wants to be in the long term
- be inspirational, motivating and empowering for staff
- be simple and clear enough to be used as a decision making criterion by management and staff.

The vision must be shared or owned by the staff of the organisation. When staff members are involved in its development, this is relatively easy to achieve. However, where the vision is set on high, there must be a process established to gain the staff's support and commitment. A vision shared in implementation is the critical objective.

Context

The strategic context defines the organisation's perceptions about the environment in which it operates and how it is likely to unfold or develop into the future. It is the organisation's view of the future. There are various methods and processes for scoping the future, including forecasting techniques, scenario planning and foresighting processes. While each method has particular attractive features, scenario planning captures all of these

and more. Its greatest strength is that it does not confine the organisation to one particular future as do the other methods. It prepares the organisation for possible futures or multiple futures, not a probable or preferred future, and it offers a means of developing strategies that allow the organisation to succeed.

Identification and selection of areas of research opportunity

Establishing a well defined set of areas of research opportunity is the key step on the path to successful priority setting and implementation. Get this part right and the rest of the process will flow smoothly.

When selecting areas of research opportunity it is essential that they be:

- mutually exclusive
- exhaustive
- consistently based
- outcomes oriented.
- future oriented
- manageable number

Areas of research opportunity should be independent of each other if they are to be effectively assessed and compared. It can be very difficult to make resource allocation decisions when there are not clear-cut distinctions between the areas of research opportunity. The set of areas of research opportunity should be comprehensive, encompassing current research areas and areas which could be addressed in the future. The priorities process is forward looking and therefore there should be consideration of areas or purposes beyond the current focus. This is critical. The strategic context and the vision are good sources for possible new areas, . Areas of research opportunity may be identified in a scenarios workshop that precedes the priorities workshop. The AROs can be fed into the research priorities exercise along with areas of opportunity identified by other means. New areas should not be pre-judged, but should be included in the set of possible areas of research opportunity. Initial identification should be free-wheeling and imaginative, unrestricted by existing areas of work. As the process proceeds the number of AROs will decline.

Consistency of definitions is also critical to meaningful comparison. Socio-economic objectives for example, allow an organisation to focus on the outcomes of the research or the user of the research rather than on the means or process by which the research is conducted or how the objective is achieved. This approach is helpful in generating a high degree of commitment among those involved in the assessment, leading to ownership of the outcomes which is critical to successful implementation.

It can be difficult to separate ends and means, differentiating the purposes for doing research from the specific research fields. Suggested areas of research opportunity often include areas which are ends, such as forest plantations or pulp and paper for example, and others which are means, such as genetic resources or tree improvement. The priorities process works best when the focus is consistently on ends or outcomes rather than a mix of ends and means or just means. The means can be addressed as part of the response to the priority assessments and as part of the supporting material contained in ARO data and evaluation sheets.

A useful approach to the effective delineation of area of research opportunity is to identify the core businesses or purposes of the organisation and the core research fields contributing to the organisation. Identify industries, sectors and community groups to which the organisation provides research and the major research fields relevant to the organisation's research activities. They can be separated into ends or purposes, and means or research fields. This can be presented as a matrix for the whole organisation or for particular sectors or industries served by the organisation. The matrix in Figure 4 shows the delineation of areas of research opportunity for CSIRO's Forestry, Wood and Paper Industries Sector.

The columns represent major products, business groupings and/or purposes to which research is directed, ranging from forest resources to forest product utilisation. These are the major areas of research opportunity. The rows complement the columns, focussing on the key resources and production processes and technologies to which specific research capabilities are allocated. These are the major research fields or research domains. They are the means by which value is added to an area of research opportunity or end. Therefore, reading down a column, it is possible to identify research fields relevant to the particular area of research opportunity. For each area of research opportunity, the question is posed, what can research and development do to address current and future priority issues or needs underpinning the purpose. This implies priority determination within each area of research opportunity as well as between them.

Agreement was reached on the following matrix structure following consideration and discussion of a number of delineations of areas of research opportunity and research areas. This approach effectively differentiates research fields and areas of research opportunity and is consistent with the definition or scope of the forest, wood and paper industries sector. At an organisational or national level Socio-economic objectives and fields of research classifications can be used where they are available to provide the necessary delineation.

This matrix can be used to indicate the contribution of the research fields to each area of research opportunity. In fact, individual projects could be allocated to the respective boxes of the matrix. The boxes could also record specific industry issues and needs for each area of research opportunity against the fields of research that can contribute to their solution or satisfaction.

Research purposes

Research fields	Plantations-industrial	New Plantations (Farm forests)	Native Forests	Harvesting, roading and transport	Solid wood	Composites	Pulp and paper	Recycling	Appearance products, including furniture
Tree selection and improvement									
Soil and water resource management									
Silviculture - stand management									
Biodiversity									
Pest and diseases and fire									
Material handling (planning)									
Processing technologies									
Product properties									
Wood protection technologies									

This may prove useful in organising material for inclusion in the data and evaluation sheets and the areas of research opportunity plans (described later).

Once the areas of research opportunity have been agreed it is necessary to appoint individuals to champion the area of research opportunity in the organisation and to coordinate the preparation of relevant background material as defined by the data and evaluation sheets. The champion or coordinator is the organisation's expert for the area of research opportunity and represents the organisation's research effort in that area in the priority setting workshop and related activities.

At this stage of the process if it has not already been done it is useful to set up a steering or coordinating group to develop a timetable for the completion of the exercise and to oversee the implementation of the schedule of activities. The steering group would also be responsible for assembling general information and data for use by the ARO coordinators, ensuring consistency in the data that is used and how it is used, coordinating the completion of the data and evaluation sheets and their distribution, supporting management in the selection and invitation of external workshop participants and other tasks, supporting the workshop facilitator and coordinating the preparation of draft plans. Finally, the steering group is able to address any issues, questions or problems that may arise in the various stages of the process.

Responsibilities of the priorities steering group

- develop a timetable for the process
- organise the research priorities workshop
- assemble general information and data
- liaise with ARO coordinators responsible for preparation of data and evaluation sheets
- distribute data and evaluation sheets and other workshop material to participants
- support management- eg identification of suitable external participants
- support workshop facilitator
- coordinate preparation of draft plans
- handle general enquiries

The processes of ARO selection, establishment of the steering group and development of the timetable should be addressed in a workshop of the organisation's top management and key support staff. This workshop also provides an opportunity to gauge the expectations of the management team, to introduce the team to the priorities process and discuss subsequent steps in the context of the agreed time table. This workshop is an important step in the preparation stage.

Selecting workshop participants

When selecting participants for a priorities workshop, representation from the following groups is considered:

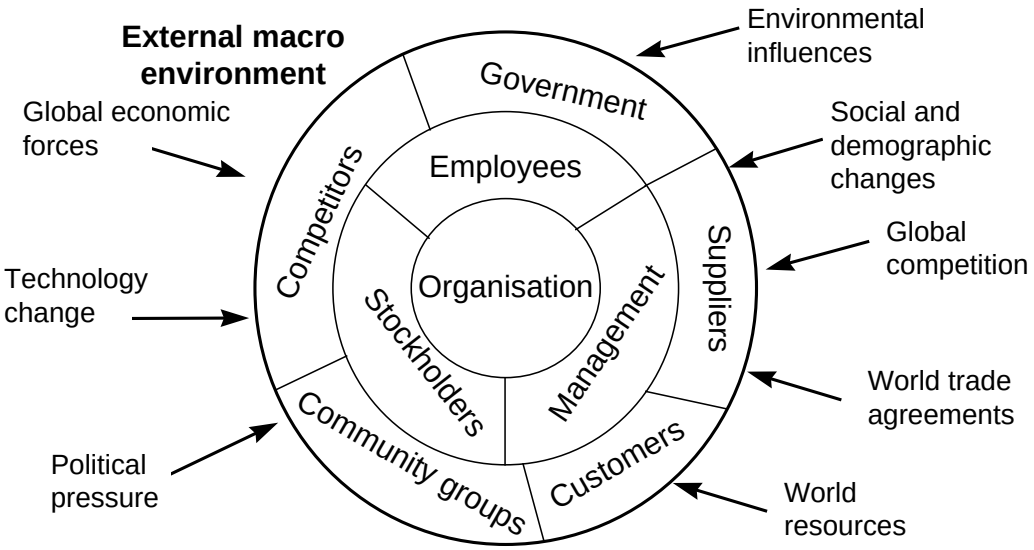
* External stakeholders, including representatives from industry, government and the community.
* Current and future customers and users of the research outputs of the organisation.
* Internal management, especially those responsible for implementing priority decisions and those accountable for the achievement of planned outcomes.
* Staff, especially those with coordination responsibility for an area of research opportunity.

In addition to these factors consideration should be given to:

* the level of representation for each area of research opportunity; and
* the total numbers involved.

The pace of change in our business environment has required organisations to broaden their focus and mind-set to a wider array of stakeholders than in the past. Priorities workshops may range from those involving representatives from all 4 key groups noted above, to those involving internal managers only. In the latter situation, prior consultation through focus groups and specific workshops can be used to gain contributions from external stakeholders and customers. This is less effective than when external stakeholders directly participate in priority determination within a workshop. External participation is highly rewarding for research organisations: it builds good relations with customers and stakeholders who value their role in assisting the organisation set priorities for the benefit of users of research, and it allows a mixing of minds, broadening the scope of the exercise. Pairing each internal expert with an external representative allows them to work together in the workshop, which reinforces the benefits noted above.

Stakeholders and external influences



When inviting people from outside the organisation, the field should not be limited to those individuals, companies and organisations with whom the organisation presently deals. In addition to known customers and stakeholders, invitations may be extended to individuals who may not be directly linked to the organisation at present, but who could be of significance in the future and who could make a valuable contribution. The aim is to cover those elements of the priorities framework where the organisation is weakest. Typically, for a public sector research organisation these would be on the Impact side and would include individuals with specific industry and market knowledge, knowledge of the role of government and policy instruments, and/or awareness and understanding of social and community attitudes and issues. The value of stakeholder involvement is depicted in figure 5. The organisation and its management may be shielded from some of the influences on its external stakeholders, influences which are important to the long-term success of the organisation. By involving stakeholders in planning and priority setting processes the organisation learns about the influence of those driving forces and can respond accordingly. This must improve the quality of decision making in the organisation.

Maintaining good stakeholder relations is critical to the success of the organisation, especially where the stakeholder base is expanding. Relations need to be mutually beneficial with each stakeholder group. The research organisation needs to monitor the impact of its strategies and policies on each stakeholder group.

An effective way of achieving effective stakeholder involvement is to set up an advisory committee for the organisation, or a series of advisory committees in specific areas of research activity. For example, CSIRO uses Advisory Committees for each of the main industry and community sectors to which it delivers research. Advisory committee members participate in priority setting for the sectors and in the development of sector research plans. The committees are made up of representatives of the main stakeholder groups served by the sector. Other mechanisms include less formal panels, irregular surveys or groups assembled for specific workshops. For a research priority setting workshop participants could be drawn from the advisory committee where one exists, or from stakeholder groups. Depending on the structure and role of the advisory committee, it may be necessary to broaden the representation for a priorities workshop. The aim should be to maximise diversity so that many different perspectives are shared.

For an organisation like FORDA an advisory committee would comprise representatives from government, industry and the community drawn from across the industry supply chain.

Data and evaluation sheets and draft ARO plans

Data and evaluation sheets are about measurement. There is a tendency to measure everything to do with a area of research opportunity in money terms. While this may be convenient, it is unlikely to be helpful. Just because some important aspects cannot be valued in money terms does not mean they should not be considered. Charles Handy offers the following quote from MacNamara, known as the MacNamara Fallacy:

The first step is to measure whatever can be easily measured. This is OK as far as it goes. The second step is to disregard that which can't be easily measured or to give an arbitrary quantitative value. This is artificial and misleading. The third step is to presume that what can't be measured easily really isn't important. This is blindness. The fourth step is to say that what can't be easily measured really doesn't exist. This is suicide.

Charles Handy (1994), The empty raincoat, Hutchinson, London.

For each ARO a data and evaluation sheet is prepared as well as a draft ARO plan. Guidelines on the preparation of these documents are presented below. Responsibility for the preparation of these documents rests with the respective area of research opportunity coordinators. The coordinators can decide how they wish to complete the task and who they will involve.

