ECI Manual of Value Enhancing Practices for Small Projects

European Construction Institute

ECI Small Works Based Projects Task Force

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April 2003

Acknowledgements

This manual was produced with the support and assistance of the following organisations:

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- The ACTIVE Initiative (now incorporated within the ECI)
- The Department of Trade and Industry (DTI)

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Foreword

Small projects now form up to 50% of the construction industry's workload. Such projects are generally intended to increase production capacity and improve product quality and production efficiency. Managing them requires specific techniques and skills.

This is an indispensable guide to those who must manage small projects, containing a wealth of advice for all stakeholders. The bulk of this manual is concerned with those value enhancing practices (VEPs) that research has shown are essential to good performance when managing small projects.

In addition, the management of small projects requires particular skills and knowledge. Such skill set requirements are set out in Appendix I.

Appendix II lists a series of key performance indicators for small projects and ECI intends to use these to construct a database of projects that will allow the benchmarking of small project performance.

I commend this report to all who are concerned with small project execution. ECI will be developing a range of supporting initiatives over the coming year, including Master Classes for practitioners as well as guidance to be built into national standards for project management. These will be publicised widely and information will be available on the ECI website (www.eci-online.org).

Terry Lazenby
Chairman, ECI Programme Committee

1. Introduction

Good management practices are as essential for the satisfactory outcome of small projects as they are for large. It must not be assumed that lesser levels of skills and knowledge are acceptable. There are, of course, differences in the set of skills and knowledge required for small projects and the following Value Enhancing Practices (VEPs) focus on these requirements.

The definition of what constitutes a small project is not precise; some key factors are shown in Section 3.

Most advice, guidance and training so far produced has been directed at large projects. It is often ignored when it comes to the implementation of a small project for a variety of reasons, not all under the control of the project manager. If the performance of small projects is to be improved, all those with an interest in the outcome will need to help bring about that improvement.

This manual contains 17 Value Enhancing Practices (VEPs) which, if implemented diligently, are capable of greatly improving the performance of small projects. It is intended that this manual should be used alongside other standard works on project management, such as the ACTIVE Workbook. It is not suggested that every element of all the VEPs be applied to every individual small project; to do so would be a massive additional burden on the project team for minimal additional benefit. However, it is essential that the project manager and the team have the necessary skill to properly judge what is appropriate for each project. To reflect the way in which small projects are often handled some of the VEPs are more appropriately applied to the overall management of a portfolio (programme) of project work.

Whilst the VEPs target smaller engineering projects, the principles and practices included are generally applicable to all projects. It should be noted that each VEP has been produced to deal comprehensively with the subject matter to avoid the need for the user to be continuously cross-referred to other VEPs. Hence, there is duplication between some of the clauses in different VEPs; it is hoped that this helps the user dealing with a specific stage of a project.

2. Background

Early in 1999 ECI and ACTIVE identified the increasing importance to industry of the effective implementation of smaller projects. A Workshop was held at the University of Durham in September 1999 which confirmed the opportunity for improvement in the performance of small (minor) projects, often managed on an operating works or site rather than in a central engineering department.

Work was subsequently commissioned by ECI and ACTIVE, supported by funding from the DTI, to form an industry Task Force and carry out a pilot study. This demonstrated the importance of undertaking further work to better understand the issues and develop recommendations for addressing those issues.

The main study was managed and delivered by an expanded Task Force. Two routes were pursued in parallel.

The members of the Task Force pooled their knowledge and experience and arrived at a long list of issues from which the key ones were selected on the basis of greatest potential benefit. Recommendations for dealing with these were written in the form of Value Enhancing Practices.

Simultaneously, research was carried out among clients, contractors and their suppliers using an extensive questionnaire to identify the issues limiting the effective performance of small projects and to seek experience of overcoming them. This work confirmed that the Task Force were addressing the issues regarded as critical by industry as a whole and highlighted additional details on which recommendations are required. The information from this survey has been built in to the Value Enhancing Practices.

