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Chapter 5

Project Scoping

Manual Contents

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Chapter 5
Project Scoping

5.1 Introduction

5.1.1 Understanding Scope

It is important to have a common understanding of what is meant by project scope. For road infrastructure proposals it is essential for project costs to be tightly managed and controlled. In this context there are two aspects of scope that need to be managed effectively during the delivery of the preconstruction processes, i.e.:

- The What or Product Scope (functional outcome); and
- The How or Project Scope (work necessary to deliver the functional outcome).

The OnQ project management methodology identifies the activities for these two aspects of scope as:

1 **Work Management** - describes the project work activities necessary to deliver the product in accordance with the specified requirements (functional specification).

2 **Project Management** - describes the project management activities necessary to manage the delivery of the product.

Road infrastructure project scope is defined within the context of the required outcomes and in accordance with the specified corporate objectives for the link concerned, i.e. "Fitness for Purpose".

Defining "Fitness for Purpose" is a critical prerequisite. The process requires articulating the problem (specific problem to be addressed), the need (functional requirements) and the determination of constraints on the options and the final solution. In this context "Fitness for Purpose" means:

1. The solution meets the Corporate Objective for the development/ maintenance of a specific part of the road network, e.g.:
   - The outcome satisfies the Investment Strategies,
   - The solution is economical,
   - The solution has the appropriate level of safety.
2. Compliance with the appropriate corporate standards in the development of the solution (Road Planning and Design Manual, *including the extended design domain for existing roads only*, Road Drainage Manual, Drafting and Design Presentation Manual, Pavement Design Manual, etc.);
3. The application of the standards to achieve a solution that is in harmony with the site/location conditions: - e.g.
   - Ground conditions;
   - Environmental circumstances;
   - Local community considerations/ restrictions (noise, vibration, local accesses, night work, visually acceptable, etc.);
   - Traffic management through the work site.

In the first instance, project operational objectives are described in a functional specification (see Section 5.1.5). The brief must clearly specify the requirement. This is important as it puts a boundary around the project deliverables to prevent scope creep during the development of the project. In this respect 'in scope' and 'out of scope' statements help to tightly define the requirement. Scope definition includes functionality requirements, maps, dimensions, plans, lists of works to be undertaken, descriptions of major components (e.g. intersections), specifications and assumptions on

what is to be encountered during project delivery (see Section 5.1.2).

In the second instance, it is necessary to identify all of the considerations, including the issues and risks that impact on the actual work comprising the deliverables. These requirements are established by investigations (*e.g. native title, geotechnical, environmental, cultural heritage, public utility plant*), consultations (*e.g. community, local member, local government, native title*), studies (traffic, hydraulic), and reports (*e.g. road safety audits, developmental proposals*).

Although the level of detailed information improves as the project life cycle unfolds, project managers should ensure adequate information is available to define project scope consistent with the level of accuracy possible at that stage in the project lifecycle.

Project scope must be carefully monitored throughout the whole project life cycle to ensure the project benefits and the infrastructure provided are consistent with that approved by the client.

5.1.2 What Defines Scope

Effective project scope definition leads to:

- Effective cost control;
- Effective time management; and
- Effective quality in outcomes.

Project scope is defined in a number of dimensions, each of which has an influence on the final outcomes, including cost, timing and quality of the product, and on the business or functional reasons for undertaking the project

Scope incorporates:

- **Location** - site remoteness, transportation, terrain type, adjoining industry (e.g. airports), presence of other infrastructure or developments (proposed, planned, perceived), population density (rural, urban), local features, etc;
- **Geotechnical** (e.g. availability of materials, construction conditions)
- **Physical dimensions** - length (start and finish point), width, number of lanes, number of carriageways;
- **Service standards** - traffic capacity, traffic delay, intersection treatments, access control, accident reduction, closure due to flooding in flood prone areas, amenity for local residents and businesses, disruption during construction;
- **Quality standards** - design speed, design standards, design life, traffic loading on structures, technical specifications, tolerances, architectural features, urban design;
- **Environment** - Noise levels, rainfall intensities, erosion and sediment control, flora and fauna preservation, heritage protection;
- **Timing** - time for completion or putting the infrastructure into service, or achieving designated milestones;
- **Estimate of cost** - while determined by other aspects of scope, the cost estimate puts a boundary on the project cost; and
- **Programming and Budget** - total funds provided, distribution of funds over the life of the project.

Some of the generic influences on the project scope include:

- Design standards;
- Traffic loading on structures;
- Technical specifications;
- Tolerances;
- Environmental standards; and
- Regulatory requirements.

It is important that the organisation has a clear understanding of these issues as changes to these can still affect the time, cost, function and other project outcomes.

The definition of the project scope must state the assumptions, constraints and exclusions that have been used. This can mean that issues not included in the list above can emerge (e.g. needs of a culturally diverse community). These should be included in the description of the scope if appropriate.

The elements listed above should be incorporated in the project scope with the appropriate level of detail. In addition, considering the required outputs of the applicable phase provides further detail for the scoping development. Some details are refined as the project develops and the project manager should ensure that these are documented and progressively approved by the Client.

Charts 4, 5 and 6 (Chapter 3) provide generic details as to the approvals, inputs and outputs of each phase.