In preparing data and evaluation sheets it is important to note all relevant and important aspects, whether they can be measured or not. The following guidelines are not meant to be prescriptive. Keep the information simple, clear and unambiguous and provide explanations where needed to enhance clarity.

Data Sheets

The data sheet is organised into two main sections. The first addresses industry or external issues and needs, while the second focuses on research issues and trends. These are preceded by a brief description of the area of research opportunity that differentiates it from the other areas of research opportunity within the Sector.

The contents of the data sheet encompass data and information consistent with criterion indicators as well as other relevant industry and research data. The structure of the data sheet should be decided by the coordinating committee and advised to the area of research opportunity coordinators. A proposed two-page data sheet is presented on the following pages. This is the structure followed by CSIRO in its preparations for the assessment of research priorities in the Forestry, Wood and Paper Industries Sector in 1996 and 1999. An example of a data sheet prepared for that exercise is included here.

Sources of data: It will be useful to discuss sources of data and information relevant to compilation of the data sheets.

Evaluation Sheet

The structure of the evaluation sheet is based on the four priorities criteria. It provides a summary of the main issues, trends, patterns, and projections relevant to each criterion, as well as a preliminary evaluation of the data and information contained in the Data Sheet. It puts into words the responses to the key criterion indicators. Therefore, the evaluation sheet should provide a clear, unambiguous description and assessment of each criterion. The evaluation sheet typically is a one-page document, based on the four criteria. The internal structure can be determined by the coordinating committee and advised to the area of research opportunity coordinators. A suggested structure is presented in the following pages. An example from CSIRO's Forestry, Wood and Paper Industries Sector is presented as well.

Draft ARO plan

It is desirable to provide some preliminary details of area of research opportunity plans among the inputs to the priority assessment. Draft details of most relevance are the area of research opportunity objective and a list of research opportunities including existing research activities where relevant. If possible or desirable strategies may also be identified and sketched in relation to the achievement of area of research opportunity planned outcomes. The coordinating committee can determine the structure of the draft plan and advise area of research opportunity coordinators accordingly. A suggested structure and an example of a draft plan from CSIRO's Forestry, Wood and Paper Industries Sector priorities exercise are presented for consideration.

Data Sheet - proposed structure

Area of research opportunity title

Description

Brief description, noting main industries or sectors encompassed by the area of research opportunity, for example:

Research to benefit (area of research opportunity), including (list of key component industries or areas)

Industry issues, trends and prospects

Issues

List current and likely future issues, problems, opportunities and threats confronting the industry in relation to the particular area of research opportunity. These should be linked to the strategic context - the scenario analysis.

Trends and prospects

- Industry gross product (value added) – contribution to GDP
- Area of research opportunity gross product - may not be able to get precise measure of gross product. Use best approximation, based on relevant industries
- Turnover
- Growth rate and forecasts - based on gross product for relevant industries
- National GDP growth rate and forecasts
- Area of research opportunity trade statistics, including value of exports and imports, past growth rates and forecast growth rates
- Concentration ratios for the area of research opportunity and rate of change
- Nation's share of international trade - note changes and prospects
- Major companies and public sector agencies - note after tax profits and return on sales and other appropriate performance measures
- Environmental impact data relevant to the area of research opportunity
- Number and intensity of linkages with other sectors and industries, noting impact or importance to other industries.
- Capital investment trends and prospects
- Social impact – including poverty alleviation, health improvement, job creation, regional development

Government policy and regulation

Note specific industry policy and regulations and other policies that positively and negatively influence R&D expenditure and the adoption of research outputs and outcomes.

Industry analysis

Identify important patterns emerging from these data, especially those relevant to potential benefits and ability capture. Summarise key industry issues and trends, emphasising possible industry futures (especially conditions influencing uptake).

Research issues, trends and prospects

Issues

Identify major research issues, problems opportunities and threats confronting the industries and sectors covered by the area of research opportunity. Don't restrict comments to internal issues, but take a broad, international perspective.

Trends and prospects

- National gross expenditure on R&D (GERD) for the area of research opportunity
- National R&D intensity (GERD to GDP ratio)
- Organisation's total research expenditure for the area of research opportunity - based on links to existing projects - appropriation and non-appropriation; external earnings ratio.
- Organisation's share of national R&D expenditure for the area of research opportunity
- Expenditure on basic, strategic and applied research for the area of research opportunity - international, national and organisational data
- International data on R&D expenditure - expenditure trends (OECD and other data)
- Publications trends
- Citations trends
- Conference invitations

Organisation's role and position

- Major research providers relevant to the area of research opportunity - national and international - (competitors and collaborators)
- Number of existing collaborative arrangements - national and international
- Organisation's unit cost of research; labour costs compared to costs in other organisations - national and international.
- Major customers
- Competitive position - major competitors
- Assess organisation's particular strengths and weaknesses in relation to research and research management for the area of research opportunity

R&D analysis

Identify important patterns emerging from these data, especially those relevant to R&D potential and R&D capacity. Summarise key research issues and trends, emphasising the organisation's position in relation to the provision of research services to the industries covered by the area of research opportunity.

Major research needs and opportunities

List major research opportunities and needs for the area of research opportunity over the next five years. Think beyond existing research activities and fields of activity within the organisation.

Evaluation Sheet - proposed structure

Area of research opportunity title

Potential benefits

Brief comments on these and other important factors relevant to potential benefits

- size and growth – outlook (link to scenarios)
- cost reduction impact
- R&D intensity
- Environmental impact
- Social impact
- New knowledge impact
- Impact on other sectors and industries (spillovers)

Overview comment and conclusion

Ability to capture

Brief comments on these and other important factors relevant to capture

- R&D intensity and innovation
- Competitiveness
- Adoption rates and costs
- Impediments – policies, behaviours, costs
- Enhancements – policies, behaviours, costs

Overview comment and conclusion

Research capacity

Brief comments on these and other important factors relevant to capacity

- Quality and efficiency of infrastructure, equipment and support
- Skills
- International status – international competitive position
- Share of total R&D expenditure
- Customer satisfaction and feedback on performance
- Unit costs and competitiveness
- Collaboration and partnerships with other providers

Overview comment and conclusion

Delivery capacity

Brief comments on these and other important factors relevant to potential benefits

- Quality and quantity of skills, facilities, networks, partnerships
- Scientific breakthrough prospects
- Nature and strength of relationships with user communities
- Existence of a knowledge and technology transfer strategy or plan

Overview comment and conclusion

Draft area of research opportunity plan - proposed structure

Area of research opportunity title

Area of research opportunity objective

The area of research opportunity objective is a statement of the overall desired outcome of the relevant research. It should be complementary to the organisation's Vision and have a five year focus. Importantly, it should be clear and achievable. It needs to be clear enough for staff to use as a decision criterion in relation to individual projects. It must be achievable in the context of industry needs (can add value) and organisational capacity to meet the needs.

Research opportunities

Include the list of research opportunities from the Data Sheet. Differentiate current projects and potential new areas of research. For each research opportunity, briefly state its main goal or planned outcome. Note resource allocations to current projects, both financial and human resources.

Present a priority ranking of all the research opportunities, current and proposed. This could be based on an assessment of aspects of attractiveness and feasibility within the area of research opportunity and other relevant criteria. This would be preliminary as revisions are likely in response to higher level decisions.

Strategies

Specific area of research opportunity strategies may relate to the following critical success factors: research performance, financing the research and transferring the research outcomes to users. In addition there are likely to be strategies for other success factors including human resource development, knowledge management, communications and business development. The plan will incorporate strategies for these and other factors critical to the organisation's long term success of research for the industry.

For the draft area of research opportunity plan brief comments on strategy in the critical areas is all that are needed. These would relate to the research opportunity planned outcomes. Subsequent iterations would allow further development of strategies and the addition of performance indicators for monitoring progress against planned outcomes.

Preliminary priority assessment

Having agreed the set of areas of research opportunity, the area of research opportunity coordinators and the workshop participants, the next step is to put the process into action. Within two weeks of the workshop all participants should be sent copies of the following:

- Data sheets
- Evaluation sheets
- Draft area of research opportunity plans
- Score sheets
- Scoring procedures
- Details for the workshop

The data and evaluation sheets and the draft plans are bound into a single document for distribution to participants. The participants use this information to make preliminary priority assessments prior to the workshop. The scoring procedure explains to the participant the general priorities process and how to score.

The scoring procedure
The following instructions are provided to workshop participants prior to the workshop:

1. Assess all areas of research opportunity prior to the workshop; record your scores on the summary score sheet and return by the required date (details below).

2. Note each criterion definition before proceeding, to avoid confusion when making assessments.

3. When making a judgement, refer to the Data and Evaluation Sheets and other relevant input material provided. The Evaluation Sheet is the logical starting point as this presents relevant information by criterion. The Data Sheet provides detailed background information, with the industry elements relevant to the Impact criteria and research elements relevant to the Capacity criteria.

4. Score by criterion not by area of research opportunity. In other words, first assess potential benefits for all areas of research opportunity, followed by ability to capture, Research Capacity and finally Delivery Capacity.

5. Assign a score of between 1 and 10 to each area of research opportunity for each criterion. For each criterion score the area of research opportunity you judge to be the highest a 10 or thereabouts and the area of research opportunity you judge as the lowest a 1 or thereabouts. Avoid giving the same criterion score to two or more areas of research opportunity, especially if there are less than 10 AROs. Record your scores on ARO score sheet and note supporting reasons as well as any questions or relevant issues that you would like to raise at the workshop discussion. Transcribe your scores to the summary score sheet. Avoid scoring areas of research opportunity at the mid range and try to separate them as much as you can. This can be difficult as all areas of research opportunity are important. The assessment is one of relative importance. The following text box offers an alternative procedure that can help when it is difficult to separate the AROs.

Scoring Procedures
Scoring is on a 1 to 10 scale. Start with Potential Benefits and score each ARO, then proceed to Ability to Capture and score each ARO, then to Research Capacity and then to Delivery Capacity. Don't score all four criteria at the same time for an ARO. As the scoring is relative it is essential to score within the criterion. For example, for Potential Benefits first rate each ARO in qualitative terms as High, Medium or Low. Use the data and evaluation sheets and other information to assess whether the potential benefits are high, medium or low from research investment in this ARO. Distribute your assessments roughly in accordance with a normal distribution. So, if there are 8 AROs, aim for 2 or 3 in High, 3 or 4 in Medium and 2 or 3 in Low. Next convert your qualitative (H, M, L) assessments to equivalent quantitative assessments. High covers scores in the range from 8 to 10, Medium from 4 to 7 and Low from 1 to 3. So, for the High rated AROs, give your lowest rated one an 8 and the highest rated one a 10. Then rate the other High ranked AROs in between. Next for your Medium rated AROs, rate the highest 7 and the lowest 4 and distribute the remaining AROs in between. Finally, for your Low AROs, assign 3 to the one that you consider to be the highest and 1 to the lowest and score the others relatively. It is important to rank the AROs across the range of 1 to 10. It is a relative not absolute scoring.

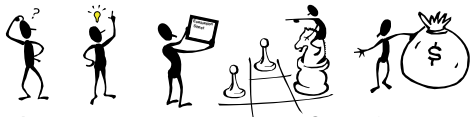
6. Review your scores using the summary score sheet as a guide. Check for consistency within each criterion. It is the relative differences in the scores which are important. Avoid bunching in the middle of the range and aim for a spread of scores.

7. Send your final scores to the address on the summary score sheet.

The pre-workshop scores are collected from participants by return fax or other means and entered into spreadsheets to generate preliminary Impact-Capacity plots and underlying plots of Potential Benefits against Ability to Capture and Research Capacity against Delivery Capacity. The result plots are referred to as screens. This is usually done 2 or 3 days prior to the workshop to allow time to prepare the initial results for presentation at the workshop. The screens and the scores are presented at the priorities workshop.

The following examples of an area of research opportunity score sheet and a summary score sheet are taken from the priorities exercise conducted in 1996 for CSIRO's Forestry, Wood and Paper Industries Sector. They are based on the original CSIRO criteria. Similar score sheets can be prepared for workshop participants based on the revised criteria and to suit the needs and situation of the organisation.