A second Task Force was convened by ECI in September 2001 with the objective of tackling some issues not previously addressed. This resulted in this manual.

The Construction Industry Institute (CII) in the US has also been studying the performance of small projects. The findings of the CII study have been reviewed and they come to essentially the same conclusions and offer very similar advice, albeit with some differences of emphasis. Their publication "Small Projects Toolkit" (Implementation Resource 161-2) provides valuable additional guidance on small project management.

3. Typical distinguishing features between major and small projects

Area of project	Major projects	Small projects
Nature of the work	Green field Total new design	Brown field/operational plant Modifications/revamps Plant overhauls/major repairs
Management	Dedicated project team More senior/experienced team Focus of attention Controlled by project	Part time job Less senior/experienced team Compete for priority with other work Divided responsibility
Project definition concept	Business management	Usually works or plant management
Detailed definition	Recorded detailed project scope/specification	Limited scope/verbal understandings
Project implementation design	Total new design CAD model	Reliance on existing design and specifications Requires accurate site dimensions
Supply	Large quantities Competitive tendering	Small quantities Term contracts/preferred suppliers
Construction	Project/construction planning Control by construction management Pre-assembled units Ease of access	Operations interface Permits to work required Built in situ Restricted access
Commissioning	Dedicated team High motivation Single responsibility	Plant operators with production priorities Low motivation An extra task

4. References/further reading

1. Construction Industry Institute (CII), Small Projects Toolkit, Document Number 161-2, July 2001.
2. European Construction Institute (ECI), ACTIVE Workbook, October 1998.
3. ECI, Small Works Based Projects Phase I Report, “Improving Effectiveness in Works Based (Minor) Projects”, February 2001.

VEP MP.01

Management/Stakeholder Buy-In

1. Definition

Management and other stakeholder buy-in is critical to the success of any project regardless of value or complexity. It involves developing sufficient strategic alignment of all key management and stakeholder representatives to ensure that the correct project is selected for development and is executed so as to realise the expected business benefits. It will also help ensure that adequate resources of funds and people are provided to maximise the chance of a successful project outcome.

2. Characteristics of successful management/stakeholder buy-in

- Management and other stakeholders are involved throughout the project up to commissioning/hand-over.
- Key management/stakeholder representatives are identified and their respective responsibilities and accountabilities are agreed and understood by all parties.
- There is an established process for authorisation of projects.
- The organisational/business culture in which the project team will operate supports collaboration and encourages teamwork at all levels.
- The project business goals, strategies and objectives (including critical success factors) are clearly defined, aligned and jointly understood by client management, other stakeholders and the project team.
- The relative priority between safety, cost, schedule, quality and any other key features of the project are clearly identified within the business priorities and, subsequently, within the project objectives.
- Communication within the team and with external management and stakeholders is open, timely and effective. Regular progress meetings should be held with key representatives from the client management and stakeholders.
- Risks and opportunities are identified at each stage of the project.

3. Benefits of successful management/stakeholder buy-in

- Improved selection of projects to enhance the business objectives.
- Improved business and project alignment.
- Improved project focus on critical performance activities.
- Reduced probability of project scope change/growth.
- Reduced probability of budget and/or schedule overruns.
- Better attainment of operational and production goals.
- Better achievement of business goals.
- Better management of business and project risks and opportunities.
- Ownership of project objectives, strategic plans and budget by both the executing project team and the client/sponsor.
- Improved customer satisfaction.

In summary, management and stakeholder buy-in represents a significant opportunity for overall improvement in all aspects of project performance and, as such, should be considered a key project metric.

4. Recommendations

To achieve the potential benefits, the following should be considered.

4.1 Organise for management and stakeholder buy-in

- Identify key client management and stakeholder representatives; develop their respective roles, responsibilities and accountabilities along with those of the project team. Appoint a client representative to act as a single point of accountability with responsibility for ensuring overall business/project alignment and providing management support to the project team.

