



ENGINEERS
AUSTRALIA

GOVERNMENT AS AN INFORMED BUYER

How the public sector can most effectively procure
engineering-intensive products and services



National Library of Australia Cataloguing-in-Publication entry

Yates, Athol, 1963-.

Government as an informed buyer: How the public sector can most effectively procure engineering-intensive products and services
2nd edition

Bibliography

Includes index

ISBN 978-1-9221007-57-2.

1. Government purchasing – Australia. 2. Letting of contracts – Australia.
3. Engineering contracts – Australia. 4. Contracting out - Australia. I. Title.

352.530994

© Engineers Australia, 2012

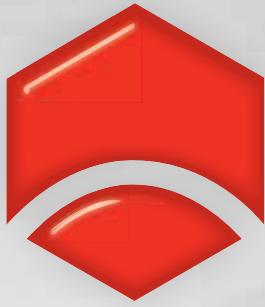
All rights reserved. Other than brief extracts, no part of this publication may be produced in any form without the written consent of the publisher.

Author

Dr Athol Yates, PhD (Public Policy), MPubPol, BEng, Grad Dip SovStudies, has expertise in engineering-related policy areas including infrastructure, national security, defence and public administration. He was the author of the seven 2010 Australian Infrastructure Report Cards set which assessed the quality of the nation's infrastructure. He has been involved in analysing and advising reform of engineering activities within the public service since the late 1990s. He was the author of the first edition of *Government as an Informed Buyer* in 2000.

ACKNOWLEDGMENTS

Many people contributed in the production of this publication. In particular, the following deserve particular recognition due to their significant input: Sal Sidoti, Gary Waters, Andrew Balmaks, John Scott and Miles Jakeman.



ENGINEERS
AUSTRALIA



CONTENTS

EXECUTIVE SUMMARY	6
ABBREVIATIONS	8
TERMINOLOGY	8
CHAPTER ONE: THE PROBLEM	13
SUMMARY	13
THE DE-ENGINEERING OF THE PUBLIC SERVICE AND ITS CONSEQUENCES	13
RE-LEARNING THE LESSONS	15
CHAPTER TWO: UNDERSTANDING GOVERNMENT PROCUREMENT IN AUSTRALIA	17
SUMMARY	17
THE NATIONAL SIGNIFICANCE OF GOVERNMENT PROCUREMENT	17
THE DELEGATED, PRINCIPLES-BASED NATURE OF AUSTRALIAN GOVERNMENT PROCUREMENT	19
PROCUREMENT SCALE ANALYSIS	21
Procurement cycle	22
The procurement system	24
Procurement aligned with multi-level governmental objectives	25
INCREASINGLY CHALLENGING PROCUREMENT ENVIRONMENT	32
CHAPTER THREE: CONTRIBUTION OF ENGINEERING EXPERTISE TO PROCUREMENT	35
SUMMARY	35
DEFINING ENGINEERING EXPERTISE	35
Professional Engineers	36
Engineering Technologists	38
Engineering Associates	39
CONTRIBUTION OF ENGINEERING EXPERTISE TO PROCUREMENT	40
Procurement cycle	40
Procurement system	42
Procurement alignment with multi-level governmental objectives	45
CHAPTER FOUR: ACCESSING ENGINEERING EXPERTISE FOR PROCUREMENT	49
SUMMARY	49
IDENTIFYING THE NEED	49
Understanding the market	52
DETERMINING SUITABLE PROCUREMENT PROCESS	56
Sourcing strategies	56
Deciding on a procurement method	57
CONDUCTING A SUITABLY SCALED PROCUREMENT PROCESS	57
MANAGING THE CONTRACT	59
MANAGING TERMINATION OR TRANSITION	59

CHAPTER FIVE: ENGINEERING PROCUREMENT CAPABILITY OF AGENCIES.....	61
SUMMARY	61
CAPABILITY MATURITY WITHIN AUSTRALIAN GOVERNMENTS	61
INCORPORATING ENGINEERING EXPERTISE ISSUES IN CAPABILITY MATURITY	62
The engineering capability maturity scale	63
Visualisation of the process of engineering expertise provision	65
Assessing an agency's engineering capability maturity level	66
CHAPTER SIX: THE CHALLENGES FOR AGENCIES IN MAINTAINING IN-HOUSE ENGINEERING PROFESSIONAL STAFF.....	71
SUMMARY	71
SHORTAGE OF ENGINEERING PROFESSIONALS.....	71
Ageing of the workforce.....	72
The remuneration gap between the public and private sector.....	74
Low level of recruitment and training of graduate engineers	74
Deficient employment classification systems.....	74
AGENCY RETENTION CHALLENGES.....	76
CHAPTER SEVEN: RECOMMENDATIONS.....	81
IMPROVING GOVERNMENT'S PROCUREMENT PROCESSES	81
ENSURING AGENCIES HAVE ACCESS TO APPROPRIATE ENGINEERING EXPERTISE.....	82
ASSESSING ENGINEERING CAPABILITY AND MATURITY	83
MAINTAINING AND IMPROVING IN-HOUSE ENGINEERING EXPERTISE.....	84



EXECUTIVE SUMMARY

Contracting by Australian governments has grown enormously over the past two decades. Today, nearly one quarter of all government budgets are spent on procurement. While most procurement was once simply an administrative task for acquiring products and services for internal use in government departments, it is now increasingly delivering infrastructure and front-line services that the public use daily. This transition has seen procurement transformed from a clerical function to one that is central to delivering an agency's program goals and advancing the government's core objectives.

Governmental procurement has become more effective and efficient over the last decade due to the increasing professionalisation of the procurement workforce and new procurement approaches. However, there is still a significant need to improve, as illustrated by high profile contracting failures such as the cancellation of Defence's Super Seasprite helicopter project after some \$1.4 billion was spent but not one operational helicopter was delivered.

Most pressing is the need to achieve better value from procurement. And this does not mean simply getting something for the cheapest possible price. It means

considering the whole-of-life, financial and non-financial costs and benefits that accrue to all relevant stakeholders including the agency, end users and government as a whole. It also means ensuring that what is being procured is actually needed, that it will actually meet the requirements, that it aligns with the agency's program and corporate objectives, and that it contributes to advancing the government's enduring and transient objectives. In too many instances, procurement has been focused on meeting the requirements of one area of an agency without considering how it could advance other government objectives.

Critical to achieving better value for money is being an informed buyer. This means having the knowledge – including costs, benefits and risks – to take a multi-stakeholder perspective in answering the following questions:

- Why buy?
- What to buy?
- When is it needed?
- How to buy?
- How much to pay?

For engineering-intensive products and services, engineering expertise is required to assist in answering these questions. It is critical in providing sound professional judgement during certain stages of the procurement cycle. Engineering professionals should not be seen just as providing technical skills and industry sector knowledge. Engineers also have an ability to apply engineering practices/approaches and organisational techniques in non-engineering contexts to enhance the procurement system more broadly. These can make a significant contribution to obtaining better value from procurement.

One neglected area in which engineering expertise can make a major contribution is identifying opportunities where one procurement can advance other agencies' and whole-of-government priorities. Through their subject matter expertise, professional networks across agencies and domains, and the application of a systems perspective, engineers can build inter-agency support for mutually beneficial projects that can generate greater benefits for less.

Capitalising on the skills and knowledge of engineering professionals to make more informed procurement decisions requires agencies to be able to access the appropriate volume and type of engineering expertise when needed, economically and efficiently. Accessing best value for money engineering expertise may mean using a combination of internally and externally sourced expertise. This report makes recommendations to ensure that agencies have access to the appropriate level of engineering expertise to support the procurement of engineering-intensive products and services.

Engineers Australia recommends that:

1. Agencies should explicitly recognise that procurement is a strategic and core function, and focus their activities on developing procurement systems that ensure alignment between procurement and multi-level governmental objectives.
2. Agencies should use the procurement cycle methodology to identify the contribution that engineering expertise makes to their procurements, to identify the volume and type of engineering expertise required, and to determine how best to access it.
3. To ensure that governments make informed decisions at a public service wide level on the most cost effective way to access engineering expertise to support agency procurement, agencies should collectively examine how improvements could be made by addressing constraints in the sourcing of engineering expertise.
4. Agencies should identify uncommon and specialised engineering expertise that is critical to their outputs, and develop effective and efficient arrangements to ensure its continued provision.
5. Agencies undertaking capability and maturity assessments of procurement systems should incorporate engineering expertise considerations into their methodology and outcomes.
6. Agencies should identify issues specific to engineering professionals and factor these into their workforce ageing strategies.
7. Agencies should identify any remuneration gap between public and private sector engineering professionals, determine if this acts as a disincentive to recruitment and retention, and if it does, takes steps to close the gap.
8. For areas where an agency is a significant market player in the use of engineering expertise and where there is a shortage, agencies should influence the supply of expertise through increased recruitment and training of graduate engineers.
9. Public service employment classification systems should accommodate engineering professionals by:
 - Recognising the four levels of engineering professionals development, practitioner, specialist and engineering manager.
 - Allowing engineers to become specialists with status and remuneration that reflects their unique and valuable contribution.
 - Ensuring that the competencies specified in job statements align with modern national competency standards.
10. Public services should seek to better facilitate the movement of engineering professionals between agencies.
11. Public services should commission a study of the reasons why engineering professionals stay or leave, and use this information to improve retention strategies.
12. Each public service should establish a cross-agency engineering community of practice to improve engineering practice, encourage multi-agency engineering workforce planning, and facilitate the movement of engineers between agencies.

ABBREVIATIONS

AIP	Australian Industry Participation
APESMA	Association of Professional Engineers, Scientists & Managers, Australia
APS	Australian Public Service
CMMI	Capability Maturity Model Integration
CPG	Commonwealth Procurement Guidelines
CPR	Commonwealth Procurement Rules
DPPM	Defence Procurement Policy Manual
EL	Executive Level
EPCM	Engineering, Procurement, and Construction Management
IDC	Interdepartmental committees
P3M3	Portfolio, Program and Project Management Maturity Model
PESTLE	Political, Economic, Sociological, Technological, Legal, Environmental
SES	Senior Executive Service
SMEs	small and medium sized enterprises
SWOT	Strengths, Weaknesses, Opportunities and Threats
WofG	whole-of-government



TERMINOLOGY

PROCUREMENT

Key procurement terms are:

- Procurement is the process of acquiring the resources needed to undertake the business of the procuring agency, and these resources can be categorised as human resources, material resources, facilities and services.
- Alliance contracts are collaborative arrangements where parties jointly work together to deliver the outcomes of a project. They are characterised by risk sharing and a no-disputes/no-blame regime.
- Strategic sourcing means strategically analysing needs and supply markets to develop plans for acquiring products and services to achieve optimal business outcomes.
- Whole-of-life costing includes initial purchase cost as well as costs arising from holding, using, maintaining and disposing of the products and services.
- Engineering-intensive procurements are those where there is a relatively large component of engineering expertise spent on analysing, designing, managing, and integrating the good or service in comparison to other labour inputs.

Procurement practices can be analysed on the following two scales.

1. The **procurement cycle** is the process for acquiring products or services. It begins with a buyer identifying a procurement requirement and continues through the activities of risk assessment, seeking and evaluating alternative solutions, contract awarding, delivery and payment, ongoing management and termination.
2. The **procurement system** is the combined effect of organisational procurement arrangements, procurement processes and technologies, procurement expertise, and procurement performance management system.

There are three categories of procurement based on their risk and complexity. Engineering expertise would normally only be required for complex and strategic procurements.

1. **Simple procurement** is a procurement category where the overall level of risk and complexity is assessed as low.
2. **Complex procurement** is a procurement category where the overall level of risk and complexity is assessed as

medium to high. Complex procurement usually involves the purchase of more complex supplies where the monetary value of the purchase is high, and broader value for money considerations apply including whole of life costing, supplier support capabilities, contractual conditions, fitness for purpose and supplier past performance.

3. **Strategic procurement** is a procurement category where the overall risk and complexity is high to extreme. The characteristics of strategic procurement typically include that the procurement is critical to the agency's core objectives, and the procurement is linked to very senior level planning decisions.

Key engineering factors that increase risk are technology immaturity, high dependence on IT, high complexity of the requirement, high level of integration with other systems, poorly-defined or over-defined specifications, ill-defined acceptance criteria, and low capability and maturity of the tenderer.

ENGINEERING EXPERTISE

Engineering expertise is defined as extensive or in-depth specialised engineering knowledge, skill or judgment required both to undertake engineering tasks typical of an experienced engineering professional, and to apply general engineering principles, approaches and tools to non-engineering areas. There are two distinct types of engineering knowledge, skill and judgment.

- Technical skills and industry sector knowledge
- Ability to apply engineering practices/approaches, and organisational techniques in non-engineering contexts (see Chapter Three for details).

Engineering expertise is essential in making informed decisions in many domains including:

- Safety advice and management.
- Project and program management.
- Engineering and design.
- Risk management and services.
- Sustainability advice and management.
- Environmental assessment, management and advice.
- Community and stakeholder relations management.
- Building surveys and due diligence reports.
- Detailed design specification for construction, refurbishment and repair.

- Infrastructure economics and access pricing and policy advice.
- Infrastructure demand forecasting.
- Integrated logistics support.

ENGINEERING CAPABILITY

Engineering capability is defined as the ability of an organisation or system to value, obtain, integrate and sustain engineering-based information and advice in order to make informed decisions regarding options, outputs (e.g. performance, cost and schedule), uncertainties and risks. Engineering capability derives from the combined effect of multiple inputs with the main ones being:

- **Engineering expertise providers:** (see below)
- **Engineering expertise users:** The users are people within the organisation who need to utilise engineering information and advice in their decision making or to complete their tasks.
- **Engineering practices and processes:** The practices and processes generate the production of engineering information and advice, and facilitate its input into the organisation's business processes.
- **The organisation's receptiveness to engineering expertise:** The organisation's strategy and culture fundamentally define the degree of value and significance given to engineering advice.

ENGINEERING EXPERTISE PROVIDERS

Engineering expertise providers are engineering team members (Professional Engineers, Engineering Technologists and Engineering Associates) that have engineering education, skills, competency and experience required by the agency to assist it with making informed decisions on engineering-related issues. They may work within the agency or external to it, and may be public sector employees, private sector employees or work for non-government agencies. Commonly, Professional Engineers have a four-year Bachelor of Engineering degree, Engineering Technologists have a three-year Bachelor of (Engineering) Technology degree, and Engineering Associates have a two-year Advanced Diploma of Engineering or an Associate Degree.

Private sector providers of engineering expertise to agencies are usually categorised as professional service contractors or consultants.

An engineering professional service **consultant** provides engineering advice to an agency which is used as the basis for decision making or taking a certain course of action. Consultants use their professional judgement to provide data, investigations, evaluations or reviews, and develop new concepts or processes that have no precedent. A consultant rarely has responsibility for implementing a course of action decided by the agency based on their input. The key characteristics of a consultant include:

- Generally an engagement for a fixed period of time at an agreed rate of payment.
- Work which is not directly supervised by the agency.
- Independent research/investigation is conducted.
- The provision of expert advice with recommendations in the form of a written report or an intellectual product.

Examples of consultancy services include:

- Providing expert advice on technical and professional matters.
- Carrying out research projects, attitudinal surveys, feasibility studies and fact finding investigations where recommendations are made.
- Developing and designing a benchmarking framework/process and standards.
- Providing advice in the development of policy and strategic planning issues.

An engineering professional service **contractor** is engaged to exercise professional and/or technical skills in the delivery of a service for the agency. The contractors normally implement or assist with an agency's existing process under supervision to deliver a known outcome. Examples of contractor services include providing and undertaking

- Workshop facilitators and training on community and stakeholder relations management.
- Information technology programmers, analysts and system support staff.
- Demand management statistical data where no recommendation will be made.
- Built environment design and production undertaken by architects and engineers.
- Due diligence checks on assets.
- Capital works and maintenance.
- Design, conceptual design services for assets.
- Workplace health and safety audits.

PUBLIC SERVICE TERMS

The following are the key terms used to describe procurement by an agency.

- **Agency** is a generic term for a government controlled organisation. It includes departments, agencies and statutory authorities.
- **Delegate** is a person authorised to enter into a contract within the powers and functions set out in a delegation from the Finance Minister or any directions in the delegation from the Chief Executive of their agency.
- **End-users** are those who are the clients which use products and services delivered through the procurement.
- **Outcomes** are results or impacts the government wants to achieve – for example, roads which make communities safe, encourage industry competitiveness, make communities liveable and conserve the environment.
- **Outputs** are the products and services produced by agencies on behalf of the government or external organisations or individuals – for example, infrastructure funding for the rail networks.
- **Stakeholders** are parties that have a legitimate interest in the procurement activity. These include ministers, senior management of the buying agency, the program office which uses the procured item, end-users of the products and services delivered through the procurement, and others affected by the contract.
- **Whole-of-government** denotes public service agencies working across portfolio boundaries to achieve a shared goal and an integrated government response to particular issues. Approaches can be formal and informal.

INTRA-AGENCY ORGANISATION OF PROCUREMENT

For complex and strategic procurements, it is common to have different parts of an agency involved in a procurement. While there are many different forms of inter-agency structures to undertake such a procurement, in general there are three principle components – the Program Office, the Procurement Team and the Budget/Finance Office.¹ The Program Office is the client for the acquired good or service. It purchases an item to achieve its program outcomes. The Procurement Team is the group responsible for developing and negotiating the contract on behalf of the Program Office. The Procurement Team may be within the Program Office, external to it or be a blended group which includes Program Office staff. The Budget/Finance Office is responsible for paying contractor invoices, when to appropriate funds, certifying funding documents, reconciling accounts, providing program expenditure data.

Other areas of an agency may be involved including legal and service delivery, and these may be called upon to contribute to the procurement through the Program Office, the Procurement Team or other structures such as management review, or may be integrated within the Program Office, the Procurement Team or the blended organisation charged with the procurement.

The actual person who signs the contract on behalf of the agency is the Delegate. This power is delegated to them as set out in a delegation from the Finance Minister or any directions in the delegation from the Chief Executive of their agency. The delegations normally establish what level of person can sign contracts of a certain value within a certain time frame. The delegate is normally within the Program Office.

Each of the above sub intra-agency groups involved in a procurement have different functions and invariably different cultural drivers. These drivers can explain why there is often tension between different parts of an agency over procurement. The Program Office is focused on the program's delivery and schedules, and generally is little concerned with how the procurement is undertaken. The Procurement Team

is focused on the contractual arrangements and complying with rules and regulation, and establishing compliance mechanisms to ensure that the contract continues to meet mandatory requirements. The Budget/Finance Office is focused on accountability issues including complying with financial guidelines and cognisant of the need to explain decisions at some future point.

The intra-agency groups and their divergent focus and culture described above are represented graphically in Figure 1. Institutional alignment by the inter-agency groups is central to an agency's ability to deliver desired cost, schedule and performance.

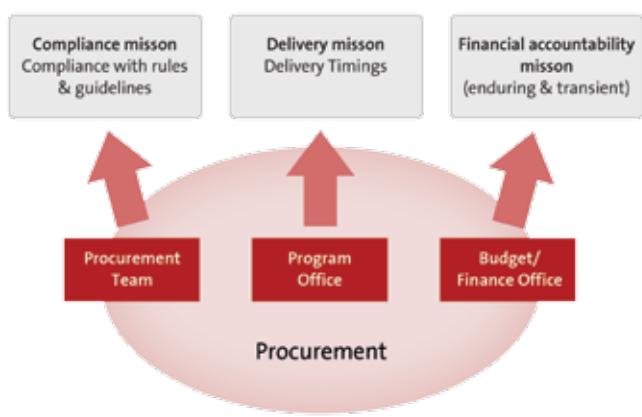


Figure 1: The intra-agency groups with their primary mission (bold) and key performance indicators²

APPLICABILITY

While this report specifically addresses engineering intensive products and services, the issues discussed and solutions proposed are relevant to many other areas of government procurement such as information and communication technologies procurement and resource policy.

¹ The term *office* is used to encapsulate the idea that function is delivered by an agency sub-organisation with its own culture and priorities. While in many procurements, the office function may be undertaken by a single person, however, as this report focuses on complex and strategic engineering-related procurements the office function will be undertaken by many people.

² This section draws significantly upon the work of Vann, James L., 2011. *Institutional Dimensions of the Government's "Smart Buyer" Problem: Pillars, Carriers, and Organizational Structure in Federal Acquisition Management*. PhD Dissertation, Virginia Polytechnic Institute and State University.

CHAPTER ONE



THE PROBLEM

SUMMARY

The number of engineering professionals employed by Australian government agencies has declined significantly over the last two decades. This has been primarily due to privatisation and contracting out which has seen the private sector carrying out engineering-related work previously undertaken in-house by governments. The downsizing of engineering expertise has meant that agencies have had less access to technical expertise which has affected their ability to be informed customers when procuring engineering-intensive products or services. Engineers Australia drew attention to the risks associated with the public sector's loss of engineering expertise in the first edition of this report in 2000.

Despite the passing of a decade, the problem has still not been addressed sufficiently. It is still too common that not enough time is being spent on project scoping, inadequate design effort is being invested in projects before they are put out to market, and demanded contract delivery timeframes are unrealistic. The cost of inadequate engineering expertise can be huge. Consult Australia argued that the loss of public sector engineering expertise could increase project costs by 20%. Non-financial costs include political embarrassment due to cost blowouts and project delays, and projects that do not meet the needs of the end users.

THE DE-ENGINEERING OF THE PUBLIC SERVICE AND ITS CONSEQUENCES

Three decades ago, the three levels of government employed about 100,000 engineering professionals. Today the number is probably about 20,000.³ The reduction resulted from major structural reforms of government – notably privatisation and contracting out. In the recent past, all Australian governments have privatised a range of their assets such as utilities, public transport agencies, construction units and manufacturing facilities. This has reduced substantially the number of public sector employees. For example, between 1984 and 2005 the

proportion of the electricity, gas and water supply industry that are public sector employed dropped from 95.9% in 1984 to 54.7% in 2005. The public sector component of the construction industry also declined with it employing 12.2% of its workforce in the public sector in 1984, to just half a percent in 2005.⁴ Another major change has been the scale of contracting out. As seen in Chapter Two, the magnitude of contracting has steadily grown and now accounts for about 25% of total expenditure by Australian governments.

The changed public service has meant major changes for the remaining public sector engineering professionals. A personal reflection on this is included in the 2011 Australian National Engineering Taskforce report called *Scoping our future: Addressing Australia's engineering skills shortage*.

As a Government department, we moved from having a large in-house engineering workforce, to outsourcing most functions. We are now largely an administrative/management agency. However with that outsourcing we lost a lot of institutional knowledge and capability. We struggle to remain an informed client and are desperately trying to build technical expertise in key areas that cannot be met through the private sector. The current situation is inadequate to meet current demands, let alone provide a sustainable model to meet future demands. The organisation has not successfully tackled the issue of attraction and retention of engineers and allied technical personnel.

The negative consequences for the public sector arising from a decline in engineering professionals were first identified in the late 1990s. Engineers Australia drew attention to it in its first edition of this report, *Government as an Informed Buyer*, in 2000. It identified that risks included:

- The inability to manage engineering contracts because contracting staff lacked the necessary technical expertise.

³ Current and accurate statistics on engineering professionals are difficult to obtain as public services across the country do not uniformly classify or record professional status of staff. The most recent comprehensive set of statistics is from the 2011 Population Census. It identified that there was 22,696 engineering professionals employed in public administration at the Australia, State/Territory and local government levels. Engineers Australia, 2012, *The Engineering Profession: A Statistical Overview*.

⁴ Kryger, T, Research Note no. 29 2005–06: The incredible shrinking public sector, (24 March 2006).

- The inability of contract staff to adequately assess the engineering competencies of contractors and subcontractors.

More recently the consequence for procurement from the loss of engineering expertise has been highlighted in a number of submissions in 2011 and 2012 to a Senate inquiry into the shortage of engineering skills.⁵ Consult Australia in its submission identified that as government agencies lose their engineering workforce, they lose the ability to be a well-informed purchaser. It noted that as a result not enough time is spent on scoping and producing quality statements of requirements, and political imperatives often take precedence over realistic planning timelines.