Area of research opportunity score sheet format



1. Plantations - industrial

Criterion	Score *1=lowest, 10=highest*	Arguments *Reasons supporting your score*	Questions *Issues arising from data and evaluation sheets*
Potential benefits The maximum additional benefits from additional investment in R&D for the Sector			
Ability to capture The likelihood of Australia capturing the estimated potential benefits from successful research for the Sector.			
R&D Potential The scope for growth in scientific knowledge and technology development in the fields of science relevant to the growth of the Sector			
R&D Capacity CSIRO's ability to competitively deliver research outcomes against the R&D potential			

Forestry, Wood and Paper Industries Sector — October 1996

Summary score sheet format

Forestry, Wood and Paper Industries Sector Research Priorities, 1997-98 to 1999-2000

SUMMARY SCORE SHEET **Name:** _____

SEO Sub-division	Potential Benefits	Ability to Capture	R&D Potential	R&D Capacity
1. Plantations - industrial				
2. New Plantations - farm forestry				
3. Native forests				
4. Harvesting, roading and transport				
5. Solid wood				
6. Composites				
7. Pulp and paper				
8. Recycling				
9. Appearance products including furniture				

Check List

1. It is preferable to **pencil** in your initial scores, as you may wish to change some following internal consistency checks. Use this summary score sheet to record your scores in association with the research purpose score sheets to record the scores and relevant arguments and questions.

2. **Scoring is on a 1 to 10 scale**. Score your lowest rated research purpose(s) a 1 and the highest rated research purpose (s) a 10, within each criterion. Having done so, score each of the remaining research purposes against these two benchmark scores. See detailed note on scoring procedure.

3. If you score by research purpose, then you will have to **check that you have been consistent** across the research purposes for each criterion. Check down the criterion column and adjust your scores accordingly.

4. You will benefit from **recording the main reasons or arguments for your scores** on the separate research purpose score sheets. Also note any **questions** that you may like to raise during the research purpose discussion at the Sector meeting. The benefit will be realised during the workshop debates.

5. PLEASE FAX or e-mail YOUR COMPLETED SCORE SHEET TO:
MICHAEL BLYTH 06 2818277, Michael.Blyth@ffp.csiro.au
BY COB Tuesday 22 October.

Determination

The research priorities workshop brings together internal and external experts (ARO representatives) for two to three days, depending on the number of areas of research opportunity and the other matters to be addressed. Two days is the minimum period, while three days allows adequate time to prepare draft ARO priority decisions and strategies. A good compromise is to have a two day and two night workshop commencing in the evening before the first full day. On that evening the group can meet and get to know each other, the workshop process can be outlined and reactions to the preliminary results can be sought. A couple of hours is all that is required and it facilitates an early start on the first day with everyone in attendance. A dinner could precede or follow the first two hour evening session. This can help ensure that everyone is there for the morning start.

The workshop should be held away from the normal place of work where the group can focus exclusively on the task and not be distracted by telephones, emails and other interruptions. Hotel or similar conference centres provide suitable venues. Equipment needs for the workshop include a data projector and screen, an electronic whiteboard, a standard whiteboard and a number of flip charts for small groups to use (when there is a large number of participants). The room should be set up to maximise interaction among the group. Depending on the number of participants, a U-shaped layout is the most effective. If there are large numbers, participants should be placed into small groups, with a mixing of internal and external participants. The tables should be layed out in herringbone fashion, pointing to the front of the room. Participants need to bring to the workshop their data and evaluation sheets and the score sheets with their arguments and questions noted against respective areas of research opportunity.

The workshop must be facilitated by a experienced and well-informed person. The job of the facilitator is to guide the process as a coach and ensure effective debate and discussion, to ask dumb questions so that there is full understanding of the subject matter and the process at all times, to keep the sessions to the time table and to settle any disputes. The facilitator is responsible for collecting the revised scores and reporting the group's assessment. The facilitator may lead the discussion of the results to ensure that all participants have common understanding and ownership of the results. Facilitation is with a light touch as much of the process can proceed undirected. Often some participants confuse the criteria and make judgments using information that are not relevant to the criterion being considered. The facilitator must continuously monitor the participants and ensure that they are familiar with the criteria and are using them correctly. Keeping to the time is critical and the facilitator will have to manage the time carefully to ensure that all sessions are completed according to the time table.

The procedure during the workshop can be adjusted to suit the particular circumstances, especially in view of the amount of time available and the number of participants.

The key steps during the priorities determining phase are as follows:

Review preliminary assessments

1. The preliminary or pre-workshop results are presented to the group and general feedback invited. This can be compared to the expectations that participants may have had. Specific results are not discussed, with only general reactions sought. These may be noted and recalled when the priorities are reassessed following the discussions for each area of research opportunity. Copies of the charts and individual scores are provided to each participant. The charts or screens are projected from the computer for all participants to see.

2. Each criterion is addressed in turn for the set of areas of research opportunity, commencing with potential benefits and concluding with R&D capacity. Normally, it takes much longer to get through the potential benefits criterion and the workshop time table needs to allow for this. The actual time depends on the number of AROs being prioritised. In each case the facilitator calls on the respective area of research opportunity coordinator or expert to make a brief presentation to the group in relation to the criterion being considered. A useful rule to follow is five minutes supported with one slide or sheet with key details. The presentation should address the key elements of the relevant section (criterion) of the evaluation sheet. A brief comment may be all that is needed, especially where there is no major divergence of opinion.

3. The pre-workshop scores are surveyed to locate the outliers within the group - those whose scores deviate most from the group mean. The outliers are invited to present their arguments for their higher or lower score. This is where the arguments and questions recorded on the score sheet will be useful. The area of research opportunity leader or coordinator may respond. If necessary discussion proceeds and then the facilitator moves on to the next area of research opportunity at an appropriate juncture.

4. Following discussion and debate participants may rescore if they consider it to be necessary. This can be done individually or collectively.

Individual assessment

Individual scores are made on fresh score sheets and handed to the facilitator at the end of the session. They are quickly entered into the spreadsheets and the new screens generated. The group can then review the revised results.

Collective assessment

Alternatively, the group may choose to use the collective approach. Following discussion, the group revisits

the ARO positions on the respective Impact and Capacity screens. The question is asked by the facilitator - is it about right, too high, or too low? To facilitate the process, each screen is divided into zones of high, medium and low for the underlying criteria. The issue is whether the area of research opportunity is positioned in the right zone. Precise location is not important. The discussion is to resolve relative positioning in terms of Impact and Capacity within the set of AROs. Having agreed the final positioning for Impact and Capacity they can be translated into positions on the final Return screen. The collective approach may save some time and generates further valuable discussion.

Individuals do not abandon their scores but can use them in the discussion. The process continues until there is agreement. The point should be made that precision is not critical, but rather it is the relative ranking of the areas of research opportunity.

5. The main arguments and points leading to repositioning of areas of research opportunity must be recorded during this session. But, consensus is not likely to be reached in every case. Therefore, it is important that a record also be taken of the alternative arguments. Factors and issues that may influence Impact and Capacity outcomes for each area of research opportunity should be noted. These should be monitored and reported as part of the on-going planning process for the area of research opportunity.

6. Finally, the group reviews the revised screens to check that the relative positions properly depict the outcome of the discussions.

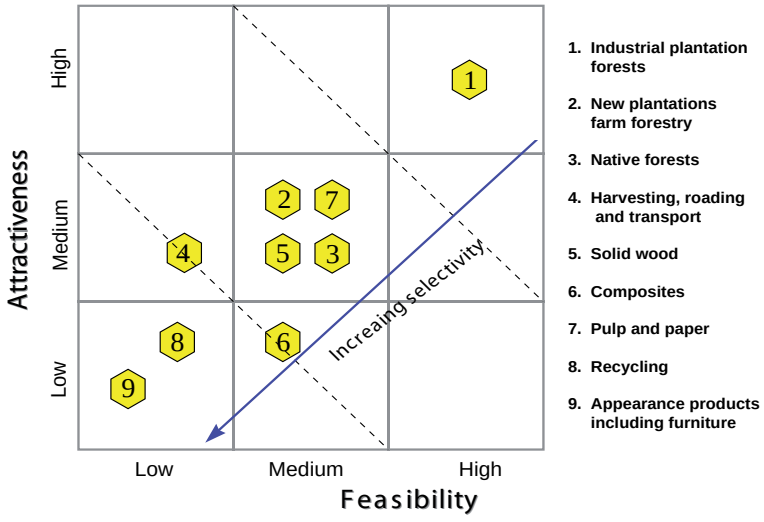
The final Return screen and the underlying Impact and Capacity screens form the basis for the group's priority decisions. However, it is only one input. Final decisions are made following further discussion on critical factors relevant to each area of research opportunity. Other criteria for example, may be considered to assist in finalising priority and subsequent resource allocation decisions.

To further aid decisions the profile of current research expenditure by area of research opportunity is prepared and compared to the priority assessment. A target profile is generated by the group, indicating the direction and magnitude of change in funding for each area of research opportunity. The target is for the end year of the planning period.

Agree priority decisions

Priority decision statements are prepared for each area of research opportunity. These are usually based on the general position of the ARO on the Return screen, the target profile and other relevant information. The comments made during the discussion of the area of research opportunity may help in formulating the priority decision statement. For example, an area of research opportunity falling into the 'limited support' zone of the return screen, such as 8 or 9 in the following Figure, is unlikely to attract additional government funding and may only expand by means of increased external funding. On the other hand, an area of research opportunity falling into the 'strong emphasis' zone, such as 1 in figure 6, may indicate an increase in government funding, especially if such a decision is consistent with appropriateness criteria (ie, is assessed to be an appropriate area for public funding in terms of market failure arguments). However, not every area of research opportunity falling into the 'strong emphasis' zone would necessarily attract an increase in funding. For some AROs, the decision may be to maintain government funding, with current levels consistent with the area of research opportunity's priority rating. Some examples of priority decision statements for CSIRO's Forestry, Wood and Paper Industries Sector AROs are presented below. Figure 6 presents the final Return screen for the Sector and indicates the relative positioning of the AROs.

Figure 6: Forestry, wood and paper industries sector research priorities - return to Australia



Example priority decisions

The following examples are selected priority decisions from CSIRO's Forestry, Wood and Paper Industries Sector from 1999.

1. Industrial plantations
Priority decision: Focus research on improving international competitiveness by lowering production costs, improving resource quality in line with product performance needs and environmentally sustainable management. Maintain appropriation funding and external earnings to at least 40%.

2. New plantations - Farm forestry
Priority decision: Research to ensure that forestry is competitive with other rural land uses. Education and technology transfer critical to successful uptake and economic analysis will be important to focus research on commercial success. Maintain appropriation funding with external earnings at least 40%.

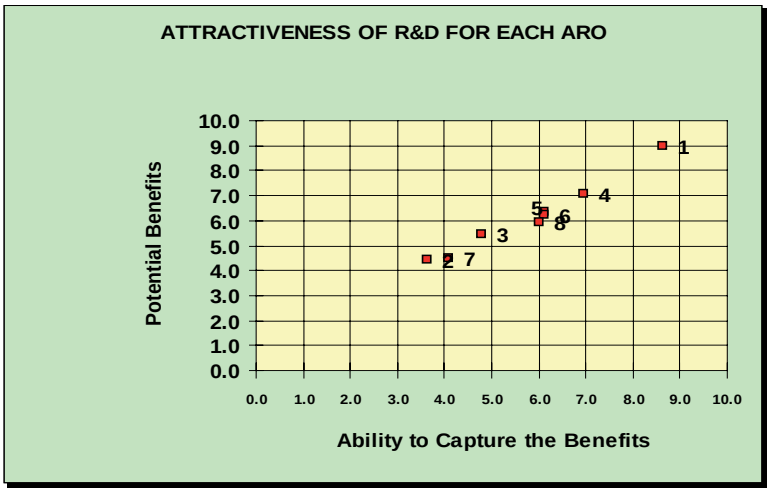
4. Harvesting, roading and transport
Priority decision: Focus on the environmental impact of alternative harvesting and planning methods. Priority research includes minimising on-site and off-site impacts of harvesting and improving harvest planning in terms of economic and environmental outcomes. Allocate appropriation funds selectively and increase external earnings from 26% to 37%.

6. Composites
Priority decision: Focus on research to aid cost reduction and quality improvement in an increasingly competitive international panel market and adaptation of technologies to Australian resources. Allocate appropriation funds selectively and increase external earnings from 24% to 40% by 1999-2000.