5.1.3 Importance of Accurate Scope Description

Since the project scope defines what is to be built, it is a key factor in delivering the Client's desired business, or road network outcomes. The risks of poorly defined scope include:

- Inaccurate estimates creating problems in funding;
- Project not being viable economically and in other ways;
- Delivered project not being fit for its intended purpose;
- Functional, social, strategic, environmental outcomes not being realized;
- Influence of stakeholders/ interested parties not able to be controlled, e.g. community pressure to make changes during construction;
- Less control occurring on the project, particularly in design (e.g. 'gold plating' vs. fit for purpose), community expectations, project and project management performance;
- No clearly defined scope of works being signed off by Client / Sponsor;
- No baseline for controlling future changes to the project hence less control on 'scope creep';
- Delayed approval process occurring as a result of the approving authority not being clear on the impacts of what is being approved. This can include funding, environmental approvals, and Government endorsement;
- No criteria for gauging Client satisfaction with the completed project;
- Uncertainty and inefficiency in budgeting, programming across projects and cash flow occurring;
- Unclear understanding of the project and project outcomes at all levels, including community and Government;
- Uncertainty affecting the project team, leading to inefficiencies, confusion and rework; and
- Uncertainty in scoping briefs, contract documentation etc needed to deliver the project occurring;

In addition, flow-on effects outside of the project can be quite damaging, e.g.

- An unaffordable project being built at the expense of affordable projects; and
- Inefficiencies occurring in delivering the Roads Program due to funding uncertainties;

The above risks highlight the importance of well-defined project scope and reinforce the need for putting sufficient time and resources into the scope definition.

5.1.4 Scope as Project Control

The project scope defines what the client wants in terms of the physical product, including its life (how long it will last), visual aspect (architectural and roadscape), how it fits in to the environment, as well as the traffic operation and other functions of the project.

It also defines what is expected of the project manager and contractors in delivering the project.

The scope is also an essential project control for:

- Benefits / economic analysis;
- Project planning;
- Cost estimating;
- Time estimating and scheduling;
- Budgeting;
- Time and cost reporting;
- Developing work packages, e.g. design briefs, construction contracts;
- Reporting on progress against requirements; and
- Finalisation and project evaluation.

Changes to the scope of a project are not to be made without concurrence or approval of the Client.

5.1.5 The Functional Specification

The functional specification is the key document in a planning and design project as it describes the scope of work, the activities to be undertaken and how the management of the scope of works will be undertaken.

Different functional specifications provide various levels of control depending on the nature of the project. There is no one correct way of creating or managing the functional specification. However, management tools and techniques that aid in the process are available to ensure that the functional specification is applied to the circumstances at hand most effectively.

The development of the functional specification requires a structured framework to ensure:

- The scope is adequately defined;
- The management of the project is undertaken such that that original scope is adequately and regularly monitored against needs and functionality; and
- Any identified changes to scope are appropriately investigated, approved and authorised before being undertaken.

When used for briefing a consultant to undertake the work, the content of the functional specification should include at least those details depicted in standard proforma specifications for Options Analysis, Business Case, Preliminary Design and Detailed Design (Refer Section 4.3.2 of the Manual - Consultants for Engineering Projects). These can also be useful for internal functional specifications.

This manual is specifically developed for the traditional process (a design then construct delivery strategy), and not the "design and construct" type project delivery strategy, even though much of the material would be useful in both cases.

5.2 Scoping

5.2.1 Scope Development

The scope will be defined in the brief / functional specification from the Client and be based on the business outcomes required, the functions the project is to perform, the funds available and the expected return on investment. Future management, operation and maintenance factors should also be considered. The process includes a number of hold points or stages where the Client can review details of the project progress and give approval to proceed to the next stage.

The Client remains responsible for the scope throughout the life of the project.

The Project Manager may assist in defining the project scope on behalf of the Client, but the Client is the one who must approve the scope. Part of the process of defining the scope should include identifying and analysing the project risk to ensure that assumptions and exclusions in the scope are well founded.

The scope is progressively defined and refined at various stages:

- Strategic level (*Studies that establish corporate objectives*);
- Pre-project activity (*project requirements described in terms of required outcomes*);
- Concept Phase (*defining the solution*); and
- Development Phase (*detailing the solution*).

Inputs include the functional specification and previous information, reports and studies. If an extended period of time has elapsed since the previous phase, the project particulars will need to be revisited and their completeness, accuracy and applicability confirmed. This especially applies to the estimate and the desired functionality.

If considerable time has elapsed, substantial rework of the previous phase might have to be undertaken. There is no benefit to be derived from proceeding with a previously dormant project without verifying its current status.

Any changes need the agreement of the Client.

5.2.1.1 Network Planning Phase

The process of defining a project follows the completion of a strategic needs analysis / link study, undertaken to identify such things as road / transport network deficiencies, traffic flow, road safety, rehabilitation requirements, structural deficiencies, new developments and relationships with existing infrastructure.

A broad project scope is defined as part of the strategic analysis. It will include location and approximate length, and have some broadly defined requirements such as level of service and traffic capacity.

5.2.1.2 Concept Phase

The major decisions on project scope are made during the Concept phase of the project. This is also the period in which the greatest ability to influence the project outcomes occurs. The process includes a number of hold points or stages where the client can review the project proposals and give approval to proceed to the next stage.

The first stage of this phase is the **Project Proposal** (Section 4.4.1), which defines the requirements a particular project is expected to deliver. In many cases the requirement may be restricted to addressing only part of the overall need to match available funding. In this circumstance a clear understanding of the requirement must be articulated to avoid scope creep during the design development process.

The project concept phase is about defining the scope to the extent where a project cost estimate (concept estimate) can be produced to within ± 20% of total project (final) cost. It includes, in addition to the Project Proposal, an Options Analysis, and Business Case development.