Consult Australia argues that statements of requirement that are developed by government agency teams without the benefit of in-depth engineering analysis have a tendency to require constant revision during the project life cycle. Problems with scoping documents are most commonly picked up only when they become a problem during project execution. Tender processes are less efficient and procurement officers are less able to assess tenders on engineering merit. The true requirements of government become evident as the project progresses, rather than at the project scoping stage. This leads to re-engineering and contract amendments. Cost blow outs are inevitable because of extensions in project delivery time and thus wages, the cost of re-engineering, changes to hardware requirements, not to mention the loss of public reputation due to late delivery of essential services.⁶

Inadequate scoping of projects has been identified as a major contributor to poor outcomes for public works. A Blake Dawson report, *Scope for Improvement 2008: A report on scoping practices in Australian construction and infrastructure projects*, stated that “inadequate scoping has severe cost consequences on projects...61% of respondents said that inadequate scope documents resulted in a cost overrun, with more than half of those overruns costing more than 10% of the value of the project and a third more than 20%”.⁷

Based on the Blake Dawson report identification that scoping inadequacies resulted in 26% of large projects being more

than \$200 million over budget, Consult Australia stated that “it can be argued that the loss of public sector engineering expertise increases project costs by 20%”.⁸

Poor project design documentation is another major consequence of a lack of expertise. In 2005 the Queensland Division of Engineers Australia published the report *Getting It Right The First Time*. It highlighted the declining standards in project design documentation within Australia’s building and construction industries, and concluded that poor documentation is contributing an additional 10 to 15% to project costs, with the annual cost of poor documentation being about \$12 billion per year across Australia. Examples of poor standards noted in the report included:

- Inadequate project briefs based on unrealistic estimates of time and cost.
- Lack of integration along the supply chain linking the parties and between project phases.
- Devaluing of professional ethics and standards of business practice.
- Lowest cost bid selection strategy rather than value for money.
- Poor understanding and skilling in risk assessment and (risk) management processes.
- Absence of an experienced client-appointed, overall Design Manager/Coordinator.
- Poor understanding of optimised and properly documented designs.
- Inadequate availability of, and recruitment of, skilled and experienced people.
- Inadequate/ineffective use of technology in design and documentation (e.g. poor application of CAD techniques: technical specifications drawn from an organisation’s database but not tailored to the particular project)
- Lack of appreciation of the benefits of effective communication.⁹

It was also found that poor documentation has led to:

- An inefficient, non-competitive industry.
- Cost overruns, rework, extensions of time.
- High stress levels, loss of morale, reduced personal output.

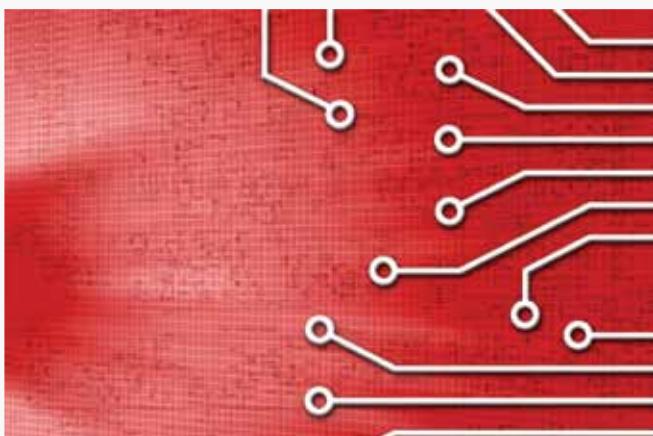
⁵ The Senate Education, Employment and Workplace Relations Committee’s inquiry is examining the shortage of engineering and related employment skills.

⁶ Consult Australia, 2012. Submission Senate Inquiry: Shortage of engineering and related employment skills

⁷ Blake Dawson, Scope for Improvement 2008: A report on scoping practices in Australian construction and infrastructure projects (2008), p 12.

⁸ Consult Australia, 2012. *Submission Senate Inquiry: Shortage of engineering and related employment skills*, p. 18.

⁹ Engineers Australia (QLD), 2005. *Getting It Right The First Time*.



- Adversarial behaviour, diminished reputations.
- 60% to 90% of all variations are due to poor project documentation.
- One price variation results from every three Requests For Information.
- Estimated Cost of Variations generated by poor documentation was 12% to 15.2% of project value (PV), based on actual cost of variation works, plus extra administration costs (1.1% of PV) and extensions of time (2.1% of PV).

RELEARNING THE LESSONS

The need to maintain engineering expertise so as to be an informed buyer of engineering-intensive products or services is frequently relearned after difficulties with major projects. Recent examples of this are the WA State Road Network and the Collins-class submarine.

In the late 1990s, Main Roads WA changed the way it maintained the state road network. It contracted out the maintenance to such a degree that it is unique in Australia. The expectation was that this would generate significant savings over in-house provision. A 2009 Auditor General's inquiry found that contracting of road maintenance had not delivered the expected results. Specifically, the expenditure under the 10-year contracts is likely to be \$467 million (59%) greater than estimated in 1999. Direct causes of this included that the level of resources needed to manage the contracts has been higher than planned, and that road condition measures used in the contracts have failed to ensure adequate

levels of planned maintenance. A major contributing cause was the decline in Main Roads' level of in-house technical expertise. Over the term of the contracts, Main Roads had lost much of its technical expertise with many of its experienced technical staff now working for the contractors. As a result Main Roads did not have the ability to manage the contracts. The Audit Report identified that one of the main lessons from the contracting out experience was to rebuild its informed buyer status. It reported that "Main Roads plan to address this issue in the new contract arrangements by placing Main Roads staff alongside contractors to enhance their technical knowledge and skills...training is also underway to regain essential knowledge in identifying types of road failure, appropriate remedial treatments and the timeframes for the work".¹⁰

The Collins Class Submarine has had a well-recorded history of difficulties, with the most recent problems being very low availability and high cost of the fleet sustainment. The problems originate from the very beginning of the program and have been worsened by continual and poorly thought through reforms since their commissioning. The 2011 *Collins Class Sustainment Review* (Coles Review) noted that levels of Defence's knowledge of submarine engineering and other submarine domain expertise has diminished substantially. A lesson the authors drew was that "no amount of business process refinement could overcome this loss of expertise".¹¹ In a 2011 review of the Collins-class submarine program, RAND identified that a key lessons was that "The program and the procurement agency must be informed customers supported by adequate technical, operational, and management expertise".¹²

This report aims to provide agencies with the knowledge and tools so that they do not repeat the mistake made by others. It concludes with recommendations that provide a systematic approach to ensuring that agencies have the appropriate level of engineering expertise to support procurements of engineering-intensive products and services.

¹⁰ Auditor General Western Australia, 2009. *Maintaining the State Road Network*.

¹¹ Coles, John, 2011. *Collins Class Sustainment Review*, Phase 1Report, p. 11.

¹² RAND National Defense Research Institute, 2011. *Learning From Experience: Lessons from Australia's Collins Submarine Program* (Volume IV)



CHAPTER TWO

UNDERSTANDING GOVERNMENT PROCUREMENT IN AUSTRALIA

SUMMARY

Procurement of products and services from the private and non-government sectors is central to the achievement of the objectives of all Australian governments, for nearly all government programs depend on contracting from the non-governmental sectors. For some agencies such as Defence, procurement consumes over 40% of their \$25 billion annual budget. Nationally, procurement accounts for about 25% of all Australian government expenditure. For the Australian Government, in 2010/11 over 32,000 contracts were signed with a combined value of over \$79 billion.¹³

Procurement not only is central to achieving the outcomes desired by the purchasing agency; its large size in aggregate means that procurement has the potential to advance or hinder government sector economic, social and environmental objectives. The centrality of procurement to delivering agency and broader government objectives makes procurement a core function of government.

Australian governments are generally aware of its importance and have continuously worked towards improving procurement efficiency and effectiveness. Most Australian governments have done this through developing and refining a principles-based procurement framework that has delegated procurement decisions to the agency responsible for the purchased good or service. This agency will usually have its own specific procurement guidance that will conform to a whole-of-government (WofG) principles-based procurement framework.

To improve procurement, all jurisdictions have invested significant effort in making the procurement cycle better. To a lesser degree they have focused on improving the entire procurement system which is the combined effect of the organisational arrangements, its procurement processes and technologies, its procurement expertise, and its procurement performance management system. Some governments have also sought to improve the alignment between individual procurements and governmental outputs, outcomes and objectives. This last area – ensuring that individual procurements contribute to advancing a range of other government objectives – is becoming more important as both the government and the public demand greater integrated government responses as well as more cost efficient outputs.

THE NATIONAL SIGNIFICANCE OF GOVERNMENT PROCUREMENT

The procurement of products and services is a major function of all Australian governments. In 2011/12, the value of products and services procured by Australian governments exceeded \$60 billion. Procurement accounts for about 25% of a government's expenditure. For the Australian Government in 2010/11, procurement was valued at over \$32 billion.¹⁴ The expenditure for the NSW Government alone was \$12.7 billion.¹⁵ Government expenditure on products and services accounts for about 10% of Australia's Gross National Product. At an agency level, procurement can account for between about 20% and 80% of its total expenditure. The considerable size of government procurement means that it has the potential to drive additional economic, social and environmental objectives, rather than just achieving an output directly related to the specific good or service purchased.

¹³ Information has been extracted from AusTender, the Australian Government Procurement Information system. It reflects contractual information reported during the relevant financial year in accordance with agencies' procurement publishing obligations, and does not represent actual expenditure. The data includes some procurement information for agencies that are not required by the policy to report their contracts. It does not contain details of contracts exempt from notification by the Chief Executive of an agency. Note: Agencies are required to report on AusTender procurement contracts valued at \$10,000 and above. Under the Commonwealth Procurement Guidelines, additional rules apply to procurements valued at or above \$80,000, other than Construction procurements, where a \$9 million threshold applies. Department of Finance and Deregulation, n.d., Statistics on Australian Government Procurement Contracts, <http://www.finance.gov.au/publications/statistics-on-commonwealth-purchasing-contracts/index.html>, accessed 1 February 2012.

¹⁴ Department of Finance and Deregulation, n.d., Statistics on Australian Government Procurement Contracts, <http://www.finance.gov.au/publications/statistics-on-commonwealth-purchasing-contracts/index.html>, accessed 1 February 2012.

¹⁵ NSW Finance & Services, 2012. NSW Government Procurement Discussion Paper.

The value of government procurements has grown considerably over the last two decades. In the 1990s, the increase was driven by outsourcing activities as governments sold or disposed of their non-core activities. In the 2000s, the increase has been driven by the expanding role of government and the increasing size and complexity of products and services being purchased. Figure 2.1 shows the growth in Australian Government procurement expenditure between 2005/06 and 2010/11. The figures include contracts with a value of \$10,000 or more, and are listed on the AusTender website. The figures underestimate the actual expenditure as it does not include contracts which have not been listed for national security and other reasons.

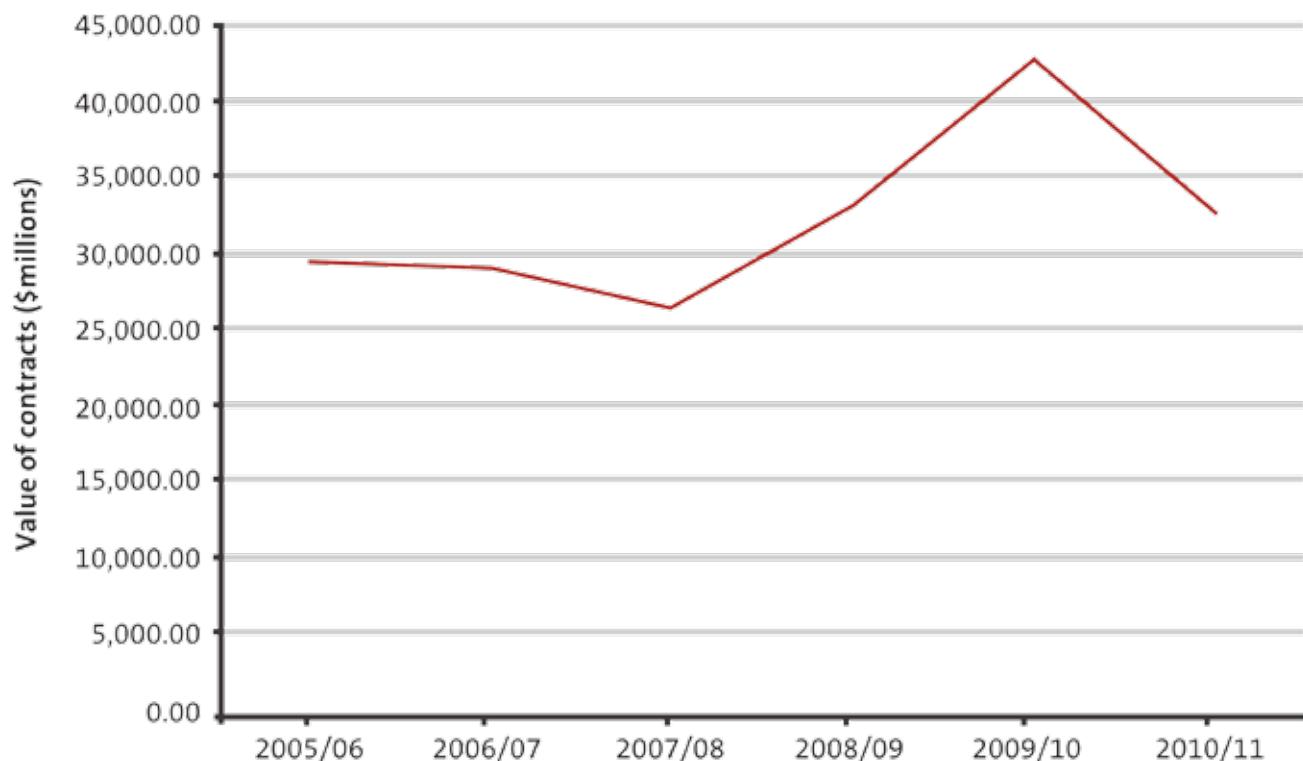


Figure 2.1: Statistics on Australian Government procurement contracts¹⁶

Department of Finance and Deregulation, n.d., Statistics on Australian Government Procurement Contracts, <http://www.finance.gov.au/publications/statistics-on-commonwealth-purchasing-contracts/index.html>, accessed 1 February 2012.

Table 2.1 lists the contract value, the number of contracts and the average value per contract. The figures indicate that over the last six years, the number of contracts has decreased. This would seem to indicate that the average size of a contract has increased at the Australian Government level. As there are no figures on the number of procurement officers in the Australian Public Service during this period, it is not possible to determine if the numbers have grown in proportion to the growth in the total contracting value, or change in the number of contracts. This lack of information makes it difficult to identify if the workload for the average procurement officer has changed.

Table 2.1: Value, number of contracts and average value per contract for Australian Government procurement contracts¹⁷

Financial year	Value (\$million)	Number of Contracts	Average value per contract (\$million)
2005/06	29,388.40	87,132	0.34
2006/07	28,978.50	82,532	0.35
2007/08	26,361.80	69,493	0.38
2008/09	32,962.40	85,870	0.38
2009/10	42,694.30	80,969	0.53
2010/11	32,641.40	79,286	0.41

Engineering-related procurement makes up a substantial component of total purchasing expenditure, because engineering inputs can be found in many products and services. Examples of engineering-dense goods include civil infrastructure, defence materiel and IT systems. Examples of engineering-dense services include environmental, project management, risk management, health and safety, mechanical and systems services. Procurement of engineering-related products and services is typically concentrated in defence, construction, transport and communications portfolios, although all agencies will undertake some engineering-related purchases each year.

While the majority of a government's procurements is undertaken in the context of program management¹⁸ and service delivery, procurement may also be required for other key agency functions – notably policy development, crisis management, regulation and internal business operations. For example procurement in policy development may

include purchasing knowledge as an input to policy analysis, assessment of the costs/benefits of policy instruments, and facilitation and consultation activities. For regulation functions, procurement activities may include purchasing expertise to evaluate the full range of costs and benefits associated with compliance options, and determining which standards are appropriate for the selected options.

THE DELEGATED, PRINCIPLES-BASED NATURE OF AUSTRALIAN GOVERNMENT PROCUREMENT

While there is considerable variation across Australian government jurisdictions in how they approach procurement, most use a procurement system made up of WofG, principles-based procurement guidelines supplemented by more detailed guidance produced within individual agencies. Principles-based procurement guidelines have been adopted because it is believed that they deliver better procurement results as

¹⁷ Department of Finance and Deregulation, n.d., Statistics on Australian Government Procurement Contracts, <http://www.finance.gov.au/publications/statistics-on-commonwealth-purchasing-contracts/index.html>, accessed 1 February 2012.

¹⁸ Program management is the coordinated organisation, direction and implementation of a group of projects and activities that together achieve the outcomes and realise benefits that are of strategic importance.

they allow flexibility and discretion by agencies in how they best handle their particular purchasing needs. This approach replaced a formulaic system which involved specifying a prescriptive procurement process that had to be followed regardless of the individual circumstances of the products and services being bought. The procurement principles are derived from what is perceived to be best practice, including sound planning, effective management, and justification of all procurement decisions, noting that value for money remains the core principle underpinning Australian Government procurement.

Another major change in procurement has been the decentralisation of procurement responsibility from supply departments/central procurement boards to the agencies that require the products and services being purchased.¹⁹ This is justified on the basis that those who own the problem are in the best position to manage the solution.

This procurement approach is readily seen at the Australian Government level. In late 1990s, the Australian Government introduced the *Commonwealth Procurement Guidelines*. These consisted of a purchasing framework that provided principles-based guidance on how to undertake procurement, and gave individual agencies both far more flexibility and responsibility to manage their own purchasing arrangements. *The Commonwealth Procurement Guidelines and its 2012 successor, the Commonwealth Procurement Rules (CPR) place value for money as the core principle of procurement decisions.* This emphasis on value for money is common across all jurisdictions, albeit not all apply and measure this principle in the same way. Below is the explanation and guidance on value for money from the CPRs.

Achieving value for money is the core rule of the CPRs. Value for money in procurement requires:

- a. encouraging competitive and non-discriminatory processes;
- b. using Commonwealth resources in an efficient, effective, economical and ethical manner that is not inconsistent with the policies of the Commonwealth;
- c. making decisions in an accountable and transparent manner;
- d. considering the risks; and
- e. conducting a process commensurate with the scale and scope of the procurement.

The price of the goods and services is not the sole determining factor in assessing value for money. A comparative analysis of the relevant financial and non-financial costs and benefits of alternative solutions throughout the procurement will inform a value for money assessment. Factors to consider include, but are not limited to:

- a. fitness for purpose;
- b. a potential supplier's experience and performance history;
- c. flexibility (including innovation and adaptability over the lifecycle of the procurement);
- d. environmental sustainability (such as energy efficiency and environmental impact); and
- e. whole-of-life costs.



¹⁹ In some public services, the decentralisation trend is now reversing as seen in the increasing use of 'piggy-backing' of panels, multi-use lists and coordinated procurement organised by a lead agency.

The CPRs include mandatory practices and procedures that must be followed for procurements that exceed particular financial thresholds. Mandatory issues include tender selection processes, tender evaluation processes, probity arrangements, and the notification of decisions. The specification of a minimum set of mandatory practices and procedures that must be followed (unless there is a justifiable exception) is also common across jurisdictions.

While the *CPRs* and the purchasing policies and statements of other jurisdictions provide high level guidance on what is expected of agencies when undertaking procurement, they lack specificity and much of the detailed information necessary for agencies to confidently assess their conformance with the principles. To address this, detailed guidance is prepared by individual agencies. At the Australian Government level, this is done through Chief Executive's Instructions and more detailed agency-level procurement documents. Chief Executive's Instructions are the primary mechanism by which agency heads set out the processes for their staff to follow, and Instructions relating to procurement nowadays are normally limited to setting out the delegations for approval to spend public money through entering a contract. An example of an agency-level procurement document is the *Defence Procurement Policy Manual* (DPPM) which applies to both the Department of Defence and the Defence Materiel Organisation.

This approach is mirrored in most jurisdictions. For example in Queensland, its State Procurement Policy establishes governance structures for procurement which consist of WofG guidance to be supplemented by agency procurement procedures that set out how procurement activities are to be

conducted in compliance with the State Procurement Policy. These agency-specific procedures may also be supported by guidance from other agencies or at the WofG level that address specific types of procurement such as building construction and maintenance, civil construction and information technology and telecommunications purchases.

PROCUREMENT SCALE ANALYSIS

The definition of procurement across Australian governments varies but most have settled on a definition that identifies it as the process of acquiring the resources needed to undertake the business of the procuring agency, and these resources can be categorised as human resources, material resources, facilities and services. Examples of different procurement definitions are:

- The Queensland Government's State Procurement Policy (2012) defines procurement as the "entire process by which all classes of resources (human, material, facilities and services) are obtained. This can include the functions of planning, design, standards determination, specification writing, selection of suppliers, financing, contract administration, disposals and other related functions".
- The Defence Procurement Policy Manual (2011) defines procurement as "the process of acquiring the resources needed to undertake the business of Commonwealth agencies. It is the entire process by which all classes of resources (personnel, materiel, facilities and services) are obtained for a specific project or procurement outcome. This process can include such capability life cycle activities as: needs, requirements, acquisition, in-service, disposal and related tasks".



These definitions reflect a focus on the actual process or stages an agency follows to acquire products and services. (This focus is henceforth known as the *procurement cycle*). This centre of attention is reflected in the procurement cycle-centric nature of most government procurement guidance.

However, procurement processes can be examined at two other scales – procurement system and the alignment between the procurement outcomes with multi-level governmental objectives.

The procurement system is one centred on considering procurement as being a system with inputs that work together to deliver effective and efficient procurement. The final analysis scale – alignment between the procurement outcomes with multi-level governmental objectives – is one in which procurements deliver not only desired agency outputs but also outcomes and outputs relevant to other agencies, and ultimately the objectives of government. These analysis scales are gaining more attention by governments as they increasingly recognise that both a systems approach and aligning procurement with governmental objectives can deliver improvements in the efficiency and effectiveness of procurement.

The rest of this section discusses these three analysis scales. Chapter Three then examines how engineering expertise can contribute to each.

PROCUREMENT CYCLE

The procurement cycle defines the process and stages undertaken to acquire products and services. It typically begins with identifying a need, followed by determining the most suitable strategy for the procurement based on the scope, scale and risk of the procurement. The next stages consist of conducting the procurement, and managing the contract. The process ends with terminating or transitioning the contract, or the disposal of assets. Throughout the procurement process, relevant risks must be managed. Figure 2.2 provides a simple illustration of the cycle.

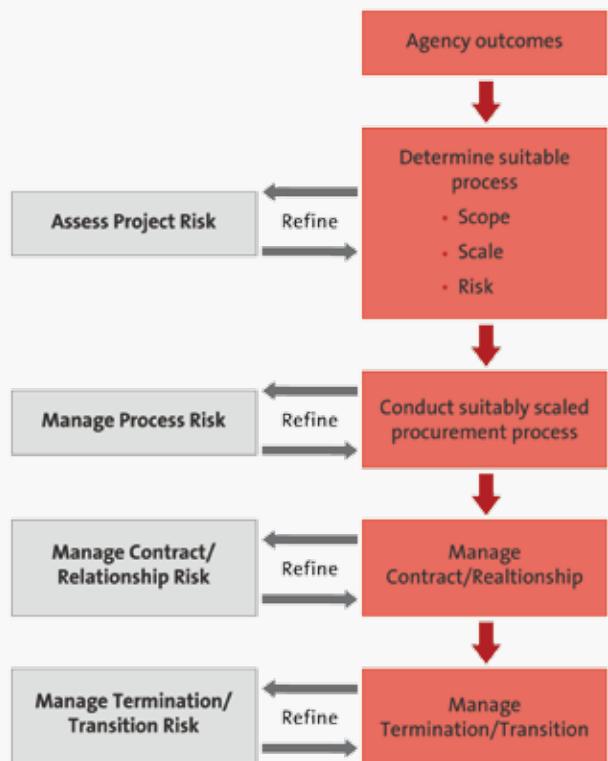


Figure 2.2: The procurement cycle²⁰

While the procurement cycle varies between jurisdictions and agencies, and for different types of procurement, most procurement cycles have similar elements. A list of stages, components and typical documents produced throughout the procurement cycle is provided in Table 2.2 to illustrate the work undertaken.

²⁰ Commonwealth of Australia, 2008. *Commonwealth Procurement Guidelines*.

Table 2.2: Documents typically produced during each stage of the procurement cycle²¹

Stage	Involves	Example of Documentation Requirements
<ul style="list-style-type: none"> • Identify Need. • Determine Suitable Process. 	<ul style="list-style-type: none"> • selecting the procurement method decision. • developing an evaluation plan, including selection criteria. • developing a procurement budget. • establishing the timetable. • producing a probity plan. 	<ul style="list-style-type: none"> • annual procurement plan. • budget papers. • business case. • risk assessment. • legal advice. • procurement method decision. • evaluation plan, including selection criteria.
<ul style="list-style-type: none"> • Conduct Procurement Process. 	<ul style="list-style-type: none"> • producing a contract management plan. • approaching the market to request tenders. • undertaking value for money assessment. • producing the evaluation report and recommended decision. • obtaining relevant approvals/or authorisations. • undertaking contract negotiations and producing a contract . • advising unsuccessful tenderers. 	<ul style="list-style-type: none"> • procurement budget. • time limits and timetable. • approach to the market. • probity plan. • request documentation (including draft contract). • due diligence process. • tenders received and acknowledgements. • value for money assessment. • evaluation report and recommended decision. • probity report. • decisions (including relevant approvals/or authorisations) and their basis. • contract negotiations and contract. • advice to unsuccessful tenderers. • reporting of contract if it is above a certain threshold.
<ul style="list-style-type: none"> • Manage Contract/Relationship. 	<ul style="list-style-type: none"> • measuring and managing performance. • managing variations. • determining and rectifying contract breaches. • determining contract completion. • managing disputes. • accepting deliverables. • making payments. 	<ul style="list-style-type: none"> • contract management plan. • performance indicators. • performance reports. • correspondence between the parties. • variations to the contract. • decisions regarding variations, records of the receipt of orders. • evaluation of property and/or services. • payment invoices.
<ul style="list-style-type: none"> • Manage Termination/Transition. 	<ul style="list-style-type: none"> • producing evaluation report. • feeding back outcomes to the procurement process. 	<ul style="list-style-type: none"> • evaluation reports. • lessons learned. • contract completion reports. • certifications of completion.