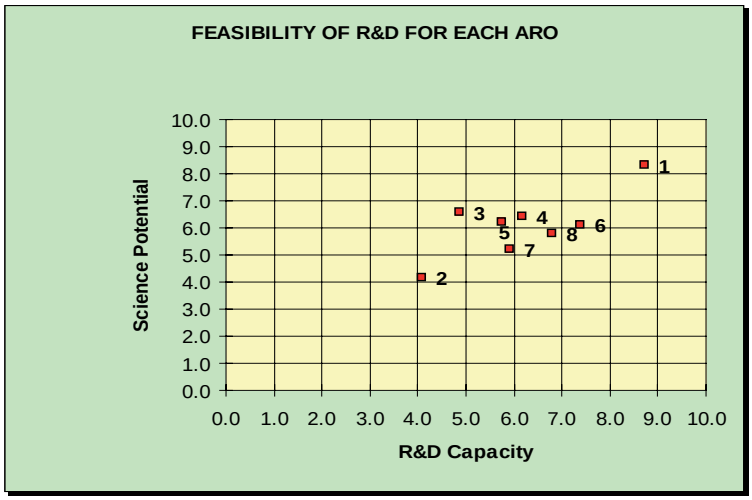
9. Furniture and other appearance products
Priority decision: Priorities include evaluation of Australian timbers for furniture, and timber performance under various environmental conditions and end-uses. Allocate appropriation funds selectively and increase external earnings from 28% to 40%.

The following charts are from a workshop held in Indonesia with the FORDA (Forestry Research and Developement Agency). They illustrate the spread of results and the relation between the return screen and the underlying Impact/Attractiveness and Capacity screens.

Attractiveness



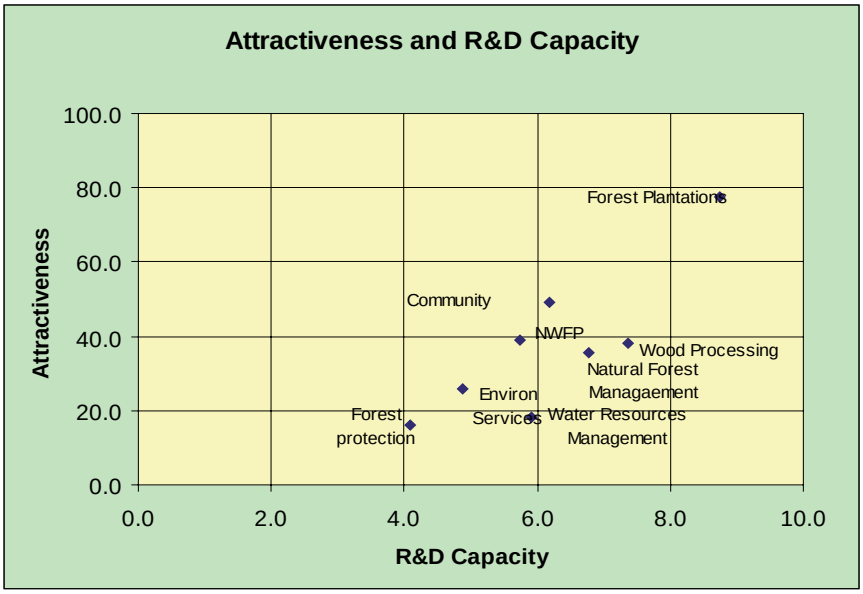
Feasibility



Key:

1. Forest plantations	2. Forest protection	3. Environ services	4. Community forestry
5. Non-wood for prods	6. Wood processing	7. Water res. mngt	8. Natural for mngt

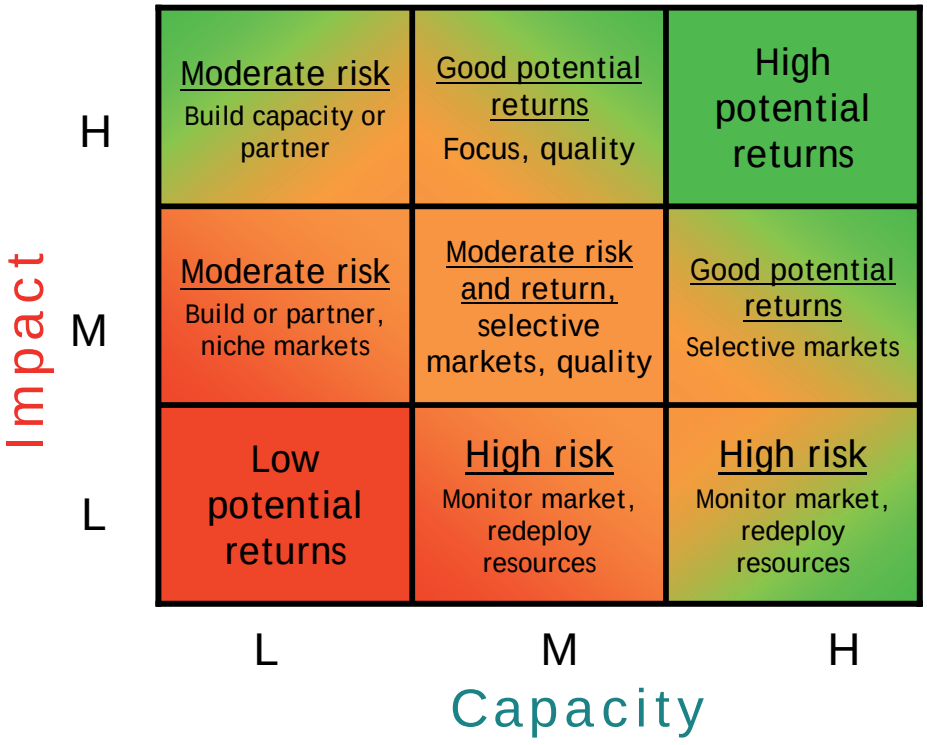
Return



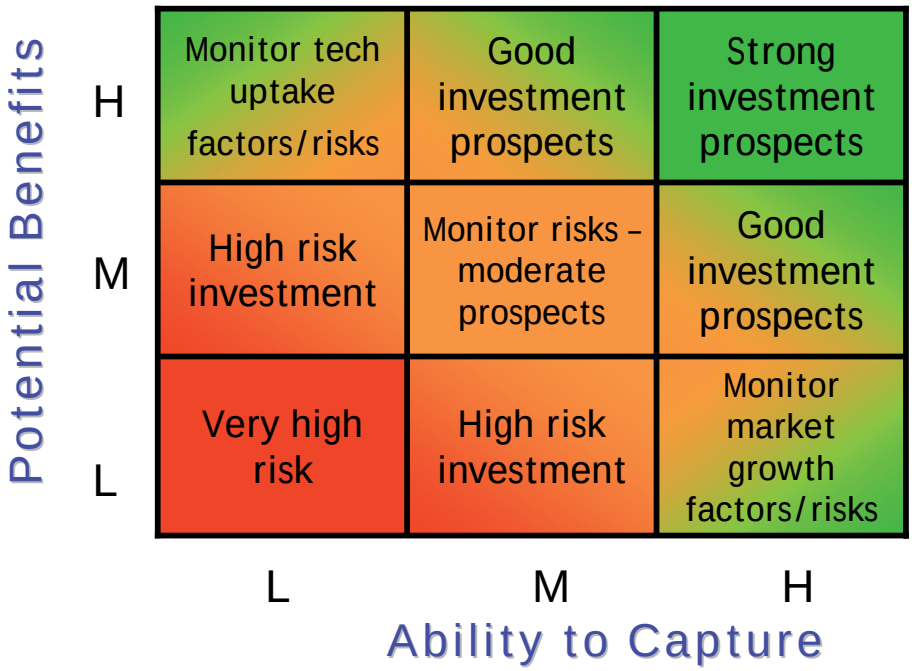
While the Return screen is not a decision rule it does provide a useful guide to decisions on resource allocation or investment. The following chart is a variation on the original Impact-Capacity screen.

This approach attempts to give more direction to the participants on resource allocation decisions. Impact is the same as attractiveness. The screen reveals the relative risks and rewards risks associated with supporting areas of research opportunity depending upon where they fall on the Impact-Capacity screen. A similar screen has been developed for the Impact screen as well. It is shown in the "impact guide" below.

Reward and risk



Impact guide



Draft priority decision statements

The process of drafting the decision statement can be agreed by the group at the time of the workshop. Depending on the time available, the statements could be drafted by small groups at the workshop using the feedback from the whole group supported by other relevant material. These could be fed back to the full group for comment and final agreement. However, where time is tight the recorded feedback and other material may be left with the area of research opportunity coordinators to draft the statement. Alternatively, the workshop coordinators may be given the job. In these two cases the statements would be circulated to workshop participants for comment and amendments and then finally agreed by the management group.

Revise area of research opportunity plans

A draft area of research opportunity plan is prepared prior to the priorities workshop and is included in the inputs to the process. Following agreement on the priority decisions the area of research opportunity plans can be redrafted, incorporating relevant material from the data and evaluation sheets and from the discussions. The structure of the area of research opportunity plan should be agreed by the organisation's management team prior to the workshop. The plan may be fleshed out during the workshop if there is sufficient time or it may be completed after the workshop. Area of research opportunity coordinators would be responsible for drafting the plans. They would work closely with a planning coordinator whose job it would be to ensure consistency, to stick to the deadlines and to distribute draft plans for comment by the organisation's management team. The individual area of research opportunity plans would be assembled together to form the organisation's strategic research plan. The organisational plan may also include higher level strategies and objectives.

The area of research opportunity plan should commence with the area of research opportunity objective, appropriately modified to be consistent with the organisation's vision. The objective should capture the essence of the research for this component of the organisation's activities as defined for the area of research opportunity. This is a long-term objective or goal, extending beyond the term of the plan, but more in line with the term of the organisation's vision. Also include the agreed priority decision statement for the area of research opportunity at the opening. The priority decision statement should be given some emphasis, such as bolding or including a boxed section.

A plan may include objectives, potential outcomes, deliverables, activities and milestones. Some simplification may help here. For each area of research opportunity a long-term objective or goal is specified. Potential outcomes also are most likely to occur beyond the time frame of the plan. However, a three year plan or a five year plan can identify deliverables (specific outputs) and when they are likely to occur (milestones). Rather than activities, a plan should indicate key strategies - how the organisation is going to achieve its objectives. These should be major research strategies. Strategies in other areas can be treated separately (marketing, communication, human resource development, financing, and agreed key performance areas). Therefore, for each area of research opportunity the following areas should be addressed:

Objective Outcomes - the long-term goal of the research for the area of research opportunity expected long-term impacts on the organisation as a result of the

research (direct and indirect impacts)

Strategies (not activities) - each planned outcome should have an associated strategy or two; a strategy describes how the planned outcomes will be achieved; they are linked via specific indicators which signal progress towards achieving the planned outcome.

Deliverables - specific, time-bound, measurable, achievable, realistic outputs from the research over the plan's time horizon. These are the main milestones over the three year period. They may also indicate the general progress of the research towards the major outcomes.

Non-research outcomes, indicators and strategies
Key performance areas other than core research activities may include knowledge and technology transfer, marketing, communication and R&D capacity. These are important areas or factors critical to the success of the research. The organisation may identify other important non-research areas or critical success factors to be included as well. For example, financing research is an important factor in the success of research, especially where external targets are specified.

It is suggested that for each factor or area note the major outcome to be achieved by the end of the planning period. Then for each outcome identify appropriate indicators and strategies. For example, an outcome for financing might be to raise the level of industry support for the area of research opportunity. Success for this outcome would be defined as increased external earnings and increased in-kind contributions to the research projects. The performance indicators would be more hard edged, such as increased external earnings from the current level of x% of total earnings to y% by the end of the target year.

Performance and evaluation measures - defining performance indicators
Performance and evaluation measures may be specified in a separate section of the plan or they may be integrated into each of the area of research opportunity objectives and planned outcomes. It would be desirable to develop appropriate indicators for research and non-research outcomes. As noted above, strategies are associated with planned outcomes and performance indicators provide a linkage.
The procedure, having identified an outcome, is to determine how success will be defined for the outcome and then develop an appropriate indicator for the success factor. When defining success consider it from the perspectives of the Minister, the Chief Executive or Director General of the organisation, Advisory Committee or similar members, and key stakeholders, including staff. A performance indicator should provide useful information. It should be expressed as a rate, ratio or percentage, or as a benchmark compared with another time period or another similar organisation, or as a target such as the external earnings target.