The **Options Analysis** (Section 4.4.2) is largely about identifying a preferred option and its scope.

See Section 4.4.2 for the purpose and objectives of options analysis.

The development of project solution options requires the benefits and costs of the project to be established, based on each option having a clearly defined scope, comparative cost and functional requirements. Determining the relevant investigations, consultations and studies to be conducted is the approach to a large extent for establishing the scope of each option, having involved community, other government agencies and planning authorities in a formal process of review and approval.

Once the preferred option has been selected it is submitted together with a recommendation to the client for approval. Approval authorises the options analysis to progress to the next stage of the project - **Business Case** (Section 4.4.3).

The development of the business case reviews the required outcomes from the project and the preferred option, including benefits to the road users and community. The project scope is further refined in the development phase by detailing how those outcomes are to be delivered.

Once the preferred option has been developed to the stage where a *reliable cost estimate* (i.e. fully validated concept estimate) has been established, it is submitted together with a recommendation to the client for approval. Approval authorises the business case to proceed to the next stage of the project - Development.

A key output of developing the business case is to identify and instigate the necessary detailed studies to consolidate the scope and to identify associated risks.

The environmental assessment requires the benefits and costs of the project to be spelled out, based on a clearly defined project scope and functional requirements. Determination of the environmental assessment (EIS or REF) fixes the project scope to a large extent, having involved the community, other Government agencies and planning authorities in a formal process of review and approval. After determination, changes to the project may require a further EIA.

Project scope determined at the Concept stage is critical to project outcomes. Unidentified issues requiring changes during design or construction can be very costly.

The Client must approve the project scope prior to the REF / EIS being publicly displayed and again prior to determination of the REF / EIS if there are any changes. Following determination of the REF / EIS for Development projects, a Project Business Case is submitted to the Client to confirm the scope and cost components and the required cash flow. This gives approval to proceed to the next phase.

This is an important stage in the process of ensuring that the scope is right and that the project is able to deliver the desired outcomes.

Client approval of the Business Case, at the end of the Concept phase, is an important milestone, allowing the project to enter the Development Phase.

5.2.1.3 Development Phase

The project development phase is about refining the scope defined in the concept phase to the extent where a project cost estimate (detailed estimate) can be produced to within ± 10% of total project (final) cost. The development phase occurs in two parts - **Preliminary Design** and **Detailed Design** (see Chapter 5 for details).

It is absolutely crucial to the project that at this stage an appropriate risk management study be conducted in order to identify all possible risks that may be associated with project delivery at various stages of its lifecycle. Each item of risk/ uncertainty must be scheduled as a separate contingency.

The **Preliminary Design** activities progress and further refine the scope by adding more detail to the preferred option by virtue of greater depth of project design, e.g. pavement structures in lieu of notional pavement design. Also, structure design (e.g. bridge design) is undertaken and the details of key aspects (e.g. foundations, substructures, superstructures) are completed.

Once preliminary design has been completed (all major design components concluded, including major structures), together with a preliminary estimate, a recommendation is submitted to the client for approval. Approval authorises Preliminary Design to progress to the next stage of the project - Detailed Design.

See Chapter 5 for the purpose and objectives of the preliminary design.

Detailed Design completes all design activities and hence finalises the scope by providing a full schedule of work for estimating and construction purposes. This provides the final scope review before the development phase is completed.

The accurate calculation of project work items cannot be made until all project risks and issues have been identified and dealt with progressively throughout the delivery process. Some of these risks and issues will result in additional work items in the project schedule whilst others that cannot be fully quantified will appear as contingencies in the schedule.

Whilst most risks are identified during the concept phase it cannot be taken for granted that all risks have been identified. For example, it is not an uncommon occurrence for further risks to be identified in relation to the design of underground structures in the development phase. In this respect it is very important to ensure risks that relate to the need to move public utility plant to accommodate proposed new work items are identified and managed. It is also important to ensure that design interfaces (including underground installations) are checked for compatibility.

During the development phase all risks should have been identified and accounted for by either removal as a risk or provision made in the schedule for each such risk as a contingency with a dollar amount to cover its treatment during construction.

This phase includes establishing the construction contract.

See Chapter 6 for the purpose and objectives of detailed design.

If, as a result of the development phase, changes are proposed to the approved scope, they must be submitted to the Client for approval.

5.2.2 Scope Planning

Scope planning includes the process of scope development together with a written scoping statement including the criteria used to measure the success of the scope development process.

It is critically important that the project passes through interfaces between phase activities without losing any information (e.g. assumptions made) or understanding of the requirements. This baton change / handover process needs to be rigorous and as seamless as possible. The client leadership approach (Chapter 3) will assist in a smooth project transition across activity interfaces as this should make the client conversant with the project details because the client agreed to development issues on a progressive basis through the phases. Also, including key personnel from adjoining upstream and downstream phase activities facilitates effective baton changing.

Ultimately the Project Plan is developed from negotiations and should document the scope of works. This becomes an output of the scope planning activities. Outputs are defined by project deliverables and these should be documented in the Project Plan. If the deliverables are already detailed in the proposal and remain unchanged, appropriate cross-referencing to the Proposal in the Project Plan could be sufficient.

5.2.2.1 Scope Definition

The scope of a project is dependent upon accurately identifying all work activities that comprise the project. For infrastructure projects the extent of work required to establish the work activities will vary depending on the project environment. However, identifying key stakeholders is essential to ensure that the less obvious project issues are identified. In addition, the studies, investigations and consultations undertaken in the options analysis stage will identify further activities that need to be considered in the development of the project.