²¹ Commonwealth of Australia, 2008. *Commonwealth Procurement Guidelines*.

Across governments, procurements are categorised as simple, complex and strategic.

A simple procurement is one for which the overall level of risk and complexity is assessed as low.

A complex procurement is one for which the overall level of risk and complexity is assessed as medium to high. Complex procurement usually involves the purchase of more complex supplies where the monetary value of the purchase is high, and broader value for money considerations apply including whole-of-life costing, supplier support capabilities, contractual conditions, participation by Australian industry and Priority Industry Capabilities, fitness for purpose and supplier past performance.

A strategic procurement is one for which the overall risk and complexity is assessed as high to extreme. The characteristics of strategic procurements typically include that the procurement is critical to the agency's core objectives, and the procurement is linked to very senior level planning decisions.

In general, the greater degree of business risk associated with a procurement (meaning that the products and services are

more likely to present risks, are critical to the agency and/or there is restriction on the competitive nature of the market), and the greater the value of the procurement, the more likely it is that the procurement will be considered complex or strategic.

THE PROCUREMENT SYSTEM

Viewing procurement as a system, rather than as a cycle made up of stages, focuses attention on inputs, the system's interactions that are required to effectively execute an agency's procurement strategy. These inputs typically include policy and procedures, strategy, people and culture, business systems, practices, and performance management. A systems understanding of procurement is reflected in Booz & Company's procurement operating model illustrated at Figure 2.3. The systems approach recognises that all elements need to work in unison to deliver an effective system, and that the outcome of the system is far greater than the sum of the individual parts.

A procurement system focus acknowledges that procurement outcomes can be sub-optimal even though the procurement cycle is followed perfectly, and that effective organisational arrangements, technologies and performance management systems may not be in place and aligned.



Figure 2.3: The procurement operating model developed by Booz & Co²²

²² Booz & Co, 2009. New Operating Model by Patrick W. Houston and Robert Hutchens.

PROCUREMENT ALIGNED WITH MULTI-LEVEL GOVERNMENTAL OBJECTIVES

Procurements undertaken by an agency are invariably linked to achieving that agency's business or program outputs. Business outputs are those that relate to the business processes of the agency such as procurement, risk management, and workforce management, while program outputs are those that deliver the outputs agreed between the agency and executive government. These outputs, defined as the products and services produced by the agency, produce the agency's outcomes, defined as results or outcomes the agency wants to achieve. The outputs and the outcomes are normally negotiated and agreed on between the agency head and the government, which ensures that there is a direct link between the agency and the government's objectives.

Conceptually, the vertical linkage from agency procurements to agency-specific outputs and outcomes to delivering government objectives is illustrated in Figure 2.4.

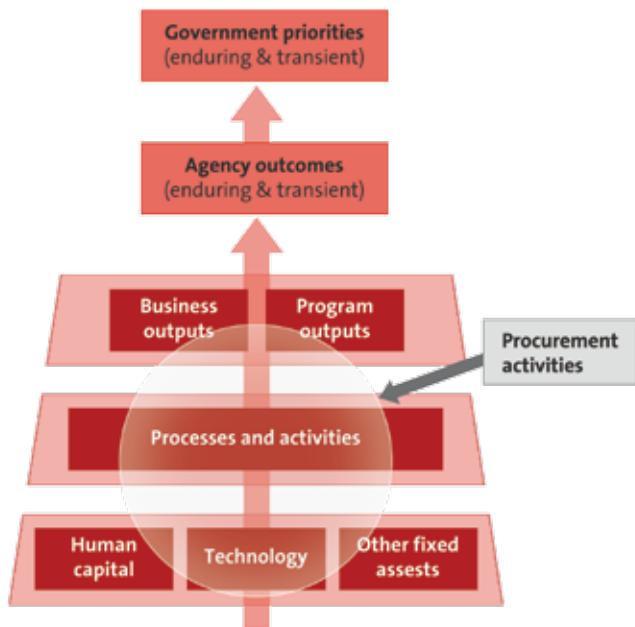


Figure 2.4: Model showing the link between procurement and the outputs, outcomes and objectives of the agency, other agencies or the government
(Adapted from the Department of Finance's Outcomes Process Model)

The above vertical linkage can be aggregated across all agencies to produce a conceptual understanding of how all agencies can deliver a WofG agenda. This understanding is illustrated in Figure 2.5.

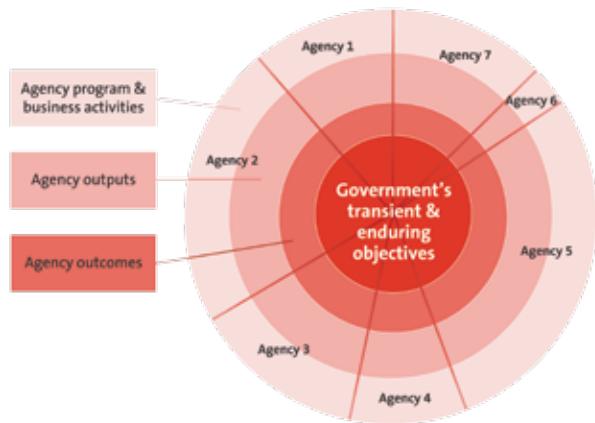


Figure 2.5: Model showing the how agency programs, outputs, outcomes can deliver WofG objectives

The above conceptualisation is somewhat simplistic when applied to procurement as it ignores:

1. The nuances of how government objectives affect procurement, and
2. How the activities of one agency can affect others.

How government objectives affect procurement

Government objectives arise from both their stated policy and from their intentions. They may be called goals, aims, priorities, agendas and purposes, and can describe either endpoints or desired processes to be followed. The two main types of objectives relevant to this procurement analysis are broad/enduring and narrow/transient objectives.

Broad/enduring objectives are typically aspirational, are open ended as they lack end points, have no simple mechanisms to achieve them, are constant across governments, and lack measurable metrics. Examples of these sets of broad/enduring objectives which have been advanced through procurement include:

- Innovation and industry development.
- Preservation of the environment and the national estate.
- Workplace relations policy, particularly freedom of association.
- Policies to advance the interests of Aboriginal and Torres Strait Islander people.
- Affirmative action.
- Occupational health and safety.

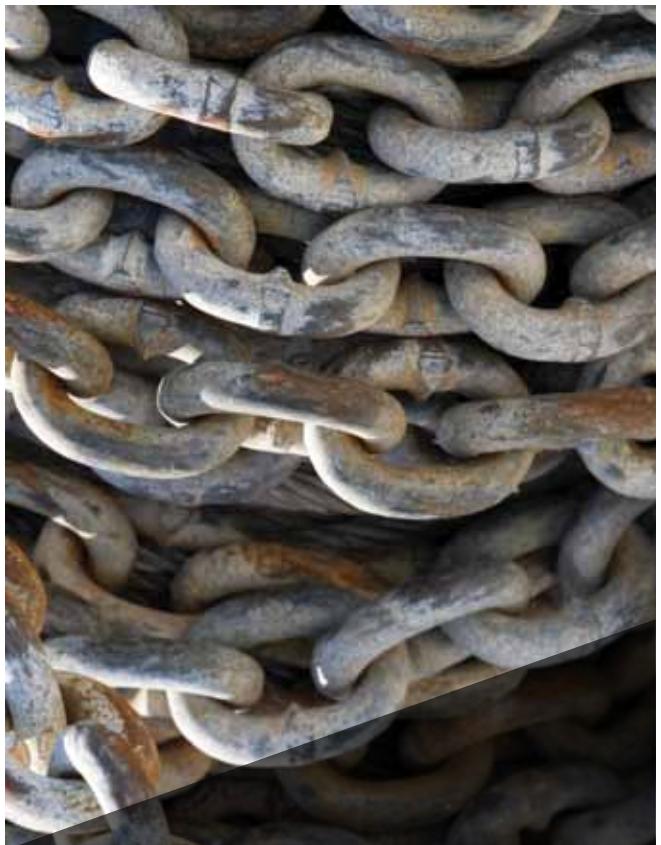
- Trade and foreign policy.
- Commonwealth–state coordination and cooperation.

Because they are enduring in nature, they are often formalised into WofG mandated policy and process obligations.

For example, the broad/enduring objective of industry development has led to the signing of the Australian Industry Participation (AIP) National Framework. This has the policy goal of increasing opportunities for capable and competitive Australian and New Zealand small and medium sized enterprises (SMEs) to participate in Major Commonwealth Procurement activities. The Framework has led to the formal requirement that tenderers for most major Commonwealth Government procurements (generally above \$20 million) prepare and implement an AIP Plan. Other examples of broad/enduring government objectives being formalised into obligations on purchasing agencies or suppliers at the Australian Government level are:

- Fair Work Principles: To advance fair, cooperative and productive workplaces, this obligation requires Commonwealth entities to obtain information from tenderers about their compliance with their workplace obligations, and precludes Commonwealth entities from contracting with suppliers in defined circumstances.
- Energy Efficiency in Government Operations: This policy aims to reduce the energy consumption of Australian Government operations with particular emphasis on building energy efficiency. It commits to a progressive improvement of overall agency energy performance through annual energy intensity reporting, the use of Green Lease Schedules, and minimum efficiency requirements.
- Coordinated Procurement: To obtain better pricing through aggregation of government purchasing power, WofG coordinated procurement arrangements are being put in place for some products and services. These are mandatory for certain agencies, and can apply across categories of products and services. For example, for ICT procurement, coordinated procurement arrangements require agencies to use suppliers on panels covering data centre facilities, data centre migration services, desktop hardware, internet based network connection services, and telecommunications management.

The other type of objectives relevant to this procurement analysis is narrow/transient objectives. These objectives normally exist for a limited time, and have limited aims related to a specific event or set of circumstances. They may





be bounded geographically or demographically. They typically require rapid implementation. Examples include stabilising the economy during economic turmoil, and regional recovery following a disaster. Unlike broad/enduring objectives, narrow/transient objectives are normally not formalised into WofG mandated policy and process obligations. Instead they manifest in specific programs or activities to be delivered by nominated agencies. Typically, other agencies do not consider they have a significant role to play in delivering these narrow/transient objectives, and do little to contribute to them.

There is considerable variation between Australian governments in the policy and operational guidance they provide to their agencies on how and when to integrate government objectives into procurement. In the case of the pre-2012 *Commonwealth Procurement Guidelines*, the link between the procurement and agency objectives are implied rather than explicit. While the Guidelines state that “Value for money is enhanced in government procurement by ... promoting the use of resources in an efficient, effective, economical and ethical manner”, and elsewhere it states that “Effectiveness relates to how well outcomes meet objectives”, only when the explanation of effectiveness is examined does it mention agency outputs. Here it states

that effectiveness “concerns the immediate characteristics of an agency’s outputs, especially in terms of price, quality and quantity, and the degree to which outputs contribute to specified outcomes”. The lack of a definitive statement of the link between procurement and government objectives fails to reflect the priority that should be given to this issue. In the 2012 *Commonwealth Procurement Rules*, references to agencies in the definition of efficiency have been removed and the CPRs state that “Effective relates to the extent to which intended outcomes or results are achieved. It concerns the immediate characteristics, especially price, quality and quantity, and the degree to which these contribute to specified outcomes”. Again there is no statement of the link between procurement and government objectives.

Even when agency procurement documents (e.g. guidelines, purchasing procedures, and corporate procurement plans) do directly link procurement with agency outcomes, it is rare for this information to detail which factors, and to what degree, they should influence the procurement. For example, the *Defence Procurement Policy Manual* (2011) identifies in its value for money checklist three longer term considerations which all contribute to agency outcomes.²³ However, it provides no further information on how procurement decisions should factor in these considerations.

The government that appears to have provided the most detail on how procurement can also advance government objectives is the Queensland Government. In its *State Procurement Policy* (2012), it identifies that value for money assessments must

²³ The Department of Defence outcomes are: (1)The protection and advancement of Australia’s national interests through the provision of military capabilities and the promotion of security and stability. (2) The advancement of Australia’s strategic interests through the conduct of military operations and other tasks directed by the Government. (3) Support for the Australian community and civilian authorities as requested by Government.

The three considerations specified in the Defence Procurement Policy Manual are:

1. safeguarding of vital sources of supply
2. length of the supply chain and its vulnerability to disruption
3. effect of procurement on price, availability and competition for future supplies (e.g. arising from dumping or artificially depressed quotations) including, as appropriate, supplies for other public purchasers.

include consideration of the “contribution to the advancement of priorities of the Government” alongside two other equally ranked areas of non-cost factors (e.g. fitness for purpose, quality, service and support, and sustainability considerations) and cost-related factors (e.g. whole-of-life costs and transaction costs associated with acquisition, use, holding, maintenance and disposal).

To assist agencies in translating the *State Procurement Policy* into action, the policy identifies the Queensland Government’s enduring priorities. These are derived from its 2020 vision for Queensland and consist of the State becoming:

- Strong – Creating a diverse economy powered by bright ideas.
- Green – Protecting our lifestyle and environment.
- Smart – Delivering world-class education and training.
- Healthy – Making Queenslanders Australia’s healthiest people.
- Fair – Supporting safe and caring communities.

The *State Procurement Policy* also provides some guidance on how these enduring/broad priorities are to be factored into the procurement process. Below is its guidance, which relates to how to integrate advancing government priorities within the concept of value for money.

In determining value for money, agencies must consider the contribution of their procurement to the advancement of the Government’s priorities. This will occur at different parts of the procurement process for different types of goods and services. For example:

- Priorities of the Government may be addressed by the way in which agencies determine that whole categories of their procurement are to be undertaken. For example, by devolving all procurement and associated budgets to the lowest practicable geographical level for goods and services that are low expenditure and for which there is a low degree of business risk strengthens regional economies. The selection of supplier is then based on other value for money considerations.

- Initiating a supplier development program fosters certain supplier capabilities and encourages the entry of new suppliers, and thereby may advance priorities of the Government related to business and industry development. Invitations to Offer may be limited to participating suppliers who can then be selected on the basis of cost and non-cost factors alone.
- For significant procurements, careful consideration of specifications is a means of assisting the agency to advance priorities of the Government. For example, specifications may be written in a way that maximises local business and industry opportunities to supply. Evaluation can then be limited to other value for money considerations. In evaluating competing offers, including and weighting evaluation criteria related to priorities of the Government is a way to advance certain priorities through the procurement.
- Achieving value for money by establishing a supplier performance monitoring and management regime may also facilitate building the capability of local suppliers and thereby advance certain priorities of the Government.²⁴

However, like other Australian governments, it does not provide guidance on how government’s transient objectives should be factored into procurement decisions. For example, should they influence the needs assessment and what weight should be given to transient objective in the evaluation criteria?

²⁴ Department of Public Works, 2012. *State Procurement Policy*, p.30.

How the activities of agencies can affect one another

The vertical conceptualisation of aggregated agency outputs/outcomes delivering WofG objectives ignores the effect that agencies can have on advancing, retarding or duplicating the activities of other agencies. An example of multi-agency benefits arising from one procurement is a road reconstructed following a fire. The Roads Department leading the procurement relocates the road from its existing location on the side of a ridge to its top, thus providing a fire break which advances the fire management objectives of the conservation, lands and emergency services departments.

Many of the factors that inhibit the alignment of procurements with priorities outside of the area relating specifically to the procurement stem from the structures of government. Agencies have historically been built around portfolios encompassing related functional domains, such as

public works or health. They have built up their capabilities over decades to the point that they invariably can deal effectively with challenges that fall within their portfolio's span of control. However, when issues cross domains or are complex due to competing demands and interdependencies, the portfolios structure of government is not effective.

Nowadays there are many issues that cross portfolio areas, and agencies are increasingly required to be coordinated horizontally rather than just vertically. This is well recognised as reflected in WofG coordination being a priority for all Australian governments. Figure 2.6 reflects the importance of the inter-agency contribution to government objectives. For procurement, this means that each agency needs to recognise how its procurement can contribute or undermine other agencies' objectives and respond appropriately.

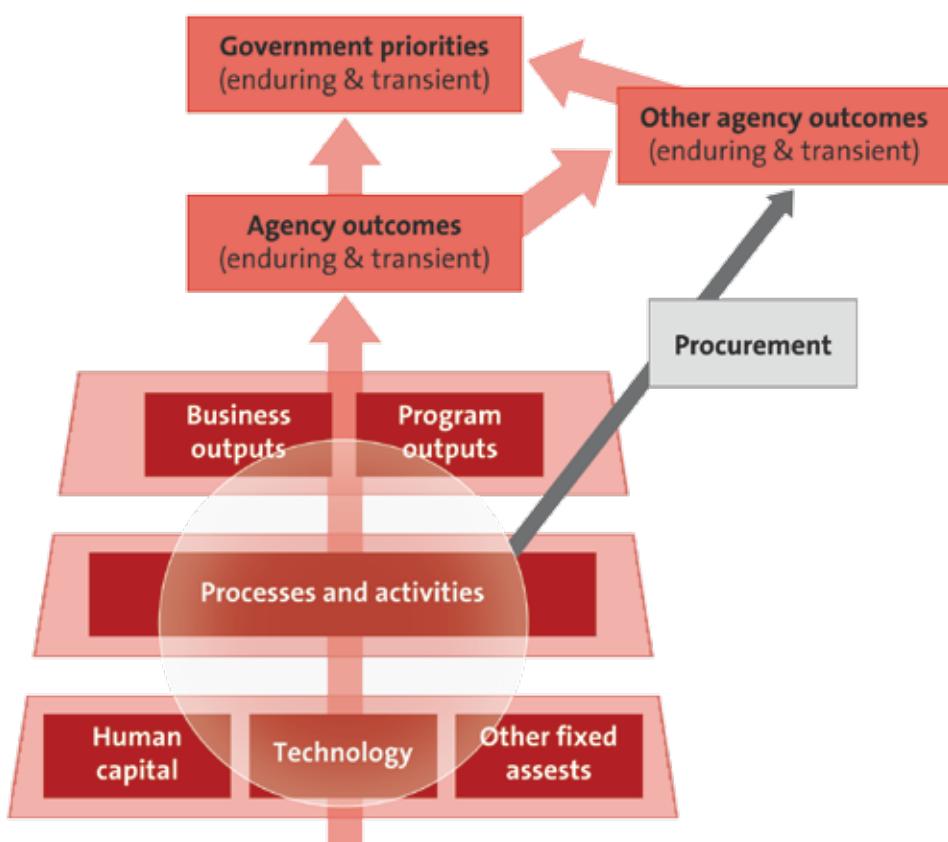


Figure 2.6: Model showing the link between procurement and outputs, outcomes and objectives of the agency, other agencies and the government

To achieve WofG coordination, various approaches are typically used. All are formal structures. The most traditional inter-agency coordination mechanism is the use of Interdepartmental Committees (IDCs). The key characteristics of an IDC are that its members are representatives of their agency, the scope of business is defined and decision making is by consensus. They are normally formed to coordinate the execution of established policies. Their relevance to procurement is limited to procurements that fall within the IDC's mandate, and these are most likely to be only procurements that are strategically important and involve multiple agencies.

Due to the IDC's representative nature, defined mandate and consensus-based decision making, an IDC may not be useful for coordinating procurements across agencies. This is because procurements that arise from one agency but affect others rarely fall within an IDC's mandate, and IDCs are not structured to get multiple agencies to adapt their procurement's need or process so as to deliver better outcomes collectively but may negatively affect the agency(ies) funding the procurement.

Another common WofG mechanism is the use of taskforces. The key characteristics of a taskforce are that they are time limited, are focused on producing a specified outcome, select members on the basis of individual skills and expertise rather than as agency representatives, and frequently require full-time secondees. Taskforces are used to coordinate multi-agency procurements, but generally these have only been for extremely large ones such as billion dollar defence projects. Such taskforces are useful in building WofG coordination so as to maximise the benefits across different sectors. Standing taskforces focused on the more numerous but smaller procurements that cross portfolios are rare.

A less common form of organisation that can deliver WofG coordination is an interagency joint team. The key characteristics of this type of team are that they have employees from two or more agencies working together on shared issues (typically program delivery) under a common management structure, however, each member is still subject to management requirements from their employing agency. Joint teams often work for several years on a range of topics relating to the team's mandate. A notable feature of these teams is that they often do not work under standardised governance arrangements, instead working under locally

developed rules that reflect their situation. They also do not have budgets or financial control as these rest with the respective agencies. Because of the limited ability of joint teams to command resources and decisions, a high premium is placed on interpersonal skills of team members, their ability to influence their relevant agencies and support of the members by their agency's senior executives. These joint teams have the potential to help drive WofG procurement coordination in the areas in which they operate.

Another form of relationship that can drive procurement coordination across agencies is ad hoc, informal contact between project decision makers from different agencies. The interaction can arise accidentally, from a chance meeting between two relevant people, or be instigated, for example following the review of another agency's procurement plan or at an annual meeting that seeks to coordinate activities in a certain area. These informal relationships have the potential to generate significant benefit for agencies, procurement and governments by better aligning procurement with the interests of several agencies. There is no substantial body of knowledge, practice or guidance on facilitating these informal relationships in relation to aligning procurement across agencies.

A final form is through the clumping of agencies under a portfolio and single minister via a machinery of government change. This allows for centralised procurement under a standardised set of strategic directives and financial controls, with a single point of accountability.

At the Australian Government level, and reflected in most other Australian government jurisdiction, are the clustering and piggybacking arrangements which allow one agency to benefit from the procurement activities of another. At the Australian Government level, these are known as Cooperative Agency Procurement agreements. This approach is defined by the Department of Finance and Administration as an arrangement in which more than one agency approaches the market together (i.e. clustering) or where an agency accesses another agency's established contract or standing offer arrangement (i.e. piggybacking). The justification for Cooperative Agency Procurement is that it enables agencies to reduce expenditure by sharing administration costs and utilising their combined buying power to achieve economies of scale. Other benefits from the perspective of agencies is that it reduces the number of approaches to the market and

thus reduces transaction costs, obtains price savings through volume discounts, and shares knowledge and expertise between agencies. From the perspective of suppliers, it can be also beneficial as it reduces the need for multiple tender processes, and provides greater financial certainty resulting in more confidence to invest in increased production capability. However, this approach can also have detrimental effects as it may fail to reflect changes in the market such as new competitors or technology that have become available. By using piggybacking arrangements, rather than re-tendering, the agency may be denying itself from accessing the benefits arising from the changed market.

The key challenges for procurement staff in this are:

- Identifying if another agency's existing arrangement would provide a better value for money outcome than a

new approach to the market (particularly in maximising market benefits by aggregating the purchase of products and services under common use arrangements, and delivering savings including reduced costs of tendering).

- If an existing arrangement is found to be not suitable, considering whether there are opportunities to approach the market cooperatively with one or more other agencies through a new procurement process.
- Incorporating suitable clauses in the request documentation to enable other agencies to access the contract or standing offer arrangements in the future.

Table 2.3 provides common reasons why procurements are not aligned with governmental outputs, outcomes and objectives.

Table 2.3: Examples of common reasons why procurements are not aligned with governmental outputs, outcomes and objectives

Problem area	Reasons for poor outcomes
Alignment between procurement and the outputs, outcomes and objectives of the agency	<ul style="list-style-type: none"> • The agency treats procurement as an administrative issue rather than as a strategic one. • A lack of visibility of procurements across the agency meaning that their potential contribution is not recognised. • A lack of alignment between the procurement and business or program outcomes.
Alignment between procurement and the outputs, outcomes and objectives of other agencies	<ul style="list-style-type: none"> • A lack of awareness across agencies of other agencies' outputs, outcomes and objectives. • No mechanisms exist to coordinate and develop an integrated response relevant to procurement activities. • No mechanisms exist to allow for ad-hoc procurement alignment across agencies. • The benefits of improving cross-agency outcomes are not recognised in individual or section performance measures. • A lack of time to gain knowledge or have the opportunity to build multi-agency knowledge. • Lack of supporting governance, budget and accountability frameworks, meaning that the outcomes for shared problems are difficult to assign.
Alignment between procurement and the outputs, outcomes and objectives of government	<ul style="list-style-type: none"> • No guidance on how government objectives should be priced or weighted in procurement. • No WofG mechanisms for coordinating procurement around government objectives. • Little capacity to modify procurement processes quickly and effectively to accommodate transient issues.