Absolute numbers are not as useful for measuring performance as are relative measures

Area of research opportunity plan structure

A suggested area of research opportunity plan structure is that used by CSIRO's Forestry, Wood and Paper Industries Sector for their 1996 research priorities exercise.

1. Overview
- Include a brief statement of the importance of the area of research opportunity as per the evaluation sheet.
- Area of research opportunity objective - long term; this should be the main focus of this section
- Priority decision - report the agreed decision from the research priorities exercise.

2. Outcomes, Strategies and Deliverables
- List the key research outcomes, associated strategies and main deliverables for the component research projects. Indicate the year of delivery.

3. Knowledge and Technology Transfer
- Expected users or customers of the research results and outcomes
- Users' preferences and expectations
- Strategies for technology transfer, commercialisation, IP management and related activities
- Link to marketing and communication

4. Marketing and Communication
- Marketing - who, what and when?
- Communication - key strategies and major events and activities
- Customer relationship management

5. Development of Research and Delivery Capacity
- Summary of scientific, technological and/or engineering advances being attempted in anticipation of developments in the industries and sectors comprising the area of research opportunity. This should encompass both market needs and S&T opportunities. Generic issues should be noted here.
- Investment in scientific and/or engineering opportunities and development of the organisation's skill base.
- Identification of appropriate capacity building options required to improve research output delivery relative to existing skills and capabilities.

6. Performance and Evaluation Measures
- How judge the success of the research? Who and When? For both research and non research.

7. Participants and Resources

- Indicate the organisation's research units contributing to the area of research opportunity.
- Note other research contributors – partners and collaborators.
- Indicate the total level of research funding for the planing period

8. Contact

- Name and contact details for the area of research opportunity coordinator and other key persons.

Notes:

Sections 1 and 2 are the main focus of the plan. The priority decision provides key direction to the researchers. Outcomes relate to the major research themes or projects of the area of research opportunity. Research strategies and major deliverables should be listed.

Where research funding is a key strategy area for the area of research opportunity, specific focus should be directed in the plan. This would be of most relevance for those areas required to make significant changes to their level or share of external earnings.

Implementation

Implementation commences the diffusion of the plan to the staff of the organisation, giving them the opportunity to comment on research directions, priority decisions and strategies for the organisation. Beyond the plan, individual research units must respond to the strategic research plan and priorities in terms of their own research project priorities. A process of prioritising research projects can be developed for use at the research project level.

Feedback on priority decisions and strategies

Drafts of ARO plans are developed in consultation with key research staff in the relevant areas. Once the plan is drafted it should be circulated to relevant staff for comment. At this time it is also appropriate to identify specific research projects to be undertaken as part of the area of research opportunity portfolio of activities. Depending on the budget allocation, it may be necessary to evaluate the relative priority of the projects to facilitate budget allocation.

To determine the final set of research projects a process may need to be devised to assess the competing projects. The project selection process should complement the priorities process. One such approach is to assess project priority and project quality. Project assessments can be scores and averages plotted on a screen, with the priority assessment on one axis and the quality assessment on the other. Priority scores are determined by the area of research opportunity rating. To establish this the organisation's projects are assigned to one or more of the areas of research opportunity in terms of which industries or sectors would be the main beneficiaries of the research outcomes delivered by the project. A high, medium or low score is assigned to each project. For projects crossing areas of research opportunity boundaries a weighted average priority rating is determined according to the estimated distribution of benefits between the industries covered by the respective areas of research opportunity.

Project quality is judged for each project against a set of criteria agreed by the management of the organisation. The criteria are defined to complement the Impact and Capacity criteria, thus maintaining the consistency between levels in the organisation. Criteria include the following:

- Clearly defined project goals and objectives
- Economic, environmental and social significance of the project
- Extent of the project's influence on the outcomes or effectiveness of collaborative or related projects
- Extent to which the project addresses agreed client needs and the degree to which the results are likely to be adopted
- The extent to which the project has an adequate plan for communication and technology transfer
- Does the project address a fertile research area?
- The extent to which the project is likely to achieve its technical objectives on time and within budget
- The level of resources required to complete the research
- The attraction of external resources
- Track record of the project team members

The set of criteria can be agreed by the management team and should reflect the most critical factors that affect the success of the organisation. A process would need to be established to develop the set of critical success factors for projects and the research portfolio. It would be desirable to keep the number to a minimum, below five or six.

Regardless of the assessment criteria the method of assessment is likely to be constant. The projects are assessed by the organisation's or unit's management team using a numerical scoring system. A similar approach to the higher level priorities exercise can be followed, with preliminary individual scoring followed by group discussion and final agreement during a one day workshop. Depending on the number of projects to be assessed the method of scoring may vary from that followed at the area of research opportunity level. For example with 10 criteria and 40 projects it would be easier to score by project for each criterion than to assess each criterion in turn for the set of projects. This places greater reliance on the interactive review

of project scores to achieve the relative rankings of projects than was the case for the area of research opportunity assessments. With fewer criteria it would be easier to assess each criterion in turn.

The review of the project quality scores proceeds at two levels - the aggregate score for each project and the individual criterion scores for each project. The scores for each criterion for each project are summed on each participant's scoring sheet. These individual totals are averaged for the group giving a project quality score for each project. Project champions are nominated and invited to open discussion on the project, especially where there is a high degree of divergence within the group. Outliers are called on to respond initially and then open discussion follows.

The source of divergence may be traced to the component criteria to help focus the discussion. This generates effective project level interaction among the research managers. However, with a large number of criteria it may be difficult to identify the source of divergence every time. As indicated earlier it is preferable to agree on a small set of criteria or success factors, rather than a large set. However, this does not necessarily mean ranking individual success factors, but rather defining them such that they encompass the most relevant aspects. Suggested factors can be clustered and suitable generic titles found, with comprehensive definitions.

Following the discussion the participants may rescore and the group averages re-estimated. The quality scores are then compared to the priority scores in a chart. Resource allocation and other decisions on projects can be based on the position of the individual projects. The focus will be on those falling into the low-low zone. These decisions are based on an informed and transparent process which makes the task of communicating the outcomes to staff more effective. The project positions suggest particular courses of actions for most projects and the underlying assessments and other supporting information, as well as the record of the project discussion is useful feedback for the project managers.

This is an example of an approach to project level implementation of organisational research priorities. There are other methods which can be used and other criteria which can be considered. It is important to have a process in place to ensure that good decisions are made for the long-term benefit of the organisation.

An alternative project selection approach which is consistent wit the Impact and Capacity Framework is that by Blyth and Humphrey (2002).

Finalise plan components

The finalisation of the plan can proceed on the basis of bottom-up feedback and the final agreement of the top management team. A process of clearance should be agreed in accordance with a completion timetable. This would be coordinated by the planing steering committee.

Finalise strategic plan

Individual area of research opportunity plans combine to form the organisation's strategic research plan. The ARO plans are integral to the organisation's plan and therefore they should reflect the organisation's vision and strategic directions. Furthermore, there should be consistency between the individual area of research opportunity plans. The structure of the organisation's strategic research plan should include the following elements:

- Vision and mission of the organisation
- The strategic context, indicating the major issues and influences shaping the future operating environment facing the organisation. If scenarios are the basis of the strategic context they could be briefly described.
- Major research themes should be identified and described and attendant strategic goals specified in each area
- Specific objectives and key planned outcomes can be presented for each area of research opportunity, together with the respective priority decisions.
- Organisational strategies in key performance areas, other than research, including customers, technology transfer, commercialisation, IP management, business development, communication, marketing, research evaluation, development of the organisation's capacity development and research financing.

Evaluation and performance may be addressed in a specific strategy or they may be integrated into each of the research and non-research strategies. Overall performance measurement of the organisation can be gauged using suitable performance indicators. Performance indicators should be specified against each objective and planned outcomes. They provide the means for assessing progress towards achieving the objective or outcome. At the organisational level it may be appropriate to identify a set of key performance indicators which would be monitored to provide an overall assessment of the organisation's performance for the key stakeholders, especially the government in the case of public research organisations.

CSIRO, for example reports annually to the federal government on performance in six key areas:

1. Contracts successfully completed as a proportion of total contracts completed
2. Shift of resources according to agreed priority decisions
3. Adoption by users of practices, instruments and processes developed by CSIRO
4. External earnings for research and services,

consistent with CSIRO's mission

5. Level and quality of publications
   - number of publications, patents and commercial reports
   - citation of publications (Science Citation Index)
   - include major awards, honours, invitations, conferences and the like)

6. Teaching - number of post graduate students jointly supervised and number of post graduate students full and partially sponsored by CSIRO, not including CSIRO employees)

CSIRO's Forestry, Wood and Paper Industries Sector agreed to judge its performance in terms of research achievements against planned outcomes and in five other key performance areas. These are:

- **Technology transfer** - uptake of research outputs, publications, reports, conferences, seminars, training programs, workshops and customer satisfaction surveys
- Commercialisation - patents, Intellectual Property protection, licences, successful contract completion
- Marketing - actual external earnings relative to the Sector target and repeat business
- Communication - media coverage; responses to articles in specific publications and the WWW
- R&D capacity development - change in resource allocations to priority areas; numbers of students and post docs; collaborations with other researchers; acquisition of new skills.

Finally, the plan should present a table showing the agreed allocation of resources by area of research opportunity for each of the years of the plan. The financial tables and accompanying charts should address the government and non-government budgets and indicate external targets for the area of research opportunity and for the organisation as a whole.

To aid the area of research opportunity coordinators in their preparation of the ARO plans the following information should be provided:

- Draft area of research opportunity plans
- Data and Evaluation Sheets
- Record of the discussion on each area of research opportunity from the priorities workshop
- Area of research opportunity priority decision statements
- The final priorities assessments including the Return screen and the underlying Impact and Capacity screens
- The current research profile and budget and the agreed target profile for the organisation's research budget for the end year of the planning period
- Other information relevant to the plans as agreed by the management of the organisation.

Monitoring and evaluation

The final stage of the process is evaluation. However, it is not really the final stage as monitoring and evaluation goes on continuously. Evaluation and review processes already exist in most organisations. Existing review processes need to be examined in the context of the changes to planning suggested by the processes associated with research priority setting. A consistent monitoring, review and evaluation process will ensure that the organisation remains relevant to its stakeholders and delivers to their needs efficiently and effectively.

Review performance

Once the plan is in place it should be seen as a living plan, not one to put on the shelf and dragged out in twelve month's time for the annual review. It is the process that is the key not the plan as such. However, the plan provides a good record and it should be referenced frequently. Planning and evaluation need to be continuous processes. Periodic monitoring and review is also important and arrangements should be established for periodic review if they are not already in place. However, to maximise the return on the investment in research, the organisation should be constantly monitoring changes in the external and internal environments.

Periodic review can track an organisation's actual performance against planned outcomes, using the performance indicators as a guide to measuring the impact of research outcomes. This should occur annually. Past review should also be a part of the development of the next strategic plan and reassessment of research priorities. Ideally it should be scheduled to coincide with end of the financial year and with external requirements such as the government's planning schedule.

Continuous review requires complementary internal communication processes to allow the frequent exchange of information at a strategic level. This may mean strategic reviews in particular areas, major seminars bringing researchers and users together, internal newsletters, workshops with key stakeholders and other appropriate means of sharing information on changes in the external and internal environments. The information generated by these activities should be shared with the whole organisation and used to improve the organisation's position. These are value-adding activities critical to the success of the research organisation.

The organisation must agree on the nature of its review processes, the frequency of the reviews and the processes for ensuring that the organisation is effective and relevant in the eyes of its major stakeholders. It should address the issue of support staff in this area and the internal business processes to ensure efficient an effective operations. While the benefits of review and evaluation can be demonstrated it is often only

the costs and distraction that the researchers see. Therefore, in addition to improving communication mechanisms staff should not be confronted with excessive additional work loads that they may perceive as adding little additional benefits. They need to appreciate the value of monitoring and evaluation.