Scope definition requires the subdivision of the project deliverables into smaller components (i.e. tasks) and aims to:

- Improve the capability to estimate costs;
- Define a base line against future performance measurement; and
- Facilitate allocation of responsibility to work packages.

Assumptions can be documented via the risk analysis process.

Identifying the major elements of the project enables structuring the Work Breakdown Structure (WBS) over the applicable phase or phases of the project life cycle. Thus the first level should include concept phase (proposal, options analysis and business case) and development phase (preliminary design and detailed design).

The next level should include work packages such as survey, geotechnical, environmental, hydraulics, impact assessment statement (IAS), road safety audits, native title and public utility plant (PUP) as applicable.

Functional units will further disaggregate activities for their management purposes, usually in the form of a project program.

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A draft program should be supplied with the proposal to represent the WBS and it is useful to indicate to the client that the Project Manager appreciates the scope of works. Major deliverables such as review and approval requirements should also be detailed in the program at the first level of break down. This draft is reviewed and amended following award of the project and forms an element of the Project Plan.

At about this stage the various programmed activities are assigned a unique identifier that reflects the costing code of accounts.

Proper scope definition is important to ensure that future inevitable changes that occur will not cause disruptions that will have significant time and cost implications.

5.2.2.2 Scope Verification

Scope verification is about formal acceptance by the client that agreed work has been done satisfactorily, e.g. the approval and sign off of the preliminary design activity is the ultimate scope verification for a planning project.

Successful scope verification requires the progress of the project to be documented, and opportunities to be provided for joint reviews (client, project manager and key team members) of the project and activities so that formal acceptance is progressive. These processes are built into the Project Quality Plan and are facilitated by various project quality forms that document the various communications, reviews and sign-off of progress evaluations (see Attachment G of the Manual for the Engagement and Use of Consultants).

5.2.2.3 Scope Control

Scope control is about:

- dentifying the factors that create scope changes to ensure changes are beneficial;
- Determining that scope change has occurred;
- Managing the changes if and when they occur, including client approval of change.

The system requires not just changing the scope because it is required but also identifying and documenting the need for, and impact of the change and the review and approval of changes.

Not all scope changes are readily obvious. A more insidious form of scope change is scope 'creep'; it often goes unnoticed until a re-estimate occurs at the end of the phase. This should be avoided by determining effective monitoring of progress against the functionality required in the brief.

The identified changes must be reflected in a revised project program and estimate.

5.2.2.4 Common Pitfalls in Developing Scope

(a) Insufficient Information

- Unable to gather sufficient facts before starting.
- Misunderstanding or insufficient knowledge of the full requirements of the original project plan.
- Decisions based on "educated guesses".

(b) Misleading Assumptions

- Erroneous interpretations or conclusions of the facts.
- Unfortunate experiences with past applications of materials, etc.
- Bias against using new and sometimes very complex technology even though it has a proven benefit.

(c) Habitual Thinking

- Doing things the same way we've always done them.
- Tendency to re-use what worked the last time.
- Copying standards of other agencies.
- Insufficient attention given to the current state-of-the-art.

(d) Risk of Personal Loss

- The use of experienced personnel minimizes risk through trial and error.
- Risk associated with trying something that you have not tried before.
- Decisions based on comparable data, rather than the actual case.

(e) Reluctance to Seek Advice

- Designers should seek advice from others in their field for projects outside their normal experience range.
- Test their design/solutions with others.

(f) Time pressures

- Need to provide a project design as quickly as humanly possible.
- Pressure becomes so great that anything with a reasonable chance of working is designed into the project.
- Acceptance of the first workable solution in order to complete the design on time.
- No time to sit and contemplate.
- No time to sit and think up alternative approaches.
- Lack of appropriate tools/software.

(g) Negative Attitudes

- Reluctance to consider a change of any type regardless of its merit.
- Check again the initial design to test there is not a better solution.
- No time to identify and call on experienced personnel.

(h) Rapidly changing technology

- Rapid strides taking place in the development of processes, products, and materials.
- Technology is constantly changing.
- No one person can be expected to be completely current in any field.
- Specialist advice not accessible.

(i) Strict Adherence to "Requirements"

- Requirements are often unrelated to required performance, materials, safety or procedures.
- Assumed requirement when not actually specified.
- Concentration on the development of a reliable system that exceeds all known and assumed requirements.
- Each unnecessary requirement that is met in a design costs money, but worse still, may increase the chance of failure of the overall system.

(j) Unsatisfactory Human Relations

- Insufficient communications.
- Misunderstandings.
- Jealousy.
- Ego/afraid to 'lose face'.
- Normal friction between team personnel.

5.3 Techniques for Scope Development

There are a number of useful processes that can be used to assist in establishing project scope, e.g. value management, risk management, value engineering and group problem solving processes. Where the community is involved in these processes, care must be taken to ensure that they clearly understand that the outputs from these processes serve as inputs into the final decision making process. Final decisions are not made at public forums/workshops. However, it is important to reach a consensus on some of the key issues. In this respect the use of specific issue selection criteria with weightings could help bring about resolution of opposing views.

Using the concepts exposed in Section 4.3.2 - Project Scope, and Sections 5.3.1 to 5.3.4 describe useful methods for identifying scope together with relevant risks/issues are.

5.3.1 Value Management

Value management is a particularly useful and necessary method when assessing options for a major project e.g. town by-pass.

Value management is usually an 'open' and facilitated process that draws together in a workshop environment as many stakeholders as possible to identify the pros and cons of alternative options e.g. alternative routes for a town by-pass, by establishing:

- Community preferences;
- Industry and other road user preferences;
- Risks for each option;
- Advantages and disadvantages of each option;
- Issues relative to each option.