INCREASINGLY CHALLENGING PROCUREMENT ENVIRONMENT

Governments are pursuing a range of activities to improve their procurement. These include:

- Improving the competency, skill and professionalism of procurement and non-procurement staff.
- Benchmarking procurement processes.
- Developing competency based training programs for procurement staff, and introducing procedure awareness training for non-procurement staff.
- Introducing consolidated procurement reporting.
- Standardising procurement work practices and introducing common contracts across an agency and government.
- Introducing procurement measurement systems.
- Assessing an agency's procurement capability maturity level.
- Improving industry relations to allow better sharing of risks.
- Providing procurement systems tailored for different types of procurement – e.g. Simple, complex and strategic.
- Making procurement a strategic issue, so that procurement contributes to the agency's business and program outputs.
- Entering into public-private partnerships so as to increase value for money and reduce overall risk and cost in complex and/or strategic procurement activities.²⁵

These measures will improve procurement outcomes, however, far more is likely to be required to address the increasingly challenging procurement environment arising out of a combination of changes in both governments' operating environments and in procurement systems.

The key changes in government's operating environment relevant to procurement are:

- Community expectations of government are rising. The community is expecting far more from government than in the past, particularly in addressing complex problems and providing an integrated governmental response at least cost.
- Increasing pressure on government resources. The financial environment is constraining the expenditure available to

government and there is rising demands on its internal resources.

- Increasing compliance obligations. Procurements need to comply with an increasing number of obligations, including those relating to sustainability (e.g. Demand management and recycling), environmental protection, carbon emissions, labour, and international trade agreements. Many of these obligations are also rising in requirements. For example, the notion of what constitutes an appropriate level of care in terms of meeting a duty of care requirement is rising.
- Reducing tolerance for errors. Due to increased scrutiny of procurements by the media, auditor generals and oppositions, more emphasis will be placed on ensuring that procurement delivers valued outcomes, that due process is followed and that the procurement is undertaken efficiently.
- Increasing pressure to deliver in tight timeframes. Governments are requiring quicker procurement activity to deliver sooner on their commitments.

The key changes in procurement systems are:

- Procurement is increasingly used to buy more complex products and services. This complexity is reflected in project scopes that include multiple capabilities, have significant flexibility in their use, are able to be continuously upgraded, and need to operate with a range of dependent and interdependent systems. Increasing complexity requires more detailed and time consuming stakeholder negotiation, and a high level of effort in aligning the activities of different stakeholders. It also requires more effort in ensuring errors do not occur in the design or procurement as errors in complex systems are extremely costly to rectify due to their inter-relationship with other systems.
- The public service procurement workforce is ageing. As the public service ages, knowledge relevant for procurement may increasingly move out of government. It may mean that the private sector or the community sector holds this information and the role of procurement may increasingly involve working with the non-government sector to develop and deliver procurement.
- Increasing visibility of outcomes. Given greater reporting on procurement, more information is readily available for

²⁵ Approximately \$5 billion at the Australian Government level is now under public private partnerships. In Victoria and SA, this is running at \$5 to \$10 billion per annum.

others to scrutinise procurement.

- New procurement models are being developed. As procurement becomes more complex, procurement models will evolve. These may include different methods to deliver multiple outcomes through combined risk and reward sharing by government, industry and the community.

The above changes are likely to make it even more challenging in the future to deliver efficient and effective procurement that produces multi-stakeholder outcomes. The next chapter examines how engineering expertise can be better utilised to deliver more efficient and effective procurement outcomes in this increasingly challenging environment.



CHAPTER THREE



CONTRIBUTION OF ENGINEERING EXPERTISE TO PROCUREMENT

SUMMARY

All Australian governments are well aware of the need to improve procurement. From a purely financial perspective, just a 1% improvement in national procurement can lead to \$600 million savings. Improvements in procurement will also result in better outcomes for agencies, which can deliver WofG objectives more efficiently and effectively. It will also reduce possible public perceptions of incompetence due to poor contracting outcomes. While failures of government procurement are relatively infrequent compared with the total number of purchases, the public perceives that they occur frequently due to high profile cases. An example is the cancellation of Defence's Super Seasprite helicopter project after some \$1.4 billion was spent but not one operational helicopter delivered.

Engineering expertise can make a substantial contribution to improving procurement through two main mechanisms. The first is the application of technical skill and domain knowledge to procurements that are engineering intensive. Using engineering expertise will result in government being a more informed buyer of these engineering-intensive procurements, thus increasing the likelihood of better value for money. The second contribution is the application of engineering practices/approaches, and organisational techniques, such as project management, systems analysis and technology management, to procurement more broadly. This can deliver more logical, measured, and justifiable activities and systems that can improve the procurement cycle, procurement systems and the alignment between the procurement and multi-level governmental objectives.

DEFINING ENGINEERING EXPERTISE

Engineering expertise, for the purposes of this report, is defined as extensive or in-depth specialised engineering knowledge, skill or judgment required both to undertake engineering tasks typical of an experienced engineering professional, and to apply general engineering principles, approaches and tools to non-engineering areas.

This definition recognises that there are two distinct types of engineering knowledge, skill and judgment. The first is what is traditionally seen as the expertise of engineers. It consists of the application of:

1. Technical skills, such as engineering design, knowledge of materials, and engineering calculations.
2. Industry sector knowledge, such as using the knowledge of industry margins to determine whether a tendered price is reasonable, or to evaluate whether a tendering company actually has the relevant experience and capabilities to deliver what it says it can.

The second type of engineering expertise is the ability to apply:

3. Engineering practices/approaches including
 - Identifying, assessing and managing risk, both of a purely technical nature and in relation to clients, users, the community and the environment.
 - Analysis using abstract thinking and originality to formulate suitable models to examine problems.
 - Application of fundamentals-based, first principles analytical approaches to examine novel problems or those outside of existing standards and codes of practice.
 - Resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other requirements.
 - Mapping of interactions between the technical system and the environment in which it operates, and integration of social, environmental, and economic outcomes over the lifetime of the product or program.
 - Interacting effectively with other disciplines and professions and ensuring that the engineering contribution is properly integrated into the totality of a project or enterprise.
 - Interpreting technological possibilities for society, business, and government, and ensuring that policy decisions are properly integrated into the totality of the project or enterprise.

- Working with clients or non-technical stakeholders to ensure that their objectives are properly reflected in a technical brief or specification.
4. Organisational techniques in non-engineering contexts such as project management, technology management, critical path analysis, risk management (including technical risk assessment) and systems analysis.

The definition recognises that engineering expertise requires experience. Engineers Australia has developed a detailed competency framework for engineering professionals and categorises them into two stages which aligns with expertise. Stage 1 engineering professionals are those who have recently graduated with a four-year Bachelor of Engineering degree. Stage 2 engineering professionals are those that have a level of competency expected of an experienced engineering practitioner. This report focuses on Stage 2 levels of engineering expertise. Below is a description of each of the Stage 2 for each member of the engineering team – Professional Engineers, Engineering Technologists and Engineering Associates.²⁶ As can be seen from the descriptions, Stage 2 engineering professionals have experience with many engineering practices/approaches and organisational techniques that can be applied in many non-engineering contexts to resolve complex problems.



PROFESSIONAL ENGINEERS

Professional Engineers are responsible for engineering projects and programs in the most far-reaching sense, for bringing knowledge to bear from multiple sources to develop solutions to complex problems and issues, for ensuring that technical and non-technical considerations are properly integrated, and for managing risk. Below is a description of Engineers Australia's expectations of experienced Professional Engineers

Professional Engineers are responsible for interpreting technological possibilities to society, business and government. They are also responsible for ensuring, as far as possible, that policy decisions are properly informed, and that costs, risks and limitations are properly understood as the desired outcomes.

Professional Engineers are required to take responsibility for engineering projects and programs in the most far-reaching sense. They are responsible for the reliable functioning of all materials and technologies used; integration to form complete and self-consistent systems; and all interactions between the technical systems and the environment in which they function. The latter includes understanding the requirements of clients and of society as a whole; working to optimise social, environmental and economic outcomes over the lifetime of the product or program; interacting effectively with the other disciplines, professions and people involved; and ensuring that the engineering contribution is properly integrated into the totality of the undertaking.

Professional Engineers at the level of Stage 2 competency are expected to have demonstrated the propensity to take charge of major projects or interactions in a work situation, even if they have not actually done so.

The work of Professional Engineers is predominately intellectual in nature. In the technical domain, they are primarily concerned with the advancement of technologies and with the development of new technologies and their applications through innovation, creativity and change. They may conduct research concerned with advancing the science of engineering

²⁶ This section is based on the publication, Engineers Australia, 2011. Chartered Status - a Handbook for Applicants.

and with developing new engineering principles and technologies. Alternatively, they may contribute to continual improvement in the practice of engineering, and to devising and updating the Codes and Standards that govern it.

Professional Engineers have a particular responsibility for ensuring that all aspects of a project are soundly based in theory and fundamental principle, and for understanding how new developments relate to established practice and to other disciplines with which they may interact. One hallmark of a professional is the capacity to break new ground in an informed and responsible way.

Professional Engineers may lead or manage teams appropriate to these activities, may establish their own companies or move into senior management roles in engineering and related enterprises.

The expertise of experienced Professional Engineers includes:

- Ability to address issues and problems that have no obvious solution and require originality in analysis.
- Infrequently encountered issues and problems, outside those encompassed by standards and codes of practice for professional engineering.
- Development of new engineering principles and technologies including use of new materials, techniques or processes for existing materials, or use of existing techniques or processes in innovative ways.
- Innovation, creativity and capacity to break new ground in an informed and responsible way. Engagement with wide-ranging or conflicting technical, engineering and other issues, and resolution of significant problems arising from interactions between such issues.
- Interaction with diverse groups of stakeholders with widely varying needs.
- Use of diverse resources including people, money, equipment, materials and technologies.
- Integration of all functional elements to form a complete and coherent system.
- Disciplined, holistic approach to complex situations and problems and to the conduct of complex activities.

- Disciplined and systematic approaches to design and synthesis on a substantial scale.
- Ability to conceptualise alternative approaches, comprehend and define the risks and benefits of each, use informed professional judgment to select an optimum solution that is deliverable in practice, and to justify and defend that selection.
- Participation in research or research and development teams.



ENGINEERING TECHNOLOGISTS

Engineering Technologists specialise in the theory and practice of a particular branch of engineering technology or engineering-related technology, and in its application, adaptation and management in a variety of contexts. Below is a description of Engineers Australia's expectations of experienced Engineering Technologists

Engineering Technologists normally operate within a relatively well-defined technical environment and undertake a wide range of functions and responsibilities. They are typically specialists in a particular field of engineering technology and their expertise lies in familiarity with its current state of development and its most recent applications. Within their specialist field, their expertise may be at a high level and fully equivalent to that of a Professional Engineer. However, Engineering Technologists are not expected to exercise the same breadth of perspective as a Professional Engineer nor carry the same responsibilities for stakeholder interactions, for system integration and for synthesizing overall approaches to complex situations and complex engineering problems.

The work of Engineering Technologists combines the need for a strong grasp of practical situations and applications, with the intellectual challenge of keeping abreast of leading-edge developments in their particular field. For this purpose they need a strong understanding of scientific and engineering principles and a well-developed capacity for analysis. The work of Engineering Technologists is mostly about applying current and emerging technologies, often in new contexts or to applying established principles in the development of new practice. They may contribute to the advancement of particular technologies as well.

Some Engineering Technologist qualifications include an emphasis on technical management as well as a grounding in a particular area of technology. Technical management is seen as an appropriate field of specialisation in itself and many Engineering Technologists build their own career paths in this direction. Examples of such specialisation include product development, mine management, and the

management and maintenance of processing plants, complex building services or testing laboratories.

Persons may also be recognised as Engineering Technologists who hold degrees in fields related to engineering and who have developed expertise and experience in applying their knowledge in conjunction with engineering work. Examples might be in geology and geotechnics, information technology and software development, mining, biomedical technology, optical communications, renewable energy systems and agriculture.

The competencies of Engineering Technologists equip them to approve and certify many technical operations such as calibration and testing regimes, compliance with performance-based criteria for fire safety and the design of components and sub-systems and of installations such as building services that do not call for significant new development. Such certification should be fully acceptable in the public domain and should not require further endorsement by other practitioners perceived to be more highly qualified.

Engineering Technologists may lead or manage teams appropriate to these activities. Some may establish their own companies or may move into senior management roles in engineering and related enterprises, employing Professional Engineers and other specialists where appropriate.

The expertise of experienced Engineering Technologists includes:

- Application of the technology in a variety of situations and contexts.
- Adaptation of the technology to varied or new applications or situations.
- Familiarity with standards and codes of practice relating to the technology, and ability to contribute to their progressive improvement based on understanding of both theoretical and practical factors.
- Design of equipment or installations utilising the particular technology.

- Management of a range of technical functions and personnel on a significant scale in an engineering or engineering-related context such as manufacturing, software development, mining, construction, building services, precision testing or plant operation.
- Knowledge and competence in a scientific or technological field other than engineering, together with well-developed expertise in its application in close conjunction with engineering work.
- Exercise of ingenuity, originality and innovation in adapting the technology to new applications and developing new practices for its use. Contributions to the advancement of relevant codes and standards.
- Participation in research or R&D teams concerned with advancing the technology or developing new technologies that relate to it.

ENGINEERING ASSOCIATES

Engineering Associates focus on the practical implementation of engineering work or the conduct of engineering operations, and in the application of recognised standards and codes of practice in familiar and unfamiliar situations. Below is a description of Engineers Australia's expectations of experienced Engineering Associates.

Engineering Associates focus mainly on practical applications. They may be expert in installing, testing and monitoring equipment and systems, in the operation and maintenance of advanced plant, and in managing or supervising tradespeople in these activities. They may be expert in selecting equipment and components to meet given specifications and in assembling these to form systems customised to particular projects.

Engineering Associates are often required to be familiar with Standards and Codes of Practice and to become expert in the interpretation and application of such Standards in a wide variety of situations. Many develop very extensive experience of practical installations. In fact, they are often more knowledgeable than a Professional Engineer or Engineering Technologist on detailed aspects that can contribute very greatly to safety, cost or effectiveness in operation.

In other instances, Engineering Associates may develop high levels of expertise in aspects of design and development processes. These might include, for example, the use of advanced software to perform detailed design of structures, mechanical components and systems, manufacturing or process plants, electrical and electronic equipment, information and communications systems. Another example might be in the construction of experimental or prototype equipment. Again, experienced operators in these areas often develop detailed practical knowledge and experience complementing the broader or more theoretical knowledge of others.

Engineering Associates need a good grounding in engineering science and the principles underlying their field of expertise to ensure that their knowledge is portable across different applications and situations. Context-specific training and experience in a particular job are not sufficient to guarantee generic competency. Given a good knowledge base however, Engineering Associates may build further on this through high levels of training in particular contexts and in relation to particular equipment. Aircraft maintenance is an excellent example.

The competencies of Engineering Associates equip them to certify the quality of engineering work and the condition of equipment and systems in defined circumstances, laid down in recognised Standards and Codes of Practice. Such certification should be fully acceptable in the public domain and should not require further endorsement by other practitioners who are perceived to be more highly qualified.

Engineering Associates may lead or manage teams appropriate to these activities. Some may establish their own companies or may move into senior management roles in engineering and other related enterprises, employing Professional Engineers and other specialists where appropriate.

The expertise of experienced Engineering Associates includes:

- Close familiarity with standards and codes of practice relating to a recognised field of engineering and expertise in their interpretation and application to a wide variety of situations.
- Specifying the components, equipment or system required to meet a given objective in compliance with the relevant standards and codes.
- Selecting and combining available components to form systems meeting given specifications.
- Installing, commissioning, maintaining, repairing and modifying plant and equipment to given specifications and/or in accordance with recognised standards and codes.
- Testing and fault diagnosis in complex plant and systems in accordance with accepted procedures.
- Utilising advanced software or other design aids to perform detailed design of critical elements and/or complex systems.
- High levels of training, and periodic updates and upgrades, in specific plant, equipment, systems or techniques.
- Contribution to the advancement of technologies, practices, codes and standards in the light of practical experience and theoretical understanding.
- Participation in research or R&D teams, as experts in the construction of research equipment or otherwise.

Table 3.1: Examples of the contribution that engineering expertise can make for complex/strategic procurements of engineering-significant products and services

Stage	Example
Identify Need	<ul style="list-style-type: none">• Define the need rigorously in terms of the potential solution's desired functional levels, performance levels, and outcomes.• Define evaluation parameters that accurately assess tenderers' ability to deliver the required outcomes.• Identify potential non-traditional options for meeting the need, including changing work practices and use of demand management.• Identify the technological costs, risks and limitations of potential options.• Identify the risk, cost and functional/performance trade-off of potential options.• Identify any over-specification as this will needlessly restrict completion and increase cost.• Ensure specifications meet industry standards if possible.• Encourage material standards to be standardised across projects.

CONTRIBUTION OF ENGINEERING EXPERTISE TO PROCUREMENT

The two types of engineering expertise can make a substantial contribution in various ways to improving procurement. The section below details specifically how engineering expertise can contribute to better outcomes through each of the three analysis scales of government procurement identified in Chapter Two.

PROCUREMENT CYCLE

The procurement cycle defined in Chapter 2 has a number of stages. Engineering expertise can contribute to each of these stages. The benefits are more likely to be pronounced for complex/strategic procurements of engineering-intensive products and services. Table 3.1 provides examples of how engineering expertise can contribute. The dominant form of engineering expertise that can benefit each stage is the application of technical skill and industry sector knowledge.

Table 3.1: Examples of the contribution that engineering expertise can make for complex/strategic procurements of engineering-significant products and services

Stage	Example
Determine Suitable Process	<ul style="list-style-type: none"> Identify industry capabilities, including the current levels of demand, distribution of capabilities, quality/price/risk capabilities of market players. Identify the transaction costs involved with different procurement strategies. Identify the technical and related risks for different procurement strategies. Identify the level of engineering expertise required by the procurement team for each procurement strategy. Develop estimates of various upfront costs versus whole of life estimates for different solutions. Create appropriate pre-qualification process that is performance-based so as to ensure that only capable tenderers can bid. Identify synergies across projects that allow tenders to be aggregated rather than put to market project-by-project, providing this is appropriate. Develop performance-based tender evaluation criteria which encourage tenderers to offer innovative solutions.
Conduct Procurement Process	<ul style="list-style-type: none"> Determine if the tenderer's proposal meets the user's needs in terms of performance and outcomes. Assess the validity of technical information provided by tenderers. Identify assumptions and omissions in proposals that may not be identified in the evaluation criteria but could affect the procurement outcome. Undertake risk management assessment of the proposals which involves identifying the risks, quantifying the likelihood and consequences of the risks, and evaluating the proposed mitigation strategies. Assess non-cost factors, including fitness for purpose, technical issues, availability of maintenance and support, compliance with industry specifications. During debriefing, explain with authority why a bid was not chosen for technical reasons.
Manage Contract/Relationship	<ul style="list-style-type: none"> Provide clear and concise engineering management oversight, control and advice to agency management and contractors. Rapidly resolve issues which arise after contract signature such as clarification of contract wording Undertake quality assurance. Manage agency and supplier demands for contract variations, highlighting their implications for cost, risk etc. Represent with authority the government's position in disputed warranty issues or defect claims. If technical test methods are required to measure outcomes, determine the appropriate test methods and their limitations.
Manage Termination/Transition	<ul style="list-style-type: none"> Determine when contract technical completion has occurred. Assess contractor performance in a defensible manner, and feed this into future procurements. Identify the actual costs of contracted provision, and determine if it represented best value considering other options such as in-house provision or alliance contracting, and feed this into future procurements.

Typically, for simple procurements engineering expertise is obtained at relevant points in the procurement cycle, while for complex/strategic procurements it may be continuously provided by engineering professionals working within the procurement team across the cycle. A challenge for agencies is to identify what engineering expertise is required and when. This is addressed in Chapter Four.

To gain the desired benefits of cost savings, higher quality, innovation and other benefits from improved procurement, it is likely that, in the future, engineering expertise, along with other sets of expertise, will be integrated throughout the procurement process rather than just accessed when needed. This is because a key source of procurement improvements is generated from the enhanced cooperation between suppliers, customers and stakeholders throughout the procurement cycle. Having engineering expertise continuously provided for engineering-intensive products and services throughout the cycle will increase the likelihood for this cooperation and thus allowing opportunities to be exploited rapidly and negative risks being addressed quickly.

PROCUREMENT SYSTEM

The procurement system defined in Chapter Two consists of four main elements: organisation, process (i.e. procurement cycle), technology and performance management. Together they function as a system to deliver procurement outcomes that are efficient, effective, accountable, and repeatable. Engineering expertise can contribute to each of these elements, with particular contribution in three areas.

The first area in which engineering expertise can contribute is in improving the procurement cycle. This contribution is described in the preceding chapter. The second area is through improving the technology used in procurement. All agency procurement rests on IT-based systems that should have two main functions. The first is to facilitate the agency's purchasing transactions, and the second is to provide internal and external stakeholders with useful, actionable and readily accessible information on procurements. Unfortunately, few agency IT procurement systems do both of these functions well, as they have been built primarily to deliver financial reporting. To address this, some agencies have built comprehensive enterprise resource planning systems. Generally these systems have been expensive, difficult to modify as the procurement system changes, and only address a limited range of procurement cycle functions. In addition,

due to the proprietary nature of these IT systems, it has often been very difficult to bolt on software from other suppliers.

IT systems today need to be flexible, expandable, and easily accept integration so as to deliver information and guidance to different users across all four elements of the procurement system. Examples include providing financial information, tools to aid procurement staff, performance information, and records of why certain decisions were taken. The current approach to this requirement is to develop a network of web-based tools that bolt on to key procurement management software. This approach is not without its challenges, such as ensuring data integrity, access management, software integration and configuration management. To develop these systems requires substantial engineering IT expertise.

The third area in which engineering expertise can contribute to the procurement system is through the application of systems engineering principles and practices. Systems engineering describes an interdisciplinary process designed to produce systems that meet customers' needs, increase the probability of system success, reduce risk, and reduce total life-cycle cost. Systems engineering has relevance to developing an agency's procurement system as it provides a mechanism to undertake a structured and disciplined examination of a very complex system. This complexity is due not only to the large numbers of inputs and processes, but also due to the many conflicts and inconsistencies within the system. Many of these have arisen due to haphazard growth of the system as it has accommodated individual agency changes such as devolution and recentralisation, legislative changes, and new agency policy requirements that have introduced incompatibility with older requirements. Applying system engineering practices/approaches allow the entire procurement system to be improved, and thus address many of the multi-causal reasons for a procurement system's poor outcomes. Common multi-causal reasons for poor procurement outcomes are listed in Table 3.2.

Table 3.2: Examples of multi-causal reasons for poor procurement outcomes by elements of the procurement system

Element	Examples of common causes of poor outcomes
Organisation	<ul style="list-style-type: none"> • A culture of blame which impedes risk management in procurement. • Inadequate guidance for procurement staff on operationalising the principles-based guidance.
Processes	<ul style="list-style-type: none"> • A lack of metrics on processes and supplier performance. • Lack of clarification on how to meet evidentiary requirements, resulting in multiple documents being created to ensure the right thing is done. • Approval requirements are not clearly stated. • Processes don't distinguish between simple, complex and strategic procurements. • Over emphasis on probity and accountability rather than outcomes.
Technology	<ul style="list-style-type: none"> • Inability to rapidly see current performance of contracts. • Inability to review historical material that explains why decisions were made. • Lack of decision support tools to support best-value decision making.
Performance management	<ul style="list-style-type: none"> • Lack of metrics. • Lack of feedback of performance information into procurement decision making and organisational policy decisions.
System-wide elements	<ul style="list-style-type: none"> • No system assessment of procurement capability. • No procurement capability improvement plan. • A gulf exists between agency policy statements and detailed guidance on how policy should be implemented, e.g. While agency policy is to assess and manage risk appropriately, risk is not defined and risk assessment tools consist of just generic checklists.

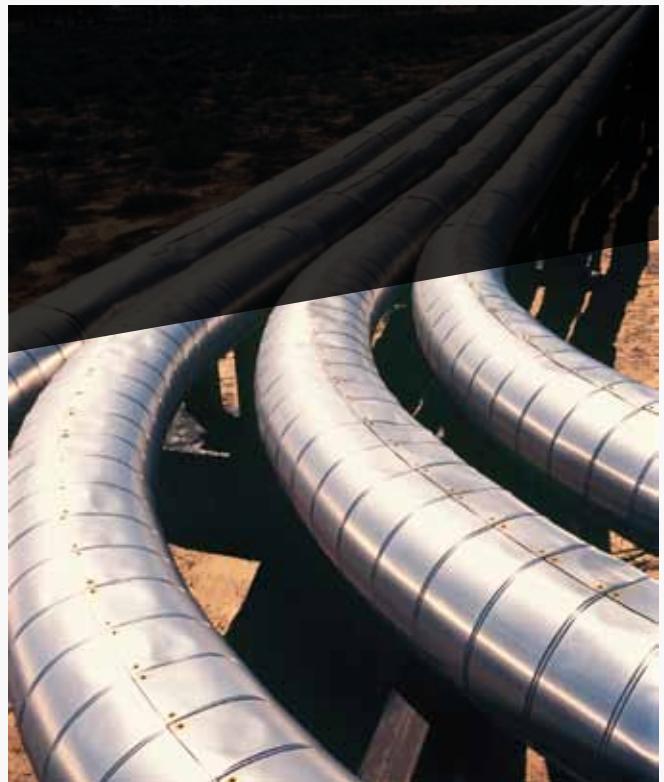
Example of the contribution of systems engineering to building a better procurement system

Below are areas where systems engineering principles and practices can contribute to building a better procurement system.