Keys to successful research priority setting

Definition of areas of research opportunity

Need to allow ample time for defining AROs – see pp. 11-16 of Priority Setting Workbook
Define AROs consistently, ensuring mutual exclusivity and clarity
Write down the definition
Make sure it is outcome focussed – such as a socio-economic objective; an end not a means
Focus on core business
Focus on users of research services; address each ARO from position of the user need, not scientist's push or interest

Appoint a champion to lead each ARO

Champions coordinate the preparation of data and evaluation sheets
Champions provide expertise and leadership during workshop – lead discussion

Establish a steering or coordinating group

This group makes sure that logistical aspects are addressed, including a venue, representation for stakeholder groups for each ARO, a facilitator
This group sets critical deadlines and ensures that participants receive data and evaluation sheets and other relevant material before the workshop
Steering groups also coordinates the preliminary scoring issuing score sheets and instructions and receiving preliminary scores, entering them into the spreadsheet and preparing the tables and charts for the workshop

Select workshop participants with balance in mind

Choose internal and external representatives – match one for one if feasible
External participants add perspectives of the users and bring a touch of market reality to the discussions

Appoint a good facilitator

Success of the process depends on having an effective facilitator who understands the process
Must be a good time manager
Must be a good people person and able to keep the process moving forward

References;

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Blyth M 2003. Research planning and priority setting – report on a training and development program for the Forestry R&D Agency (FORDA), Ministry of Forestry Indonesia. Unpublished confidential client report

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Section 3
Knowledge and Technology Transfer

3.1 Improving the Adoption of Research Results

Introduction

The document provides an overview of strategies and initiatives available to research organisations to efficiently and effectively deliver the output of their research to their customers and users. The different types of research are acknowledged, as are the different natures of research outputs. Adoption pathways are discussed aligned with the purpose and intended audience for the research. An assessment framework is outlined and a template provided for FORDA research managers to complete during the workshop. Suggested strategies and actions are provided for consideration by the FORDA managers in the context of their assessment of the Agency's current status and performance. The strengths and weaknesses of a number of strategies are documented for consideration. Project level and organisational level initiatives are addressed.

Maximising returns from investment in R&D

The level of economic, social and environmental returns from investment in research and development (R&D) can be influenced at the research stage and at the transfer and adoption stage. Furthermore, returns are influenced in planning stages prior to commencement of the research, with the determination of priority investment areas.

The outputs of research can be described as knowledge products. Some knowledge products are adopted as collective or public goods delivering industry-wide benefits while others are adopted as private goods, delivering direct competitive benefits to the owner of the knowledge product. In the case of a private knowledge good, the owner is afforded intellectual property rights by way of secrecy and various non-disclosure agreements with employees and contractors. While this approach to realisation of the commercial benefits of new intellectual property may be suitable for private companies, it is less so for public research organisations such as universities and some government research institutions which have limited capacity to convert the knowledge into marketable end-products. In this situation the research provider's route to commercialisation of the knowledge is to sell it to the highest bidder, patent the invention and then enter into an exclusive licensing arrangement with a private company or establish a spin-off company based exclusively on the new knowledge product.

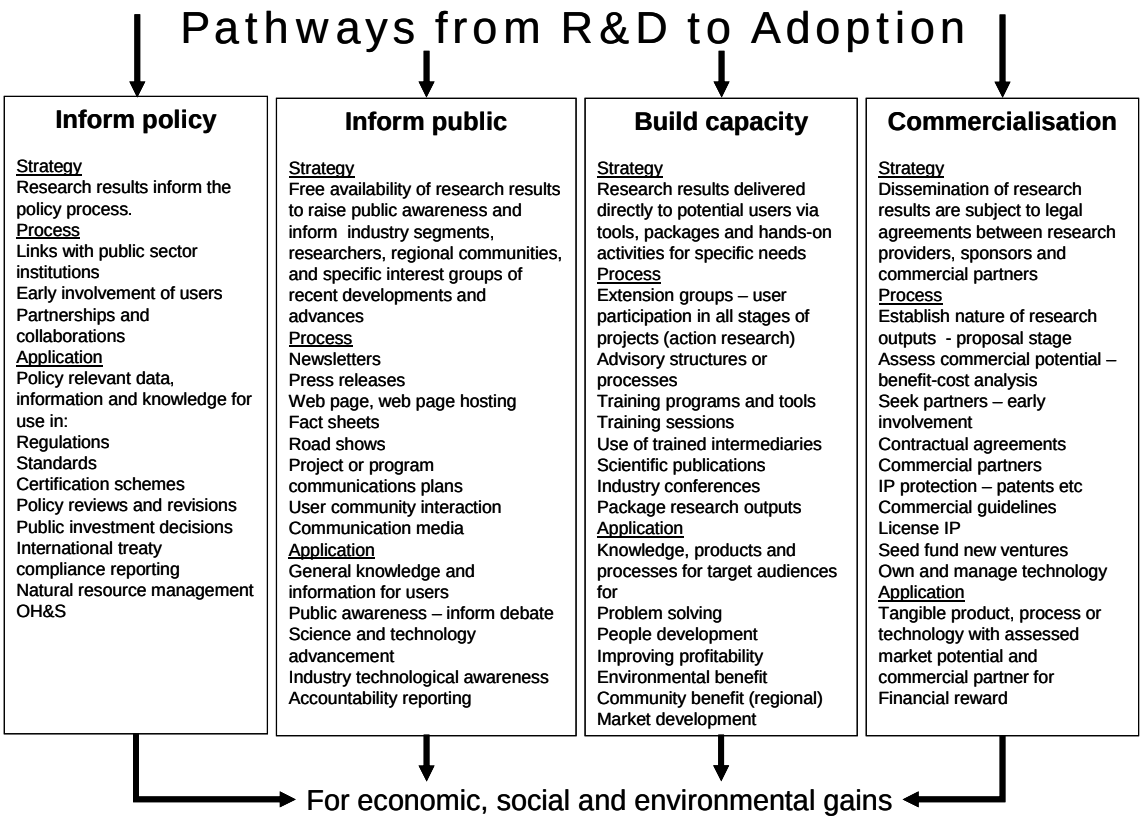
Howard (2005) distinguished two types of innovation: science-based and technology-based innovation. Science based innovation is driven by the discovery of new knowledge and inventions that can be legally protected with patents with the prospect of high commercial returns. The associated research is high risk and often long-term producing entirely new products for untested markets. Technology-based innovation is driven by the search for new or improved products and processes from the application of existing knowledge. While technology-based or product-based innovation requires continual generation of new knowledge through scientific discovery, an industry such as forestry and forest products can draw on new knowledge inputs from many fields including biotechnology, information technology and materials technology.

The outputs of research may be delivered as:

- new knowledge and information which can be used to make improvements to existing proesses, procedures and practices
- new knowledge and information that benefits the scientific community or the general public
- new technologies, products or processes

Maximising the benefits of research does not mean supporting only those projects that are expected to deliver commercial outputs. Research outputs may be directed at building capacity among potential users, informing public policy or contributing to the stock of knowledge in the public domain for the benefit of science, industry and the wider community. The following figure shows possible pathways for adoption of research project outputs.

Figure 1 reveals that the steps taken towards adoption of research outputs differ between projects depending on the target audience and the nature of the output. To ensure that potential benefits of research investments are maximised it is critical to know in advance whether they will be of a commercial, scientific, environmental or social nature and which user groups will be the main beneficiaries. With this knowledge researchers, in consultation with relevant stakeholders, can design appropriate and effective dissemination and adoption strategies. These critical aspects are incorporated into the assessment framework which is described in the next section.



Based on material from RIRDC (2004) Research priorities 2005-2006; and CIE (2003), The rural research and development corporations: a case study for innovation, Centre for International Economics, August

Assessment framework

Success in transferring research results to users depends on the existence of a clear need for the new knowledge, product or process, the form in which the research results are delivered to the users, the medium used to deliver the results and the ease with which the results can be incorporated into existing operations. Therefore, when assessing the likely impact of individual projects the following questions are relevant:

1. Do the research results address a priority need of the users?

2. Do the results address a short-term or a long term need?

3. Is the form in which the results are to be presented and the media selected for delivery appropriate for the target audience and consistent with the nature of the research results (see above)?

4. Can the results be readily incorporated into current operations?

To answer these questions project adoption strategies need to demonstrate:

- alignment of the research with the national or organisational research priorities, including whether or not it is a response to a short-term problem or it is contributing to longer-term improvement (assess strength of alignment)
- knowledge and understanding of preferences of the target audience for receiving and accessing different forms of technical information (assess ability of researchers to deliver in terms of knowledge of the target audience)
- competence in using the selected communication media for disseminating research results (assess ability of researchers to deliver in terms of communication proficiency including skills, tools and techniques)
- knowledge of existing operations or processes in place and of the factors that users take into account when investing in new technology (assess capacity of the target audience to take up a new product, process or knowledge including their financial, physical, technological, psychological and legal capacity)

Assuming all other things to be equal, it is proposed that if a project is strongly aligned with national or organisational priorities and project staff demonstrate a high level of knowledge of the target audience and a high of level of proficiency in engaging with and transferring research results to that audience then adoption is likely to be high.

Various actions can be taken to influence dissemination and adoption of research outputs. These can occur at a strategic and industry or sector-wide level and at the individual project level. Table 1 presents actions that may be taken at the strategic and project level based on reviews by the author of various research organisations and research funding organisations and relevant literature.

Actions taken to enhance dissemination and adoption of research results

Area	Strategic and industry level actions	Project level actions by researchers
Alignment with research priorities – short term and long term	Use a participative priority setting process involving representatives of the key stakeholder groups	Be aware of organisational research priorities
	Align priorities with industry and government priorities and plans	Prepare project proposals in line with research priorities
	Disseminate research priorities to all stakeholders (research plans, internet access)	Respond to calls for research needs in specific areas
	Maintain on-going communication with the user community to identify short-term needs	Propose projects with strong support and commitment from industry partners
	Establish appropriate advisory committees drawn from users	Maintain informal contact with industry and other relevant stakeholders through various means – e.g., direct contact, industry conferences, seminars and workshops
	Advise short-term research needs to research providers – tenders, commissions, expressions of interest	
	Fund research in priority areas, but remain open to new ideas and opportunities (maintain flexibility)	
	Periodically review and revise research priorities in light of industry changes	
	Stipulate structure or balance of the organisation's research investment portfolio in terms of return period and other relevant performance criteria	
	Conduct formal evaluation of selected projects – eg, benefit-cost analysis (periodically)	
Knowledge of target audience in relation to preferences and capacities for receiving and using technical information	Conduct periodic surveys of stakeholders and customers	Include research partners from among key stakeholder/user groups (target audience)
	Seek audience feedback on effectiveness of current methods	In the planning stages, identify clearly the nature of the research output and the best pathway to adoption
	Access specialist communication, knowledge and adoption expertise/ skills	Include an adoption strategy in the project plan with specific communication activities
	Package research outputs for specific audiences – regional, sectoral, species	
	Develop a communication plan	
	Develop a separate adoption-enhancement strategy	
	Provide guidelines for researchers on adoption strategies relative to target audiences and the nature of the research output	

Knowledge of delivery formats or platforms suitable for particular research outputs and audiences	Set communication guidelines, policy and principles for projects in line with the communications plan	Identify an appropriate format for communicating outputs in line with the project adoption strategy in association with stakeholders – industry partners, advisory committees, government officers, steering committees
	Provide guidelines for researchers on adoption strategies relative to target audiences and the nature of the research output	Include relevant expertise on project team
	Provide a forum for lessons learnt in dissemination and adoption activities and initiatives	Maintain regular dialogue with user community – eg via a reference group or similar
	Support individual projects with relevant industry forums at a sectoral, regional, issue, species level – involve all relevant projects	Clearly identify target audience, noting significant sub-groups – geographical, sectoral, etc
	Progress reporting on projects through newsletters and internet	
Delivery competence of researchers	Provide specific training sessions for researchers on aspects of communicating and commercialising research to enhance knowledge, understanding and performance	Include relevant expertise and/or experience on project team
	Support particular researchers with good dissemination and transfer reputation	Promote past success
	Develop and/or disseminate communication and technology transfer training tools	Nominate preferred persons
	Sponsor suitable forums for disseminating research results	Avoid sequencing dissemination and adoption – integrate adoption into all stages of research project
	Use intermediaries or agents of change to synthesise and integrate research results and deliver them to potential users	Identify relevant industry, regional and other forums for presenting research results
	Determine the most appropriate level at which to communicate research outputs – may not be at project level	Comply with government or organisational requirements
	Decide on a specific communication strategy	Utilise organisation or department resources where available
	Allocate resources to communication and adoption	
	Engage in high level partnerships to access necessary skills – at Program level	
Knowledge of factors influencing users' decisions to adopt	Monitor and report on key factors at an industry-wide level	Seek views from a project steering committee
	Conduct benefit-cost analyses of projects and other quantitative and qualitative evaluations	Gather intelligence on how potential users gain and apply knowledge
	Provide a list factors to be addressed as part of project adoption strategy (strategy guidelines)	Conduct risk assessment on user adoption factors and monitor accordingly as part of adoption strategy
	Review adoption patterns for completed research – five years after project completed	Integrate adoption into all stages of research project – engage with users from the commencement of the research project

Knowledge of factors influencing users' decisions to adopt (cont.)	Involve users in review of research milestones	Establish a highly participative 'action research' project
	Promote dialogue between research providers and users – annual research meetings involving selected users	
	Use of 'action research' projects, where appropriate	
	Educate and train the intended users of the research outputs an dhow they can be effectively incorporated into existing operations	

The table above reveals that the transfer of R&D results can be influenced by process or procedural factors, people factors and institutional factors.