This type of workshop must include the community and other major stakeholders, e.g. representatives of local businesses and the transportation industry.

5.3.2 Risk Management

Risk management is a useful way of identifying specific risks/issues. The process often involves a facilitated workshop of appropriate stakeholders to review the project. These workshops can be held at any time during the preconstruction process to provide confidence that nothing has been overlooked in the scoping process.

Traditionally, risk management exercises are undertaken at the following process stages:

- In the project proposal where the risks relate more to the project itself; whereas
- In the options analysis where the focus moves towards item work risks; andIn the business case and the development phase where the focus is almost totally on work item risks.

5.3.3 Value Engineering Reviews

The goal of a Value Engineering (VE) study is to achieve design excellence. Its objectives are to improve quality, minimize total ownership costs, reduce construction time, make the project easier to construct, ensure safe operations, and assure environmental and ecological goals are met. The VE team is looking for the optimum blend of scheduling, performance, constructability, maintainability, environmental awareness, safety, and cost consciousness.

The VE review process seeks to overcome the pitfalls listed in Section 5.2.2.4 because it uses a team of individuals representing different disciplines who do not have a vested interest in the project. Value Engineering reviews are successful because they use multi-disciplined teams to break down a project into its basic functions and then use creativity to find different ways to perform these functions.

The following steps are used in every VE review:

- Identify the major elements of a project;
- Analyze the functions these project elements perform;

- Use brainstorming to develop several design alternatives to perform those functions;
- Evaluate the alternatives to ensure they do not degrade the project;
- Assign costs (including life-cycle cost) to each of the most promising alternatives; and
- Develop the promising alternatives into acceptable recommendations.

Value Engineering teams should provide management with as many recommendations as practicable. Staff officers whose specialty areas are impacted by the proposed recommendation should then evaluate the recommendations. Management must then decide, based on all available information, whether or not to approve the recommendation.

5.3.4 Group Problem Solving Process

5.3.4.1 Context

Group problem solving processes form part of providing strong client leadership to all parties towards gaining common and accepted project outcomes. It does this through increased integration of the supply chain in which there is increased participation by:

- downstream suppliers in upstream processes;
- upstream suppliers in downstream processes; and
- end users in upstream processes.

Correctly used, group problem solving processes will provide Main Roads with better whole of life outcomes across the project life from concept through to operation and maintenance.

5.3.4.2 Definition

Group problem solving processes are structured, systematic and analytical processes in which a group of interested parties (decision makers, stakeholders, technical specialists and others) combine to optimise value in systems, processes, products and services.

Value relates not only to price or value for the resources used but also to achieving what is of benefit or importance to the stakeholders in a particular circumstance.

The primary concept is that the collaborative output and thinking power of the group is greater than the sum of the output and thinking power of the individuals.

Typical group solving processes include Participatory Strategic Planning, Value Management, Value Engineering, Risk Identification & Management, Partnering (including Relationship Contracting) and Post Construction Reviews.

5.3.4.3 Purpose

The purpose of group problem solving processes is to produce a range of alternative ideas which may be used by the client and those participating in the planning, design and construction process to assist in taking decisions about the project. The process may be used to arrive at a decision on a project or to develop alternatives for further analysis.

5.3.4.4 Benefits

A number of benefits arise from Group problem solving processes:

- Shared understanding among a wide range of stakeholders;
- Savings in life cycle costs;
- A holistic solution to meet particular needs;
- Clarity, focus and improved communication;
- Savings in design and construction time;
- Reduced or well managed risks;
- Reflections and learnings transferred to future projects; and
- Injection of alternative ideas.

5.3.4.5 Appropriate Use

The use of group problem solving processes will vary with the project scale and complexity.

Group problem solving processes can be used in various phases of a project and for various reasons:

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- In the early concept phase to identify the base needs and the functional requirements to be incorporated into the project brief along with other physical characteristics;
- In the preliminary design stage to ensure that the design options generated meet the functionality requirements, to eliminate factors that do not contribute to the functionality and to optimise the balance between function cost and worth;
- In the detailed design phase to optimise the technical components of the project;
- During the project to identify and manage the risks associated with the project;
- During the project to identify the optimum delivery process and packaging for the project;
- During any contract process (e.g. consultancy, construction and maintenance) to quickly identify and resolve issues that arise during the contract; and
- At project completion to identify specific learnings arising from the project.

The most appropriate uses of the varying group solving processes are:

- Participatory Strategic Planning workshops - the concept phase of a project;
- Value Management workshops - the concept, planning and packaging decision phases;
- Risk Assessment and Management workshops - from planning through to design;
- Value Engineering workshops - in the design phase;
- A Post Construction Review workshop - would be held shortly after project completion; and
- Partnering workshops including team building and team problem solving techniques - could be used at any stage of a project that involves a form of contractual relationship from the concept phase through to maintenance and operation.

In general the participants at group problem solving workshops will come from a more diverse background in the earlier phase of a project than the latter phases.

5.3.4.6 The Process

Although the process differs slightly for the different techniques, the underlying principles are very similar. One of the major differences in the varying workshops is the type of group or individual that is requested to participate in the workshops.

The process starts by identifying the base need or project outcome required.

The process is based on analysing the function performed by products or services. This involves clearly identifying what they do and what they must do at a high level to meet the project objectives.

Once these high level functional objectives have been set, they are listed in priority order and ideas are generated as to how the functional objectives can be met.