- Use appropriately skilled and experienced development team members who can respond to business and project objectives whilst providing critical inputs from business, project management, technical and operational interests. These representatives must have appropriate levels of authority and competency to make necessary decisions within their respective areas of control.

- Clearly agree with client management, stakeholders and project representation the business objectives/priorities for the project at each stage of development. Consider the need to review/repeat this event at key project phases or, if business drivers change, during the project development. Particular consideration should be given to external factors which may not necessarily be seen as business drivers, e.g. changes in legislation, local consent levels, regulatory requirements.

- Agree key measures to be applied at the end of each of the stages of project development that will determine readiness to progress into the next phase.

- Identify at the beginning of each stage the management/stakeholder representative who will be responsible for reviewing and agreeing that the project can proceed to the next stage.

- Ensure that the agreed objectives and strategies are clearly understood and communicated to all parties involved in the project. Where appropriate, these should be recorded and reviewed at relevant stages in the project. For example the client should explain to contractors (both at management and project supervisory level) the basis for the project, the business objectives and any other critical success factors. Similarly, the contractor needs to inform the client of how the work impacts upon their business drivers.

- Develop a project review schedule that will enable all parties to ensure that the business and project objectives continue to remain aligned and on target.

4.2 Specific issues for small projects

- Recognise that the management, stakeholder(s) and project leadership representatives may have many responsibilities, possibly dealing with a number of projects at differing stages of development. Their time will be at a premium and the project is unlikely to be perceived as highest priority. Ensure that use of their time associated with the project is limited to areas of necessity; on the other hand, do not accept non-involvement with important issues.

- Recognise that small projects by their very nature generally receive significantly less attention to detail than large projects. However, time spent developing an agreed statement of requirements, fully defining the scope and agreeing the required client resources to support the project team is of key importance to achieving a successful implementation.

- Recognise that small projects tend to be a "reactive" solution to a particular situation and, as such, generally suffer from inefficiencies resulting from the lack of proper planning and development. The effectiveness of small projects teams can be greatly improved if they can work together with the business/client to put in place strategies based on longer term objectives. This will improve project definition, development and execution, and aid resource planning.

- Pursue opportunities to "bundle" similar types of projects (especially those with common business objectives) or those with common client/stakeholder support representatives together to obtain the benefits of developing working relationships and sharing of common learning. This will improve team integration and alignment and make more efficient use of limited resources.

- Review interactions and dependencies between multiple projects to ensure overall business alignment is being maintained.

- Project resource planning for all stages should clearly recognise the restricted availability of key client resources. Any implications should be clearly reflected in the project plan and within risk management.

- For projects which are to be executed on existing/established assets it is important that the strategy details not only what the project will deliver but also how it will be delivered. Effort should be made to include the operations staff in key project reviews (e.g. design, safety, constructability) in order to ensure awareness of project scope and execution plans, and also to receive comments/input as to the most appropriate way of working on their asset.

- Access to, and availability of, operations support staff should be a key element in the project execution strategy. Restricted access or availability may influence the level of activity which the project team can undertake to ensure successful project execution and achievement of the desired business goals.

4.3 Project authorisation process

Authorisation is always a key milestone for a project. It is important that there is a clearly stated process and that requirements and responsibilities are understood by all concerned. It is also important that the process is appropriate for the scale of project being authorised.

The exact process will be designed to meet an individual company's requirements but, for small projects, the following should be considered :-

- The approval documentation and information requirements should be clearly stated. Ideally there should be a standard form. The extent of requirements should be commensurate with the value of the project to be approved. Requiring the same level of documentation for a £10,000 project as for a £10M project is obviously a waste of effort.

- Aim to keep approval levels at the location where the project will be implemented. Once approval needs to go to a central office it is inevitable that the time and effort needed will increase dramatically. One possible route is to get approval of an overall programme of small projects and associated spending up to an agreed limit from a central source with individual project authorisation at local level.