Process factors include:
- users and researchers involved in joint planning and priority setting
- users involved in reviews of research milestones
- the adoption strategy is an integral part of the project plan, implementation and periodic review
- packaging research outputs for particular audiences

People factors include:
- culture of communication between user community and researchers established and sustained
- responsibilities for project elements are known and shared between researchers and users
- reliance on reputation and past performance of key individuals for project success
- facilitated exchanges between users and researchers with the aid of specialist intermediaries

Institutional factors include:
- establishment of partnerships with research and other organisations
- allocation of resources to specific communication and adoption functions and initiatives
- engagement of intermediaries to integrate, synthesis and/or add value to discrete research outputs with the aim of improving delivery effectiveness

Institutional changes are the most difficult to accomplish, while process and people changes are easier to develop and implement. Critical to any change process are people. Successful change is participative, involving representatives of all stakeholder groups. This builds ownership of the change and commitment to its implementation.

The contents of the above figures and tables provide a useful framework for reviewing dissemination and adoption activities used by research organisations. R&D organisations can apply the framework to establish the status of its current knowledge and technology transfer strategies and activities.

3.2 Strategic and Industry Level Activities

Determining the right balance between project-level activities and strategic and industry level activities in relation to adoption of research outputs is a subject of review by most R&D organisations. A recent study of planning, adoption and monitoring and evaluation practices of Australia's Rural R&D Corporations (RRDC) found that 'for a number of RRDCs the balance is weighing in favour of a more concerted effort by the RRDC itself to promote adoption' .

The following tables provide a framework for listing current activities and initiatives used by R&D agencies in each of the five areas defined in the previous section. The table also allows R&D agencies to explore means of improving performance in each of those areas.

Alignment with research priorities – short term and long term

Actions	FORDA's current activities and initiatives and how they support knowledge and technology transfer	Changes needed to improve knowledge and technology transfer
1. Use a participative priority setting process involving representatives of the key stakeholder groups		
2. Align priorities with industry and government priorities and plans		
3. Disseminate research priorities to all stakeholders		
4. Maintain on-going communication with user community to identify (short-term) needs		
5. Establish appropriate advisory committees drawn from users		
6. Advise (short-term) research needs to research providers		
7. Only fund research in priority areas		
8. Periodically review research priorities in light of industry changes		
9. Stipulate structure or balance of Corporation's research investment portfolio in terms of return period		
10. Conduct formal evaluation of projects – eg, benefit-cost analysis		

Knowledge of target audience in relation to preferences and capacities for receiving and using technical information

Actions	Your agency's current activities and initiatives and how they support knowledge and technology transfer	Changes needed to improve knowledge and technology transfer
1. Conduct periodic surveys of stakeholders and customers		
2. Seek audience feedback on effectiveness of current methods		
3. Invest in communication, knowledge and adoption expertise/skills		

Knowledge of delivery formats or platforms suitable for particular research outputs and audiences

Actions	Your agency's current activities and initiatives and how they support knowledge and technology transfer	Changes needed to improve knowledge and technology transfer
1. Package research outputs for specific audiences – regional, sectoral, etc		
2. Develop a communication plan and adoption strategy or plan – separate		
3. Set communication guidelines, policy and principles for researchers involved in projects		
4. Provide a forum for lessons learnt in dissemination and adoption activities and initiatives.		

Delivery competence of researchers

Actions	FORDA's current activities and initiatives and how they support knowledge and technology transfer	Changes needed to improve knowledge and technology transfer
1. Provide specific communication training sessions for researchers		
2. Support particular researchers with established dissemination reputation		
3. Develop and disseminate communication training tool		
4. Sponsor suitable forums for disseminating research results		
5. Use intermediaries to synthesise and integrate research results		
6. Determine the most appropriate level at which to communicate research outputs – may not be at project level		
7. Decide on a specific communication strategy		
8. Allocate resources to communication and adoption		
9. Engage in high level partnerships to access necessary skills – at Program level		

Knowledge of factors influencing users' decisions to adopt

Actions	FORDA's current activities and initiatives and how they support knowledge and technology transfer	Changes needed to improve knowledge and technology transfer
1. Monitor and report on key factors at an industry-wide level		
2. Conduct benefit-cost analyses of projects and other quantitative and qualitative evaluations		
3. List factors to be addressed as part of project adoption strategy (strategy guidelines)		
4. Review adoption patterns for completed research		
5. Involve users in review of research milestones		
6. Promote dialogue between research providers and users – annual research meetings involving selected users		
7. Use of 'action research' projects		
8. Educate and train the intended users of the research outputs		

3.3 Project-level initiatives can enhance adoption

Researchers can address adoption of prospective research outputs during project planning and seek out possible sources of support. Responsibility for technology development, commercialisation and related activities needs to be clear from the outset, especially for projects involving partners. Some research providers do not have access to business development and commercialisation services and resources within their organisations and must seek external partners or providers of such services. Another option is for research organisations to invest in and develop in-house expertise.

Based on evidence from reviews of projects, involvement of industry partners will accelerate uptake. First, consulting industry operators who are potential users of the technology at the proposal development stage gets the project off in the right direction. Second, on-going interaction with users helps refine the development of the technology so that by the time it is ready to release it can be implemented with relative ease, complementing existing practices. Third, as the innovators or early adopters of the technology, industry partners provide models for the rest of the industry. This aspect of research and development should be exploited in dissemination and technology transfer campaigns, such as testimonials by partners and demonstrations at partner sites. The approach described here is not dissimilar to participatory action research.

A clear understanding in the early stages of a project of the nature of research outputs and its potential users will help in project planning and budgeting and identifying the best adoption pathway for the research output. From the projects reviewed, there was evidence of inadequate attention to commercialisation aspects in project planning and during the course of the project. A stop-and-start research to adoption pathway for a project can result in costly delivery delays. When a project stops because funding ends, subsequent loss of key contract staff is a major risk to realisation of the project's potential.

Dissemination and adoption strategies may not be fully developed at the project proposal stage but evolve as the project progresses with expert advice and guidance from the project steering committees or internal review processes such as milestone reviews. Progress in these important areas should be monitored together with progress of the research activities.

Procedures for identifying, assessing, monitoring and treating risk factors for individual projects need close attention; management and monitoring of risks needs to be an ongoing component of project management and milestone reporting.

The following points summarise a review of various research projects:

- Individual projects aligned with organisational priorities and strategic goals attract management's interest and continuing support
- Industry support can be strong for projects which are not aligned with agreed priorities, at a sectoral, technology or regional level (while these are less likely to be funded from internal sources such projects may be sustained by investment from external sources)
- Knowledge of target audience preferences is enhanced through established relationships with users, the use of project reference, advisory and/or steering committees and the direct involvement of users in research projects
- Greater understanding of consumer attitudes and behaviours in relation to use of information, products and process and how attitudes and behaviours are influenced benefits adoption
- Tailoring research output packages for particular regions, including specific content, delivery format and delivery media enhances uptake
- Adoption delays should be expected where adoption is influenced by institutional arrangements beyond the control of the researchers or the organisation – alternatives include working with progressive industry participants willing to work outside agreed arrangements
- Close adherence to adoption strategy generates positive outcomes.

3.4 Improvement options for research organisations

A number of options exist to improve knowledge and technology transfer performance for research organisations. These may lead to improvements in adoption of research results and increased awareness of research outputs. The pros and cons of a range of knowledge and technology transfer approaches are assessed in order to provide some guidance for research organisations to select the most suitable approach to use in a range of situations.

Knowledge and technology transfer approaches

Technology transfer has been a subject of much review in the agriculture sector. In a recent review of extension theory and practice in Australia Black (2000) identified four main approaches:

1. linear 'top-down' transfer of technology and/or knowledge (broadcasting approach)
2. participatory 'bottom-up' approaches (also referred to as 'group empowerment')
3. one-to-one advice or information exchange
4. formal or structured education and training

Black identified various strengths and weaknesses of each approach. While these relate to the agriculture sector, there are many relevant points for the forest and wood products sector. Pros and cons of each approach for use in the forest and wood products sector are outlined below. These assessments are based on Black's review, modified and extended in the context of the forest and wood products sector. Table 5.1 summarises the key strengths and weaknesses of each approach and indicates their respective value in application to a forestry research organisation. Your knowledge and technology transfer strategy should have the capacity to use all of these approaches and be able to select the most appropriate one in light of the situation and desired outcome.

Typical features of the linear or broadcasting approach

New knowledge and technology are typically developed and validated by the research scientists – science or researcher push.

The knowledge or technology is promoted to users principally by focussing on early adopters– the strategy is based on the expectation that once these progressive users have embraced the new technology, others will follow.

While there is past evidence in support of the success of this approach especially in agriculture, it has weaknesses not the least of which is the separation of users and researchers. An aspect of this shortcoming that has become increasingly relevant in all industries is accounting for multiple objectives, notably environmental and social outcomes as well as productivity or economic objectives.

The approach devalues the knowledge, skills and adaptive abilities of the users.
The linear approach can be used most effectively in association with other approaches to broadcast research results and other relevant information and knowledge to large audiences, such as the hardwood plantation managers and owners, the entire forest and wood products industry and to the general public.

Typical features of the participatory 'bottom-up' approach

Active involvement of users in research ranges from simple information exchange between researchers and users, to users developing and leading complex research projects.

The approach starts with the users' knowledge, problems, analysis and priorities rather than the researchers (user pull rather than researcher push). In agriculture this approach is referred to as 'farmer first' which can be generalised to 'user first' in the context of the forestry and wood products industry.

The main locus of action is not the research station or laboratory, but the user's farm, plantation, mill or factory.

Among the advantages of participative approaches, as listed by Black are that they:

- Recognise local ways and draw on accumulated knowledge of users.
- Accommodate and augment diversity and complexity.
- Facilitate multiple stakeholder involvement in research which may have community or environmental impacts (spillovers or externalities).
- Can accommodate issues characterised by complexities associated with a diversity of interests, as in the case of landscape management.
- Facilitate and value exchange of knowledge between users as well as between users and researchers.
- Encourage user ownership of both the problem and the solution.
- Make use of group processes which embrace divergence and provide the basis for exploring more creative solutions to problems – requires effective facilitation.
- Are considered to be more efficient (in terms of cost) that one-to-one approaches.

Weaknesses of the participative approach include;

- Its inability to effectively deal with previously unencountered problems which are likely to be beyond the capabilities of users.
- Its tendency to assume consistency among the user community and its weakness in recognising and dealing with conflict, which excludes valuable ideas – can be overcome with effective facilitation.
- Prejudices, ignorance and the pursuit of short term goals can be reinforced by groups unless a critical learning style is embraced.
- Participants may be not be representative of the user community, as many users are unwilling or unable to participate; this characteristic may result in the participative approach looking similar to the linear approach (in the case of the forest and wood products industry this may be relevant in those segments of the industry where there are a small number of enterprises and where the same group of users are involved in a variety of research activities).
- The focus of the group may converge to consider just technical matters at the expense of other important needs.
- Not all participants are able to perceive the problems or solutions in their own context – what may be a problem for one user may not be for another; often the exchange of knowledge among users can be sufficient to improve user outcomes, precluding the need for new research in a focus area.
- Valuable knowledge may not be documented by the group and therefore it may not be disseminated beyond the group.
- Lack of recognition of the weaknesses of the participative approach can lead to its ineffective use with inadequate planning and resourcing relative to the expectations of the user group – leadership and facilitation are critical to success of participative approaches.
- Popularity of the approach places demands on users with the risk of group overload for some individuals; the costs of participation could outweigh the benefits (in the case of the forest and wood products industry this is especially relevant to those segments that have only a few players and who are called on for a number of representational duties).