- Collection of information:
  - present any project information such as current design proposal and cost estimates;
  - define any givens;
  - identify the known assumptions;
  - define what's important about the subject of the study; and
  - identify any restrictions;

- Analysis of functions:
  - define the primary intended purpose; and
  - identify functions to be performed;
- Generation of alternatives;
- Evaluation of alternatives;
- Development of selected alternatives; and
- Conclusions, recommendations and action plans.

5.3.4.7 Critical Success Factors

There are certain factors that assist in the success of the process:

- Disseminating the information, implementation plans and final decision to the participants of the workshop at the earliest opportunity;
- Holding the workshop prior to strong opinions being generated regarding decisions;
- Stating any non-negotiables at the beginning of the process; and
- Limiting the issues to be addressed at a workshop to one key issue i.e. does not attempt to address, say, functionality and project packaging in the one workshop.

Facilitators trained in the group problem solving techniques achieve the best results from the process.

5.4 Scope Management

5.4.1 General

When developing the scope, the characteristics of the requirement should be identified and documented as completely as possible and in measurable terms.

At the commencement of the project lifecycle (at concept) there is naturally some uncertainty about the project's deliverables and the methods used to achieve them. The level of uncertainty can be reduced significantly during the initial stages through careful appreciation and briefing processes. The more information that can be learned about the project, its objectives and background to the decision to proceed, the less will be the uncertainty about how the project is to be developed. In this respect proper briefing by the client together with progressive client leadership during the process offers significant advantages in meeting client requirements.

The prime focus of the scope risk management study is then to identify all aspects where vagueness, lack of clarity and/or needs for further investigation exist. A carefully planned and logical approach to the scope risk management study is essential.

The ultimate solution exists in the range of possible solutions available at that time - the question is how to get to the right solution efficiently and effectively. To do so we follow the "Framework for Delivery of RIP Projects" undertaking the various studies, investigations, consultations and reviews required gradually narrowing the field of possible solutions until one option emerges as the preferred option.

Within this process, while many other activities are being undertaken to narrow down the field, scope review is regularly being undertaken keeping in mind the goal of defining functional outcomes that satisfy the needs.

Scope management for design is about ensuring that enough work is done to enable the project to be sufficiently documented to enable the client to enter into a contract for construction. This includes monitoring for scope creep and influences that could lead to scope creep. Anything extra that does not achieve stated needs and functionality, despite being desirable, should be resisted. These add-ons only consume time and cost more.

5.4.2 Success Measures

Identifying measures or mechanisms by which the success of the project can be determined provides additional focus.

A guide to suitable relationship measures is provided in the Manual - Consultants for Engineering Projects, Section 8.2.4. It details the establishment of Key Performance Indicators (KPI's) to monitor the health of the relationship and communications between the parties.

Similarly there must be a mechanism that enables the project activities to be monitored and assessed. One such mechanism is to build into the functional specification a management review process together with client leadership actions.

Generally, project deliverables are reviewed at the milestone points occurring at the end of the following activities:

- Proposal;
- Options Analysis;
- Business Case;
- Preliminary Design; and
- Detailed design.

These milestones are shown in Figure 3.1.

All reviews must be undertaken by appropriately qualified and experienced staff to enable them to be undertaken effectively. To ensure the quality of the outcomes, required reports are provided for review prior to meetings to enable comments to be gathered and issues adequately addressed beforehand.

5.4.3 What Work Needs to be done

Determining the scope of work is not an easy matter and depends heavily on the state of knowledge available. There are, however, some generic studies that must be done (e.g. Review of Environmental Factors (REF), cultural heritage, native title) as they have statutory implications. Other studies or work required are a result of project features (e.g. no hydraulic studies if no rivers, no noise studies if in a remote location).

Irrespective of delivery by a consultant or not, the project must have a Project Management Plan developed at each phase to provide a structured framework for project definition. The Project Quality Plan, aided by a scope risk analysis, improves the state of knowledge, provides certainty as to influences that might affect measures of success, and gives confidence to proceed down a planned path of activities.

5.4.4 Amount of Work

This is more difficult to define for planning projects as the level of enquiry can only be subjectively assessed. How much is enough?

- Some say that there is never enough, but that approach only leads to endless enquiry;
- Some say a useful measure is when the cost of enquiry costs more than the potential impact it is time to call it quits, but that approach might not enable the question asked to be answered; but
- A better view is that the level of enquiry should be sufficient to enable the question to be answered within an acceptable degree of confidence.

This will vary from project to project and initial scoping studies may be required. This is why, for example, the REF is undertaken before the IAS. The REF provides the ability either to differentiate between options or to justify further enquiry.

5.4.5 Source of Scope Change

Changes of scope may be initiated by the Client or suggested by the project manager. Either way the Client must approve them.

The scope can change as a result of changing community expectations, Government priorities, changed funding, changed standards or legislation, or other external influences. In addition, the project manager may identify issues such as improved benefits, reduced costs, or other worthwhile opportunities that could arise from a change to a project.

