

# **Management of Scientific Research and Development Projects in Commonwealth Agencies**



**Better Practice Guide  
For Senior Management  
2003**

ISBN No. 0 642 80740

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# Auditor-General's Foreword



This Better Practice Guide has been prepared to provide practical assistance to senior managers in establishing processes and structures to support management of scientific research and development projects.

During 2003–04, the Commonwealth will invest over \$1.3 billion in the major public research agencies, and a further \$890 million in direct support for science and technology (for example, through Cooperative Research Centres, rural research agencies and other programs). It is important these funds are invested and managed well.

Management of research projects is challenging, often involving management of uncertainty and risks. At the same time, stakeholders increasingly hold agencies accountable for the efficient and effective use of scarce research dollars and achieving cost-effective outcomes.

A well-structured, explicit framework for project management can assist agencies and their staff to meet these varying pressures by clarifying the sometimes different perceptions and expectations of the various stakeholders, as well as fostering a more strategic approach to their research portfolios.

The guide emphasises three aspects of project management:

- ▶ selecting and prioritising projects so that overall return to the taxpayer is maximised
- ▶ establishing robust risk-management processes for projects
- ▶ maximising the opportunities for organisational learning through post-project review.

The guide is not intended to be a straitjacket, but more the base for further development and adaption by relevant agencies, to the extent that it suits their circumstances.

The ANAO would like to express its appreciation to the various agencies which assisted with the guide's development, either by commenting on drafts or contributing examples and ideas. These include the Commonwealth and Scientific Industrial Research Organisation, the Bureau of Rural Sciences, the Defence Science and Technology Organisation, the Australian Nuclear Science and Technology Organisation, the Fisheries Research and Development Corporation and the Department of Education, Science and Training. Appreciation is also expressed for the assistance provided by the CPMGroup and Origin Consulting.

PJ Barrett  
Auditor-General



# 1. Introduction

## —The Importance of Project Management in R&D



*This Government believes that innovation—developing skills, generating new ideas through research, and turning them into commercial success—is key to Australia’s future prosperity. Innovation is not only the province of new or high tech industries, but also essential to the future of many of our traditional sectors such as agriculture, manufacturing and mining.<sup>1</sup>*

Innovation is a key to Australia’s future prosperity. Australia has many world-class research agencies that have highly skilled, committed scientists producing high-quality scientific outputs. Each year, many millions of dollars are allocated by Government to public sector research agencies to support innovation. Increasingly, it is being recognised that to maximise the return to the community, the science needs to be complemented by excellent project management.

### **Why use project management in scientific research and development?**

In recent years there has been increased external scrutiny and accountability requirements on public research agencies, along with greater interest in the return from public research funding. These factors, along with greater engagement by public research agencies with other sectors (such as private companies) have led to a greater focus on the efficiency and effectiveness of research.

Scientific research and development (R&D) projects can be very different from other types of projects. The outcomes may be long-term, dependent on actions by others or be difficult to define. Ultimate benefits may be intangible and/or be a more informed basis for future projects. Their research or policy environment may change rapidly, with new breakthroughs or problems affecting the relevance of the project. Projects may necessarily be high risk.

These aspects of R&D projects reinforce the need for sound project management, and for organisations to have robust supporting frameworks for project management.

Notwithstanding the unique environment in R&D organisations, research projects can benefit from the use of standard project management techniques. In a rapidly changing environment, with diverse issues and projects, project management can support the achievement of project and organisational goals, as well as give greater assurance to stakeholders that resources are effectively managed.

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<sup>1</sup> John Howard The Hon, M.P., *Backing Australia’s Ability* (2000).

Defining work as a project helps:

- ▶ clarify goals
- ▶ identify the resources needed
- ▶ ensure accountability for results and performance
- ▶ foster a focus on final benefits to be achieved from research.

It is important to note that there will be some aspects of R&D, such as ongoing monitoring of trends or corporate activities supporting research, that would not benefit from being defined and managed as a project. Each organisation will need to carefully delineate such activities.

## Focus and structure of this guide

Projects are not delivered in isolation. As well as skilled individuals and well-structured teams, organisations need an appropriate infrastructure to support staff in doing the best job possible in an efficient and effective manner. With this infrastructure in place, project staff are more likely to achieve and demonstrate value-for-money for the general public.

The focus of this guide is therefore on the organisational policies, principles and practices supporting management of scientific R&D projects.

This guide is intended to be used by those responsible for putting in place the broad, organisational supports for project management, usually senior divisional or organisational management.

Organisations such as public-sector research agencies, public-private consortia (for example, Cooperative Research Centres) and funders of research (for example, Research and Development Corporations) should find much of the guide relevant.

Organisations may select from the guide the sections most relevant to their environment and role in R&D. For example, an organisation that funds or purchases research, but does not deliver research, will find the sections on project selection and review particularly relevant. Organisations that operate mainly under contract to outside organisations will find the sections on planning and monitoring projects most relevant.

The guide focuses on scientific R&D. However, management of other types of research in other disciplines may also benefit.

The structure of the guide reflects the project delivery cycle of initiate-plan-deliver-finalise and evaluate. It has a strong emphasis on the importance of a clear user or client focus for guiding research. Within this framework the focus is on the organisational aspects of project management, as set out in Figure 1.

**Figure 1: Structure of this guide**



## 2. Creating the Right Infrastructure for Effective Project Management of R&D Projects

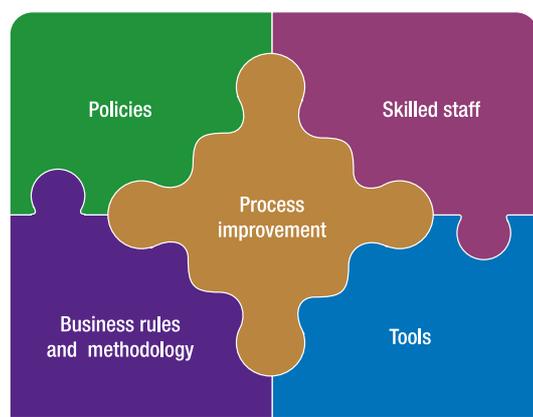


### Introduction—why supporting infrastructure is important

Public research agencies face particular challenges in ensuring value for money in research. They often have longer term goals than do private agencies. They may have a wider range of stakeholders. They are also often expected to undertake 'riskier' research. For these reasons, a robust project management infrastructure is particularly important

Figure 2 shows the key elements of organisational infrastructure that will make project success more likely. These are clearly articulated organisational policies, guidance and methodologies, supporting project teams with robust project management tools and information, and ensuring staff have appropriate skills to manage projects.

**Figure 2: Key elements of project management infrastructure**



Source: ANAO

## Project management policy

The foundation of an effective organisational approach to project management will be a formal act of policy, relevant standards and guidance for project management.

Project management policy plays a key role by:

- ▶ setting out organisational expectations
- ▶ providing a rationale or justification for more detailed procedures
- ▶ facilitating a consistent approach to project management across the organisation.

For example, organisational policy may require that all projects pass through an early scope definition or preliminary proposal stage, and provide the rationale for this policy and its broader context in relation to organisational priorities.

Organisational project management policy need not be expressed extensively. It can simply focus on the broad expectations and requirements for project management with further definition in manuals/procedures. Regular monitoring and review of policies will ensure continued relevance and effectiveness.

The project management policy would address issues such as:

- ▶ standardised or suggested methodologies for priority setting and ranking projects
- ▶ the need for project objectives to link with organisational goals and recognise broader linkages to the organisation's environment
- ▶ the typical contents of project plans
- ▶ project approval principles
- ▶ how costs are to be attributed to projects
- ▶ management of intellectual property
- ▶ management of partnering or consortia arrangements with other bodies (both public and private)
- ▶ requirements for project monitoring
- ▶ the role and conduct of post-project review
- ▶ project risk assessment, allocation and management principles<sup>2</sup>
- ▶ linking policies to project management systems and practices.

Organisational policies may also include clear standards, for example, setting out what type of project should be subject to a more detailed risk assessment.

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<sup>2</sup> Risk allocation is of prime importance, particularly where the private sector is involved.



## Case study 1: Policy frameworks in CSIRO

The CSIRO Project Management Guide contains broad policy. For example, statements such as ‘On completion, all projects must be reviewed ...’. It also contains detailed guidance on issues such as:

- ▶ the role of project plans
- ▶ scope management
- ▶ use of work breakdown structures
- ▶ resource management
- ▶ people management
- ▶ quality management
- ▶ risk management

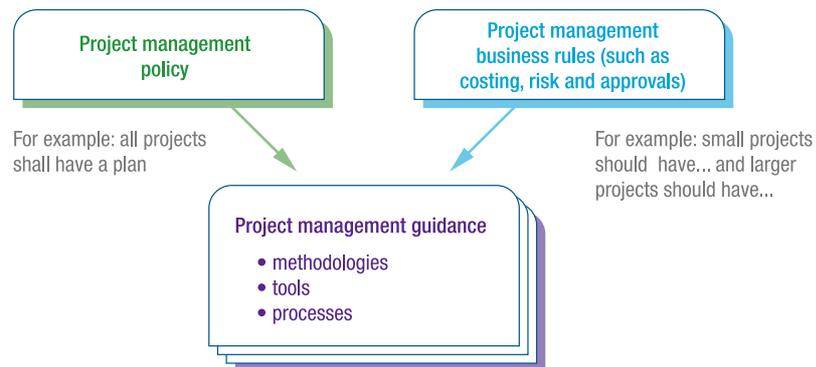
Source: CSIRO Project Management Guide

## Business rules and methodology

Broad project management policies need to be supplemented by more specific guidance on the organisation’s expectations of how the policy will be implemented. Guidance on this stage would set out the order in which tasks are done, the content of relevant documents, and the use of particular methodologies or templates.

Guidance will often be set out in a project management manual that expands on each aspect of policy, and suggests how to achieve its objectives (see Figure 3).

**Figure 3: Links between policy and guidance**



Source: ANAO

The aim of the guidance is to provide practical assistance and standards to project managers. It also sets out the role of supporting tools, such as project management information systems, and related policies on matters such as intellectual property.

Guidance also needs to advise how the extent and detail of project management varies according to the characteristics of projects. Figure 4 gives some examples of this. The flexibility to vary the approach is particularly important for organisations that have a wide range of types of projects. A ‘one size fits all’ approach can waste resources by over-managing small projects. Alternatively, it may put outcomes at risk by under-managing large projects.

**Figure 4: How project management might vary depending on the scale, length or risk of a project**

	<b>Minor, simpler project.</b> <i>Low risk, opportunity or impact</i>	<b>More significant project.</b> <i>Moderate risk, opportunity or impact</i>	<b>Major project.</b> <i>Substantial risk, opportunity or impact</i>
Planning	short pro-forma(s)	more detailed plan, including risk analysis	detailed implementation plan, risk management process, and benefits realisation plan
Monitoring	informal during life of project, simple tracking of milestones, quality and budget	more formal progress reports, supplemented by quantitative tracking	regular milestone reviews, possible external input or review by steering committee
Finalising and reviewing	short review focusing on findings and 'lessons learned' using a pro-forma approach	more formal review, covering key aspects of project using longer pro-forma	specific study into project delivery and benefits, such as a cost-benefit study

Source: ANAO

The guidance may also establish a standard methodology for project management. Such methodologies may be developed in-house or purchased from specialist providers. Benefits of a standard methodology include consistent terminology within the organisation and ready-prepared templates for many project management documents.

The use of a standard methodology can also provide assurance to clients that projects will be appropriately managed. Where an organisation has disparate projects and types of clients, it may be desirable to make the methodology flexible enough to be adapted to the different projects undertaken.

### Shared terminology

One important feature of a coordinated organisational approach to consistency is the use of key terms of project management. Shared understanding of terms such as 'project', 'risk' or 'benefits' fosters clear communication between staff and teams. It also helps foster a shared approach to project management and makes it more likely that supporting systems reinforce and support sound project management. Confusion about key terms can inhibit coordination across an organisation, reduce transparency and accountability and reduce the quality of management information.

Figure 5 lists some of the key terms that should be defined for shared understanding.

## Figure 5: Key terminology

■ project	■ budget
■ prioritisation	■ milestones
■ alignment	■ project risk
■ project objectives	■ sponsor/client
■ project outcomes	■ issues
■ project goals	■ delivery and acceptance
■ project plan	■ project finalisation
■ project proposal	■ post-project review
■ project scope	■ work breakdown structure
■ costs	■ schedule

Source: ANAO

## Tools for project management

### Templates and checklists

One simple way to foster a consistent approach to project management and streamline project management is through the use of standard templates.