Systems engineering can rigorously identify the various outcomes required by different stakeholders of the procurement system. This outcomes focused approach is the foundation upon which all procurement systems should be built. Stakeholders are those within and external to the agency. Within the agency they include the senior executive, procurement cycle staff, procurement trainers, finance staff, and staff that require the procurement. External stakeholders include end users of the good or service that the procurement delivers, suppliers, auditors, staff of other agencies affected by the procurement, and ministers. Identifying their precise needs, and the value they place on them, is critical to developing a system that reflects their needs and produces the most valuable outcomes.

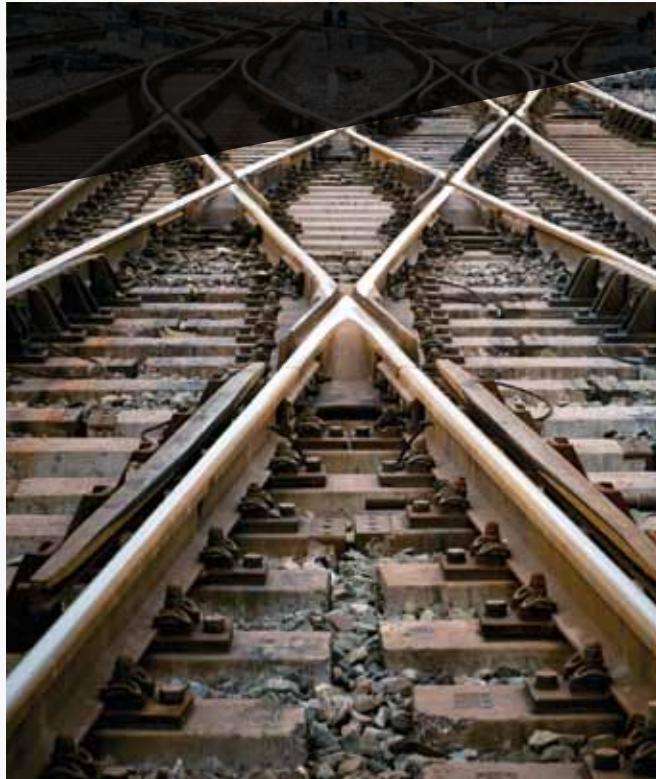
Systems engineering recognises that it is not possible to satisfy all stakeholders, so trade-offs need to be made. A rigorous assessment of the competing needs will allow the trade-offs to be made rationally and defensibly. This information in itself is useful for preventing future ill-conceived changes to the system being made, as it will identify the effects they would have on other key stakeholders. Systems engineering requires a model of the system to be developed. For procurement, this would include identifying subsystems (e.g. different systems for simple, complex and strategic procurements), defining inputs (e.g. identifying the competence level of procurement and non-procurement professionals), and functional analysis (e.g. mapping procurement tasks to people or IT systems).

A key insight into the procurement system can be made by the use of systems engineering's classification of requirements into mandatory and trade-off requirements. Mandatory requirements are those that the system must deliver for certain customers. In procurement, these could be legislative requirements, or policy requirements. Trade-off requirements are those that would make one class of customer happier. For example, increasing speed of procurement delivery may make one end user class happier but it could increase the risk to senior executives by circumventing certain processes.



Another example is the trade-off between centralisation and decentralisation of procurement. Procurement could be structured in such a way that all decisions are made centrally within a procurement administrative unit, thus increasing central control. The cost of this is a loss of flexibility and control for business units and regional groups who require the procurement's good or service to deliver their roles. The clear identification of all the mandatory requirements and trade-offs will allow customers and stakeholders in the system to better understand the rationale for certain measures, and be more aware of the risk of varying them. It should also lead to the creation of a systematic process to enable new or changed mandatory requirements being rapidly integrated into the system, and provide an audit trail demonstrating this.

A key stage in systems engineering is to evaluate alternative system designs based on performance, cost, schedule and risk criteria. In designing a procurement system, this approach will allow a variety of designs to be proposed as there is rarely one optimal system that meets all customer needs, all of the time. By developing a range of procurement scenarios, the merits of each alternative system design can be evaluated. Inclusion of procurement scenarios that consider potential future changes in procurement approaches and policy requirements enables each alternative system's operation to be examined under a range of future states.



Another key element of systems engineering is performance measurement. Performance metrics should be focused on outcomes required and report information that is actionable. In the case of procurement they should reflect stakeholder needs and are likely to include procurement efficiency, effectiveness, and transparency. An important element in performance measurement is to identify acceptable performance levels including identifying the band of variation that can be tolerated. Identifying how this variation band is likely to change with time is also important as this enables parameters to be selected that are sensitive enough to identify negative trends before they reach a scale to be considered problems that require rectification.

Configuration management is a method central to systems engineering used to ensure changes in requirements, inputs or system design are identified and analysed before implementation. For a procurement system, configuration management processes are useful for preventing ad hoc changes as they prevent changes from being made without assessing the likely impact on outcomes. As configuration management requires the reason for changes to be recorded, this should encourage better decisions by allowing alternative mechanisms to be assessed so as to determine if there is a better change that can be made to meet customer requirements.

Project management, being the planning, organising and directing of resources to deliver specific goals within time, cost and at the desired performance, is an essential element in implementing a systems engineering approach. Given that a procurement system, with its inputs of people, processes, technology and governance, is a complex system, sound project management is essential in delivering the outcomes.

While other professional disciplines may also employ system approaches and tools similar to those described above, engineering expertise has the advantage of having a large inventory of tools and a body of knowledge that spans the spectrum of conceptualisation, development, implementation, refinement and measurement of complex systems such as a procurement system.

PROCUREMENT ALIGNMENT WITH MULTI-LEVEL GOVERNMENTAL OBJECTIVES

Procurements can assist in delivering government objectives through the hierarchical linking of government's broad/enduring and narrow/transient objectives with procurement, and through one agency's procurement activity contributing to another agency's outcomes, which in turn can assist in delivering WofG outcomes.

As identified in Chapter Two, the government's broad/enduring objectives are factored into procurement through formalised WofG mandated policy and process obligations. These are mostly conformance requirements and while there is some need for engineering expertise required, there is limited latitude for this to consist of more than assessing conformance with guidelines.

Implementing narrow/transient objectives normally requires new programs to be developed. Engineering expertise is required as one input to ensure that engineering-intensive programs are delivered effectively and efficiently. Recent examples of new programs in which engineering issues were not factored in appropriately are the domestic solar power rebates, roof insulation scheme and the Building the Education Revolution programs.

However, the greatest contribution that engineering expertise would make to aligning procurement with multi-level governmental objectives is in the area of one agency's engineering-intensive procurement contributing to another agency's outputs. An illustration of how engineering expertise can align procurement to advance multi-level governmental objectives relates to civil works. Typically, government civil works in a geographic region are driven by Commonwealth/State road, transport, land development, regional development, water, electricity and local government agencies or authorities. Engineers are typically involved in these agencies through activities including planning, design, construction, procurement, maintenance, operations and emergency management. Given their involvement, they can improve project synergies by:

- Timing demand on suppliers so as to provide a constant level of work, thus minimising price spikes due to demand exceeding supply.
- Coordinating work to minimise the degree or duration of disruption to the population.
- Relocating projects so as to reduce the need for the duplication of infrastructure.
- Combining expenditure to deliver better whole-of-life outcomes.
- Combining resources, including design, planning or studies, to increase efficiencies.

Increasing the synergies of projects across agencies can also help deliver government's broad/enduring objectives in different ways. For example, by coordinating demand and bundling civil work in a geographic region, companies will have the confidence to invest in developing their capabilities including staff training and new capital equipment. This will advance the objective of increasing employment, building sustainable industries and developing a region.

Example of how engineering professionals can advance projects that deliver multi-agency objectives

All Australian governments recognise that cross agency coordination is essential to advancing the majority of their transient and enduring objectives. This recognition is reflected

in the fact that the Australian Public Service and its senior leadership has explicitly identified that one of its key priorities is collaboration and coordination to deliver WofG objectives.

However, to date, the actual achievement of cross agency coordination to advance WofG objectives has been limited. While there are good examples of this occurring, such as the establishment of Centrelink and the creation of the Office for Youth at the Australian Government level, there are many more examples where it could improve. Most telling are the views of those working within Government. The 2010 *Blueprint for the Reform of Australian Government Administration* reported that "53 per cent of employees believe that other APS agencies are willing to collaborate to achieve whole of government outcomes."²⁷

The typical approach to addressing WofG challenges has been a top down and bureaucratic process involving forming an IDC, taskforce or working group. This group is given the mandate to develop a plan of action, and the agencies then implement them.

A neglected method of delivering multi-agency outcomes is through opportunistic activities initiated by mid-level staff. This method involves individuals in one agency identifying an activity their agency is planning to undertake which has an effect on the work of another agency. By approaching the staff in the affected agencies, opportunities could be identified where agency activities could be modified to deliver combined benefits far greater than the sum of the individual agency benefits.

An engineering-related example would be where an agency is involved in building a major road in an area which has suffered previously from floods, and where a new suburban development is planned for the following decade. Four State agencies (transport, land planning, environment and disaster management) have an interest in the area, as do the other levels of government (Australian Government for funding, and local governments for planning and approvals). If the road was planned with little discussion with other affected parties, it would most likely be elevated above the relevant flood level, but in doing so it could result in flooding consequences for the nearby future suburban development. However, if

²⁷ Department of the Prime Minister and Cabinet, 2010. *Ahead of the Game: Blueprint for the Reform of Australian Government Administration*, p. 21.

the engineering professionals in the road building agency informally discussed the planned project with their peers in the affected agencies, they could identify that by changing the design of the road and its embankment, the modified road could act as a flood levy for the future community. The road could also be built to include earthworks for ramps so that providing road access from the development to the major road would not lead to major disruption or cost.

Agency engineering professionals could have a major role in identifying multi-agency collaborative opportunities, particularly in areas of public works and built environment developments. This is because of their general awareness of activities occurring in a geographic area or domain in which they work, and their professional networks which span agencies, levels of government, and the private and public sector. The Australian Government Report, *Connecting Government: Whole of Government Responses to Australia's Priority Challenges*, identified the key attributes to promote cooperation with other agencies as:

- Readiness to think and act across agency boundaries.
- Effective teamwork.
- Organisational flexibility.
- Openness to innovation and creativity.
- Ability to capitalise on windows of opportunity.
- Tolerance of mistakes and ability to manage risk.
- Building of strategic alliances, collaboration, trust and to negotiate to achieve joint outcomes.
- Adaptability to changing circumstances.
- Persistence.
- Acceptance of diverse views, and awareness of different cultures and appreciation of their strengths.
- A capacity to balance the tension between short-term and long-term goals.
- Effective knowledge management.²⁸

Engineering professionals generally have the above attributes due to their academic and professional training which is based on pragmatism, outcomes focus, and working in complex environments where outcomes and processes need to be negotiated due to different stakeholder interests.

However, just because there is the potential for collaboration does not mean it can or should be pursued. Key factors in determining if collaboration should be pursued are time requirements, employer support, the benefit/cost calculation, and implementation likelihood. Identifying potential opportunities requires discussing and negotiating options, and these are time consuming. And once there is informal agreement by peers in how activities could be modified, considerable time is also required to get approval from the respective agencies and implement the change. If there are resources involved, such as transferring funds between agencies or delaying/accelerating expenditure, the time required to drive the change could be huge. Also, agency support of pursuing collaborative opportunities is essential. Without this, engineering professionals who identify opportunities will be seen as wasting time, and working at odds to the agency's objectives.

Work on actually realising an opportunity should be undertaken only if the benefits exceed the cost. The benefit/cost calculation should include affected agencies as well as relevant stakeholders (e.g. ministers, local government representatives, end-users and industry). The sharing of costs and benefits between stakeholders is likely to be one of the main factors that affect the implementation likelihood. If one stakeholder captures most of the benefits, and the other the costs, there will be strong opposition to the collaborative activity. In these cases, pursuing collaboration can waste time and resources, and sour relationships.

²⁸ Connecting Government: Whole of Government Responses to Australia's Priority Challenges. p.5

CHAPTER FOUR



ACCESSING ENGINEERING EXPERTISE FOR PROCUREMENT

SUMMARY

The procurement cycle provides an appropriate and proven method by which an agency can determine how best to access engineering expertise to support its procurement needs.

By following the procurement cycle, an agency will gain the strategic information required to make an informed and justifiable decision on what mix of internally and externally sourced expertise is optimal, and how that expertise should be integrated into the agency's procurement activities.

Following the procurement process also provides an agency with operational information that allows the optimal sourcing strategy and procurement method to be identified.

Using the procurement cycle does not presuppose that engineering expertise will be provided externally rather than in-house. Both in-house and external provision of expertise needs to be considered and compared as part of the procurement process.

This section is structured around the procurement cycle identified in Figure 2.2, and draws heavily from *Procurement Guidance Material: Planning for Significant Procurement* (Queensland Department of Public Works, 2010).

IDENTIFYING THE NEED

The starting point in the procurement cycle is to identify the procurement need. This requires detailed research and analysis so as to produce a clear and in-depth understanding of the agency's current and predicted demand for engineering expertise. It necessitates examining who requires it, when they will need it, and under what conditions and for what purposes.

As identified in Chapter Two, the expertise required should be defined in terms of the application of technical skills, industry sector knowledge, and the engineering practices/approaches and organisational techniques used in a non-engineering context. The expertise should also be explicitly defined in terms of how it contributes to delivering value-for-money procurement outcomes, as well as how it contributes to the

agency's outcomes and advancing WofG objectives. It may also be appropriate to identify the link between the provision of expertise and how it can contribute to advancing the outcomes of other agencies.

Defining the links with outcomes is critical in establishing the objectives, critical success factors and performance indicators for the provision of engineering expertise in procurement. Without these, it is difficult to gauge the contribution that engineering expertise makes, and the effectiveness of efforts to improve its contribution. Determining measurements of the objectives, factors and indicators for engineering expertise is not simple as many other contributions also affect the procurement outcomes. Ideally, the measures would be specific, measurable, achievable, relevant and time-bound (SMART), but given the complexity of engineering provision within the procurement cycle, it is likely that a combination of qualitative and quantitative measures will be required. The measures should include ones focused at the strategic level, linking expertise provision with procurement and agency outcomes. The measures should also include operational ones that link expertise provision with Program Office requirements. A possible measure might be assessing the sustainability of the engineering expertise workforce or developing workforce capability.

Sources of information to develop performance measures are end-users, peers, external experts, and procurement evaluation reports that identify how engineering expertise contributed to or undermined desired outcomes.

The agency should define how it currently uses engineering expertise to support procurement, as well as identify the strengths and weakness of the agency's approach. This could include assessments of the:

- Contribution of engineering expertise to cost, performance, schedule, and risk outcomes.
- Support provided by engineering professionals in Procurement Teams and Program Offices to operations in other parts of the agency.
- Sustainability of engineering expertise considering career

- structures, opportunities for professional development, employment challenges and leadership positions.
- Degree to which the existing level of expertise can accommodate changes in volume and domain of expertise.
 - Maturity and capability of the agency (see Chapter Five).

In any analysis of its current use of expertise, the agency must identify any positions requiring engineering expertise which also exercise delegations as per agency policies such as the Chief Executive Instructions. Delegation to non-government personnel is not allowed in certain circumstances. Attention should also be given to identifying positions which allow the discretionary application of government authority. There may also be some legislatively defined functions that have to be undertaken by public servants such as testing and evaluation. Those positions that have combined engineering expertise with delegations, discretionary or legislatively defined functions either cannot be outsourced or else they need to be separated.

The agency should identify how it uses engineering expertise in terms of its integration within the agency. There are three descriptors of increasing levels of integration – discrete, collaborative and integrated. Most agencies employ a discrete and collaborative approach. Below are definitions of each level.

Discrete expertise provision exists where the expertise provider supplies information when required but does not have a strategic role in shaping the procurement. This approach is more likely to be used to access engineering expertise where the need can be clearly defined, the output is produced in standard forms and there is little need to test the validity of the solutions provided by the contractor due to established practice in the area. It is also likely to be used when the input is part of a system that is well-defined and where there is little need for management intervention with the supplier. For external providers, discrete expertise provision is likely to be provided under a fee-for-service contract where the fee can be fixed or variable based on the costs of provision plus some supplier margin. For internal providers, expertise is likely to be provided by salaried personnel and/or internal cost recovery arrangements.

Collaborative expertise provision exists where the expertise provider supplies information on an ongoing basis during a procurement, and this can be both reactively following

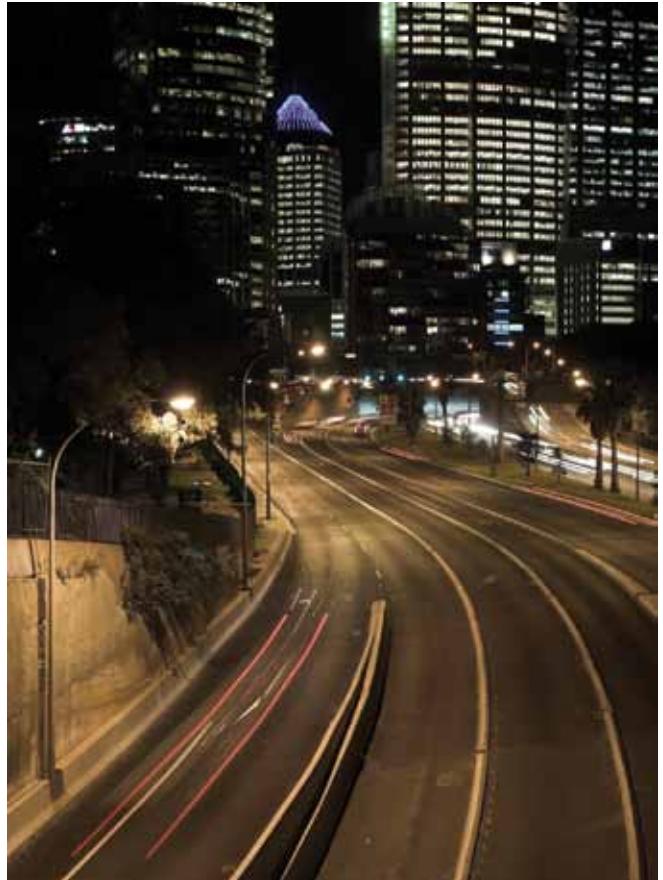
requests and proactively when they see a need for it. In collaborative provision, the expertise provider has a moderate ability to shape the procurement through their interaction with the procurement team. This approach is more likely to be used when the procurement requires expertise at multiple points in the procurement cycle. Such procurements are likely to be moderately complex with some engineering trade-offs in cost, performance and schedule, and/or may include a medium level of engineering risk. Collaborative provision is likely to be provided under a fee-for-service contract or a buy-in contract, under which the agency buys in resources to supplement in-house capabilities. These purchased personnel usually work on-site and are managed by agency staff. Collaborative expertise provision normally occurs on longer duration projects which encourage both the agency and provider to invest in the relationship.

Integrated expertise provision exists where the expertise provider is an integral part of the procurement team and process, and supplies information continuously during a procurement. The expertise provider has a significant ability to shape the procurement. This approach is more likely to be used for accessing engineering expertise when the procurement is complex, meaning that the expertise requirements will evolve as the project evolves, and a wide range of expertise is required as is considerable professional judgement. Such procurements are likely to be very complex or strategic with many engineering trade-offs in cost, performance and schedule, and/or may include a high level of engineering risk. Integrated provision is likely to occur under an alliance, joint venture, partnering, or partnership arrangements. Distinguishing features of integrated provision are that both the agency and the provider each contribute significant resources, there is a sharing of resources, and the arrangement aligns with the overall strategic direction of both organisations. Integrated provision is a strategic approach to accessing expertise and is more likely to indicate that the agency recognises that sourcing engineering expertise is critical to the success of the agency and hence deserves significant management attention.

Questions that assist in defining an agency's need for engineering expertise to support procurement are:

- How is engineering expertise used to support procurement?
- How important is engineering expertise in supporting procurement and what is the basis for this assessment?

- Who are the major agency users of engineering expertise?
- How do these users utilise engineering expertise?
- What expectations do key external stakeholder have of engineering expertise?
- How do the users and stakeholders trade off the cost, performance and schedule for engineering expertise?
- Is the expertise a pure service or a mixture of service and goods (an example of a mixture is Engineering, Procurement, and Construction Management (EPCM) software with engineering services attached)?
- Does demand for expertise fluctuate, and if it varies, what are the drivers?
- What is the total annual current and forecast spend on engineering expertise to support procurement by the agency, by business units and by region?
- Do engineering professionals who supply engineering expertise to support procurement also support other functions, and/or do engineering professionals in other areas contribute to supporting procurement? If so, how is this paid for?
- What are the key cost drivers in the use of engineering expertise to support procurement?
- What are the historical high, average and low prices charged by expertise providers?
- How do the costs occur over the procurement cycle?
- Do government and agency procurement policy requirements drive engineering expertise requirements (e.g. environmental sustainability)?
- What reviews are required to ensure the solution is supportable (e.g. system design reviews, provisioning reviews, configuration audits and verification and validation assessments)?
- Is there/has there been an existing supply arrangement?
- How are price changes negotiated, and what is the basis for price changes?
- What price variation formulae are used, if any?
- Are volume discounts applied by suppliers?
- How have existing or previous supply arrangements performed?
- What are the attitudes of the agency and providers towards previous arrangements?



By identifying clearly the need for the procurement, it is possible to identify effective strategies to better manage the demand or reduce it. Ways to do this could be through the aggregation of demand into fewer contracts, accelerating or postponing projects to prevent peaks and troughs of demand, and using industry standards rather than unique specifications that require higher levels of engineering input.

In cases where the agency currently relies on external sourcing, the reasons for this should be identified. These may have been a decision to not invest in recruitment, training and building internal capacity as internal engineering expertise was not seen as critical to procurement outcomes or the agency may have been unable to offer competitive pay rates or challenging work. Identifying these sorts of reasons may locate key constraints or opportunities when evaluating sourcing strategies.

UNDERSTANDING THE MARKET

Effective procurement requires understanding the market from which the expertise will be sourced. A technique to do this is to use a supply market analysis. This generates a strategic understanding of how a market works, the direction in which the market is heading, its competitiveness, its capacity, who the key providers are, the value that the providers place on the agency as a customer, and the sustainability opportunities and performance within the market.

The market for engineering expertise provision has two components – internally or externally sourced expertise. Internal sourcing involves using agency employees. External sourcing involves non-agency employees to provide services on a contractual basis.

While the terms *outsourcing* and *insourcing* are more commonly used in procurement than internal and external sourcing, the former terms are not used here as they can be confusing because they are often defined differently, and because they cannot be used to analyse all cases in which engineering expertise must be sourced to support procurement. As an example of the latter point, the term outsourcing generally is not used to describe the use of external service providers to supplement in-house procurement processes during peak load periods. However, for the purposes of this study, these external service providers need to be identified as externally sourced. Hence the term

external sourcing is more applicable than *outsourcing*. There are advantages and disadvantages to both internal and external sourcing, and described below.

Internal sourcing advantages and disadvantages

When engineering expertise is sourced internally, employees are more likely to have a good knowledge of the agency's operations. This includes corporate knowledge, agency objectives, knowledge of relevant personnel, and work currently underway elsewhere in the agency, and an understanding of public sector ethics, administration and organisation. This eliminates the learning curve required for externally sourced personnel, which is particularly important if the work involves interacting with different parts of the organisation and gaining their resources or assistance.

Agency employees can usually be redeployed quickly within their agency, allowing for a rapid reprioritisation of the agency's activities. This is particularly important if urgent procurements arise which require rapid action.

Agency employees can be more cost effective where the demand continues for many years, because the cost of an internal agency employee is less than that of the equivalent external person providing that they are fully utilised.

Maintaining and developing in-house expertise ensures that the expertise will actually be available to the agency. For some technical expertise, there is a shortage of relevant engineering professionals available at a reasonable price. This could be because the government is the only user of the expertise, such as ship munitions storage engineering, or because other sectors of the economy have attracted the expertise and have more flexibility in the wages and other incentives they can offer.

Having internal sourced expertise means that the ownership of intellectual property generated during a project is straightforward as it remains with the agency. If external sourced expertise is used, intellectual property issues may require more attention.

Having all internal sourced expertise may mean that there is less risk of cultural differences as all staff work within an organisational culture that usually has well understood

expectations. This should result in fewer misunderstandings and greater clarity of purpose.

Other benefits that may apply under certain circumstances include:

- Less management time is required to oversee internal sourced expertise as the requirements of individuals and the quality of their work is well established.
- Greater certainty of the skill and competence levels as those providing the expertise have a track record within the agency.
- The cost of staff is known in advance and easy to budget for as the salaries and overheads can be identified easily.

Internal sourcing of engineering expertise can also have disadvantages. To ensure maximum efficiency of internally sourced staff, the workload needs to be relatively constant. If the volume of work is sporadic, the resources may be under-employed or if it is too high, then the work cannot be completed on time without additional resources.