5.4.6 Management of Scope Changes

Client and project manager must closely manage changes to scope. This includes:

- Notification by the **Client** to the project manager of possible changes to scope. This is to ensure that the cost of changes is minimised by reducing rework. Full details of the change are not needed at this stage;
- Notification by the **project manager** to the Client of suggested scope changes. Full details of the change are not needed at this stage but the notification should include reasons and possible benefits;
- Preparation of detailed change of scope:
  - For Client initiated changes, the variation to the scope must be documented and agreed to by the Client at least to the same level of detail as in the original scope definition. This will allow the project manager to assess the impacts on the time, cost etc and the project management fees;
  - Changes proposed by the project manager must be detailed in a submission to the Client Representative for approval by the Client. The submission should outline alternatives and indicate impacts on time, cost, budget, commitments and other project benefits and outcomes. The submission should also detail any implications of the approval not being granted. The Client Representative might need to add information to the submission on the impact of changes to the Program, project outcomes and benefits;
- Keeping a record of scope changes, dates of approval and impacts on project time and cost; and
- Adjusting other project controls such as Project Plan, and estimates of time and cost in accordance with the new approved project scope.

Where a project appears to be going outside scope and cannot be covered by contingencies, it is important to inform the Client as soon as possible. This will allow early assessment of possible impacts on the Program. Reporting to the Client on contingency usage is also important in assisting with managing these possible over runs.

Changes outside the project scope can include over-expenditure due to unforeseen circumstances or unforeseen risk occurrence, rectification or mistakes, or delays within the control of the project manager.

Change approvals must be dealt with in a timely manner at all levels. Undue delays can create problems with achieving agreed deadlines and contract duration, and cause other inefficiencies.

5.4.7 Impact on Project

Proposed changes to the project that impact on the approved scope can often arise during project concept, development and implementation phases. Some of these changes may have little or no effect on the total project cost, time, quality, budgeting or benefits or require no additional funds to be required. However if they affect the project scope, they still require approval by the Client.

The cost of scope changes during the concept and development phases is managed by the use of contingencies that are included in the respective budgets for the concept and development phases. Future activities can be allowed for in the project budget, the project schedule or both, for responding to risks of scope changes if and when they occur. Being essentially a reactive response, contingencies aim to reduce the impact of such risks.

If the Customer approves these changes they can then be incorporated in the project base lines. Performance of the project at completion is measured against this approved amended baseline.

5.5 Scope Risk Management

5.5.1 Introduction

Risk pervades all functions of project management because all things cannot be known in advance. Risk therefore is a natural ingredient of all environments in which projects are undertaken. For example, risk will impact upon the requirements of the functional specification, since in the case of a consultancy, the consultancy contract is a risk transfer device.

The scope of a project will contain a mix of work activities that are:

- Readily identified;
- Identified but not quantified; and
- Unknown.

It is important to establish a standard, systematic approach to risk management planning and to the development of a project risk management plan, as the basis for ensuring that issues that could adversely impact the project scope are understood and controlled.

Uncertainties should be managed by a structured approach, the aim being to take full advantage of opportunities for improvement by minimising the impact of potential negative events. The potential for improvement is sometimes overlooked, caused by the traditional view that risk means suffering harm or loss.

The risk management methodology applies to all projects. It covers the following:

- Risk identification;
- Risk analysis;
- Risk response planning; and
- Risk monitoring and control.

Risk management applies to all project phases. The process of risk management interacts with other project management processes to different degrees as risk is greatly influenced by the characteristics of the project. For example, projects that are innovative are inherently riskier. Risk management is not a discrete element and should be repeated at least once in every phase.

Risk management is covered in more detail in the Main Roads Project Management Methodology, which can be found on the Queensland Transport and Main Roads intranet site "OnQ" - not available to external sources.

5.5.2 Identifying Scope Risk

The purpose of this step is to identify project risks that should be taken into account during project appraisal and to provide a basis for development of the project plan.

Identifying risks that are likely to affect the project is not a one off event and should occur on a regular basis throughout the project. Functional specifications should include requirements for a risk analysis to be undertaken to review past evaluations and to make a reassessment within each phase a necessary activity.

Inputs into risk identification consist of all previous reports of the preceding phase; cover internal and external project and organisational matters impacting upon the project; and require external involvement to be effective. Project team knowledge, files and previous reports used for scope definition are applicable as inputs into risk identification.

Using checklists is efficient and their value cannot be overestimated.

Cause and effect (fishbone) diagrams are also useful. The cause can be derived from the purpose of the risk analysis being undertaken. The extent of detail required is decided by answering:

- Is the level of detail sufficient for the purpose of the analysis?
- Can the risk be assigned to one identifiable owner?
- Are specific responses indicated?

Negative answers to any one of these questions indicate a requirement for greater detail.

As tolerances to risk vary across stakeholders (internal and external) it is imperative that a wide range of stakeholders participates in the risk management process. Participants invariably consist of local government representatives, local chamber of commerce representatives, community groups, industry representatives, civil contractors, suppliers and DMR staff (especially previous phase staff who can provide valuable historical perspectives on matters that arise).

Identifying potential risks can be achieved by consultation with as many stakeholders as possible. Brainstorming a group of stakeholders is an appropriate technique to use. The risk management workshops held can be quite dynamic as there are many competing interest groups and associated agendas. This is not to be suppressed but valued but a capable and experienced facilitator is required to guide the participants through the process.

During these workshops, the project should be reviewed in a global manner first (from the top down) and then at task level (bottom up). Risks may include, but not be limited to:

- Lack of definition of the requirement;
- Restrictive time frame;
- Product maturity;
- Availability of resources;
- Reliability of test and acceptance procedures;
- Wide span of activity;
- Developing infrastructure; and
- Lack of capacity.

5.5.3 Scope Risk Analysis

Once the risks have been identified:

- Document the risk factors, organised in accordance with the categories of risk; and
- Assess the probability of occurrence of the risk factors and the relative significance of their impact on the project if they do occur.

Generally, impact will be determined in terms of either time or cost.