Such templates bring several benefits. They simplify the task of preparing project documentation for busy project managers; facilitate a consistent approach to project management; and can streamline decision-making, as senior management can compare 'like with like'.

Figure 6 shows a sample list of possible templates. However, it should be noted that there may be several versions of each template, depending on the type of project involved.

### Figure 6 : Possible standard templates

■ project scope definition	■ change request form
■ project proposal	■ monthly or milestone reporting format
■ business case	■ costing modules/spreadsheets
■ project plan and charter	■ project health checklist
■ work breakdown structure	■ project completion/finalisation
■ responsibility assignment matrix	■ post-project review
■ risk management plan and register	■ lessons learned
■ issues register	

Source: ANAO

- Examples of templates used by some organisations are at  
[http://www.utas.edu.au/major\\_projects/](http://www.utas.edu.au/major_projects/)  
[http://www.projectmanagement.tas.gov.au/pm\\_templates/pm\\_templates1.htm](http://www.projectmanagement.tas.gov.au/pm_templates/pm_templates1.htm)

## Project management information systems (PMIS)

Better practice organisations will establish an electronic project management information system or PMIS. Typically, the PMIS, will record each project's:

- ▶ title and description
- ▶ whole-of-life budget and projected cash flows
- ▶ objectives
- ▶ relation to organisational goals
- ▶ client
- ▶ expenditures to date and forecast
- ▶ status (about to commence, closed etc)
- ▶ milestones (and the achievement of those milestones)
- ▶ risk rating
- ▶ staffing
- ▶ whether a project review has occurred.

Issues to consider in implementing a PMIS are:

- ▶ integration with existing financial and other systems
- ▶ ensuring terminology and definitions are clear, so projects can be tracked and assessed consistently
- ▶ preparing the ground with staff, particularly to ensure that data entry is reliable.

The principal benefits of a reliable PMIS are:

- ▶ a common database of project information
- ▶ helping to establish a common process for project management that can be adapted to project types
- ▶ consistent tracking and reporting of project status.

The PMIS can also provide tailored reports for project staff and senior management on the progress of individual projects or groups of projects. As well as being a passive repository of project data, a PMIS can be used to actively support project management by:

- ▶ including templates (see Figure 7)
- ▶ requiring steps to be completed in sequence (such as completing a risk assessment before seeking approval for a project)
- ▶ producing standard reports to facilitate management oversight (such as through milestone reports).

**Figure 7: Typical templates provided by a PMIS**

Project management function	Providing	PMIS template
Scope	Broad parameters for initial approvals	- Scope definition - Project proposal
Schedule	Durations, start/finish and dependencies	- Work breakdown structure - Schedule (GANTT)
Cost	Costing and pricing	- Budget - Contingency estimates (risk based)
Quality	Project success criteria and performance expectations	- Quality checklist - Standards criteria
Project human resource management	Who does what? Accountability, who expects what?	- Resource assignment - Responsibility assignment - Stakeholder matrix
Project communication	Who needs to know what?	- Communications chart - Reports formats (periodic or exception)
Risk	What can go wrong, and what to do about it?	- Risk register - Risk matrices - Issues log - Change request proposal
Contracts/procurement	Agreements with collaborative agencies and contracted resources/facilities	- Forms of contract - Checklists

Source: ANAO

Usability will be improved where the PMIS avoids duplicated entry of data, allows different types of users to customise reports and contains standard reports.

Better practice organisations have complemented PMIS with ‘workflow’ systems. These systems record and monitor key information about the status of projects, and embody the organisation’s preferred sequence and structure for project management. For example, the Defence Science and Technology Organisation (DSTO) uses a ‘Task Management Information System—Automated Work Flow’ which includes standard PMIS functions for creating and approving project plans, and for reporting on them. It is also a repository of project information. A similar system is being developed by the CSIRO.

Figure 8 below shows computer screenshots of two systems being implemented by CSIRO and DSTO.

**Figure 8: Examples of project workflow systems**



Source: CSIRO and DSTO

## Case study 2: Automated work flow system in DSTO

The automated work flow system within the Task Management Information System works via emails. The emails advise staff of the task approval/reporting process that must be followed.

If needed, follow up emails are sent, with advisory emails to more senior management. The purpose is to ensure that the task plan approval process proceeds without undue delay, or if a delay does occur, that it is managed appropriately.

There is also a provision for the Task Manager to be alerted when the task is approaching its approved expenditure or approved duration limits. If the task is expected to exceed these limits, the system prompts the task manager to either seek additional funding/time (if these are within certain predetermined limits) or to approve the task. Failure to do so, and if the task is overspent or is overdue, result in the task being suspended.

Source: DSTO

## Project support

Many organisations have found benefits in centralising support for busy project managers and teams. This has particularly been the case in research organisations, where staff leading projects may not have the in-depth skills of project management. It is also relevant where organisations want to leave project managers as free as possible to concentrate on the technical/scientific aspects of a project.

Project support functions may be located in a central unit as part of broader financial or corporate arrangements. Alternatively, they can be decentralised to, for example, individual research programs (sometimes called a Project Support Office).

The project support role can include:

- ▶ creating and maintaining key project documentation
- ▶ storing project records
- ▶ running project management information systems
- ▶ providing or organising training in project management
- ▶ monitoring and reporting on project performance against agreed organisation benchmarks
- ▶ providing risk management and other support services
- ▶ monitoring the overall project portfolio and linkages between projects.

However, it should be noted that these arrangements do not change the responsibility for project managers to be accountable for their projects.

## Appropriately skilled staff

As with other types of projects the skill, knowledge and commitment of project staff are fundamental to achieving successful outcomes.

Organisations need to constantly upgrade the scientific and other knowledge of staff. Project management competence must also be developed and maintained.

Better practice organisations provide a structured approach to project management training, rather than just leave staff to learn skills 'on the job'. The benefits of such structured training are that it:

- ▶ gives the opportunity to promulgate the organisation's policy on project management
- ▶ ensures that staff get appropriate training as they progress to positions requiring more project management skills
- ▶ fosters a common approach to project management across different parts of the organisation.

Such training should link to (or be based on) the agreed methodology and policy for project management in the organisation, thus helping to institutionalise the organisation's approach to project management. Many organisations adopt a flexible and graduated approach, offering different levels of training as staff progress to more responsible positions.

Training is often more effective when it is linked to articulated competencies. Figure 9 shows one set of competencies developed by the Australian Institute of Project Management.<sup>3</sup> These can serve as a useful starting point for either developing training, or choosing training courses and providers.

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<sup>3</sup> See <[www.aijpm.com.au](http://www.aijpm.com.au)>.

## Figure 9: National Competency Standards For Project Management

The National Competency Standards for Project Management (NCSPM) were developed by the Australian Institute of Project Management (AIPM) in consultation with industry and under the auspices of the Australian National Training Authority. The AIPM adopted the Project Management Body of Knowledge (PMBOK®) as the knowledge-base for the NCSPM. The NCSPM is therefore structured around nine units of knowledge:

- |                           |                               |
|---------------------------|-------------------------------|
| 1. integration management | 6. human resources management |
| 2. scope management       | 7. communications management  |
| 3. time management        | 8. risk management            |
| 4. cost management        | 9. procurement management     |
| 5. quality management     |                               |

Source: Australian Institute of Project Management.

Some organisations have chosen to recognise project management as a core competency to promote and monitor project management skills. The aim is to incorporate project management into career paths and create dual streams for individuals, supporting project management and technical/research specialisation.

### Ensuring policies are implemented

In practice, organisations may have appropriate policies and guidance on project management, but such policies may not be consistently applied in practice. These difficulties may be because of lack of time on the part of project managers and/or competing priorities.

Some strategies that can help manage this risk and foster a culture of continuous improvement include:

- ▶ using part-time project 'coaches' to assist teams to implement better practices
- ▶ ensuring individual and unit performance assessment includes project-related measures, such as conformance to budgets, project timeliness and customer/sponsor feedback
- ▶ encouraging reliance on the main project information systems for tracking project and unit performance
- ▶ conducting ad hoc audits of project management practice, with an emphasis on quality control and improvement
- ▶ engaging line managers in monitoring the effectiveness of project tools such as the PMIS or the conduct of project risk assessment.

Better practice organisations recognise project management as an important business process in its own right, and develop specific strategies to improve it across the organisation. One framework used to do this is the concept of 'maturity' in project management.

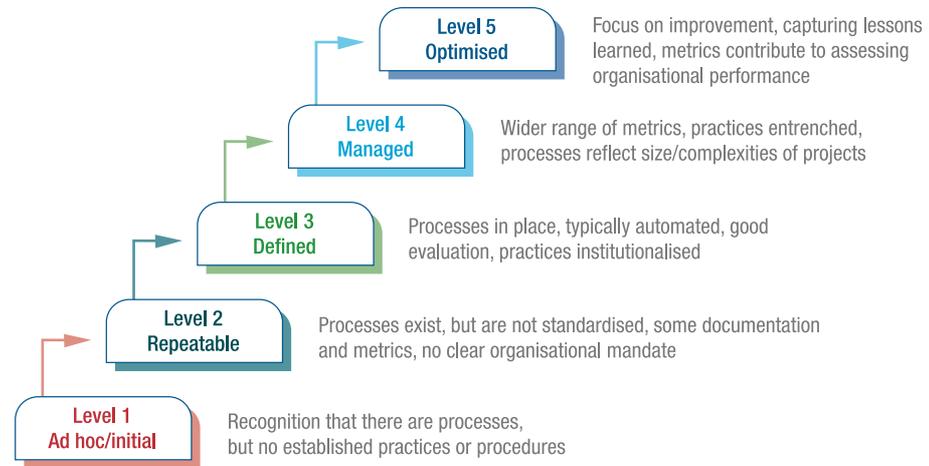
### Assessing and improving an organisation's project management processes

To improve organisational project management competence, organisations need to regularly assess their project management capabilities. Depending on the result of the assessment, the organisation may decide that their processes are appropriate, or need to be improved.

There are a number of maturity models being developed.<sup>4</sup> One example is shown in Figure 10.

<sup>4</sup> The United States Project Management Institute (which publishes PMBOK®) is currently developing an Organizational Project Management Maturity Model (OPM3™) which aims to create an endorsed maturity model that is recognised worldwide as the standard for developing and assessing project management capabilities within any organisation. For more information on this model see <<http://opm3.pmi.org>>.

**Figure 10: Maturity levels in project management**



Source: ANAO

Figure 11 shows how, in practice, the maturity of the various elements of project management discussed in this guide may vary across organisations.

**Figure 11: How organisational project management maturity levels may vary**

Element of project management	Less mature	Developing	Better practice
Right infrastructure	basic tools, policies and templates, but 'optional' and varied approaches	comprehensive policies, templates, PMIS, standardised requirements	comprehensive policies, templates, PMIS, workflow, project support, standard methodology
Portfolio management and project selection	simple manual procedure, informal	formal policies for use of standard techniques	more complex scoring process,
Planning	simple standard, templates and tools	more complex tools	use of workflow systems
Monitoring	reliance on informal methods of review, supported by sound cost and time data	more formal mechanisms, with standard pro-formas, informal consideration against corporate priorities	use of workflow systems, more formal review and re-prioritisation, use of 'gating' techniques
Finalising and reviewing	ad hoc review	mandated sample of projects for review of outcomes and project management process	use of workflow systems, selected projects undergo major cost-benefit review

Source: ANAO

One of the first decisions an organisation will have to make is how much effort to put into choosing the right mix, or portfolio of projects. This topic is discussed in the next chapter.



# 3. Portfolio Management

## —Aligning R&D Projects with Corporate Priorities



### Introduction

Choosing which projects to start is one of the most important and difficult decisions facing R&D organisations. It is important because these decisions will determine outcomes, often over several years, and the ultimate return to funders. It is difficult because organisations have to choose projects from a wide range of possible opportunities in a complex, rapidly changing environment. Also, research projects are often difficult to change or terminate.

Research opportunities and returns are constantly changing. Deciding which ideas and proposals should be further developed is a complex process. It involves judgements of scientific and community value/benefit, relevance to broader goals, feasibility of research and comparisons with other projects.