- A "stage gate" process will assist in ensuring only the right projects are developed for authorisation, thereby reducing the risk of work on developments which eventually are abandoned whilst also assisting early involvement of management who will later be responsible for authorisation. Stages may include :-

    1. Agreement for inclusion of business objectives in the portfolio of development work, together with the initially projected time frame. At this stage the means of achieving the objectives may not be clear and various options may still be possible.
    2. Having carried out the initial development of options, approval of selection of a preferred option based on a cost/benefit review is required. This will probably require rough cost estimates for the options and a statement of benefits and disadvantages for each. Any such decision will agree one of the following :-
        a) A project option to be fully set out, together with the agreement of a time frame for definition and funding for this work as well as the type of estimate to be provided for final authorisation.
        b) A solution which does not require a capital project.
        c) Abandonment of the development if none of the options are considered attractive and/or the business objectives are no longer required.
        d) Requirement for further initial development before a decision is made (possibly including assessment of additional options).

       This "stage gate" should be considered significant, as it is the point where significant staff resource (and cost) starts to be committed to a given course of action.
    3. Final authorisation to proceed with implementation. This should include agreement of the base budget, available contingencies, timeframe to completion and financial authority of the project manager.

If during the work leading towards stage 3, it becomes evident that any of the key premises upon which initial selection was based will be significantly changed, e.g. significant increase in cost, then the work should be halted and referred back to the stage 2 decision point.

5. References/further reading

1. CII Publication RS 39-1, Pre-Project Planning, Beginning a Project the Right Way, December 1994.
2. CII Research Report 113-12, Team Alignment During Pre-Project Planning of Capital Facilities, January 1997.
3. CII Source Document 102, Perceptions of Representatives Concerning Project Success and Pre-Project Planning Effort, September 1994.
4. ECI Benchmarking Steering Group, Uncertainty Management Workshop, October 1998.

VEP MP.02

Project Development and Definition

1. Introduction

Project development and definition forms the foundation for the evaluation, authorisation and implementation of any project. A sound project definition will not guarantee success but, without it, it is unlikely that the project will meet all the requirements of its sponsors. Definition identifies the key requirements and provides a benchmark against which the eventual outcome can be measured. Failure to carry out adequate development and definition is very common for smaller projects.

The amount of effort to be expended in development and definition needs to be optimised for the project. Better definition will always benefit the future certainty of project outcome but requires more time and resources and, therefore, more cost.

A key aim must be that the definition package, including plans and estimate, is accepted by all relevant parties and that they commit to supporting the requirements for its effective implementation.

This VEP is aimed at smaller engineering projects; however the principles and practises referred to are generally applicable to all projects.

2. Selection of best solution to meet business objectives

A key element of the early development of a project is to undertake a critical review of the options for achievement of the objectives (this may include non-project options as well as different project scopes). This review should include all relevant parties and will first need to confirm the agreed objectives. It should be carried out as soon as there is sufficient information available to make a reasonable assessment of the options. The reasoning for the selection should be recorded.

Allowing the consideration of multiple options for longer than is strictly necessary is very likely to delay the project as well as adding to the cost.

(NB. Option selection, though it has some similar characteristics should not be confused with a detailed Value Engineering exercise which may be carried out towards the end of the definition work phase.)

3. Characteristics of good project definition

The definition of a project should include :-

- Agreed prime business objectives.
- Critical success factors.
- The relative importance of cost, quality, time and performance of finished project; simply stating all are important fails to address the issue.
- Clear identification of staff (numbers and capabilities) and other labour resources needed to implement the works and sources (internal and external).

- Any specific quality requirements including applicable standards and specifications.
- Any other key issues which may significantly influence outcome.
- Estimate of cost, identifying quality of estimate.
- Evaluation of required time schedule and the key elements which determine this schedule. This must realistically assess resource availability in the light of overall priorities.

The definition should ideally be summarised in a Project Implementation Plan (PIP), which is presented as a key document for authorisation. The PIP can be used as the basis against which all parties concerned take ownership of the project and commit to its requirements.