Typical features of the one-to-one exchange approach

In Australia the one-to-one approach to technology transfer has shifted from being a government sponsored service to a user pays service in the rural sector. However, in situations where the benefits of adopting new knowledge or a new technology extend beyond the adopter, some publicly funded services remain. This is especially so for natural resource management where public funds have been allocated to programs and groups such as Landcare and Catchment Management Authorities.

According to Black the typical services provided on a one-to-one basis by private agents in agriculture include financial, planning, specific enterprise production (crop and livestock), risk assessment and management and new management or production systems. Typical providers include private (agricultural, farm management, forestry) consultants, accountants, bankers and financial advisors. Other sources include suppliers to the rural sector, advisors attached to seed, fertilizer and chemical companies and staff of government departments and agencies. A similar situation exists within the forest and wood products sector.

Black observed that with the growth of private consultants and other providers of knowledge in agriculture there is a danger of the resulting competitive environment for knowledge resulting in fragmentation between research organisations and extension advisors or agencies, between different government agencies involved in agriculture and natural resource management, between public and private agencies and between related industries. Independent intermediaries can prevent fragmentation by facilitating the two-way exchange of knowledge and information.

Typical features of the formal or structured education and training approach

Studies have shown that individuals employed in agriculture, forestry and fishing have lower levels of formal education than the rest of the Australian labour force, although the trend has been improving.

In the case of agriculture Black found that farmers are reluctant to engage in formal, long-term educational programs for a number of reasons including lack of time, relevance, a belief that the competencies they need are more practical than theoretical, lack of awareness of courses, lack of confidence and rural attitudes towards the roles of men and women. This situation may be similar for some segments of the forest and wood products industry, although given its diversity it is not be possible to generalise without industry specific information.

There is willingness to participate in planned learning activities that are of direct relevance to the user and that require relatively short blocks of time.

Studies of farmers' preferences for content, approach and delivery of learning and development programs have identified the importance of meeting specific knowledge needs relevant to current and future developments, using short, modularised courses which encourage participation, project-based learning, develop competencies, are practical, have measurable outcomes, fit in with work patterns, involve home study with access to local support and involve some social interaction. Black observed that these preferences align with the principles of adult learning. This should be investigated for the forest and wood products industry.

Black concluded that no single approach is likely to be sufficient by itself. The linear approach may have weaknesses, but it can be an effective strategy for dissemination of new knowledge and information about new technologies when used in association with other strategies. The success of the participatory approach lies in its management and the knowledge and skill of those coordinating participatory programs. User participation in research projects is attractive, but it does not guarantee uptake. Exclusive reliance on the participatory approach is not sufficient to enhance uptake of research outputs. Use of one-to-one and education and training approaches in association with the participatory approach may enhance adoption. In some case uptake may be enhanced including training programs as part of the adoption strategy.

Initiatives and issues associated with knowledge and technology transfer approaches

Approach	Application initiatives
Linear or knowledge broadcasting	Fact sheets and info sheets
	Newsletters for industry operatives
	Web-based information, including completed research reports; progress reports;
	Press releases
	Manuals, software, decision support tools
	Publishing in scientific and trade journals and presentations to scientific and industry conferences
Participatory	Participative planning and priority setting processes - consultations with all stakeholder groups (industry, community and consumers)
	Collaborative research – users and research providers working together
	Action research – users leading research programs
	Research partnerships
	Advisory Groups – priority setting, review and evaluation
	Use of intermediaries or agents of change – industry development officers, knowledge brokers
	Industry and regional forums – work with industry associations on selected research activities – syntheses or individual projects
	Project steering committees involving user representatives
	User surveys and feedback mechanisms for evaluating research performance, project performance and other activities and identifying areas in need of improvement
One-to-one	Use of intermediaries or agents of change to work with individual users
	Use of established advisory services – private and government services - to facilitate technology and knowledge transfer
	Use of secure website, Extranet e-mail service for individual personalised service
Education and training	One-off events – short programs delivered in regions
	Industry associations – development programs
	University and technical college courses (for users)
	Supported by web-based material for instructors and students
	Specific program linked to research project and delivered as part of project adoption strategy

3.5 Options for improving knowledge and technology performance

Intermediaries

An intermediary or agent of change is an individual or group who is active in the industry and can provide an effective link between researchers and the user community. Their role is to communicate research outputs to users in way that is understandable and usable. The CIE (2003) report lists several agents of change including industry leaders who are early adopters and often actively involved in R&D, producer groups, industry-based research bodies, public extension agents, private extension agents, agribusiness purchasers and suppliers and point of sale services such as stock and station agents. In addition there are industry development officers, regional development officers and business and investment advisors.

Action research projects

Action research is far more than simply involving users in research projects. Action research involves a family of research methods which simultaneously pursue action (change) and understanding (research). It is an iterative process which involves cycling or spiralling between planning, action, critical reflection, revision and implementation of revisions involving users and researchers. It may lead to refinement and revision to methods, data and interpretation in light of the learning gained through the stages of the approach. It represents a capacity building pathway to adoption for both users and researchers. Users learn how to apply new knowledge and researchers learn about user behaviour. The research is conducted in an actual work place such as a factory or a forest rather than in a laboratory or experimental plot. It is collaborative research which is dependent on people skills and process and the development of relationships between scientists and users.

According to a recent review by the Centre for International Economics (2003) action research is increasing in Australian agriculture because of the growing need for R&D results to be replicable on-farm. According to CIE 'demonstration of the application of R&D outputs on commercial farms has been shown to be one of the most effective forms of communication about R&D outputs and outcomes.' They suggested that action research goes beyond demonstration as it improves the quality of the R&D by capturing the knowledge of primary producers and gaining their ownership of and commitment to the research.

Action research projects within forestry are not uncommon, especially in relation to community forestry, sustainable forest management, natural resource management and forest management in developing nations. The action research model provides an effective framework for involving representation from each of the key stakeholders. The success of the approach lies in the skill of the action researchers in remaining independent, yet being accountable to the user community. In action research projects user(s) that have a share of control of the project rather than it being the exclusive role of the researchers as in the traditional model.

Action research-type projects are emerging naturally as industry and researchers form closer working relations. Greater project success may occur by applying the principles of action research and the action research framework to such projects.

Evaluation framework

An efficient and consistently applied evaluation framework is critical to managing research for maximum impact. Such a framework will facilitate assessment of project proposals, inform researchers of key aspects of their project that are relevant to its impact and uptake and provide a basis for assessment of longer-term impacts of completed research projects. An efficient framework is one that economises on data and information inputs to estimate likely impact and the best possible adoption pathway.

The evaluation framework should be an integral and continuous part of every research project at each stage including inception, execution and implementation. It should be the basis for defining critical performance indicators which can be monitored periodically to assess project performance. It should allow ready assessment of the progress of the research (factors affecting probability of success of the research) and steps taken to transfer research results to users (factors influencing probability of delivery success and likelihood of adoption of research results). It should be linked to the project risk assessment where treatments for residual risks (such as those influencing research success and delivery and adoption performance) are described for later monitoring, review and revision.

At the project level, evaluation strategies need to be tailored for each project. There is no one best way of conducting an evaluation. Project evaluation strategies should be consistent with the project method. For example, a participatory action research project would be matched by participatory evaluation approach.

Focus on knowledge and adoption

The focus for many research organisations has broadened from communication to knowledge and adoption as they strive to find ways of increasing the uptake of research results. Research organisation are developing knowledge and adoption strategies and appointing knowledge management and research adoption experts to improve the uptake of research results. Greater responsibility for knowledge and technology transfer from conception of an idea to adoption of new knowledge is being assumed by research organisation management. At the same time researchers' responsibilities have not eased. They must adapt to changing knowledge management and adoption arrangements for the success of their research and its adoption.

The increasing focus on knowledge management is aimed at improving adoption. It is not only about the new knowledge generated by the sponsored research but also knowledge of current production and processing systems, industry conditions and relevant issues in the broader external environment and knowledge of attitudes and behaviours of user communities, including past adoption performance and factors influencing adoption. Adoption is enhanced when knowledge of the complete production system is taken into consideration. Knowledge and technology transfer must be an integral part of research management from planning and priority setting, through proposal development and project management to implementation of outputs.

Glossary of Important Terms

Action research or participatory action research	Projects where researchers and users work in close collaboration to achieve science and practice objectives involving an iterative learning process of reflection, review, revision and action at all stages of a project. Projects may be coordinated by users rather than researchers.
Adoption	The incorporation, implementation and use of new knowledge, process or technology in commercial, industrial, social and/or environmental contexts. The process by which users accept a new product, process, idea or technology.
Capacity building	Strengthening the knowledge and capabilities of individuals in industry and the science community to apply new skills and knowledge for productive advantage.
Client	An individual or organisation that pays for a specific product or service by way of an exclusive legal agreement with the supplier.
Commercialisation	From a research organisation's perspective it is the process of selling or licensing research results and/or the sale of services based on application of knowledge through contracts or consultancies.
Communication	The process of delivering and receiving knowledge and information, of keeping key stakeholders informed about relevant activities and of raising awareness and improving understanding of priorities and important issues.
Customer	An individual or organisation that consumes a product or service, either by direct purchase in the case of private goods or by sharing in free assess to public goods (non-exclusive).
Data	Data are observations or facts which when collected, organised and evaluated become information or knowledge.
Development	The D in R&D. Development encompasses the application or use of the new knowledge from research to create new and improved products, processes and services. It completes the R&D process or cycle.
Dissemination	Raising awareness of and interest in research outputs – new knowledge – among potential users with a view to promoting adoption.
Information	Information is data that has been organised to serve a useful purpose – data with context or perspective.
Innovation	Innovation is the process that translates knowledge into economic growth and social well-being. It encompasses a series of scientific, technological, organisational, financial and commercial activities. Research is only one of these activities and may be carried out at different phases of the innovative process.
Intermediaries (agents of change)	Industry professionals working as consultants or advisors who provide a bridge between researchers and users for the efficient and effective two-way exchange of knowledge and information.
Knowledge	Knowledge is information with guidance for action or a purpose for use. Knowledge is awareness and understanding of facts, truths or information gained in the form of experience or learning. Knowledge is an appreciation of the possession of interconnected details which, in isolation, are of lesser value.
Priorities	Agreed areas of importance that are to be addressed ahead of other areas.
Process	The way or means by which a product or service is designed, created or transformed and supplied involving the systematic interaction among a range of key inputs or resources.
Product	The tangible output of a process.
Public domain	The body of material and knowledge that is freely available to the public (non-excludable), referred to as public goods. Consumption of a public good by one person does not limit its use or consumption by others (non-rivalrous).
Public policy	Policy developed and implemented by governments for the benefit of society
R&D	Research and Development - Comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture, society, and the use of this stock of knowledge to devise new applications in the form of new products and processes.

Research	The systematic exploration and investigation of phenomena – can be basic, strategic or applied.
Research results	The output of research which may be in the form of new knowledge, processes or products.
Science	Systematic organised knowledge. The systematic study of humans and their environment based on the deductions and inferences which can be made, and the general laws which can be formulated, from reproducible observations and measurements of events and parameters within the universe. (Macquarie Dictionary)
Stakeholder	A person or organisation with a stake or interest in the operations, inputs and/or outputs of a particular activity or organisation.
Technology	A body of skills and knowledge by which humans control and modify the world: Human innovation through action that involves generation of knowledge and processes to develop systems that solve problems and extend human capabilities. The innovation, change, or modification of the natural environment to satisfy perceived human needs and wants.
Technology transfer	The transfer of knowledge or technology between organisations through licensing or marketing agreements, co-development arrangements, training or the exchange of personnel.
Users/user community	Organisations or individuals who adopt and use research outputs to benefit their operations or performance.