An agency may need to choose among many options in both individual projects and mixes of projects. The aim is to:

- ▶ select the right research projects to commence
- ▶ continually review their relevance during their life
- ▶ enable any emerging research opportunities to be included in a revised portfolio.

Better practice organisations are devoting more effort to project selection and prioritisation. A key criterion to be used for this is how well the objectives of a proposed project will align with corporate goals and client or stakeholder needs. The aim is to minimise the risk of selecting the wrong projects, or selecting the right projects at the wrong time. The concept of ‘alignment’ is fundamental to organisational success.

### Portfolio management in R&D

Increasingly, research organisations recognise that they are choosing from a set of potential R&D projects, each with its own potential risks and returns. They are using concepts of ‘portfolio management’ (adapted from business finance and new product development theories) to guide the selection of new projects.

Portfolio management is the management of prioritised projects. It is a dynamic process requiring re-prioritisation as necessary to meet changing business circumstances or emerging opportunities. It demands a balance of effort, resources, opportunity and risk across the portfolio to derive the best possible outcome for the organisation. Portfolio management has been described as:

*...a dynamic decision process, through which a list of active R&D projects is constantly updated and revised. In this process, new projects are evaluated, selected and prioritised; existing projects may be accelerated, terminated or de-prioritised; and resources are allocated and reallocated to the active projects. The portfolio decision process is characterised by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependence among projects, and involvement of multi decision-makers. (Pasek 2002)*

Robust methods of portfolio management allow organisations to:

- ▶ maximise return on research projects
- ▶ properly and efficiently allocate scarce resources
- ▶ link higher level strategy or priorities with selection of individual projects
- ▶ foster communication within the organisation, through showing staff what projects are occurring outside their own area
- ▶ foster knowledge sharing, and a science-based approach to project development
- ▶ achieve balance between projects of various size, length and risk
- ▶ communicate priorities within the organisation
- ▶ improve the objectivity and transparency of project selection, reducing the likelihood of internal disagreements.

However, portfolio management can be difficult to implement. Some challenges in implementing portfolio management, and possible strategies to address them are shown below.

## Challenges 1: Project selection and prioritisation

Challenges	Strategies
■ Selecting best value projects	■ Use common selection and prioritisation criteria
■ Quantifying benefits as a basis of balancing a logical well-structured portfolio	■ Define weighting scores against key selection factors for comparisons (see Figure 14)
■ Providing even-handed priorities evaluation across organisational boundaries	■ Develop a common culture emphasising alignment of project to strategic goals
■ Juggling demand for project approval within limited appropriation and investment funding	■ Have a formal reserve list of projects available if more funds become available
■ Having a view of the whole picture as new projects are initiated, prioritised and submitted for approval	■ Good portfolio management system (incorporating reporting and resource management). Track the portfolio over several years and enable reporting of the overall mix to senior management

Source: ANAO

The major elements of an effective portfolio management system are:

- ▶ clearly specified corporate strategy and/or broad research areas (from organisational strategic or business plans)
- ▶ accepted and consistent project-ranking methodologies

- ▶ processes for generating and capturing new project ideas (discussed in the next chapter)
- ▶ explicit stages for agreeing what projects will be approved through, for example, 'gates', such as scope definition and project proposal.

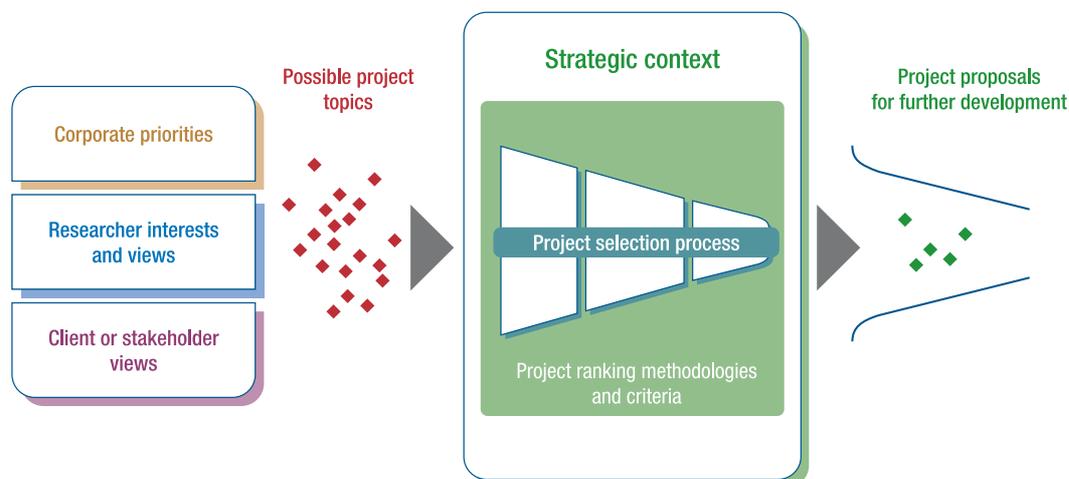
## Setting the strategic context

A prerequisite for effective portfolio management is a robust framework for, or statement of, the organisation's strategic direction or priorities. Such priorities can be developed either through the organisation's general strategic planning process, or a distinct review of research priorities. This can occur in many ways, but better practice organisations have processes that:

- ▶ involve relevant external stakeholders
- ▶ include input from staff and senior management
- ▶ focus on opportunities, as well as risks
- ▶ use transparent criteria or processes to generate and assess priorities, such as structured workshop techniques
- ▶ result in documented, unambiguous priorities able to be used by management in choosing projects or funding programs.

An overview of such processes is shown in Figure 12.

**Figure 12: Process of portfolio management**



Source: ANAO

## Some ranking methodologies

There is a range of methodologies that can be used to rank projects. The optimal method(s) will depend, in practice, on an organisation's clients, industry, degree of external funding sought and future directions. Wherever possible, it is beneficial to include a client perspective in such ranking.

The benefits of using explicit ranking methods are that they foster a critical approach to project assessment and put the onus on proponents to justify the project where it compares poorly. This guide focuses on the broad principles of some recognised approaches, which are discussed below.

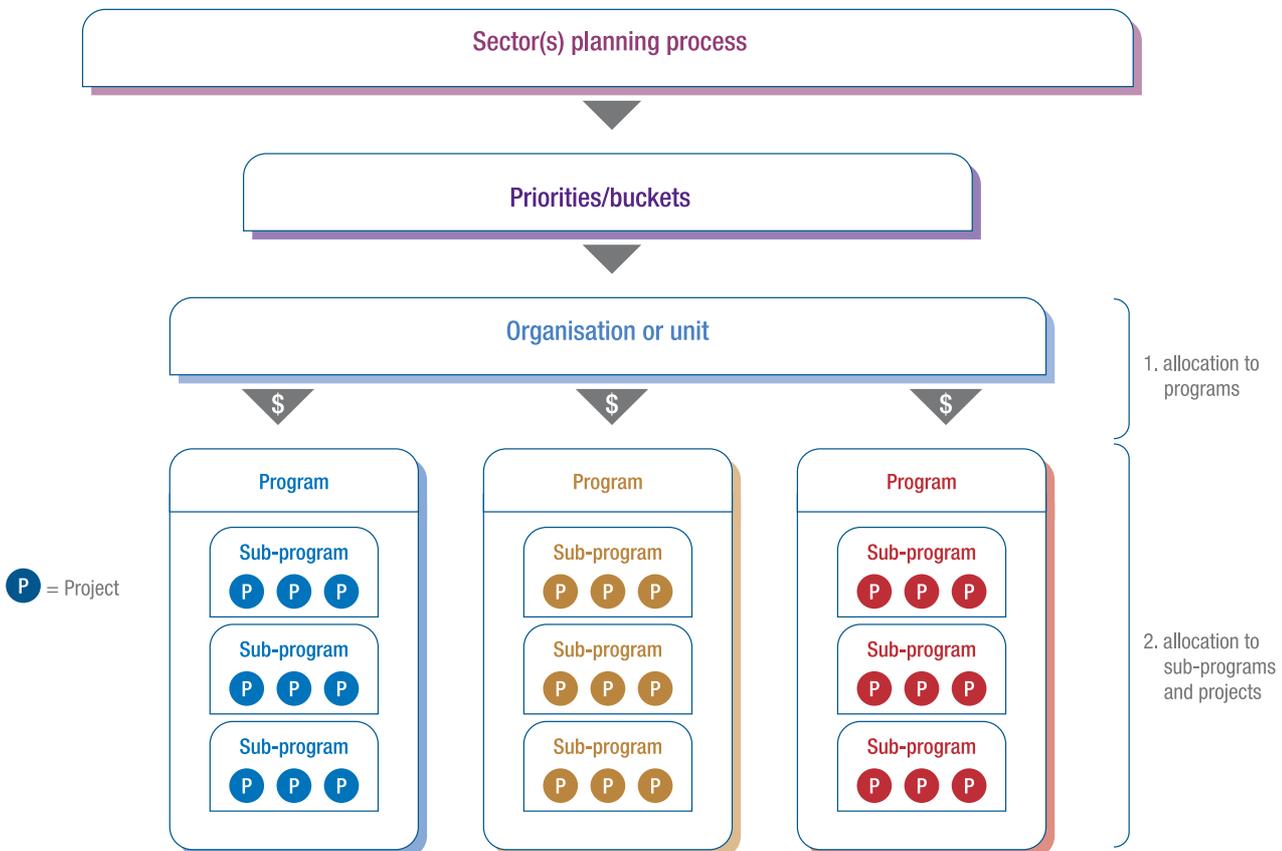
## Business strategy (strategic buckets)

A common approach to allocating funds among research opportunities is to use various 'strategic buckets'. The buckets should be based on the organisation's corporate strategy or strategic plan. In a research context, such categories might include:

- ▶ research or technology area/topic priority
- ▶ particular research methodologies
- ▶ expansion of existing expertise or markets
- ▶ development of new expertise or markets
- ▶ project risk
- ▶ project size
- ▶ project return.

Once resources have been allocated to these buckets, projects need to be ranked within each category or program. This may be done by using one of the other ranking methods discussed in this chapter (for example, bubble diagrams, scores, checklists or financial ranking) to rank projects for ultimate approval. Figure 13 shows how CSIRO has in the past cascaded priorities from its planning process to organisational units and programs.

**Figure 13: Allocation of priorities to programs**



Source: ANAO

One potential disadvantage with this approach is that there can be so many buckets (such as research area, type of project, region, industry or discipline) that it becomes difficult to effectively balance across them. Another disadvantage is that it can be difficult to develop objective criteria for allocating funds to program areas or assigned priorities.

### **Financial approaches**

One ranking method for new products or research frequently used in private sector companies is to focus on financial returns from a project. Options include using methods such as net present value (NPV), payback calculations, or expected commercial value. These methods may be less useful in solely public-funded research organisations except where the project may be expected to lead to future external revenue. It can also be difficult and time consuming to calculate NPVs for projects that do not directly result in an income stream.

### **Checklists**

The most simple method to rank projects is to apply a checklist. In this approach, a project is evaluated on a set of yes/no questions, with a minimum score to be achieved. The questions on the checklist should clearly relate to broader strategic goals of the organisation. Checklists can be particularly useful at a very early stage of assessing potential projects. One benefit is that they can be applied by relatively junior staff to quickly assess if the idea is worth developing further. Applied carefully, checklists are a useful screening tool.

### **Scoring models**

An enhancement of simple checklists is to develop a formal scoring methodology which scores projects against a set of criteria that reflect the organisation's strategic and business objectives, and other characteristics of the project.

Common criteria include

- ▶ technical maturity or uncertainty
- ▶ relevance/contribution to strategic priorities
- ▶ likely risk and return
- ▶ ability to capture benefits.

A sample scoring summary is shown in Figure 14.