From consideration of risk factor, probability and relative impact it is possible to prioritise the risks. This provides focus on the risks that must be managed closely as distinct from those that need only be monitored.

Risk quantification can be presented in terms of a monetary value, statistical simulations (Monte Carlo simulations), what-if simulations using Project Evaluation Review Technique (PERT) or Critical Path Method (CPM) network analysis, decision trees and experienced judgment.

Quantified risks can be compared to developing criteria enabling a decision to accept the risk or to treat it in some manner.

Treatment options should be developed and evaluated as part of the Risk Management Plan subsequently produced. The Risk Management Plan includes the results of the risk identification and quantification process, documented procedures of how risk will be managed throughout the project, who is responsible for managing areas of risk, contingency plans and how reserves are allocated.

Treatment of risk can consist of:

- Elimination of the cause (design out the problem such as deleting an intersection by grade separation), and/or mitigation of the effect (reduce risk of accidents by signalizing an intersection or providing carriageway separation; provide financial reserves); and/or
- Acceptance, but actively managing (fire incident in tunnel managed by fire, life and safety treatments such as CCTV monitoring, jet fans, heat sensors, cross doors, hydrants, etc; contingency plans); and/or
- Control risks (monitor and review).

5.5.4 Scope Risk Response Planning

Notwithstanding that identified risks might or might not eventually occur contingency plans must be developed for the eventuality that they do.

These plans may operate at a number of levels such as the initial response (contain event), medium term (implement response), and long term (evaluate response for effectiveness and amend if not achieving required outcome).

These different approaches reflect the requirement that the required risk management plan must reflect the nature of the underlying cause of the risk for adequate treatment.

Following the risk analysis, determine a strategy for the containment of each factor. In broad terms, one of three decisions needs to be made:

- Avoid or reduce the risk through application of alternative approaches to achieving the objective, or through changes to the project plan, schedule, quality, budget or resource requirements;
- Transfer the risk through the use of contracts and internal agreements; or
- Adopt the risk with contingency plans to minimise the impact if the risk eventuates.

For some risks it is appropriate to plan around the occurrence of the risk such that the risk no longer has any bearing on the project. This strategy might involve identifying an alternative course of action such as revised timing, different technical solutions or a different resource mix.

For other risks it is sufficient to put in place a monitoring process to capture the occurrence of the risk, supported as necessary by contingency plans which can be applied should the risk situation occur.

Risk can also be transferred to another party that has greater control over the risk situation, or is less susceptible to the impact of the risk factors. Commonly, this is achieved through a contractual arrangement.

Options to plan around the occurrence of a risk must take into account the impact such a change in planning will have on the time, cost and quality of the project, in comparison to the assessed impact of that risk on the project. A judgment then needs to be made as to whether the implications of changing the project plans to accommodate the identified option are worthwhile in comparison to the probable impact the risk situation will exercise on the project.

The Project Risk Management Report is essentially a document for use by the project manager. Elements of the document will form part of the Project Plan.

Some of the most common risks encountered for road infrastructure projects are shown in the Risk Managemet Report (Form M4213).

5.5.5 Scope Risk Monitoring and Control

Risks should be reviewed on a continuous basis as the process moves through the concept and development phases and identify other risk factors that may have arisen as a consequence of:

- Refining the project planning;
- Making changes to the scope of the project;
- Undertaking discussions/ negotiations with the client; and
- Deleting previously identified risk factors that are no longer relevant.

From a review of the risk assessment table it is possible to make judgments concerning the relative importance of risks to the project. For those of high importance (high probability and significant impact), immediate action to manage the risk is required. For other risk factors, a contingency approach can be used. These strategies will provide the basis for a proactive approach to risk management.

For those risks that can be managed by monitoring occurrence and implementing a contingency plan, or through transfer via a

contract, the questions that need to be addressed at this time are:

- When is the risk situation likely to occur?
- What can be done if it does occur?
- What are the possible courses of action available if it does occur?
- What pre-planning can be undertaken ahead of the risk occurring?
- Is it worthwhile developing contingency plans to address this risk?

For each risk factor, a schedule for monitoring and control needs to be developed. Review points can be milestone based, periodic (e.g. daily, weekly, monthly), deliverable based, or in accordance with standard operating procedures. As guidance, risk factors should be listed for discussion at periodic progress meetings.

A single appointment should be given a role responsibility for monitoring and controlling the risk. This appointment should be the person or organisation who/that has most control over the risk factors.

5.5.6 Secondary Benefits of Risk Management

Experience has found that the risk management process has other valuable secondary benefits such as:

- Providing an aid in the baton change between parts of the organisation (e.g. from Transport Planning to Infrastructure Delivery in a District). Why? If for no other reason than the previous phase team has intimate knowledge of the project history that lies behind the various documented reports;
- Avoiding the review process becoming either a digging exercise to find the project "secrets" or an ad hoc overview that does not enable real issues to be analyzed. Both of these processes are unsatisfactory and ineffective. This would be overcome if the receiving team were actively involved with the previous team to present a seamless baton change across the various parts of the project life cycle particularly across the Concept and Development interface;
- Jogging the corporate memory after projects are reactivated after long periods of inactivity, to raise matters long suppressed by more recent and pressing events;
- Helping redefine the scope after reactivation of a project; and
- Documenting the risks to enable the functional specification to be scoped so the elements of risks (both threats and opportunities) can be actively addressed. This includes not only drawings and specifications but also such things as communication plans, environmental management plans and safety plans. None of these plans in themselves result in a physical asset such as a pavement, bridge, culvert or traffic signals but are absolute necessities for successful project implementation.

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