4 Recommendations

4.1 General

It is essential that the key drivers and deliverables are clearly understood and agreed by both the business sponsors and the project management.

Before starting the main part of definition works, the people resources and time needed for definition should be identified and agreed. Overrun of time for definition, and/or poor definition due to lack of resource is a common problem, which can subsequently compromise project implementation.

4.2 Business objectives

- Identify the specific aims, i.e. those aspects which, if not fulfilled, will result in the project being a failure regardless of cost, time, execution performance etc. Some background explanation of the objective is usually helpful. These objectives should be fixed and agreed by all parties as early as is practicable.
- Identify the critical success factors. If there is more than a single objective, identify the relative importance of each.
- Specify other essential requirements, i.e. absolute maximum cost, installation at a specific date (e.g. plant shutdown). Do not confuse with desirable (but not essential) aspects.
- Identify priority of the project versus other works and whether there is a conflict of available resources or finance. Does the timing of other work need to be reconsidered? This is often an issue for small projects where resources (especially people) are shared. In this case the priority ranking should be agreed with all relevant customers (see also VEP MP.17 Portfolio Management).

4.3 Project strategy

Every project should have a stated strategy for its development, definition and implementation. This should fulfil the stated business objectives. An outline strategy should be agreed early in the development of the project, and refined or changed during development and definition. If a significant change is proposed, this needs to be agreed with the owner (client) and other relevant stakeholders.

An initial project strategy statement should give an overview of how the project will be implemented and key issues relating to that implementation. It should not go into detail as this will be addressed elsewhere in detailed plans. Typically it will include :-

- Brief statement of objectives.
- Desired overall timeframe and related key dates (i.e. authorisation timing, assumed dates of relevant plant shutdowns).
- Intended “stage gate” reviews.
- Any identified major issues which may impact upon achievement of objectives, together with a (brief) statement of how they will be managed.
- Whether the project will use internal or external resources for various elements of work and what constraints this may impose.

4.4 Scope of work

- Provide a list of the main physical elements of the scope, their performance requirements and key design parameters. More detail lessens the chance of future unforeseen additions or changes arising. However, there needs to be a judgement as to the extent to which to spend resources and time prior to any authorisation of the project.
- Provide supporting drawings and specifications where possible.
- Seriously consider, for all but very small or very simple projects, splitting definition into two:-

  1) Preliminary development supported by outline plan and order of magnitude cost, against which initial support and funding can be agreed to allow selection of preferred option and further definition prior to full authorisation.
  2) Full definition with more detailed planning and better quality estimate to allow best possible assessment and reduced risks at time of request for full project authorisation.

- Identify the key limitations of scope definition and assess risks for project implementation.
- Ensure that all option reviews and value analysis reviews are carried out in this definition phase.
- Ensure the scope identifies a list of deliverables, including documentation requirements.

4.5 Applicable standards and specifications

- Decide which standards must apply and whether there is a requirement for compatibility with existing equipment and facilities. Standards are just as important for small projects as for large ones.
- Decide whether company standards must be applied or whether industry and national/international standards are acceptable. Company standards usually add to project cost (and in some cases to time).
- Is there a requirement for standardisation with existing facilities (e.g. instruments and control systems, rotating equipment)? This is an important issue for retrofits to existing plant.
- Identify particular specifications, which must apply to parts of the scope, required to meet performance requirements.

4.6 Risks and uncertainties

It is important to consider and identify the limitations of the definition. There are a number of risk assessment tools which can be used. It is important to focus on those risks which, potentially, have a major impact on the project and/or have a fairly high probability of occurrence (see also VEP MP.07 Project Risk Management).

- Are there fundamental elements of the technical definition which are incomplete or, as a result of further work, may need to be changed? If so, what might be the impact on cost and time?
- What are the key durations which determine the overall schedule? Are these realistic and are they vulnerable to change?
- How good is the cost estimate? What is the probability of higher cost and by how much? If this occurs is the project still justified? Are there parts where there is significant uncertainty of cost? This may occur due to:-

    1) insufficient detail of requirement (both in quantity and specification);
    2) accuracy of cost of items or services;
    3) the need for additional payments to secure schedule.