**Figure 14: Example of one project's scoring**

Factor	Risk/value	Weight 1–10	Score 0–5	Total
<b>Strategic</b>				
Meets corporate strategy	Value	9	3	27
Corporate image	Value	7	2	14
Retains relevance in 5 year strategy	Risk	-8	5	-40
<b>Governance</b>				
Regulatory authority/statutory obligation	Value	5	3	15
Project innovation v. compliance requirements	Risk	-8	4	-32
<b>Technical</b>				
Re-use of technical solution	Value	7	3	21
Technical uncertainty	Risk	-8	3	-24
Innovation/technical excellence of solution	Value	8	5	40
<b>Project</b>				
Complexity	Risk	-7	2	-14
Resource availability	Risk	-5	4	-20
			Total value score	117
			Total risk score	-130
			Value/risk score	-13

Source: ANAO

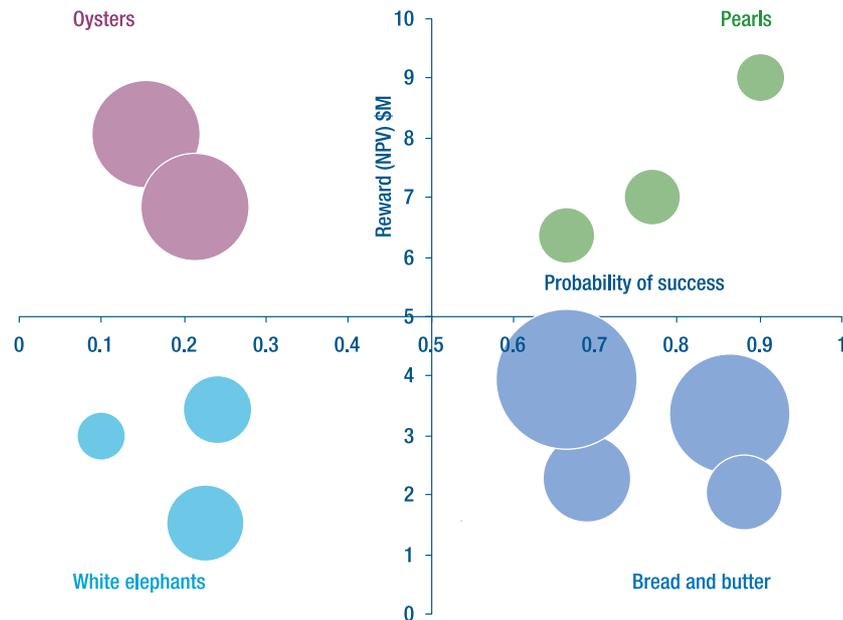
## Bubble diagrams

A more sophisticated ranking method, used in some better practice organisations, is to use a 'bubble diagram' or portfolio map. These diagrams place projects against a set of agreed criteria and allow visual comparison of project attributes. Bubble diagrams provide an easily interpreted visualisation of the value projects can add to the organisation, plotted against the risk associated with the project. One common matrix is to assess projects against both their degree of risk and return. Figure 15 shows such a diagram. Depending on their place in the matrix, projects might be:

- ▶ high risk with limited returns—sometimes described as 'white elephants'
- ▶ high risk with good returns—sometimes described as 'oysters'
- ▶ low risk and moderate returns—sometimes described as 'bread and butter'
- ▶ low risk and good returns—sometimes described as 'pearls'

The size of the bubble typically represents the cost of a project.

**Figure 15: Typical risk-reward diagram**



Source: Based on Cooper, Edgett et al. (2001)

## Summary

In practice, organisations can use several methodologies to create the project portfolio. A project assessment may mix a checklist approach as an initial filter, with a scoring approach to assess its relative worth compared to other projects. Both methods may be used within a strategic bucket approach.

Whatever method or methods are used, research organisations must have a clear rationale for allocating scarce resources across a wide range of competing opportunities or needs. A sound method:

- ▶ is explicit and established across the organisation
- ▶ is implemented consistently across all projects
- ▶ has rules and procedures that are clear and understood by internal and external stakeholders
- ▶ considers all projects together and treats them as a portfolio
- ▶ results in a portfolio that clearly implements agreed corporate priorities.

Once a system is in place, it needs to be implemented through the process of approval for individual projects. Better practice organisations establish a series of stages or gates for decision making. The project selection framework is then applied, with increasing rigour at each gate. The next chapter discusses such a staged approach to approval, and includes two additional steps of 'idea generation' and 'scope definition'. The extent to which organisations wish to formally separate these stages will depend on their environment, particularly the number of projects being developed.



# 4. Developing, Planning and Approving R&D Projects



## Introduction

The portfolio management processes described in the previous chapter are primarily applied as the R&D projects move from an initial idea, to project scope definition or concrete proposal, and eventually to the fully planned project.

This chapter sets out:

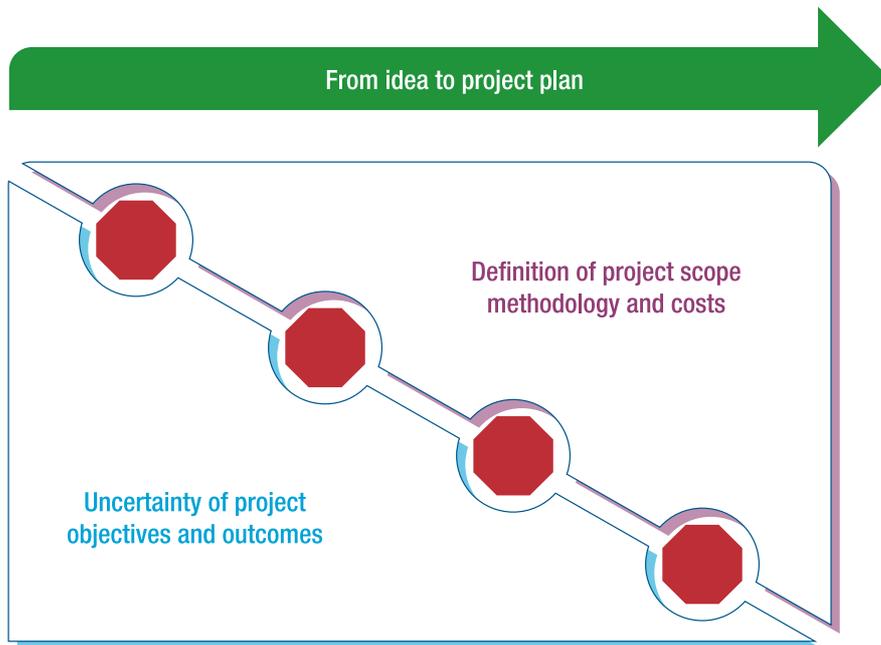
- ▶ how organisations can develop ideas through these preliminary stages and, once the project is agreed
- ▶ encourage effective planning of the final project.

## From idea to project plan

As Figure 16 shows, the initial phase can be broken down into several steps. These are discussed below. Better practice organisations progressively move potential projects through a series of stages or gates/checkpoints, from initial idea, through to project proposal, before agreeing to development of a full project plan. This allows management to progressively confirm a project's goals, costs, risks and return without fully committing to the full project, and thus maximise the number of possible ideas and opportunities. It also allows the project to be progressively adapted as risks and their treatments are more clearly identified and, as necessary, re-allocated.

At each stage the organisation applies the portfolio management processes discussed in the previous chapter.

**Figure 16: Role of checkpoints in the project development process**



Source: ANAO

### Idea generation

Better practice organisations recognise the generation of ideas for projects as a distinct phase in initiating projects. The aim is to encourage the suggestion of ideas for new projects that will be relevant to the organisation’s strategic focus.

Ideas for new projects can come from several sources, for example from within the organisation or from strategic priorities set in consultation with stakeholders. They can flow from previous projects or be entirely new areas of research.

It is common practice to seek and assess new research initiatives at set times. This gives all participants an opportunity to be heard, and for ideas to be compared against each other and against the assessment criteria discussed in the previous chapter. The process will be more effective if it is structured into the organisation’s planning cycle. This would allow, for example, major ideas to be considered annually, but smaller initiatives to be proposed more frequently, as opportunities emerge. This rewards innovation and creativity—crucial in an R&D environment.

Once approved, the next step will often be to further develop the idea into a broad scope definition or more detailed business case.

### Broad scope definition

An early, brief definition of the possible project scope is part of establishing a staged approach to project approval. It minimises the risk of excessive effort being put into projects that are ultimately rejected. The purpose of scope definition is to establish broad parameters for consideration, such as:

- ▶ relevant research stream
- ▶ background (how the idea was generated)
- ▶ statement of project objective (what it will produce in terms of outputs and outcomes)
- ▶ strategic objectives alignment (how it serves stated corporate goals or priorities)
- ▶ benefits which will be realised

- ▶ what broad activities are required to achieve the objective
- ▶ major risks
- ▶ related research
- ▶ assumptions
- ▶ approximate timings and costs.

Scope documents need not be detailed—if the scope is approved it will subsequently be developed into a more detailed project proposal for consideration by decision makers.

Once an idea has been developed by a proponent in the form of a scope definition, it is considered against selection/prioritisation criteria. Many organisations move straight from a project idea to proposal. The benefits of inserting an extra step are: avoiding developing proposals that are ultimately rejected and encouraging a focus on the strategic relevance of a project/idea at an early stage.

## Project proposal

Once a scope definition is approved, the next step is more a detailed project proposal. This includes clarifying objectives, strategic alignment and identifying benefits to be realised, as well as an initial risk assessment. Such a risk assessment needs to address both technical uncertainty and other risks to delivery of successful outcomes or outputs, including potential opportunities that might also be created. An initial project structure and phasing or schedule, is developed to allow refinement of cost estimates. An example of the contents of a project proposal or business case is shown in Figure 17.

### Figure 17: Example outline of project proposal/business case

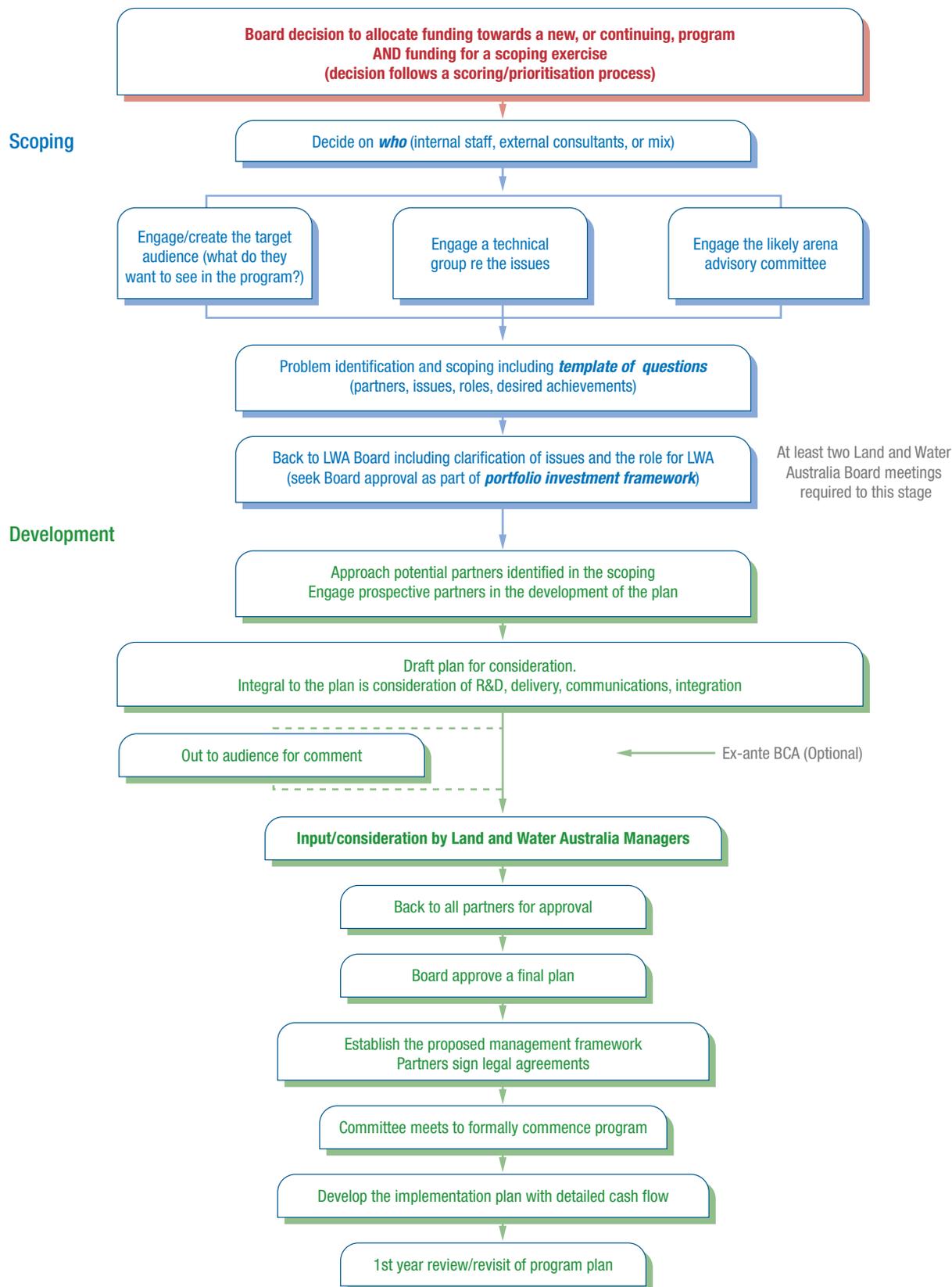
<b>1. Introduction/Background</b> <b>2. Overview</b> 2.1. Project Title 2.2. Vision 2.3. Organisational Objective <b>3. The Business Case</b> 3.1. Purpose of the Business Case 3.2. Sponsor <b>4. Situational Assessment and Problem Statement</b> <b>5. Critical Assumptions and Constraints</b> <b>6. Analysis of Options</b> 6.1. Identification of Options 6.2. Recommended Option	<b>7. Implementation Strategy</b> 7.1. Target Outcomes/Benefits 7.2. Outputs 7.3. Stakeholders 7.4. Related Projects 7.5. Work Plan 7.6. Resources 7.7. Project Management Framework <b>Appendix A—Benefit Analysis</b> <b>Appendix B—Risk Analysis</b>
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Source: University of Tasmania

Proposals will be subject to more detailed scrutiny than a scope definition before being approved. Organisations may, for example, wish to seek review of the proposal by staff or other parties external to the project team or proponent.