If the expertise required changes due to changing technological environments or agency needs, ensuring in-house experts retain technical currency can be both costly and time consuming. It may entail considerable training, and possibly industry work placements.

Maintaining in-house expertise can be expensive due to the cost of recruiting, initial training, and on-going training.

Sustaining a critical mass of internal expertise requires a sufficiently large enough pool of people so as to provide career paths from entry level to experienced practitioner to leadership positions, and to provide mentoring and peer support. It may also require the development of special particular training and education packages, as well as industry placements and agency rotational opportunities.

External sourcing advantages and disadvantages

External sourcing can provide agencies with access to a wide range of competencies, skills and expertise. This may be important for activities subject to large shifts in technology. External sourcing can provide a way to obtain additional staff to meet different volumes of work.

Additional personnel can be obtained to meet large or rapid demand, rather than up-skilling or transferring agency employees which can disrupt other work.

A potential benefit of using externally sourced personnel is that it brings in a wider set of perspectives as these personnel will generally have worked in a wider range of industries doing a variety of jobs. They bring with them not only technical knowledge, but also business process and management knowledge which can be applied within the agency to improve individual procurements, the procurement cycle, the procurement system, and the alignment between procurements and agency outcomes.

The use of externally sourced personnel can drive a requirement to measure costs and performance outcomes. This information is essential to evaluating the outcomes of the engagement method used to access the expertise.

Other benefits that may apply under certain circumstances include:

- Externally sourced personnel can cost less than agency employees in particular circumstances. For example, in Defence, an externally sourced engineering professional is normally cheaper than a uniformed engineer providing support to procurement as a military member's rate factors in their military training requirement. Another instance is where the work is sporadic and a full-time resource cannot be justified.
- External sourcing can eliminate potential conflicts of interest. This can be important if the technical advice may be contrary to agency policy or programs.
- The ability to spread risk from the agency to the provider.

It may be noticeable that missing from the list of benefits arising from external sourcing is one of allowing an agency to focus on core business. This argument is not particularly relevant to procurement which is a core activity for many agencies. In addition, it is assumed that outsourcing frees up management time, but this is unlikely to be true for engineering expertise required to support procurement. This is because more complex procurement processes are management intensive and the source of the expertise is unlikely to change this.

External sourcing of engineering expertise can also have disadvantages for an agency. An over-reliance on external sourcing can result in a loss of control by the agency over the quality, quantity, timing and even the nature of the work. This loss of control can occur when the agency's internal capabilities decline to such an extent that it cannot confidently define and manage the externally provided expertise. When the internal capability is at this level, the agency has to rely on the externally sourced personnel to direct and manage themselves. The loss of this capability means that the agency cannot identify when market conditions change, such as when new methods of expertise provision are developed, or when new entrants appear in the market. This means it cannot take full advantage of new opportunities.

Another disadvantage of externally sourced expertise may be that staff in other parts of the agency who might have accessed the expertise informally will no longer be able to do so unless this requirement was factored into the contract between the agency and the supplier. This can be an important issue if employees wish to get informal advice on whether they should seek formal, technical advice.

Another disadvantage is that experience gained by externally sourced engineers during their work will be lost if they are replaced frequently. In addition, externally sourced personnel may lack contextual knowledge of the problem or the culture of the agency, which can lead to misunderstandings or sub-optimal solutions being advanced.

Other disadvantages that may apply under certain circumstances include:

- External sourcing could be more expensive for long-term projects, or where there are hidden costs from the suppliers, inadequate scoping by the agency, and for high entry and exit costs in establishing the arrangements.
- Conflicts can arise from the different objectives of the agency (e.g. being responsive to the Minister) and the supplier (e.g. profit maximisation).
- Agencies are exposed to reputation risk if significant or perceived failings exist with the supplier's behaviour or work.
- Inflexibility in meeting changing agency requirements if the contract is badly scoped or written.

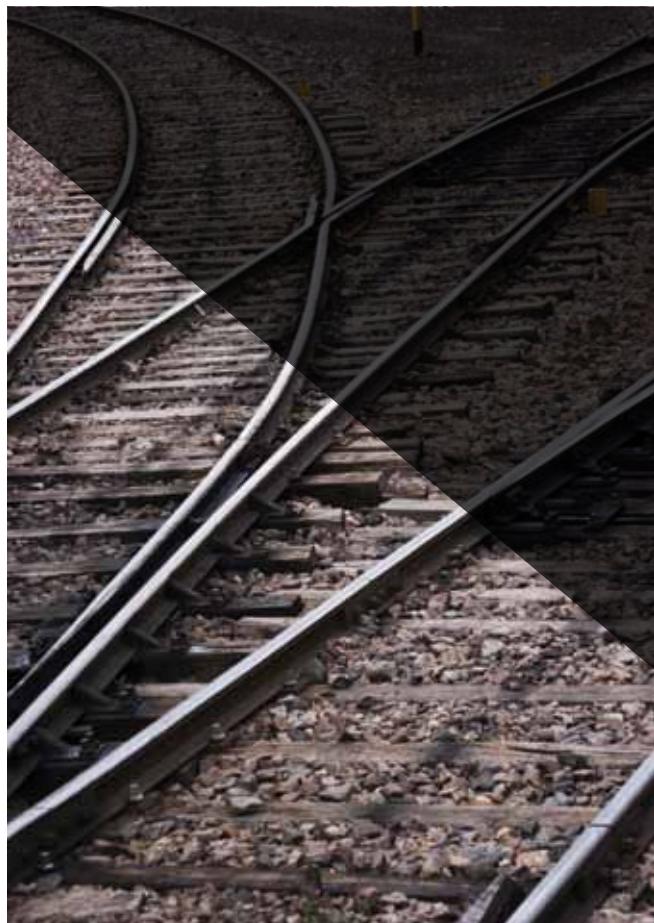


A disadvantage of external provision unique to the public sector and rarely addressed in management literature relates to public and political perceptions. From the 1980s onwards, governments in Australia have embraced and championed the private sector provision of products and services under the belief that it opens up the provision to the discipline of competition. Other common rationales include allowing government to focus on core functions, and greater flexibility as the private sector can respond more quickly to changes in government demand. The public's acceptance of these rationales has waxed and waned with time. At times the public has expressed concern about the high level of private sector provision. One dimension of this has been the characterisation in the political debate that there is an unhealthy overreliance on contractors. Specific assertions to support this have included that agencies are spending too much of taxpayers' funds on contractors, projects are too expensive, and agencies are no longer accountable for the work produced on their behalf. This can translate into a perception that government is not making decisions in the public interest, with the contractors who are performing the work making decisions in their own best interests. This in turn can undermine public confidence in the ability of government to be an effective representative of the people.

The strength of this public perception is reflected in frequent criticism over expenditure on consultancies and contractors from Opposition Ministers and even Executive Government

Ministers. When the Opposition does this it is to suggest that the government is an incompetent financial manager and wasteful. When the Executive (Government) does it, it may seek to transfer blame for the practice onto the agencies, creating the impression that they are inefficient. Another indicator of concern over expenditure on consultants is that it is usually one of the first targets for governments seeking to make budget cuts. The identification of consultancies, as well as staff travel, government advertising and printing, create the impression that consultancies are a luxury and discretionary expenditure that can be cut without affecting the work of the agency.

The political dimension of external sourcing should be factored into sourcing decisions. Specifically, the risk of external sourcing for the Executive (Government) is that as the government's total consulting budget increases, this class of expenditure can become a political liability. For agencies, the risk is that Executive (Government) will make arbitrary decisions to reduce external sourcing expenditure, forcing agencies to curtail their expenditure on engineering expertise regardless of its criticality.



Supply market analysis and marketing sounding

A supply market analysis requires identifying providers and their capabilities. Questions to assist in developing this understanding are:

- Who are internal and external providers of expertise, and what are their respective sizes and capabilities?
- What is the level and type of competition between providers?
- How substitutable are these providers?
- What is the value of the agency to potential suppliers?
- What are the broad contextual factors (e.g. political, economic, social/cultural, and technological) affecting the supply market?
- What are the political, reputational and other risks associated with providers?

It should be noted that the engineering expertise market is not homogenous as it comprises dozens of disciplines (e.g. mechanical, civil and mechatronics), and hundreds of skills (e.g. finite analysis and root cause analysis). An agency is likely to need expertise derived from different disciplines and skills sets, meaning that any supply market analysis needs to consider several specific sub-sectors. Questions to assist in understanding each sub-market include: how many people are in it, what is its age profile, and is it sustainable?

An assessment of providers should also include sounding out potential providers to determine their reaction to any change in the way engineering expertise is sourced. Called market sounding, this involves communicating directly with the potential providers rather than just completing a desktop analysis. The information obtained can be used to validate other findings as well as providing new information, such as rates and capabilities. However, this information is not a substitute for a broad market analysis, as both sets of information need to be correlated and synthesised to generate an accurate picture of the market. The use of market sounding is very important if there is the prospect of major changes to the sourcing of expertise, in particular if developing an integrated, long-term relationship between the agency and a provider is considered desirable. This is because there is limited maturity in the market for integrated expertise provision, and there may be uncertainty over the level of provider interest in such arrangements.

DETERMINING SUITABLE PROCUREMENT PROCESS

Determining a suitable procurement process for accessing engineering expertise to support procurement requires both a sound sourcing strategy (also known as a buying strategy) and the procurement method to be used.

SOURCING STRATEGIES

Evaluating potential sourcing strategies builds on the results of the demand analysis, supply market analysis and market sounding described above. This information needs to be synthesised using a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis, Political, Economic, Sociological, Technological, Legal, Environmental (PESTLE) analysis or an equivalent structured methodology. Sourcing strategies relevant for engineering expertise are:

- Obtaining supply from regionally based providers under centralised arrangements. This may lower the transaction costs of accessing the expertise while allowing an agency's regional locations to better manage the supply.
- Modifying demand to provide a constant demand. This would reduce peaks which may be more costly to service.
- Modifying demand to fit in with other user's demand for the expertise. For example, if it is expected that there will be large industry demand due to major projects or rapid growth in industries, then it can also be expected that there will be increased costs for the expertise. By changing industry demands through accelerating or slowing demand to fit around other industry demand, excessive costs could be avoided.
- Aggregating and consolidating demand across business units, the agency or multiple agencies which increases an agency's buying power.
- Modifying the level of engineering expertise required so as to allow less qualified members of the engineering team to provide that expertise.
- Developing a mix of internal and external sourced expertise so that internal sourcing meets the base load demand and external sourcing is used only for peak periods.
- Dividing demand into tiers based on transaction, collaborative or integrated arrangements with providers. This then allows for different strategies for procurement based on tier.

- Developing long-term integrated relationships with certain providers to increase sustainability and security of expertise provision.

In the selection of a sourcing strategy, the agency needs to determine how it will manage conflicts of interest if external sourcing is used. In many sub-sectors such as civil engineering, most engineering practitioners who could provide an agency with expertise work for private sector companies that offer a full range of services including procurement, design and construction management. If these companies provide the agency with engineering expertise, then the engineering professionals may be conflicted when their employer submits a tender for work the agency procurement group generates. Sourcing strategies to address this conflict could include:

- Requiring providers to be 'above-the-line' contractors. Above-the-line refers to professional service providers that work solely for the client, and work as part of the agency team. They can be thought of as the buyer's representative. Below-the-line refers to the supplier of the product or service that is being procured. For large and complex engineering products and services, below-the-line suppliers are prime contractors who work with sub-contractors to deliver the contracted item.
- Requiring providers to establish a Chinese wall or firewall between its provided engineering expertise to support an agency's procurement and those engineers that work on delivering the contracted item.
- Prohibiting companies that supply engineering expertise to the agency from tendering for its contracted items.
- Imposing additional requirements on companies that supply engineering expertise to support an agency's procurement when they tender for the contracted item.
- Reserving certain work for agency-employed engineering professionals.

Understanding the sub-sectors within the engineering market is essential to predicting whether the agency's sourcing strategy will distort the market to such a degree that it changes the fundamental structure, potentially creating shortages for other users of the expertise or reducing training opportunities for engineering graduates.



Another factor to be considered when procuring expertise is to prevent over-dependency on a single provider. This creates a number of risks including:

- Excessive prices charged by the supplier.
- Loss of agency control of its work, including ability to manage demand.
- Loss of confidence that decisions are being made in the public interest rather than in the interests of the contractors.
- Loss of public confidence in the government through a perception of heavy reliance on contractors who may not be acting in the public interest.
- If one or a small group of suppliers dominate the market, they could use their position to deter new competitors from entering the market or prevent innovative solutions being offered.
- Loss of supply and reputational risk if a supplier collapses or is found to have engaged in inappropriate practices.

To prevent over-reliance on a single supplier, sourcing strategies could include:

- Requiring the supplier to undertake activities to stimulate new market entrants and innovation.
- Ensuring that the incumbent supplier is well aware that continued business is not guaranteed.
- Requiring a mix of internal and external sourcing of engineering expertise.
- Creating a panel of suppliers and ensuring that the work is distributed across the panel.

Bundling of demand across the agency or across multiple agencies may be optimal given the high transaction costs associated with establishing the need for engineering expertise and running the procurement process. Bundling may generate other benefits, including reduced bidding costs by suppliers, increased investment in improving their services due to the size and duration of the contract, better information on the use and benefit of expertise due to the aggregation of agency information, better management of the supply chain, and an increase in the value of the agency as a customer. However, there are also risks associated with bundling for expertise, which include distortion of the market, failure of the centrally managed arrangement to meet individual agency unit needs, unintentional exclusion of suppliers due to large contracts, anti-SME bias, and lengthy 'lock-out' periods for potential new entrants.

DECIDING ON A PROCUREMENT METHOD

The second element in selecting a suitable procurement process is selecting the optimal procurement method. This requires determining how risk should be shared between the agency and the provider. If the agency is best placed to manage all of the risks in the procurement cycle, then the contract should be input focused (meaning it should define contract performance measures as inputs such as skills needed, hours worked and processes to be followed). When the agency assumes all of the risks, the agency needs to have strong project management skills to manage the entire procurement cycle and ensure the correct level of input is

supplied by the expertise providers. An input focus normally means a fee-for-service contract.

If the agency and expertise providers are in a position to each manage some of the risks, then the contract should be output focused. Such a contract is likely to apply to complex projects and requires a collaborative or integrated relationship between the expertise provider and the agency. While it is theoretically possible that the contractual arrangement could be outcomes based, this seems impractical because the expertise providers are not able to control all of the factors that shape project outcomes.

A number of supply arrangements are suitable for the provision of engineering expertise, and the selection will be based on the degree of business risk and expenditure. Ones that could be applicable are:

- Standing offer arrangements for a single supplier or multiple via a panel.
- Long-term supply contracts.
- Alliance contracts.
- Incentive-based contracts.
- Bundled fully-serviced contracts (prime contractor).

The standard options for approaching the market for products and services are equally relevant when accessing engineering expertise. These include direct negotiation (sole source tender), limited tender, or open tender.

The selection of the optimal procurement process requires analysing the options using some form of qualitative evaluation such as SWOT or PESTLE analysis. One outcome of the evaluation could be to determine that the expertise should not be procured at all. Procurement should only occur if the business case justifies doing so. It may be that the cost of packaging, sourcing and managing a contract exceeds its benefits. The alternative to procurement of the expertise is to simply employ engineering professionals as agency employees.

CONDUCTING A SUITABLY SCALED PROCUREMENT PROCESS

A procurement implementation plan should be developed which lays out the steps that need to be taken in order to successfully implement the chosen procurement strategy. The plan should address the required resources, roles and

responsibilities, implementation schedule, key stakeholders, communication and risk management. Actions the agency needs to plan for in both evaluating market responses to the agency's request and ongoing contract management are:

- Identify the key skill sets and capabilities required by agency staff to evaluate industry responses. In addition to the standard knowledge required such as supplier relationship management, contract administration, negotiation and legal, contractual and commercial issues, additional knowledge required includes evaluation of the quality and relevance of the expertise offered, and identification of deficiencies in the expertise offered.
- Establish the governance and contract management framework. Challenges for the agency relating to expertise provision are defining the responsibilities and level of authority of the expertise providers within the procurement process, identifying a relevant person for monitoring the expertise provided, and developing meaningful reporting mechanisms for the outputs and outcomes of the contract to higher management levels.
- Identify enabling processes and technologies. Challenges for the agency relating to expertise provision include enabling the appropriate level of expertise to be made available at the correct time in the procurement cycle, ensuring that the information is relevant and actionable, and allowing the level of input to be sufficiently flexible to make both operational and strategic contributions to the procurement.
- Identify risks at each stage of the procurement cycle. Each stage of the procurement cycle has different risks which require different expertise to manage. This requires the agency to identify the type of engineering expertise needed at each stage and ensure that it is available when required, and those providing the expert opinion are aware of all pertinent information.

If there is to be a major change in expertise sourcing, the procurement implementation plan needs to ensure there is continuity of expertise provision during the transition. This is because in many agencies, a loss of one or two engineers can have a significant impact on the agencies' procurement capabilities.

An evaluation plan needs to be established to enable the selection of the most appropriate offer based on value for money, which should explicitly include contributing to WofG objectives. The evaluation plan would include a timetable

for the evaluation and details of the evaluation processes. It should also include those involved in the evaluation process, which would be those normally involved in procurement (e.g. purchasing/procurement officers, legal experts, and agency staff who can exercise financial delegations), plus the users of the engineering expertise and those responsible for managing the expertise provided. For complex procurement, it is not uncommon for tenderers to provide data and information that cannot be easily compared. This requires each tenderer's information to be normalised so that it can be compared. This can require considerable engineering experience and knowledge.

Given the complexity of engineering expertise provision, it is unlikely that the winner will be the lowest priced compliant response. Far more likely is that the evaluation process will use some form of numerical rating based on a weighting being applied to different evaluation criteria so as to reflect their relative importance.

MANAGING THE CONTRACT

The resulting contract requires continuous monitoring to ensure that satisfactory outcomes are being achieved on time and within budget. This is helped by good practices including:

- Appointing a project manager responsible for the contract. It may also be worthwhile appointing an Agency Chief Engineer who has a leadership role for engineering expertise provision across the agency.
- Maintaining adequate contract records.
- Assessing the achievement of defined performance measures.
- Identifying and addressing instances of unsatisfactory performance, and variations in cost and time.
- Using stakeholder monitoring which could include agency staff, suppliers, and an independent third party such as a cross-agency engineering manager.
- Organising regular review meetings to discuss performance trends, contract activities, and technical challenges.

A common risk facing many outsourced activities, which may also occur when shifting the sourcing of engineering expertise, is that the agency has an over optimistic belief that contracting out the requirement will be a quick fix to problems of insufficient skills or substandard quality. This belief leads

to an underestimation of the management effort required to manage the new contract.

Another possible risk in changing sourcing is that the agency does not evolve to exploit the new opportunities arising from the change. For example, if an agency has only used a transactional approach to obtaining external expertise, it should consider shifting to a collaborative or integrated approach. However, to do this requires changes in business processes, and the roles and responsibilities of all involved in the procurement process.

A final risk will be a failure to maintain agency expertise sufficiently to manage the provision of engineering expertise. If the agency does not retain expertise in specifying and interpreting engineering requirements to a sufficient level, communications can become confused and requirements might be misunderstood.

MANAGING TERMINATION OR TRANSITION

Towards the end of the contract, an assessment should be made to decide whether the contract should be renewed or extended. This involves assessing if the strategic and operational performance outcomes have been achieved, along with the expected value for money outcomes. It also requires an analysis of the past and future demand from the agency for engineering expertise, and how the market has changed since the beginning of the contract. It would also evaluate the effectiveness of the procurement process used by the agency.

A significant factor in determining the future path is to ensure there is continuity of expertise during the evaluation and commencement of the contract termination or transition arrangements. This period may be stressful for those who provide the expertise due to their future employment uncertainty. If an agency is a significant market player in the provision or use of expertise, consideration of any termination or transition should factor in the effect on the market.

CHAPTER FIVE



ENGINEERING PROCUREMENT CAPABILITY OF AGENCIES

SUMMARY

Governments around Australia are starting to formally assess and enhance the capabilities of their agencies as a method to improve their outcomes. For example, the Australian Government is requiring that agencies conduct agency capability reviews. To aid this, governments are providing review methodologies and guidelines. For example, the Queensland Government has developed a roadmap to determine agencies' sustainable procurement capability.

Given the importance of procurement to government as a means of achieving their objectives, focusing on building procurement capability is important. For agencies involved with procuring engineering-intensive products and services, a key factor in predicting their procurement outcomes will be determined by the engineering procurement capability.

To aid agencies in their capability assessments of their portfolio, programs and projects management, this chapter presents guidance and issues that should be considered if procurement of engineering-intensive products and services is a significant activity.

CAPABILITY MATURITY WITHIN AUSTRALIAN GOVERNMENTS

Australian governments are increasingly using capability maturity as a tool to identify an agency's or area's current level of maturity and highlight areas that would give them the most value and performance improvement in the short and long term. The goal of maturity capability improvement is to determine whether the organisation has the right people, processes and systems to deliver high quality outcomes and forward looking advice.

In the Australian Government, the primary policy driver for this has been the *Ahead of the Game Blueprint for the Reform of Australian Government Administration*, released in 2010.

The Blueprint sets out an ambitious agenda for the reform of the Australian Public Service with a focus on improving outcomes for citizens through greater integration of services, developing the long term strategic and leadership capability of the APS and introducing new accountability measures. A key recommendation from it has been to develop agency capability reviews. To implement this, the Australian Public Service Commission has developed a standard review methodology and common framework focusing on leadership, strategy and delivery capabilities.

Examples of the application of maturity models and assessment across Australian governments include:

- The Australian Government's Attorney-General's Department in 2010 implemented a maturity assessment of their agency using the P3M3 methodology.²⁹
- E-Health Interoperability Maturity Model, proposed by National E-Health Transition Authority Ltd.
- The Australian Government Business Process Interoperability Framework, prepared by the Australian Government Information Management Office.
- Software Licence Whole-of-Government Maturity Model, developed by the Chief Information Office, Queensland Government.
- The Defence Materiel Organisation generates a Project Maturity Score for major capital equipment proposals that are currently planned for Australian Government consideration. This score assists the government in comparing the maturity of options as a measure of the relative confidence associated with them at the time they are considered. The Project Maturity Score quantifies the maturity of a project, and is made up of seven attributes. These attributes are examined through a set of focusing questions. For example, in the capability development phase, the attributes and key questions are:
 1. Schedule – What confidence do we have in the schedule?
 2. Cost – What confidence do we have in the project cost estimate?

²⁹ ASPIRE, 2010. *A P3M3 Maturity Assessment for Attorney Generals Department*.

- 3. Requirement – How well is the requirement defined and understood?
- 4. Technical Understanding – How well do we understand the solutions?
- 5. Technical Difficulty – What is the technical complexity in delivering the solution?
- 6. Commercial – What confidence do we have that industry can deliver the solution?
- 7. Operations and Support – Is the effect on the operating and support environment understood and planned?³⁰
- A group within the Attorney-General's Department called the Resilience Community of Interest of the Trusted Information Sharing Network has developed the Resilience Maturity Model Quick Assessment Tool. The tool is designed to assess an agency's resilience and promote thinking about the resilience behaviours. It comprises 39 high and low-level resilience maturity descriptors arranged under the eight behaviour headings of agility, integration, interdependency, leadership, awareness, change, communications, and culture/values.³¹
- The Queensland Government's Chief Procurement Office has produced guidance to allow agencies to identify their capabilities in achieving sustainable procurement, and a roadmap to building capability along six stages of maturity.³²
- Some agencies request their supplier's maturity level as part of their procurement or panel selection process.

Most maturity models are derived from Carnegie Mellon University's 1987 Capability Maturity Model which was developed to evaluate software development processes. However, given its applicability to business processes more broadly, it has been adapted into a generalised process called the Capability Maturity Model Integration (CMMI). This model has five levels of maturity which describe an evolutionary path from ad hoc, immature processes to disciplined, mature processes with improved quality and effectiveness. Each higher level builds incrementally on the previous maturity levels. An example of a derivative model is the P3M3 methodology commonly used by agencies. It has a five level maturity framework, and examines seven process perspectives (management control, benefits management,

finance management, stakeholder management, organisation governance, risk management and resource management).

For agencies involved with procuring engineering-intensive products and services and who are undertaking capability reviews, consideration needs to be given in the assessment process of engineering specific issues. The inclusion of engineering issues will not only lead to a better assessment of the agency or its portfolio, program and project management, it will also improve engineering expertise provision and ensure engineering expertise aligns with the agency's strategic outcomes. Other benefits of applying a capability methodology to engineering expertise include:

- Encouraging the agency to see engineering expertise as a business asset that should be developed and exploited.
- Facilitating the agency's identification of priority areas that offer the greatest improvements in engineering expertise for the lowest cost.
- Providing the agency with a rigorous method of measuring improvements in its engineering expertise provision.
- Allowing the agency to formally identify those key activities, processes and efforts that are required to maintain its critical engineering capability, and conversely allowing the unimportant functions to be discontinued.