Once approved, the project can then be planned in more detail. Figure 18 shows an example of the scoping and development process used by Land and Water Australia in the development of new research programs, or groups of projects. Particularly noteworthy is that the process includes use of a scoring/prioritisation process, and leads to development of a full project plan. The role and content of project plans are discussed in the following sections.

Figure 18: Example of scoping and development process



Source: Land and Water Australia

## Project planning

All projects need a plan. Clearly articulated and documented project plans are an important part of project management. They provide a clear statement of project objectives to guide implementation, give a baseline scope, as well as the, cost and schedule against which to assess project achievement. The plan is usually the key document supporting the decision by management to proceed with the project. The contents of a project plan will vary according to the scale, complexity and risk of the project. In large projects, there may be justification for breaking the plan into several component plans, for example individual plans for managing risk, or realising identified benefits.

Project plans rely on consideration of project structure, schedule, costs and risks. The plan should, of course, also set out the research methodology.

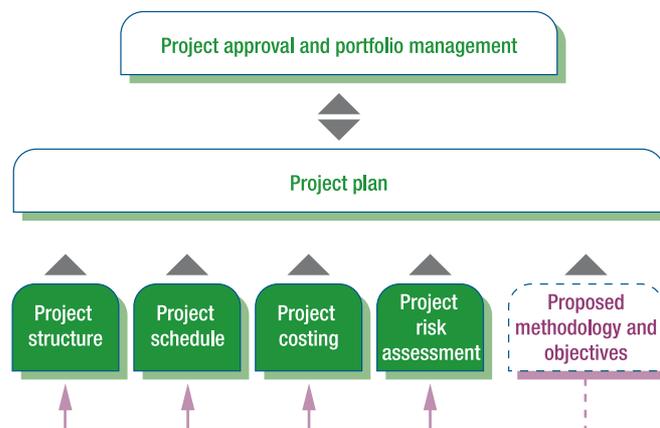
There are many techniques for planning projects. The responsibility of organisations is to support effective planning through access to appropriate technologies; ensure staff have been trained in how to plan projects and encourage a risk management culture.

Developing effective project plans requires consideration of:

- ▶ how will the work be done – this is usually done by developing a Work Breakdown Structure
- ▶ what risks threaten the project's success
- ▶ what resources are required - human and financial - for the project to have a chance of meeting its goals
- ▶ how long will the project take, and in what order should the tasks be completed
- ▶ the research question to be answered or technology to be developed. This will naturally vary greatly depending on the project.

Figure 19 summarises the key elements of project plans. These elements (in particular project risk assessment) are considered further below in terms of the general principles that organisations might apply. There is extensive literature and other resources such as dedicated training courses that address project planning in detail.

**Figure 19: Project planning and approval stage**



Source: ANAO

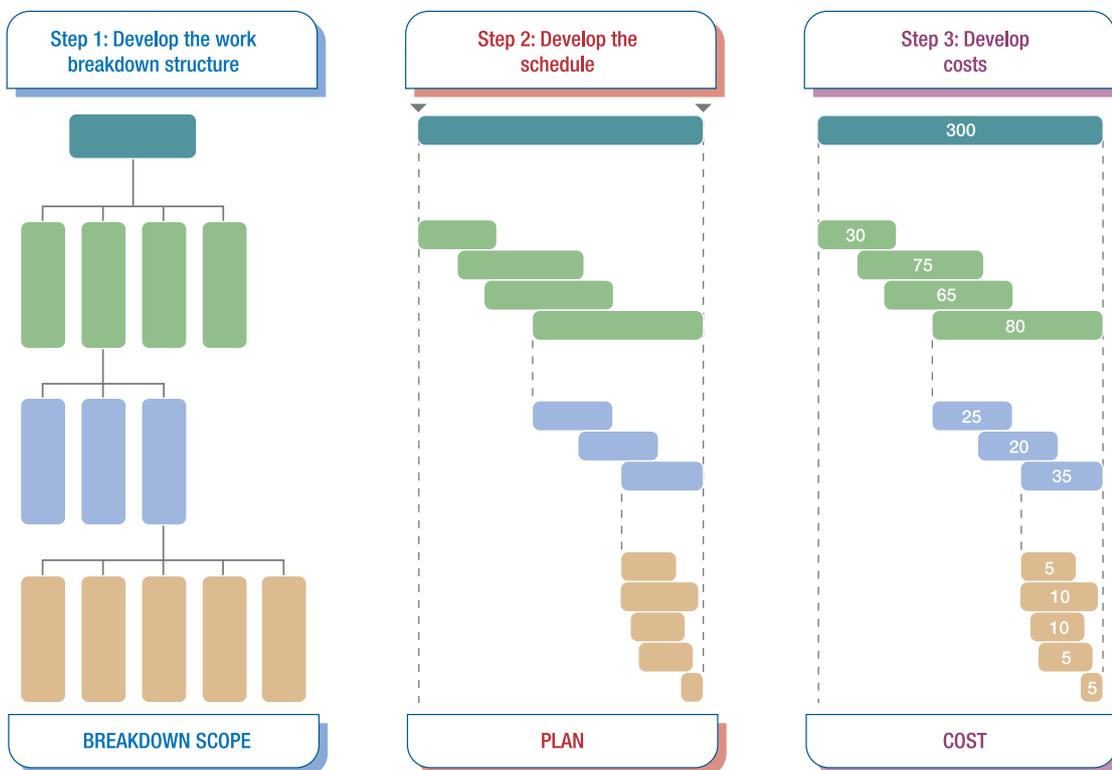
## Structuring projects

Adequate definition of a project is a necessary foundation for project success. The two main aspects to consider in structuring a project are the overall outcomes to be achieved and the work breakdown structure.

The work breakdown structure is simply a hierarchical description of the work that must be done to complete the project. There are various ways to create the work breakdown structure, but all attempt to take each major expected deliverable and break it down into individual pieces of work or tasks that can be separately managed. A work breakdown structure facilitates accurate estimation of resources, cost and time. It also facilitates performance measurement and control, by establishing intermediate milestones and outputs which will contribute to final outcomes, and by identifying appropriate responsibilities and accountabilities.

Figure 20 shows how once the work breakdown structure has been developed, it is used as the basis for scheduling and costing the project.

**Figure 20: Stages in developing a project plan**



Source: ANAO

## Project scheduling

The next step after creating a work breakdown structure is to estimate the duration of each of the individual tasks, and put them in their sequence. This produces the project schedule.

Research projects will often have high levels of uncertainty, which can make detailed scheduling challenging. Nevertheless, there will be many tasks (for example, sample collection and laboratory analysis iterations) which can be reasonably predicted and scheduled. Scheduling also allows teams to plan contingencies for what remains uncertain. One of the benefits of good estimating and scheduling is that it provides a suitable basis for project costing.

## Project costing

Experience shows that consistent project costing is particularly difficult in the research environment, because of the diversity of project types and environments. Nevertheless, a key principle in research project management is to establish the requirement that every project should have a budget that identifies its costs over its whole life. It may also be important to identify any second-order costs borne by other parties, both within and outside the agency, or its impact on other projects.

Accurate estimation of a project's full costs over its life is needed to assist management to:

- ▶ determine whether the investment return is justified by the project
- ▶ set the price to be charged to any external party
- ▶ justify the organisation's entitlement to intellectual property in co-investment projects
- ▶ monitor cost outcomes against budget.

In most research organisations the major challenges to appropriately costing projects are treatment of overheads and allocation of other fixed costs to individual projects so their full cost is known.

Organisational overheads can be identified and allocated across the whole organisation or, alternatively, within units of the organisation. The latter approach can be particularly valuable when the level of overheads varies between units.

Some organisations convert indirect costs and overheads to direct costs as much as possible, and charge these out on a usage basis. Examples of this include:

- ▶ charging use of glasshouses on a per-square-metre basis
- ▶ charging electricity to individual laboratories
- ▶ charging library facilities on a usage basis.

The advantage of this approach is that actual charges to a project more closely reflect usage of resources. Management then has a clearer idea of true costs.

Whichever approach is taken, the methodology should be standardised across the organisation so that project costs, and project cost outcomes, can be consistently compared.

## Project risk assessment

*'It is an unhappy fact of life that there are usually many more things than can go wrong with a project than can unexpectedly go right.'* John R Schuyler, *Decision Analysis in Projects*, (Project Management Institute, 1996)

*Risk—the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood.* (AS/NZS 4360:1999)

*Risk management is the systematic process of identifying, analysing and responding to potential project risk. It includes maximising the probability and impact of positive events and minimising the probability and consequences of events adverse to project objectives.* (Draft Project Management Body of Knowledge (PMBOK) 2001)

Risk management is recognised as an essential part of good management practice. Research projects benefit as much, if not more than other management activities, from a structured approach to risk management. However, research indicates that this is one of the least well implemented aspects of project management (Ibbs and Kwak 2000).

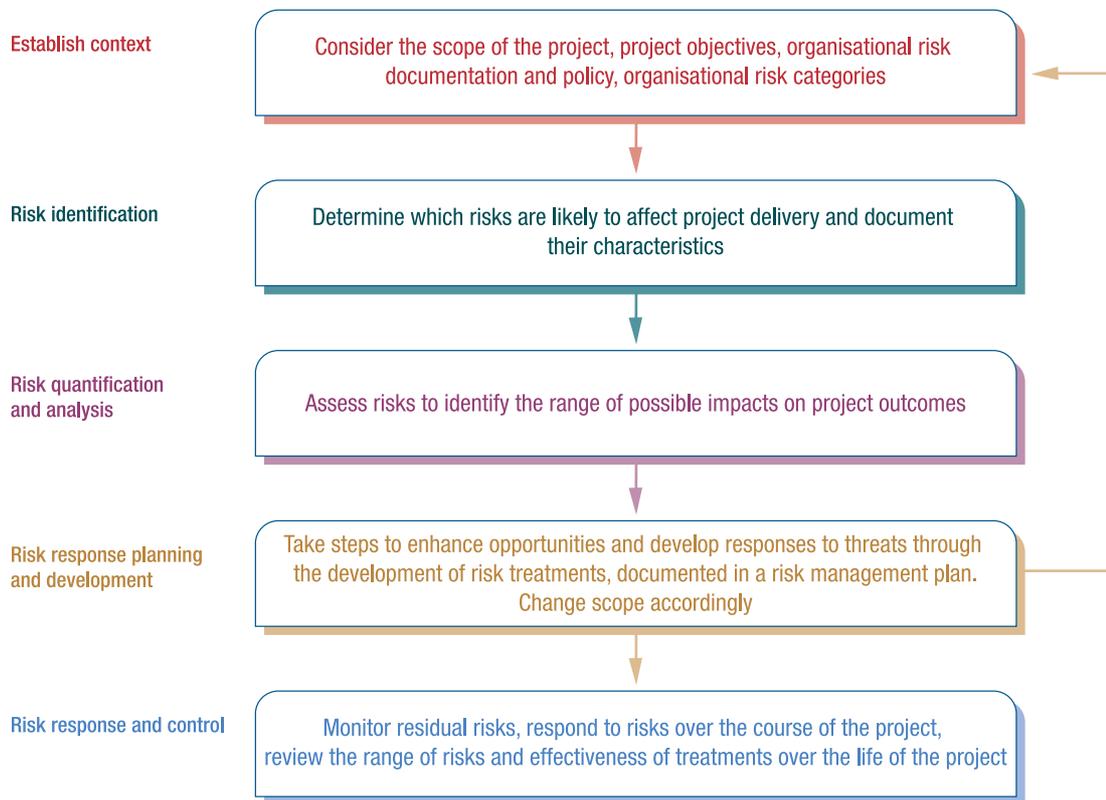
The acknowledged framework for risk management in Australia is the Australian/New Zealand Standard on risk management (AS/NZS 4360:1999). In addition, the guide of the Project Management Body of Knowledge (PMBOK)<sup>®</sup> contains a risk management framework specifically tailored to projects.<sup>5</sup>

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<sup>5</sup> Project Management Institute, *Guide to the Project Management Body of Knowledge* (PMI 2000).

The extent of the risk assessment will depend on the project's size, complexity and degree of innovation. Figure 21 sets out one approach to analysing project risk, and identifies the link between identifying risks and their treatments, and project design.

**Figure 21: Overview of a generic project risk management process**



Source: ANAO from AS/NZS 4360:1999 and PMBOK

From an organisational perspective, better practice research project risk management will usually:

- ▶ be supported by clear policy on the extent and approach of risk management
- ▶ apply consistent categories of risk across all projects
- ▶ be linked to wider or organisational risks (for example, if management of biotechnology or radiological hazards is a key organisational risk, then it should be reflected in individual project risk assessments).

One possible set of categories and associated questions is shown in Figure 22.

**Figure 22: Typical risk categories and questions**

<b>Commercial</b>	are contractual or intellectual property risks recognised?
<b>Financial</b>	are payments appropriately structured? What financial exposure is there for overruns?
<b>Project management</b>	is the plan achievable? Has it appropriate resources?
<b>OH&amp;S</b>	is any hazardous technology being used?
<b>Natural disaster</b>	is the project susceptible to climate extremes or other factors?
<b>Operational management</b>	are third parties involved? Are relationships being managed?
<b>Personnel</b>	are the right staff available for the right amount of time?
<b>Program/project outcomes</b>	will outcomes from the project be realised?

Source: Based on CSIRO Commercial Practices Manual and ANSTO Project Management Guidance

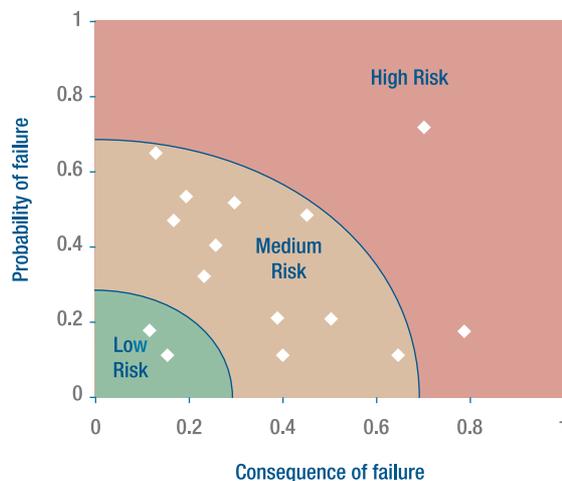
Other risk categories could include technical maturity, risk to delivery, and the organisational environment.

**Some techniques in project risk assessment**

There is a wide variety of approaches to assessing project risk. The most common is qualitative risk assessment using a risk matrix. These matrices compare the likelihood of a risk consequence and its estimated consequence. Risk treatments are then planned on a prioritised basis, starting with the most severe (that is those with highest consequence and most likely to occur).

Better practice organisations may complement these assessments with a graphical presentation of all the risks of a project. An example of such a risk chart is shown in Figure 23. Such a chart can help to identify which project risks will need the greatest attention. At a higher level, risk charts can be used to summarise risk across multiple projects, within a portfolio.

**Figure 23: Risk chart showing multiple risks for a particular project**



Source: ANAO

Another better practice approach, particularly for large projects, is to use quantitative risk assessment. Various tools and techniques are used, including programs and spreadsheet-based systems. All of these programs depend on accurately compiled schedules and budgets. They can also be applied in a more limited way to key activities that are most likely to impact on overall schedules/budgets.

For a substantial project, it is beneficial to reassess risks throughout the project's life. For example, a preliminary risk analysis is undertaken at project proposal stage. A more detailed risk analysis follows planning of the development of work breakdown structures and scheduling stage, and may be repeated at key points in the project's implementation.

### **Risk registers**

A key output of a sound risk assessment process will be a risk register. The risk register contains a list of the identified risks, along with assessment of their likelihood, consequences, adequacy of existing controls, overall risk priority and strategies for managing the risks (treatments). Risk registers are the foundation for effective monitoring and review of risks through the life of the project.

A risk register is developed to:

- ▶ provide the project sponsor, steering committee/senior management with a documented framework for monitoring risks
- ▶ set out risk mitigation strategies
- ▶ facilitate the communication of risk management issues to key stakeholders
- ▶ identify the mitigation actions required for implementation of the risk management plan
- ▶ ultimately reduce the impact of risks and contribute to the success of the project.

Risk registers also contribute to knowledge management and broader organisational risk management. For example, if a similar risk is identified in a number of projects (such as release of genetically modified organisms), the organisation may consider it worthwhile to develop a broader response to handling the risk (such as a general policy on the handling of such organisms). Developing such organisational responses requires senior management to have an involvement in risk management to provide an integrated response to risk, avoiding 'stovepipes' or isolated approaches.

A common weakness in risk management processes is for an initial identification of risks to occur, but then for assessments to be left on the shelf over the life of the project. Sound risk management includes processes for ensuring treatments have been put in place, and that their effectiveness is monitored.

Some of the common challenges to effective project risk management, and possible strategies to deal with the challenges, are shown below.



## Challenges 2: Project risk management

### Challenges

- Project staff may consider there are too many risks to analyse
- Risk assessments may vary depending on who is doing the assessment
- Staff may consider that risk assessments don't change anything
- Risk management documentation is seen as excessive, weighing down an already complex project with things that might not happen
- Too much time can be spent pondering events that might not occur
- Organisations perceive risk as negative, something they do not want to hear about 'unless it happens'
- Many risks are beyond the control of project managers

### Strategies

- Prioritise and address major impact risks; moderation for treatment depending on type, size, complexity of project
- Have clear policies, standards, templates supported by training and coaching
- Track scope changes so the project is evaluated against the right goal posts, and address risk treatment to areas where treatments will impact on an outcome
- For minor projects, keep documentation to simple pro-formas; address risks to priorities, i.e. plan for treatment of high likelihood, high impact risk events
- Keep a database of previously identified risks, and treatments, to streamline analysis
- Educate management in the benefits of good risk management
- Make project risk management an organisational issue: project managers assess risk, but should be able to task senior personnel with monitoring of and response to risk events beyond the control of project managers; clearly define roles and responsibilities of all levels in risk management

Source: ANAO

## Project approval and portfolio management

As discussed in Chapter 3, portfolio management occurs through much of the R&D project life cycle. It is particularly important to re-assess the priority of a project when it has been fully planned and presented for final approval. At this stage the full costs and risks of conducting the project, as well as expected benefits, are available for consideration. It is not too late to terminate a project if reviews indicate that risks (of failure) now outweigh quantified benefits.

Similarly, even if the project offers good returns, the relevance or alignment of the project with program or business goals needs to be confirmed before final approval.

Management of projects will be enhanced by clear decision points or gates, relying on explicit processes and criteria. A particular consideration for management is that there are points permitting the organisation to change or even terminate the project. This can be done by ensuring the project has clear stages, and associated exit points.

A clear decision is also important to provide the benchmark for future monitoring and control of projects, which is discussed in the next chapter.



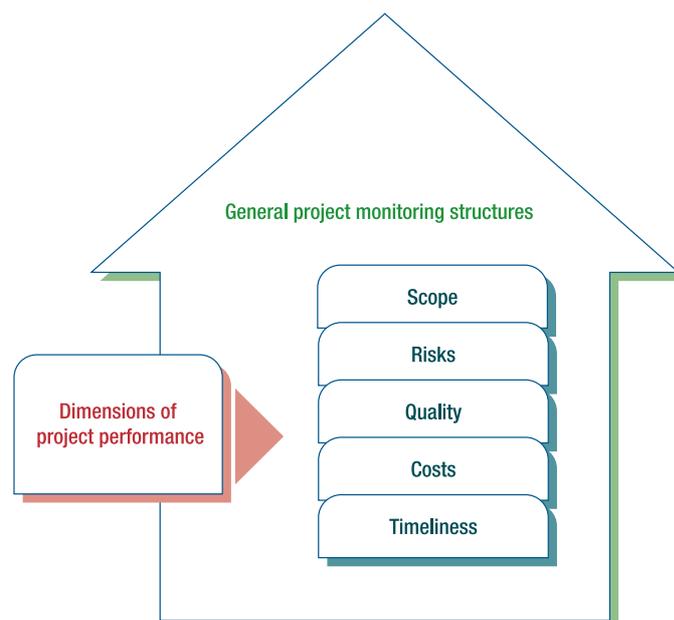
# 5. Monitoring, Reviewing and Controlling R&D Projects



## Introduction

Effective project monitoring enables senior management to assess each project's progress, identify and address problems, and reassess the project's relevance and priority. As Figure 24 sets out, R&D project monitoring requires sound management structures to ensure all projects are appropriately monitored, and key dimensions considered. The various dimensions are discussed in turn in this chapter.

**Figure 24: Monitoring structures and project performance**



Source: ANAO

## General project monitoring structures

Effective ongoing project monitoring requires:

- ▶ appropriate management processes, such as review committees and program review cycles
- ▶ accurate and accessible information on project progress against milestones
- ▶ a structured approach to monitoring and project review.

## Management processes for project monitoring

Good management process for project monitoring enable organisations to:

- ▶ identify problems and take corrective action in a timely way
- ▶ provide assurance to funders that projects are proceeding appropriately
- ▶ support project managers in resolving any difficult issues
- ▶ intervene to change project direction, if required.

Better practice organisations tend to:

- ▶ conduct project monitoring and review formally. There are regular (quarterly or at least annually) reviews for all projects
- ▶ structure the review process to address aspects of project performance (cost, timeliness, quality, scope and risks) in a balanced way
- ▶ document the outcomes of review. This may only be brief, but sufficient to provide accountability and transparency
- ▶ link project monitoring and post-project review. Collection of data on project progress, reasons for change and documenting project history will facilitate a more accurate and efficient post-project review. Identifying and promptly recording any lessons learned also streamline later review, and contribute to organisational learning.
- ▶ have processes for ensuring follow-up action is taken (for example, that funds have been re-allocated and scope adjusted).

Some of the challenges to effective research project monitoring, and possible strategies to deal with the challenges, are summarised below.