INCORPORATING ENGINEERING EXPERTISE ISSUES IN CAPABILITY MATURITY

To incorporate engineering expertise issues into capability maturity, agencies need to consider what engineering capability maturity means, how the engineering expertise process operates, and how engineering capability maturity would be measured. To aid agencies, the following has been developed:

- A five level engineering capability maturity scale.
- A visualisation of the process of engineering expertise provision that links engineering expertise provision goals, work practices and work products.
- An assessment framework to measure the engineering capability maturity level.

³⁰ Department of Defence, 2011. Defence Capability Plan, <http://www.defence.gov.au/dmo/id/dcp/html/about/index.html>, accessed 10 December 2011

³¹ Attorney-General's Department, n.d., Resilience Community of Interest webpage, http://tisn.gov.au/www/tisn/tisn.nsf/Page/AbouttheTISN_ResilienceCommunityofInterest, accessed 10 December 2011

³² Queensland Government Chief Procurement Office, 2010. *The Queensland Government Sustainable procurement Roadmap*.

THE ENGINEERING CAPABILITY MATURITY SCALE

The levels of engineering capability are adapted from those of the above mentioned Capability Maturity Model Integration. The five levels are summarised graphically in Figure 5.1 and is characterised in Table 5.1.

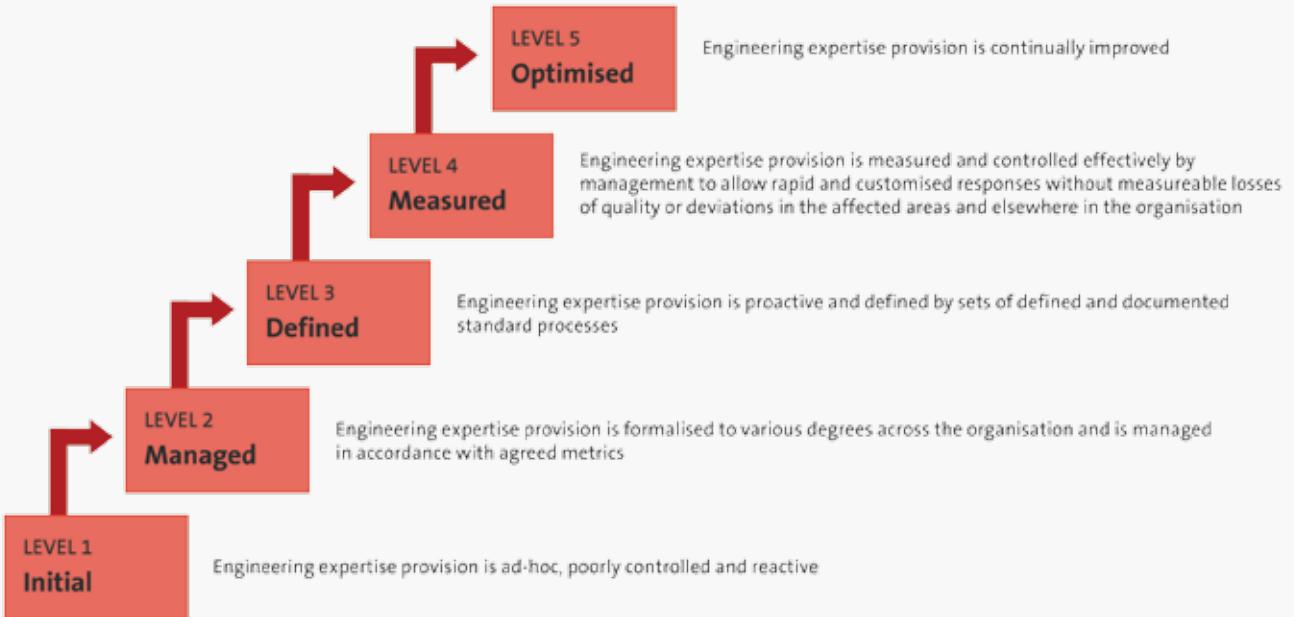


Figure 5.1: The five level engineering capability maturity scale

Table 5.1: Characterisation of Engineering Capability Maturity Levels

Level	Characterisation
Optimised	The focus of engineering expertise provision at this level is on continually improving outcomes through both incremental and innovative information and advice being used in business processes. Engineering expertise provision is driven by outcomes with continuous feedback so as to encourage continuous improvements in provision.
Measured	Engineering expertise provision at this level is measured by quality and process metrics which allows management to effectively control engineering expertise provision. In particular, management can identify ways to adjust and adapt engineering expertise provision in particular areas without measurable losses of quality in other areas. Compliance and assurance are a priority.
Defined	Engineering expertise provision at this level is defined by documented standard processes to ensure consistency of performance across the agency, and facilitate proactive information and expertise provision. These processes identify accountability and have some elements of continual improvement elements. A collegiate cadre of engineering expertise providers exist.
Managed	Engineering expertise provision at this level is formalised to various degrees across the agency and is managed in accordance with agreed metrics. This results in some areas obtaining repeatable and consistent information and advice. Conformance with formal provision processes is unlikely to be rigorous, but where it exists it may help to ensure that existing processes are maintained during times of stress. The agency has gained an early understanding of the value of engineering expertise provision across the agency. Groups of engineering experts exist in some areas.
Initial	Engineering expertise provision at this level is typically undocumented and in a state of dynamic change, tending to be driven in an ad-hoc, uncontrolled and reactive manner by users or events. This provides a chaotic or unstable environment for the processes. There is limited awareness of the value of engineering expertise across the whole agency, although there are localised areas of expertise which is valued due to its contribution. There is a limited ability of engineering experts to contribute proactively.

VISUALISATION OF THE PROCESS OF ENGINEERING EXPERTISE PROVISION

The process of engineering expertise provision can be visualised as three elements – engineering expertise provision goals, work practices and work outcomes. Goals influence work practices, and these in turn are reflected in the work products that are produced. Assessing both work practices and products allows the agency's engineering capability to be assessed. The engineering expertise provision process is illustrated in Figure 5.2.

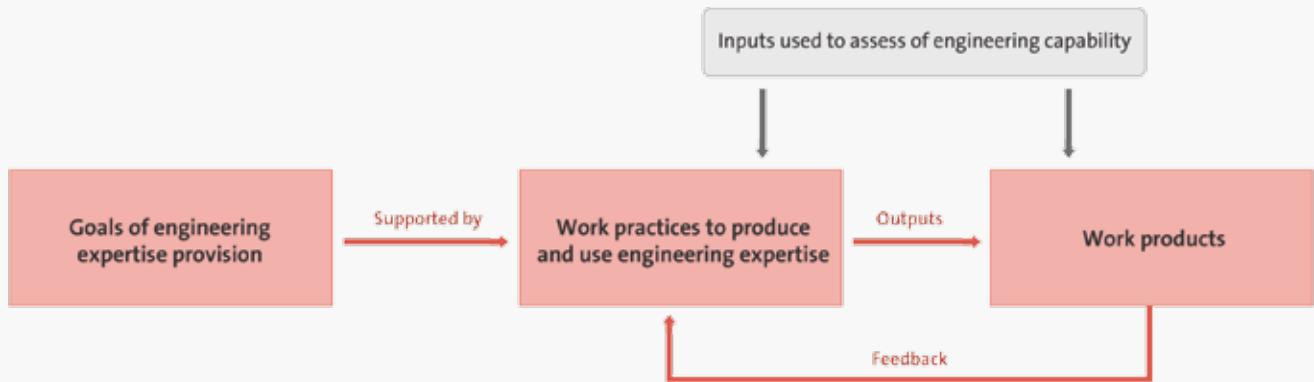


Figure 5.2: The engineering expertise provision process

Goals are the defined objectives of engineering expertise provision. They are universal and independent of each agency's strategic outputs. The goals are identified by analysing the provision of engineering expertise across a range of agencies and identifying best practice. The goals of engineering expertise provision are:

1. Engineering expertise provision assists the agency to be more efficient, effective and equitable in the delivery of its desired outputs and outcomes in a dynamic environment, and hence assist the government to better achieve its policy objectives (summarised as *strategic factors*).
2. Best practice engineering expertise provision practices and processes are identified and utilised (summarised as *process factors*).
3. Engineering expertise providers are generated and sustained in an optimal manner, and the engineering expertise users have the capability to understand and exploit the information and advice (summarised as *people factors*).

To determine the achievement of these goals within each agency, a series of measurable factors are identified. These factors measure work practices to produce and use engineering expertise, and work products. Work practices are the approaches used to do something. Examples include processes, techniques, procedures and methods. Work products are the physical implementation or 'footprints' of work practices. They provide objective evidence and can exist in a range of forms including documents, files, products, systems, services and specifications.

ASSESSING AN AGENCY'S ENGINEERING CAPABILITY Maturity LEVEL

The assessment of an agency's engineering capability maturity level is done by evaluating the degree to which engineering expertise provision goals are achieved. To do this, the goals are broken down into a number of assessable Measurement Elements. The Measurement Elements identify key components of each goal. Table 5.2 provides a template containing Measurement Elements derived from the goals identified above. It is expected that each agency will customise the list of Measurement Elements to meet its specific needs.

Evidence is collected relating to each Measurement Element, and based on an assessment of the evidence, a maturity score is given to each Measurement Element that reflects its level of

achievement. The agency should summarise the evidence used to support the level given so that changes can be identified over time. To aid an agency undertaking this assessment, Table 5.2 provides both low and high maturity indicators for each Measurement Element.

Below is the sequence of steps for assessing an agency's engineering capability maturity level:

1. Identify the organisational element (e.g. whole agency, sub-organisation, project and system) for which the engineering capability maturity level is to be determined.
2. Customise the list of Measurement Elements to meet the agency's needs.
3. Identify evidence from work practices and work products that provide an indication of the maturity of the Measurement Element.
4. Assess the evidence for each Measurement Element and assign a maturity score to it.
5. Utilise this information to plan for improvement.

In summary, engineering capability in most agencies arises from localised decisions, however, in higher performing agencies it is fostered and developed in a targeted way through a strategic process. Including engineering dimensions when assessing and building maturity helps agencies focus on developing a strategic approach to building their unique engineering capability. It will also raise awareness of the importance of engineering expertise to the agency's strategic objectives. As such, it will be highly valuable to agencies that rely on engineering information and advice to achieve their goals.



Table 5.2: Assessment framework to measure an agency's engineering capability maturity level

Goals	Measurement Element	Low maturity indicators
Strategic factors	Link between the strategic outcomes and engineering expertise provision	<ul style="list-style-type: none"> No link between engineering expertise and the agency's strategic outcomes in key documents such as in the corporate plan or doctrine. Lack of key performance indicators linking engineering expertise with the agency's strategic outcomes. Inadequate systematic monitoring of engineering expertise needs and provision to enable the agency to detect and respond to vulnerabilities, threats and incidents in a timely manner.
	The agency culture's receptiveness to engineering expertise	<ul style="list-style-type: none"> Engineering expertise provision is not welcomed, is seen as a delay or mistrusted. Decisions making assumed to not need technical input unless proven otherwise. Other priorities dominate to such an extent that engineering considerations are dismissed, downplayed or postponed. Negative information and advice is massaged and less weight given to it as it moves up the chain of responsibility.
	The quality of strategic leadership of engineering expertise	<ul style="list-style-type: none"> Distributed, <i>incohesive</i> or no leadership of engineering expertise. Engineering expertise across the agency not managed effectively.
Process factors	The degree that engineering expertise provision is incorporated into business processes	<ul style="list-style-type: none"> Engineering expertise provided in an ad-hoc manner, often dependent on the efforts of individuals. Quality/quantity of engineering expertise provision varies across the agency's. Engineering expertise provision from one area or within the agency's does not integrate or link with other areas or external to the agency. Engineering expertise provision is typically reactive. Process documents lack specification of engineering expertise provision requirements and timings. Engineering expertise provision is assessed in isolation of other information inputs. Engineering expertise provision supplied for only part of the decision process. Diversity of engineering expertise is not recognised.
	The quality of engineering expertise provision practices and processes	<ul style="list-style-type: none"> Engineering expertise provision uses sub-optimal methods. Engineering expertise provision addresses narrow objectives rather than contributing to the agency's key outcomes.
	The specification of responsibilities for the provision and use of engineering expertise	<ul style="list-style-type: none"> Overlapping, blurred or confused responsibility for the provision and use of engineering expertise. Lack of explicit traceability of assumptions.
	The level of compliance and assurance of engineering expertise	<ul style="list-style-type: none"> Not accepting the importance of technical compliance. Lack of reviews to ensure assurance.
People factors	The ability of engineering expertise users	<ul style="list-style-type: none"> Engineering expertise users do not understand the significance of the engineering expertise information and advice provided, nor how to use it. Engineering expertise users do not understand the engineering impact of their decisions.
	The quality of the generation and sustainment of engineering expertise providers	<ul style="list-style-type: none"> Mismatch between competence, needs and job design. Workforce lacks depth and breadth to allow critical skills to be maintained, and knowledge to be passed on. Inadequate workforce recruitment and retention, performance appraisals and mentoring. Inadequate numbers of experts and inappropriately located. Excessive workload. Isolated and lack of information sharing between engineering expertise providers. Lack of continuity in positions.

High maturity indicators	Score (1 to 5)
<ul style="list-style-type: none"> The contribution and value of engineering expertise is recognised as central to delivering the agency's outcomes efficiently and effectively. Performance indicators explicitly link the agency's outcomes with engineering expertise. Continuous monitoring of engineering expertise provision, focused on continuous improvement. <ul style="list-style-type: none"> Engineering expertise is valued as a key business asset. Engineering expertise provision assumed to be of value in all relevant areas. Concerns about performance, risk and uncertainties from the engineering community are listened to. People with engineering expertise are able to move into senior management roles. 	
<ul style="list-style-type: none"> Engineering expertise leadership point identified at a senior level and given specified responsibilities. Engineering expertise is managed optimally across the agency's. 	
<ul style="list-style-type: none"> Engineering expertise provision incorporated into standard operating processes across the agency's. Engineering expertise provision timely and of the required quality and quantity. Engineering expertise provision proactive. Reactive engineering expertise provision in one area of the agency's does not result in loss of quality or deviations from specifications in other areas. Processes documents specify engineering expertise provision (e.g. guidelines, standards, policies). Engineering expertise provision integrated with other inputs including strategic, operational, safety, business, reputation and environmental factors. Engineering expertise provision applies across the decision spectrum (e.g. problem definition, planning, design, implementation, testing, operation, disposals). 	
<ul style="list-style-type: none"> Engineering expertise provision uses best practice methods (e.g. whole of life, reliability centred maintenance). Engineering expertise provision is goal driven and business focused, to ensure the outcomes are timely, useful and valuable. 	
<ul style="list-style-type: none"> Defined responsibilities for the provision and use of engineering expertise. Traceable assumptions and the decision rationale. 	
<ul style="list-style-type: none"> An effective compliance regime exists across the agency and its key stakeholders to ensure the agency's compliance with legislation, regulation, policies, standards and best practices. Internal and external reviews provide independent assurance that the compliance processes are working effectively. 	
<ul style="list-style-type: none"> Engineering expertise users are able to understand, exploit and manage the engineering expertise information provided. Engineering expertise users understand the engineering affect of their decisions. 	
<ul style="list-style-type: none"> Alignment between competence, needs and job design. Sustainable workforce. Appropriate numbers or access to externally provided engineering expertise. Appropriate workload levels. Collegial engineering workforce exists. Individual rate of retention is high. 	

The background features a close-up, perspective view of several server racks. The racks have a dark grey or black finish with a prominent perforated metal panel design. Each panel has a grid of circular holes. Between the panels, there are horizontal white rectangular strips, likely representing drive bays or ventilation grilles. The racks are stacked vertically, creating a sense of depth. In the top left corner, a small portion of a screw or bolt is visible. The overall aesthetic is industrial and technical.

CHAPTER SIX

THE CHALLENGES FOR AGENCIES IN MAINTAINING IN-HOUSE ENGINEERING PROFESSIONAL STAFF

SUMMARY

Many agencies are currently facing shortages of engineering professionals. This shortage is expected to worsen over the medium term. There are a number of reasons for this with those most within the control of agencies being the ageing of their engineering workforce, the gap in remuneration between the public and private sector, the low level of recruitment and training of graduate engineers, and deficient employment classification systems.

In response to shortages, agencies have increased their efforts to retain existing employees. These have included offering salary bonuses, professional development opportunities and well-being programs. While these will increase retention, far too little effort has been given to building job satisfaction and increasing recognition of an individual's expertise and contribution to their agency.³³

SHORTAGE OF ENGINEERING PROFESSIONALS

The shortage of engineering professionals has become an ongoing problem for most public services. For example in 2010/11, technical experts (which included engineers, economists, scientists and statisticians) were one of the top four occupational groups that Australian Government agencies had the most difficulty in recruiting or retaining.³⁴

The shortage is not unique to the public sector but is an Australia-wide, long-term phenomenon. Although the global financial crisis in the late 2000s reduced the size of the engineering shortages, this was temporary and since then the engineering labour market has resumed the pre-crisis trend. Even during the worst of the crisis,

engineering unemployment remained very low at a time when immigration was at its highest in a decade. Since 2001, the average annual growth in the demand for engineers has been 4.8% per annum which has matched the average annual growth in the supply of engineers.³⁵ Through much of this period, the unemployment rate for engineers was well below the unemployment rate in the Australian labour force overall and consistent with rates generally regarded as frictional unemployment.

The shortage over the last decade has occurred despite an unprecedented growth in immigration of skilled engineers, including both permanent migration and those on temporary 457 visas. The continuation of the shortage despite increased immigration points to a persistent gap between the demand for engineers in Australia and the capacity of educational institutions to supply new graduates. Although recent changes in the tertiary sector, including allowing universities to determine how many undergraduate student places they will offer, has increased university commencement numbers in engineering courses, these changes have not yet materialised in an increase in the number of graduates. Even when this occurs, taking into account historical retention and attrition rates, the increase in graduation numbers is likely to be marginal and insufficient to make a substantive difference to the demand-supply gap.

There are many reasons to explain the current and growing shortage. Ones related to education are:

- Not enough students in years 10 to 12 studying subjects suited for engineering.
- Not enough year 12 students choosing a course of engineering.

³³ This section draws heavily from the Engineers Australia's 2012 *The Engineering Profession: A Statistical Overview*, which in turn uses information from the 2006 Population Census and APESMA surveys.

³⁴ Australian Public Service Commission, 2011. *State of the Service Report 2010–1*. p. 201, pp. 127-8.

³⁵ Engineers Australia, 2012, *The Engineering Profession: A Statistical Overview*.

- Not enough students at tertiary institutions completing their studies.
- Engineering students are choosing not to work in engineering.
- A lack of cohesion between universities and TAFEs meaning students cannot articulate easily from one course to another.
- Difficulty in undertaking part time or distance education in engineering.

Ones which are most relevant to agencies are:

- The ageing of the workforce.
- The remuneration gap between the public and private sector.
- Low level of recruitment and training of graduate engineers.
- Deficient employment classification systems.



AGEING OF THE WORKFORCE

The professional engineering workforce in government agencies is substantially made up of workers over 45 years of age. The average age of engineers has been increasing over the last decade as seen in Table 6.1 and in 2010 was 45.3 years. Public sector engineers are typically five years older than the average age of engineers in the private sector.

Table 6.1: Average age of engineers³⁶

Year	Private sector	Public sector	All engineers
1997	35.6	42.2	38.7
1998	35.9	42.6	38.3
1999	36.4	42.4	38.3
2000	36.9	43.6	39.0
2001	36.5	42.8	38.8
2002	37.4	43.8	40.3
2003	37.5	43.7	40.2
2004	37.9	43.0	40.2
2005	38.2	43.9	40.7
2006	40.3	45.0	42.1
2007	39.3	44.4	41.3
2008	40.7	44.9	42.4
2009	39.8	44.9	41.8
2010	39.1	45.3	42.0
2011	38.5	43.6	40.8

³⁶ Engineers Australia, 2012 *The Engineering Profession: A Statistical Overview*, p. 77.

A more nuanced examination of age trends can be obtained by examining experience levels. The union which represents engineering professionals, APESMA, defines the following five levels of experience:

- **Level 1 Professional Engineer.** This is the graduate engineer entry level. The engineer undertakes engineering tasks of limited scope and complexity in offices, plants, in the field or in laboratories under the supervision of more senior engineers.
- **Level 2 Professional Engineer.** This level recognises the experience and competence gained as a Level 1 Engineer. At this level engineers have greater independence and less supervision, but guidance on unusual features is provided by engineers with more substantial experience.
- **Level 3 Professional Engineer.** This level requires the application of mature engineering knowledge with scope for individual accomplishment and problem solving that require modification of established guides. Original contributions to engineering approaches and techniques are common. This level outlines and assigns work, reviews it for technical accuracy and adequacy and may plan, direct, coordinate and supervise other professional and technical staff.
- **Level 4 Professional Engineer.** This level requires considerable independence in approach with a high degree of originality, ingenuity and judgment. Positions' responsibilities often include independent decisions

on engineering policies and procedures for overall programs, provision of technical advice to management, detailed technical responsibility for product development and the provision of specialized engineering systems and facilities and the coordination of work programs, administrative function, directing several professional and other groups engaged in inter-related engineering responsibilities or as an engineering consultant. This level independently conceives programs and problems to be investigated and participates in their resolution within existing organizational operating and management arrangements. Typical reporting line is to senior management.

- **Level 5 Professional Engineer.** This level is predominantly engineering senior management positions including, Managing Director, Chief Executive Officer and Group General Manager.

Over the last decade, the average age of the more experienced engineers in the public sector has been increasing with less experienced engineers declining in average age as seen in Figure 6.1. This indicates that there is a growing gulf in experience with senior engineers becoming more experienced and junior engineers becoming less experienced. An implication of this is that when the older cohort of engineers retire, the ones filling the positions from within the agency will be far less experienced than their predecessors.

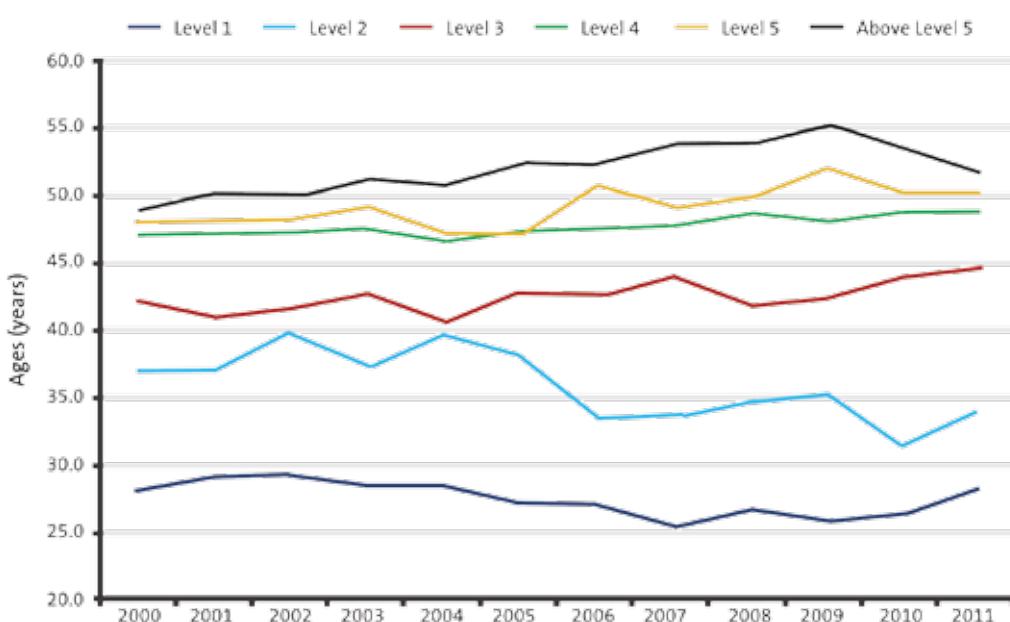


Figure 6.1: The average ages of public sector engineers by responsibility level³⁷

³⁷ Engineers Australia, 2012 *The Engineering Profession: A Statistical Overview*, p. 77.

The public sector has seen an increasing concentration of engineers at more senior responsibility levels. In 1997, the proportion of engineers at levels 4 and 5 made up 43% of all engineers. In 2010 they made up 57%. The proportion of engineers at levels 1 and 2 have fallen and in 2010 together accounted for about 15%.³⁸ An implication of this is that when the older engineers retire, there will be insufficient numbers of less experienced engineers from within the public sector to replace them.

THE REMUNERATION GAP BETWEEN THE PUBLIC AND PRIVATE SECTOR

Senior engineers in the public sector earn considerably less than their counterparts in the private sector. The 2011 APESMA wage survey identified that an experienced engineer working in a state public service earns an average remuneration package 36% less than their private sector counterparts, while experienced engineers working in local government earn 41% less.³⁹ In dollar terms in 2011, level 4 engineers had an average remuneration package of \$144,523 which is \$23,000 less than their private sector counterparts. Level 1 engineers earned about \$4,000 less than equivalent engineers working in the private sector.⁴⁰ This remuneration gap is a disincentive for public sector engineers to stay working for government.