## Challenges 3: Project monitoring

Challenges	Strategies
<ul style="list-style-type: none"><li>■ Monitoring and review may focus on scientific issues only</li></ul>	<ul style="list-style-type: none"><li>■ Complement scientific reviews with simple and reasonable cost, timeliness and relevance questions.</li></ul>
	<ul style="list-style-type: none"><li>■ Stress the opportunity costs—is the organisation getting optimal value from funds invested in the project?</li></ul>
<ul style="list-style-type: none"><li>■ Project scope needs to be flexible to respond to changing environment, but the original rationale may be lost</li></ul>	<ul style="list-style-type: none"><li>■ Have clear go/no-go points to ensure relevance</li><li>■ Compare project outcomes of further investment with possible new projects</li></ul>
<ul style="list-style-type: none"><li>■ Risks may be forgotten or not treated</li></ul>	<ul style="list-style-type: none"><li>■ Require the use of, and report against, risk registers</li></ul>
<ul style="list-style-type: none"><li>■ Monitoring can be burdensome</li></ul>	<ul style="list-style-type: none"><li>■ Use project offices to monitor progress</li><li>■ Integrate project monitoring into staff performance agreements</li></ul>
<ul style="list-style-type: none"><li>■ Ensuring an objective review</li></ul>	<ul style="list-style-type: none"><li>■ Include external stakeholders/reviewers at key points</li></ul>

Source: ANAO

### Management information for monitoring

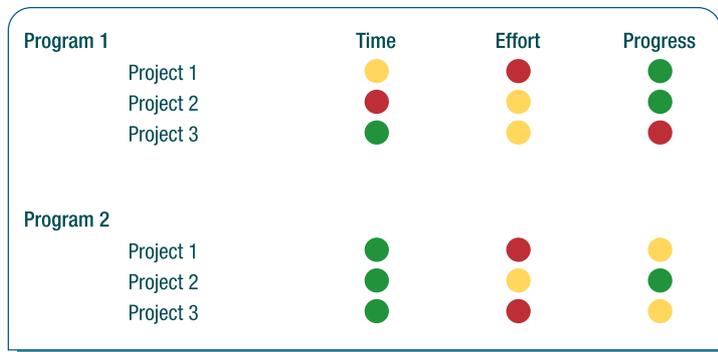
Management will often rely on data from the project management information system to monitor projects. Often, however, it is difficult to form both an overall picture and identify projects that need additional support.

An emerging trend is the use of computer-based project dashboards to draw together key information on the progress of projects. Dashboards will often vary depending on the user. A daily dashboard of one project for a project manager, a summary dashboard for senior management. Such dashboards draw together in a simple visual format, key information on project progress such as:

- ▶ milestone status
- ▶ cost trends
- ▶ timeliness trends/status
- ▶ key risks
- ▶ project-specific data such as the number of activities conducted in recent periods
- ▶ earned value information.

**Figure 25: Sample project dashboard screen**

DIVISIONAL DASHBOARD



Source: ANAO

## Change Management

All projects will change during their life, this is particularly the case with R&D projects which operate in a changing or uncertain environment. Such change is often a desirable response to a changed environment. A clear process for project change management offers several benefits. It reduces the risk that a project will continue when it will no longer be needed. It makes it more likely that a project will get the management support and review needed to deal effectively with the change. In addition, it facilitates effective post-project review. Accordingly, change management should be a standard element of project management.



### Challenges 4: Change management

#### Challenges

- It can be difficult to forecast what will happen in research projects
- Managers may feel that if too many issues are raised, there is risk of a research project being cancelled
- Senior management may be seen as not responding appropriately to change requests
- Project managers may keep quiet about issues to keep the research going

#### Strategies

- Proactive planning for potential threats (risk management), integrated with effective issues and change management
- Reinforce positive nature of integrated risk, issues and change management
- Create and maintain an environment of trust
- Quick response system
- Change management system, including change control authority for each project
- Organisations should stress issues/change management as a normal function of project management, particularly in research, and reinforce positive nature of process through allowing a switch to new opportunities.

Source: ANAO

## Specific project review

As well as ongoing monitoring, at particular points a distinct review may be appropriate to take stock of progress, or as a way to identify whether changes are needed. Reviews may be driven by apparent difficulties in a project or be planned at the project's commencement.

One approach is to conduct a project health check to ensure that the fundamentals of project management are in place, as well as to identify any additional actions. Such checks can be done quickly through a checklist or questionnaire, and conducted by the project leader and/or external reviewer. The example below lists some possible questions which should be adapted to reflect the stage of the project. A simple scoring system can help indicate which projects need more assistance.

**Figure 26: Some possible project management health check questions**

1.0	Scope & objectives	Score	Comments
	Is the scope still relevant?		
	Are project goals and objectives still appropriate?		
2.0	Scope change management	Score	Comments
	Have changes to date been documented and signed by both parties?		
3.0	People & organisation	Score	Comments
	Are roles and responsibilities documented and agreed?		
	Has a health and safety assessment been done?		
4.0	Work breakdown structure & deliverables	Score	Comments
	Have milestones with dates been defined?		
	Have deliverables been specified?		
	Has costing been done taking into account all people and other costs?		
	Are cost targets being met?		
5.0	Schedule & progress management	Score	Comments
	Is the project and schedule being regularly monitored via suitable meetings?		
	Is the project on schedule?		
6.0	Risk management	Score	Comments
	Has a process been documented for periodic risk review and update?		
	Has the risk register been updated within the last 2 months?		
7.0	Issues management (including problems)	Score	Comments
	Are issues being logged and actions tracked to completion?		
8.0	Quality management	Score	Comments
	Are lessons learned being documented?		

Source: ANAO, from CSIRO Project Management Review

The value of project reviews will be further enhanced if the findings and decisions are appropriately documented. This will streamline the post-project review process and make conclusions more accurate.

## Monitoring scope/alignment and re-prioritising

In the scientific environment, many projects will face uncertain and rapidly changing environments. New breakthroughs may be made by other researchers, a client's needs may change or the organisation's own priorities may change. In addition, projects will often be relatively long-term and their success might be dependent on partners or other projects. Finally, a project will have often competed with other projects for scarce research funding, and funders will want assurance that the project will meet the original goals, or be persuaded that changed goals are appropriate. To deal with these issues, monitoring of scope and relevance needs to occur at three levels.

**At the project level**, the project manager reviews the achievement of milestones to ensure the project will still meet expectations set when it was approved.

**At the program level**, the program manager reviews progress of each project in the context of the program portfolio.

**At the organisational level**, management needs to assure itself that the mix of effort between programs, and likely benefits, is optimal for the organisation and in line with stakeholder expectations.

For these reasons, systematic processes for dealing with scope change, such as explicit processes for agreeing to and documenting such changes, are an important part of sound project management practice.

## Monitoring project risks

*Risk monitoring and control is the process of keeping track of the identified risk, monitoring residual risks and identifying new risks, ensuring the execution of risk plans and evaluating their effectiveness in reducing risk. It occurs continually through the life of the project. (Guide to PMBOK, p. 144)*

R&D projects will often, by their nature, involve uncertainty. The foundation of effective risk review will be the risk management plan and risk register developed as part of the project planning process.

Risk review can occur at several levels, reflecting the varied nature of project risks:

- ▶ at the strategic level; for example, to monitor changes in the environment or strategic direction of the organisation
- ▶ at the program level; for example, to monitor client or stakeholder risk
- ▶ at the project level; for example, to monitor risks of suppliers.

In practice, project staff and managers are often reviewing risks to their project on a daily basis. Often the challenge for organisations is to ensure that the consideration of project risk occurs in a consistent, structured way. In particular, that risk reviews are carried out at the appropriate level. Some of the ways to do this are:

- ▶ using standard templates
- ▶ sampling project documentation
- ▶ using risk registers as the framework for project review
- ▶ ensuring that project risks are considered as part of program reviews and other higher reviews.

## Monitoring project costs

Staff costs are often the major component of research projects. It is therefore particularly important that organisations are able to monitor the extent of staff contributions to projects. Most organisations attempt some estimating or tracking of actual staff time spent on projects.

At its simplest, this can involve an up-front estimate of how much time is likely to be spent on a project, which is occasionally reviewed (either annually or quarterly). One weakness with such approaches is that the reviews may not occur.

Better practice organisations tend to utilise more systematic and frequent tracking of time spent on projects. This is usually done on a weekly or fortnightly basis and is often known as effort logging.

The benefits of effort logging compared with occasional reviews are:

- ▶ greater precision in the actual time spent, and therefore actual cost of a project
- ▶ precision in the allocation of costs between projects
- ▶ better data on the impact of non-project tasks, or overheads on staff time
- ▶ the ability to identify more easily if staff are having to work extended hours to get the project done.

In addition to staff costs, effective monitoring requires that overheads and other costs are distributed during the project's life, as they are incurred, thus enabling management to monitor the project against budget and outcomes. Additional control over costs is facilitated by breaking overall project costs into discrete elements that reflect the tasks being done, and monitoring the costs of these tasks.

## Monitoring project timeliness

From a customer's perspective, timeliness is a key aspect of project performance. Systems should therefore be in place to reliably record if (and to what extent) a project is early, late or on time. This requires clear milestones in the project plan.

Senior management also requires systems to record milestones, and their achievement. Better practice systems will allow tracking of all milestones, not just those that relate to, for example, external products, deliverables and invoices.

One approach for monitoring progress which is increasingly used is earned value reporting. This combines schedule and cost data to provide a status report of progress. It then allows forecasts to be made of likely completion time. Standards Australia has recently released an Australian Standard for the use of earned value.<sup>6</sup>

## Monitoring project quality

The quality of the project outputs—the science—is fundamental to research organisations. R&D organisations generally have comprehensive methods for monitoring and controlling project quality. These include regular internal review (by supervisors and peers), external review of the overall science base in the organisation/unit, and review of reports or data before transmission to the client or publication. Scientific quality is often the principal focus of periodic reviews.

The focus on scientific quality needs to be complemented by consideration of whether the scientific outputs of a project are appropriate. Better practice organisations particularly focus on:

- ▶ ensuring a critical, independent review, possibly by external parties
- ▶ having strong internal quality assurance arrangements that are systematic and well documented.

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<sup>6</sup> Standards Australia, Project Performance Measurement Using Earned Value AS4817-2003.

In regard to internal quality assurance, organisations may mandate the processes for clearing reports and other research products to include review by other project managers or experts in the field within the organisation.

Overall, a clear, systematic process for project monitoring and review not only helps projects achieve their objectives in a timely, cost-effective manner, but also prepares the way for more summative evaluations at the end of a project, in the form of post-project reviews. These are discussed in the next chapter.

# 6. Finalisation and Review of R&D Projects



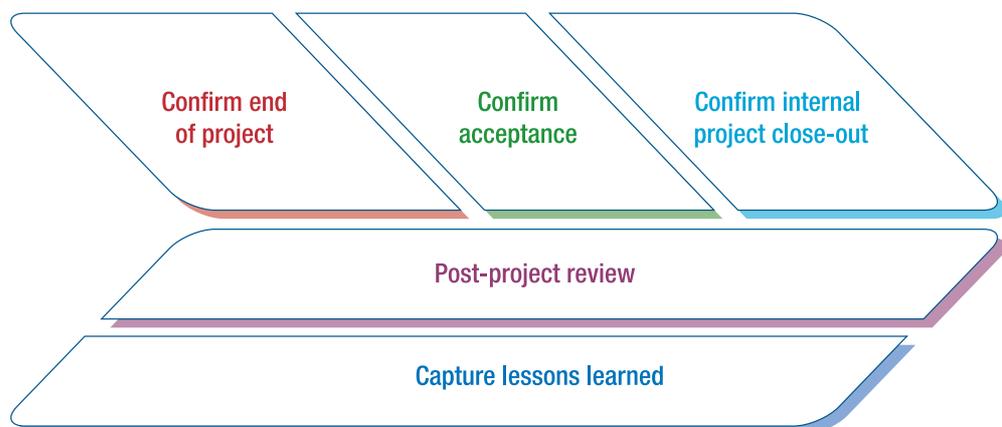
## Introduction

Careful management of the finalisation of research projects yields many benefits to research organisations. In particular it:

- ▶ maximises the value of effort spent in executing a project
- ▶ confirms when, or whether, a project has finished, enabling rationalisation of resources
- ▶ ensures that insights and data on project performance, the value of benefits from the project and lessons for future projects will not be missed.

The key elements of the finalisation phase are set out in Figure 27.

**Figure 27: Key elements of project finalisation**



Source: ANAO

## Confirm end of the project

It can sometimes be uncertain when, and if, a project is completed. This is particularly the case with projects funded from internal funds that do not have an explicit client or sponsor. Even where there is a client, there may be an inclination to continue the project to follow-up new ideas, or augment findings or products. This can cause several problems. Because they are extensions of existing projects, the decision to continue may be subject to less management scrutiny than an equivalent new project. Also, if not well controlled, extensions may end up being of greater scale than the original project.

Clear confirmation of project end-points enables management to draw unambiguous conclusions about the timeliness and cost of the project. For other changes/additions that realistically remain within the spirit of the original scope, the solution is to conclude the existing project as it was specified at initiation, and progress to a new project. The best way to ensure a clear end-point is for the project plan/contract to clearly specify, in terms of deliverables or outputs, what constitutes the project being completed.

### Case study 3: Project completion in DSTO

As part of its policy on task (project) management, DSTO has a procedure on 'task termination' which applies to completed tasks, as well as tasks that are terminated prematurely. This requires that a termination report in the format of a standard template be issued within one month of task completion which must set out:

- the outcomes expected to meet the sponsor's needs in relation to each deliverable in the task plan (including any successes or failures)
- list of publications resulting from the task
- total resource usage.

The task sponsor is asked to agree termination of the task and give comments on the task within one month. For internally created tasks, the relevant program manager completes these comments.

Source: DSTO

## Confirm delivery and acceptance

Most projects are a response to an external need, and have a client who is funding it. A key stage in concluding a project is to confirm that the project has, in fact, met the expectations of the client. This step requires a mixture of process and communication, addressing the following questions:

- ▶ have all agreed outputs/deliverables been received by the client?
- ▶ were they to the agreed quality?
- ▶ are there any resulting obligations on the provider, such as warranties, guarantees or other commitments?
- ▶ are processes for handling intellectual property established and agreed, including for any future revenue?
- ▶ is there a clear communication channel for follow-up contact between the client and provider. This is particularly important if a dedicated project team had been established to run the project?

Seeking this feedback as part of a broader, structured assessment of client satisfaction (such as through a validated survey) is an indicator of better practice.

## Confirm internal project close-out

Once the post-project review has been completed, further tasks remain. These are to ensure the project is well documented; ensure that staff are transferred to new tasks; and that financial resources are appropriately re-allocated. The project information systems should make it clear that the project is complete, and prevent any further charging of resources to the project.

## Post-project review

### Role of post-project review

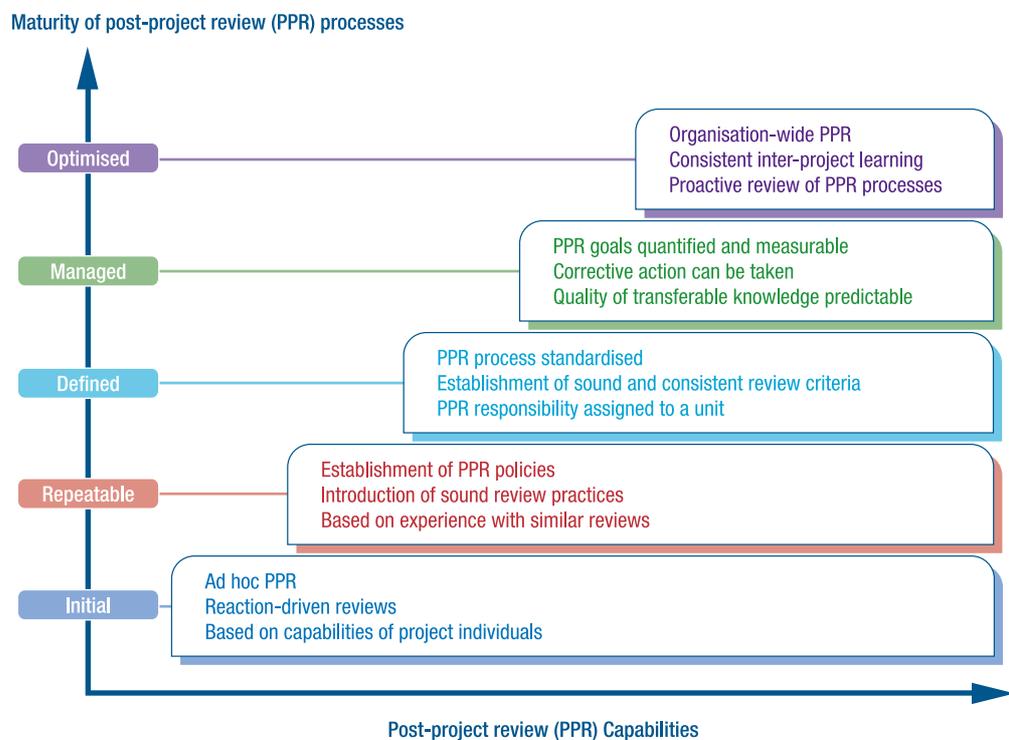
A key aspect of good project management practice is the conduct of post-project review by the organisation. Such reviews can provide:

- ▶ insights into scientific methods and approaches that might be used in other projects
- ▶ data for upwards accountability, including program and unit reviews, and organisational performance measures
- ▶ external accountability to stakeholders
- ▶ substantive information for future selection of research projects
- ▶ information for the planning and estimating for future projects
- ▶ a measure for possible return on investment of the project
- ▶ generally improved level of project management in an organisation.

However, despite their importance they are often not conducted. One recent study suggested that 80% of scientific R&D projects are not reviewed after completion, and most of the remaining 20% were reviewed without established guidelines (von Zedtwitz 2002).

One useful model developed in assessing how well an organisation implements a post-project review is the capability or maturity model (see Chapter 2). See Figure 28.

**Figure 28: Capability model of post-project review processes**



Source: von Zedtwitz (2002)

## Choosing projects for review

All projects merit some level of post-project review. However, the intensity of review may vary from a brief tick-the-box template for minor projects applied by project staff, to a very detailed and externally conducted study for major projects. An organisation's project management guidance should make it clear how to decide what level of review is needed.

Criteria to guide the selection of projects for a major review might include the:

- ▶ level of funding dedicated to the project or stage of the project
- ▶ risk associated with the project
- ▶ significance of the customer to the organisation and/or to Australia
- ▶ novelty of the project methodology
- ▶ importance of the field of science to the organisation
- ▶ involvement of the customer in the project management.

As noted above, there is considerable risk that a post-project review receives insufficient attention. Some of the reasons for this, and possible organisational strategies to increase its use, are set out below.



### Challenges 5: Effective post-project review

#### Challenges

#### Strategies

<ul style="list-style-type: none"> <li>■ Managers consider there is little benefit from conducting reviews</li> </ul>	<ul style="list-style-type: none"> <li>■ Have a system in place to pick up, disseminate and implement lessons learned, reward and recognise good performance</li> </ul>
<ul style="list-style-type: none"> <li>■ Program managers consider they lack resources to conduct a review</li> </ul>	<ul style="list-style-type: none"> <li>■ Set aside a proportion of each program budget for post-project review</li> <li>■ Ensure review process is streamlined, and reflects the size and complexity of the project</li> <li>■ Have a project support office assist teams conducting the review</li> <li>■ Collect relevant data regularly during the life of the project, including: scope change requests/approvals, staffing changes, costs, review reports and presentations</li> <li>■ Agree the methodology for reviewing project success and value at the start of the project</li> </ul>
<ul style="list-style-type: none"> <li>■ Projects will often change markedly from original scope, making reviews more difficult</li> </ul>	<ul style="list-style-type: none"> <li>■ Track scope changes so the project is evaluated against the appropriate goal posts, allowing flexibility for positive change</li> </ul>

Source: ANAO

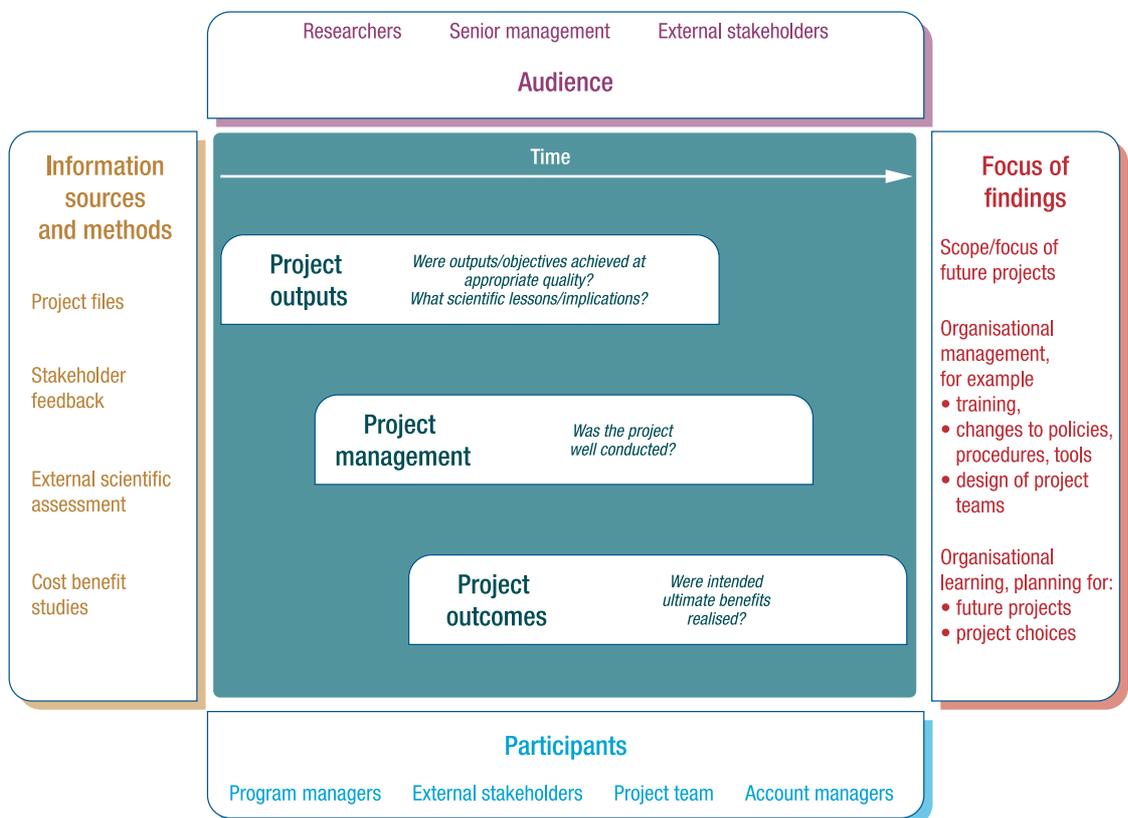
## Focus of post-project review

There are three principal aspects of project performance that can be assessed in a post-project review:

- ▶ the quality of project outputs
  - was the project goal achieved
  - were findings/outputs delivered to the standard expected by the organisation—was the scientific quality appropriate
- ▶ the effectiveness of the management of the project
  - was the work done on time, within budget, according to specification
  - was project communication, contract management and reporting effective
  - were staff managed appropriately
  - were risks managed
  - what lessons were learned in science or project management terms (that is, what worked, what didn't)
- ▶ the outcomes achieved and/or benefits realised by the project
  - are the expected longer-term impacts likely to occur
  - were there any unexpected impacts
  - are there implications for future research

Figure 29 provides an overview of considerations in planning or undertaking post-project reviews.

**Figure 29: Overview of post-project review environment**



Source: ANAO



## Case studies 4: Post-project review by the Fisheries Research and Development Corporation (FRDC)

Each year the FRDC selects a random sample of five completed projects for review. The reviews are conducted by a mix of internal and external staff.

Reflecting the FRDC's focus on improving industry performance, the reviews particularly focus on the economic and efficiency benefits of research.

They also recognise the long lead-times required to demonstrate project impacts. For example reviews may be conducted up to five years after the project was formally completed to enable it to identify any changes to industry or fishery characteristics and behaviour attributable to the project.

Source: FRDC

### Capture lessons learned

The conduct of a post-project review will usually generate insights for the immediate participants of the project. However the findings of post-project reviews often contain valuable lessons for the organisation overall that will be lost unless a deliberate effort is made to disseminate them.

Better practice organisations try to capture and disseminate lessons learned in several ways. These methods include:

- ▶ requiring presentations of post-project reviews of major projects to staff
- ▶ capturing lessons learned in a repository of similar findings and making this available to staff, for example on an intranet
- ▶ linking lessons learned to strategic and project planning by referring reports to senior staff, or other staff responsible for reviewing and improving project management practices and policies
- ▶ publicising post-project reviews on internal intranets
- ▶ integrating post-project reviews with a broader knowledge management database or process.

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## 8. Glossary



alignment	The extent to which a project conforms with organisational, client or stakeholder priorities.
deliverable	Any measurable, tangible, verifiable outcome result or item that must be produced to complete a project or part of a project.
issues	Events that occur in the life of the budget requiring management attention.
milestone	A significant event in the project, usually completion of a major deliverable.
project	A temporary endeavour undertaken to create a unique product, service or result. Usually has a defined start, finish and budget.
scope	The sum of the products and services to be provided as a project.
work breakdown structure	A deliverable-oriented grouping of project components that organises and defines the total work scope of the project. Each descending level represents an increasingly detailed definition of the project work.