LOW LEVEL OF RECRUITMENT AND TRAINING OF GRADUATE ENGINEERS

With the privatisation of government functions, and the increasing use of contracting out, governments expected that private sector organisations would assume the responsibilities for hiring and training the number of graduate engineers that the government used to do. This belief led to many agencies reducing their commitment to training as they thought that they would be able to hire experienced staff as required.

However, industry has not taken up the responsibility for training to the level that the government agencies previously did. There are many reasons for this including high levels of competition which forces companies to reduce non-essential costs such as reducing the employment of graduate engineers who are not very productive for several years, and the lack of incentives for training. A consequence of the difficulty in hiring engineers has been that some agencies have had to

reintroduce their own cadetships and graduate engineering development programs.

Pressure on agencies to reduce costs, such as through a productivity dividend, means that agencies may be less willing to spend money on employing graduates and training them in the future. If agencies do not have a large enough pool of graduate engineers, corporate knowledge and experience gained by senior engineers will be lost when these engineers retire.

DEFICIENT EMPLOYMENT CLASSIFICATION SYSTEMS

The employment classification systems for engineering professionals in most public sectors are a source of dissatisfaction for engineers. The inadequacies of the system can be a contributing factor in engineers leaving the public sector.

An employment classification system defines position levels. These levels are linked to pay bands and job definitions (e.g. functions, skill levels, competency standards and educational requirement). Employment classification systems in most jurisdictions are based on a general spine with various position levels (typically between 10 and 15 levels) and have streams for individual occupational groups, such as administration, operations, professional and technical. Most jurisdictions have professional and technical streams within which engineering professionals are generally classified (e.g. Qld, ACT, NT, Tas and SA). The Australian Public Service (APS) currently does not have any streams, for in 2000 it merged its streams into one generic structure. Today the APS has an employment classification system based on a single spine made up of 8 broad work value bands (APS1 to APS6 and EL1 and EL2) plus 3 senior executive grades (SES 1-3)

Even within a public service, there is considerable variation between agencies on how they classify the same professional group. For example in the APS, within its generic structure, each APS agency can develop more detailed classifications that meet its particular needs. Some agencies have extremely detailed job definitions for certain occupational groups. The consequence of this devolved decision making has been

³⁸ Engineers Australia, 2011 *The Engineering Profession: A Statistical Overview*.

³⁹ APESMA, 2011. APESMA wage survey 2011. www.apesma.com.au, accessed 25 February 2012

⁴⁰ Engineers Australia, 2012 *The Engineering Profession: A Statistical Overview*, p. 80.

that no two APS agencies share the same pay scales, salary advancement arrangements or broadbanding schemes.⁴¹ The profusion of classification levels is also repeated in the State public services. For example in the ACT Public Service, there are 236 different classifications across the different agencies.⁴²

Most classification systems are over a decade old and have not kept pace with the changes in agencies' work requirements. This can result in a job being undertaken by a person with different skills and experience to the ones identified in the job definition. For engineering positions, it is not uncommon that this disconnect results in people undertaking work at a higher level than they are being paid based on the outdated job definition. Due to the evolution of engineering, the skills and competency for certain job function will change. However, this is not reflected in many job definitions resulting in unqualified people undertaking the work. Another problem with many engineering job definitions is that they do not align with modern national competency standards, and instead use unique agency-defined competency definitions. The consequence of this is that the engineer is required to meet the agency's competency requirement which is not recognised by other agencies or the private sector. This reduces an engineer's employment portability.

A structural problem in some public services arising from their generalist classification system is that engineering job definitions may not be aligned with position levels. The

generalist structure rests on the idea that each position level reflects a different role. For example in the APS, generalist APS1 to APS6 level positions are working level administrative positions while EL1 and EL2 positions are principally management positions. However, for engineering professionals, the role undertaken at most junior through to some high level position levels are similar. The difference in position levels is more a reflection of the amount and depth of experience held by the person in that position and the level of support and supervision required. Using the APS as an example, the majority of APS4/5 and EL2 professional engineering positions undertake practitioner-based, working level functions. Compared with generalist EL1 and EL2 positions which are mostly managerial roles, only a small proportion of engineering professionals at these levels undertake management roles. As management responsibilities are tied to higher position levels and pay levels, it can be difficult for many engineering job definitions to be classified as higher position levels despite the high level of expertise required to undertake the work.

Another problem with most classification systems is that they do not accommodate engineering specialists who make a great contribution to the agency through technical mastery, rather than management. The reason for this is that classification systems are based on the assumption that the greatest contribution to an agency is delivered by management skills rather than technical mastery. This



⁴¹ O'Shea, T. & Smith, A., 2011. *ACT Public Service Classification Review (interim report) Element 1: Career Clusters*, p. 18.

⁴² O'Shea, T. & Smith, A., 2011. *ACT Public Service Classification Review (interim report) Element 1: Career Clusters*, p. 27.

construct ignores the value that engineering professionals can deliver by having technical mastery of a domain that is central to the effective delivery of an agency's objectives. Consequently for many engineering specialists there is a remuneration ceiling which they reach despite their continual growth in expertise and contribution they make to an agency.

AGENCY RETENTION CHALLENGES

In response to shortages, agencies have increased their efforts to retain existing employees. The typical action taken has been to offer monetary incentives, notably retention allowances and project/location allowances. This focus on higher remuneration packages is increasingly recognised as simplistic because it fails to acknowledge that there are multiple causes for people staying or leaving. This conclusion is supported by the evidence in a 2010 survey of Australian Government agencies that reported that 'retention and project allowances were found to be ineffective in improving retention by more than half of the agencies that used these strategies'.⁴³

As agencies have increasingly recognised the limitations of monetary rewards for improving retention, they have introduced additional strategies. These have included:

- Professional development.
- Well-being programs.
- Multi-skilling positions.
- Greater autonomy.
- Improved working time/work-life balance.

Each of these strategies has had varying degree of effectiveness as seen in Figure 6.2. This figure illustrates APS agencies own assessments of the effectiveness of their retention strategies, and identifies that study assistance, management or leadership training and flexible work practices were most effective while retention and project allowances were the least effective.

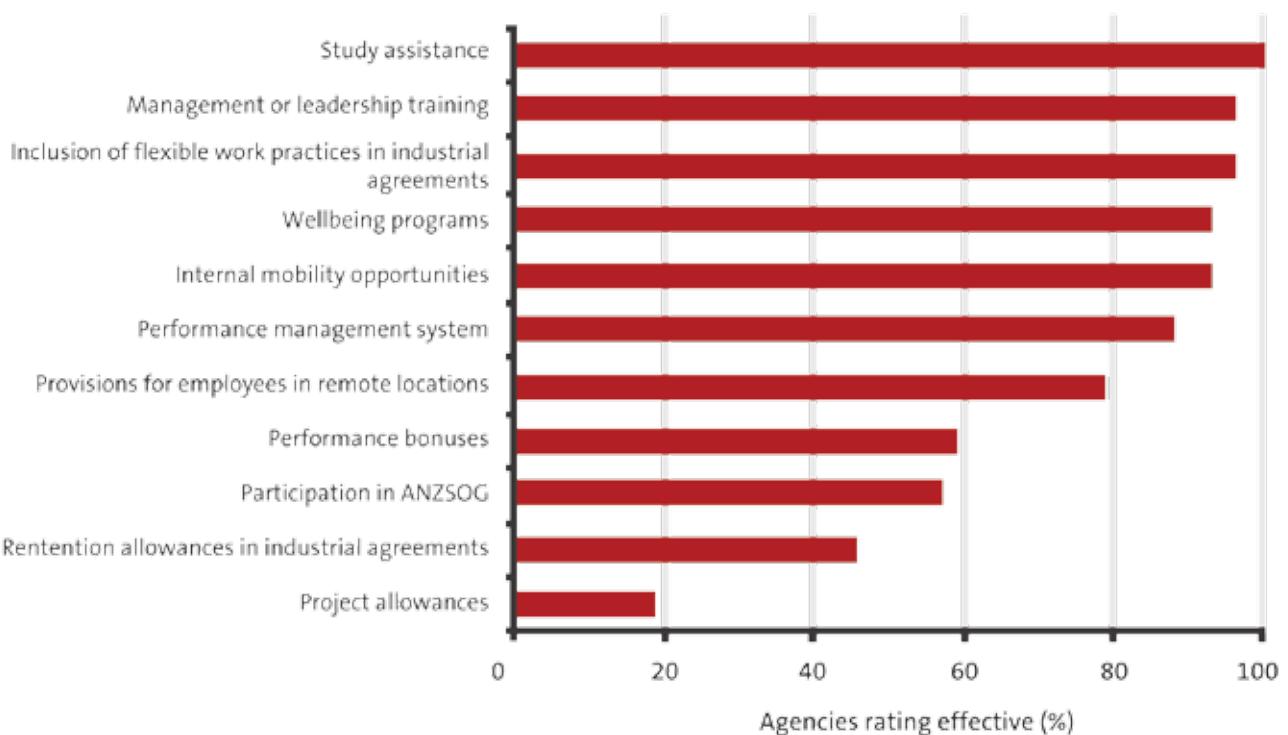


Figure 6.2: Effectiveness of retention strategies as reported by agencies, 2010–11⁴⁴

⁴³ Australian Public Service Commission, 2011. *State of the Service Report 2010–11*. p. 198.

⁴⁴ Australian Public Service Commission, 2011. *State of the Service Report 2010–11*. p. 200.

Most of the above retention strategies address job conditions, such as salary, training and time. This is because these are the issues that can be targeted through particular initiatives. However, this approach fails to address many of the reasons why people actually leave or stay. In a survey of APS employees who had indicated they would leave their agency in the next two years (Figure 6.3), the most common departure reasons were:

- Desire to gain more work experience.
- Lack of career opportunities in their agency.
- Desire to change their work or career.
- Lack of recognition, and
- Lack of opportunity to work on innovative programs.

As can be seen from the list of retention strategies in Figure 6.2, few of these address directly the main reasons why people leave their employment.



Figure 6.3: Employee reasons for intention to leave agency within the next two years, 2010–11⁴⁵

⁴⁵ Australian Public Service Commission, 2011. *State of the Service Report 2010–11*. p. 201.

Figure 6.3 was compiled for all employees, and probably underestimates the importance given by engineering professionals to the top five reasons. This is because most professionals place high value on professional growth, interesting work, making a valuable contribution, and being recognised for their expertise. While remuneration and job conditions are obviously important, most technical professionals are at a level where these are satisfactory, and thus they are not major motivating factors. (However, for more junior engineering professionals, greater importance may be given to remuneration/job conditions compared with career/status issues).

Another common oversight in agencies' retention strategies is the lack of recognition by them of an individual's expertise and contribution. The last decade or so has led to a decline in the status of technical professionals which has corresponded with the rise of generalists and new public sector management approaches. This is reflected in the frequent use of pejorative phrases such as that professionals should be "on tap, not on top". Another illustration of the decline is the disparaging public statements made by senior public sector leaders about specialists. For example, Duncan Lewis, presently Secretary of the Department of Defence and then Deputy Secretary, Department of the Prime Minister and Cabinet, was quoted as saying "I would prefer to have a well developed generalist in charge and hire in specialists"⁴⁶ when referring to the desirable characteristics of senior managers.

⁴⁶ Hay Group, 2008. *Public Sector Evolution (Focus)*. p. 3.





A large satellite dish antenna is positioned in the lower right foreground, its metallic grid reflector and support structure visible against a clear, light blue sky. In the upper left background, another massive satellite dish antenna is partially visible, its massive truss and mesh reflector extending across the frame.

CHAPTER SEVEN

RECOMMENDATIONS

Being an informed buyer is central to achieving value for money from procurement. Value for money should not be based solely on determining the costs and benefits that accrue to the agency from the procurement. It should also consider the costs and benefits that the procurement makes towards advancing Government objectives, the outcomes from other agencies, and interests of key stakeholders including end-users, industry and other levels of government.

Achieving this wholistic concept of value for money requires agencies to have an effective procurement system underpinned by the provision of a range of expertise. The procurement system is more than just procurement cycle, which is made up of the stages of a procurement process (i.e. identifying the need, determining the procurement process, conducting the procurement process, managing the contract and managing the termination or transition). The procurement system is the combined effect of the agency's procurement organisational arrangements, procurement processes and technologies, procurement expertise, and procurement performance management system.

Engineering expertise is an essential component of the expertise needed by an agency to procure engineering-intensive products and services. This is because these procurements require technical skill and domain knowledge so as to make informed judgement on the costs, benefits and risks across the stages of the procurement cycle. For example, engineering expertise is needed to define a procurement's desired functional levels, performance levels and outcomes, and to evaluate tenderers' estimates of whole of life costs. Engineering expertise can also make a major contribution to improving procurement systems through the application of engineering practices/approaches, and organisational techniques, such as project management, systems analysis and technology management.

The following recommendations aim to ensure that agencies have the appropriate level of engineering expertise to support procurements of engineering-intensive products and services.

IMPROVING GOVERNMENT'S PROCUREMENT PROCESSES

Procurement is a strategic and core function of governments. Without it, most agencies would not be able to deliver their programs nor would governments achieve many of their broad objectives such as innovation and regional development.

While once procurement was an administrative function used to obtain supplies for their in-house groups to deliver services, today agency procurement results in the private and non-government sectors actually delivering public services and public goods. Given the centrality of procurements to achieving governmental outcomes, the last decade has seen all Australian governments work towards improving procurement. Most effort has been focused on improving the procurement cycle and its constituent stages, with less focus on improving the procurement system.

Examples of agency initiatives to improve the procurement cycle are providing guidance on activities required within each stage, defining what constitutes value for money, and developing different procurement processes for different procurement risk profiles. Examples of improvements to procurement systems are developing competency based training programs for procurement staff, introducing procedure awareness training for non-procurement staff, and assessing the procurement system's maturity level.

One priority area for improvement is better aligning procurements with multi-level governmental objectives such as whole of government outcomes, multi-agency outcomes, and transient and enduring government objectives. Such alignment is critical to achieving integrated government responses which is increasingly being demanded by executive governments and the public.

Recommendation

- Agencies should explicitly recognise that procurement is a strategic and core function, and focus their activities on developing procurement systems that ensure alignment between procurement and multi-level governmental objectives.

ENSURING AGENCIES HAVE ACCESS TO APPROPRIATE ENGINEERING EXPERTISE

Agencies need to have access to the level of engineering expertise that is appropriate to the scale, complexity and risk of engineering-intensive procurements. To determine the appropriate level requires a detailed analysis of the needs, and evaluating the costs and benefits of different options for its provision. The method that should be used to undertake this analysis is the procurement cycle as used by each public service.

By applying the procurement cycle, an agency will gain the strategic information required to make an informed and justifiable decision on what mix of internally and externally sourced expertise is optimal, and how that expertise should be integrated into the agency's procurement activities. Following the procurement cycle also provides an agency with operational information that allows the optimal sourcing strategy and procurement method to be identified.

Using the procurement cycle does not presuppose that engineering expertise will be provided externally rather than internally. Both internal and external provision of expertise needs to be considered and compared. The analysis of the need should be done at a strategic level in the agency, rather than at a unit level and then aggregate the results. This is because the engineering expertise capability is a strategic resource that can only be managed efficiently and economically at a whole of agency level.

Recommendation:

2. Agencies should use the procurement cycle methodology to identify the contribution that engineering expertise makes to their procurements, to identify the volume and type of engineering expertise required, and to determine how best to access it.

An agency in its analysis of engineering expertise provision is likely to identify external constraints that prevent it from accessing the optimal balance between internally and externally sourced expertise. Examples include:

- Government imposed personnel ceiling caps and recruitment freezes.
- Agency efficiency dividends and productivity initiatives forcing reduction in recurrent costs including staff.
- Government imposed caps on contracting.
- Public service limitations to offering competitive remuneration for engineering professionals.

Governments may be unaware of the costs that constraints can have on agencies. If the government became aware of the true costs and the benefits from their removal such as reduced costs, reduction in procurement delays and better integrated government responses, they may be more receptive to removing the constraints.

Recommendation:

3. To ensure that governments make informed decisions at a public service wide level on the most cost effective way to access engineering expertise to support agency procurement, agencies should collectively examine how improvements could be made by addressing constraints in the sourcing of engineering expertise.

Agencies can use a number of procurement approaches to obtain externally sourced engineering expertise to support their procurement activities. The selection will depend on the type of professional engineering services required and the market for it. Choosing the wrong approach can have significant cost, time and performance penalties. For example, a factor leading to the unavailability of Navy's two amphibious ships in 2011 was the use of "short-term, individual contracts for the conduct of external maintenance"⁴⁷ as these were both resource intensive and failed to foster needed investment by industry in building the capabilities required in terms of scale, availability and quality.

⁴⁷ Department of Defence, 2011. *Plan to Reform Support Ship Repair and Management Practices* (Rizzo Review), p. 23.

If agencies require skills that are readily available, then competitive contracting may be the optimal solution. If the agency requires uncommon specialised expertise, a more strategic approach would be better. This could include using panel arrangements where a number of suppliers are selected, each of whom could supply the required services. In instances where the skills are both uncommon and specialised, and where the skills are critical to the agency's outputs, a partnership arrangement may be appropriate. Such an approach would involve the agency committing to a long term arrangement that is sufficiently attractive to a company to develop co-capabilities specifically to support the agency. An example would be that the agency and company develop co-capabilities to better develop and define statements of requirements for contracts. Given that the company's staff would have access to commercial information of government, a condition of the arrangement could be that the company would not bid for agency work. Such a partnership arrangement is likely to be rare due to the costs and risks in establishing such arrangements. The need to develop these partnerships may be controversial but they recognise the risk posed by not having access to expertise.

Recommendation:

4. Agencies should identify uncommon and specialised engineering expertise that is critical to their outputs, and develop effective and efficient arrangements to ensure its continued provision.

Recommendation:

5. Agencies undertaking capability and maturity assessments of procurement systems should incorporate engineering expertise considerations into their methodology and outcomes.



ASSESSING ENGINEERING CAPABILITY AND MATURITY

Agencies are increasingly using capability and maturity assessment to drive system improvements. When these assessments examine procurement of engineering-intensive products or services, it is essential that agencies consider engineering expertise issues. This requires agencies to understand how the maturity level of engineering expertise can be defined, how the process of engineering expertise provision operates, and which factors are important in assessing their engineering capability maturity level.

MAINTAINING AND IMPROVING IN-HOUSE ENGINEERING EXPERTISE

Recognising that agencies are likely to face continued shortages of engineering professionals, they need to develop a coherent and comprehensive approach to the challenge. This includes addressing the ageing of the workforce, the remuneration gap between the public and private sectors, the low level of recruitment and training of graduate engineers, and deficient employment classification systems.

Just as the average age of all employees in many agencies is increasing, so is the age of the professional engineering workforce. Many agencies have developed generic strategies to address this problem, and it is important that specific issues relating to engineering professionals are factored into them.

Recommendation:

6. Agencies should identify issues specific to engineering professionals and factor these into their workforce ageing strategies.

Given the existing and growing remuneration gap between public and private sector engineering professionals, agencies should seek to analyse and where appropriate, close the gap.

Recommendation:

7. Agencies should identify any remuneration gap between public and private sector engineering professionals, determine if this acts as a disincentive to recruitment and retention, and if it does, takes steps to close the gap.

There is a low level of recruitment and training of graduate engineers by many agencies and private sector organisations. For those areas where the agency is a significant market player in the use of engineering expertise, it should consider influencing the supply of expertise through increased recruitment and training of graduate engineers. This could include developing cadet programs with a return of service requirement, and imposing training requirement on successful tenderers.

Recommendation:

8. For areas where an agency is a significant market player in the use of engineering expertise and where there is a shortage, agencies should influence the supply of expertise through increased recruitment and training of graduate engineers.

The employment classification system used by the public sector significantly shapes the engineering capabilities of agencies. This is because the classification system influences career options, determines the link between skills, competencies and education and position level, and links position levels with remuneration. Unfortunately most public services lack a modern employment classification system relevant to the engineering profession.

To improve classification systems, each needs to provide professional engineering position levels, and either a professional officer or a stand-alone engineering professional stream. The classification system should recognise the following four levels of engineering professionals:

- Development – These are engineers who have recently graduated and are still gaining practical skills. They require considerable supervision and support. They benefit from formal graduate development programs exposing them to a broad range of engineering activities.
- Practitioner – This is the most common level of engineer in a public service. They undertake a wide range of design, regulatory, policy and program activities including procurement. The experience of these professionals grows with time, and they normally undertake work at a level commensurate with their ability rather than their formal position level.
- Specialist – These are engineers who have deep subject matter expertise and are recognised as experts by their peers. They are primarily expert practitioners, and usually undertake little engineering management.
- Engineering manager – These are engineers who focus on the management of engineering functions such as project management, procurement and engineering staff management. They are usually involved in the delivery of an engineering capability rather than the technical aspects of the inputs to the capability.

The employment classification system should allow engineering professionals to become specialists with status and remuneration that reflects their contribution to the agency. Currently engineering specialist positions are rare within public services, and where they do exist, their level is often capped at below senior executive equivalents. The reason for this is that most classification systems are designed around the assumption that higher level management skills make a greater contribution to the agency than increasing levels of technical mastery. However, this approach ignores the value that engineering professionals provide by having technical mastery of a domain that is central to the effective delivery of agency objectives. To rectify this deficiency, classification systems should have specialist position levels.

The employment classification system also needs to ensure that competencies specified in job statements align with modern national competency standards, rather than using unique agency-defined competency definitions. The consequence of specifying agency unique competencies is that these are not recognised by other agencies or the private sector, meaning that they inhibit an engineer's employment portability.

Recommendation:

9. Public service employment classification systems should accommodate engineering professionals by:
 - Recognising the four levels of skills development of engineering professionals development, practitioner, specialist and engineering manager.
 - Allowing engineers to become specialists with status and remuneration that reflects their unique and valuable contribution.
 - Ensuring that the competencies specified in job statements align with modern national competency standards.

Facilitating movement of public sector engineering professionals across agencies is a tool that would improve retention. Currently in most public services, staff find it difficult to move between agencies. There are two main reasons for this. Firstly employment contracts are signed between individuals and an agency rather than with the public service as a whole. This is a recent phenomenon. For example, APS centralised recruitment ceased only in 2000. This means that to change positions within the public service is effectively the same as changing employers, and this typically requires a comprehensive selection process. Secondly, agencies define position levels differently and although the position may have the same title, it can have different remuneration, conditions, work responsibilities, duty statements, and educational prerequisites. This means that determining equivalence in positions across agencies is time consuming and in some cases impractical. By having standardised position levels across agencies, movement between agencies would be facilitated.

Recommendation

10. Public services should seek to better facilitate the movement of engineering professionals between agencies.

The retention of engineers has become an ongoing problem for most public services. Many reasons for the shortages are advanced including more attractive salaries in the private sector, and a lack of career opportunities in the public service leading to low levels of job satisfaction.

Undertaking an all-agencies study of the reasons why engineering professionals' stay of leave is an essential first step to gaining the evidence to determine the most cost-effective methods for improving retention. Such a study should give particular attention to determining the relative importance of intrinsic and extrinsic motivation as a driver of job satisfaction.

Invariably, efforts to improve intrinsic job satisfaction will involve a multi-pronged and comprehensive approach that will require changes to career structures, workplace culture and the senior public sector leaders' assessment of the correct balance between generalists and specialists. These issues are unlikely to be addressed at an individual agency level as

many are linked with public sector wide issues. Consequently, this study is likely to feed into the public sector wide change management agenda. The study's findings will also be useful to individual agencies in benchmarking their retention efforts.

Recommendation:

11. Public services should commission a study of the reasons why engineering professionals stay or leave, and use this information to improve retention strategies.

Establishing communities of practice across a public service has been a proven way to build key whole of government capabilities. Examples exist in all public services, such as the APS's Workforce Planning Working Group Community of Practice and the ACTPS's Return to Work Coordinators Community of Practice.

Establishing an Engineering Community of Practice Network that spans all agencies in a public service would assist in building and maintaining collective expertise. This semi-formal information sharing network would form a number of interest groups that correspond to the public service's needs, such as engineering graduate training programs, engineering procurement standards, and engineering regulation. The network would be open to engineering professionals from across all agencies. It would:

- Lead to the dissemination of leading practice.
- Build a collegiate atmosphere.
- Facilitate multi-agency engineering workforce planning, and
- Assist in improved management of temporary and permanent transfer of engineers between agencies.

An Engineering Community of Practice could also lead to the development of whole of government guidance for agencies on raising, training and retaining engineering professionals.

Establishing this network would provide a single point of reference for public sector wide planning and management relating to engineering professionals. The leadership group of the network would be a point of contact between senior

public service leaders or politicians, and the engineering profession. The head of the network would provide opinions on public service wide issues. They would not comment on actual engineering decisions or the activities undertaken by agencies.

At a symbolic level, creating the position of Public Service Head of Engineering Practice would make a significant statement by the public sector about the importance of engineering in delivering government objectives.

Recommendation:

12. Each public service should establish a cross-agency engineering community of practice to improve engineering practice, encourage multi-agency engineering workforce planning, and facilitate the movement of engineers between agencies.