- Are resources (especially staff) available when required?

4.7 Safety, health and environment (SHE)

A first review to identify SHE issues likely to be relevant to the project should be carried out in the definition phase and should address both SHE for the completed project and construction. Consider also whether the initial HAZOP should be carried out in this phase (there are merits and demerits of early HAZOP). It is not necessary at this stage to aim to resolve the issues, only to identify them for later attention. See also VEP MP.04 Management of Safety, Health and Environment.

4.8 Planning and resources

Ensure there are sufficient resources to carry out the definition works in the required timeframe.

Develop an initial time plan for the project, taking account of :-

- Complexity.
- Time sensitivity (how important is a fixed completion date?).
- Key elements which will significantly affect the plan.
- Whether durations planned are proven by experience, or are simply “best guess”.
- Main areas of schedule risk.
- Where applicable, the need for external (corporate and government) authorisation. These often have long (and sometimes indeterminate) durations.

Additional detail for schedule planning is given in VEP MP.10 Project Planning and Schedule Management.

Identify the resources needed to implement the project :-

- Who will manage the work?
- Who will carry out design, procurement, construction/installation?
- What involvement from plant operations and maintenance is needed and when? Get commitment to meet needs.

- Are staff with the correct knowledge and skills available when required? Named individuals should be identified if possible. Non-availability or conflict of priority of staff is one of the most common causes of project delay.
- Ensure definition work is resourced.
- If design is to be contracted out, support will be needed from the organisations own staff to advise all the company and plant specific requirements and interfaces. This requirement is often under-estimated, especially for retrofit projects where plant specific knowledge is essential.
- Where construction contractors are to be used how will this project impact on overall work loading? Check with potential contractors that resources will be available.

Ensure that the end-user of the project (usually plant operations) is involved in definition work and review of detailed design.

4.9 Procurement and contracting strategy

Where work, materials and services are to be obtained by purchasing/contracting, identify the strategy to be used. See also VEP MP.06 Procurement of Materials and Services.

4.10 Cost estimates and cost control

In almost all cases, a cost estimate is required for project evaluation and authorisation. This typically becomes the project budget. The accuracy of an estimate is inevitably linked to the quality of definition against which the estimate is based.

- Obtain agreement from the project sponsor as to the quality of estimate required for authorisation.
- Ensure that any estimate specifically states the level of accuracy, the probability of overrun and contingencies included.
- Include a statement of assumptions, key cost risk issues, and exclusions.
- Where preliminary estimates must be given, include strong warnings on validity and, if practicable, quantify the risk of overrun.
- Note that a typical "10% Estimate" (where there is a very low probability of cost exceeding the base estimate cost by more than 10%) requires that approximately 25% of detailed design be complete and firm prices be obtained for all major non-standard cost items.
- Ensure that estimates include additional costs to achieve sub-optimal schedules. Such costs can be significant.
- Identify the extent of cost monitoring and reporting required during the project. Ensure that relevant data and the means by which it can be obtained are readily available.

Make it clear that a formal procedure for scope changes will apply. Scope changes are notorious for destroying the validity of project plans and costs.

4.11 Evaluation of project definition

A typical checklist for evaluating the quality of project definition and identifying areas of deficiency is attached as Appendix A.

For larger multi-discipline projects, consider use of a more sophisticated tool such as CII's Project Definition Rating Index (PDRI) available from ECI. Such tools identify whether existing definition is sufficient to commit to full implementation and highlight specific aspects which are deficient. Plans can then be developed to manage the deficiencies. Note that such checklists should only be used by staff with the relevant experience and knowledge of the specific project being considered.

4.12 Availability of funding

Small projects are often funded from a common pool of monies made available for such items. This often leads to considerable uncertainty over whether a project will be authorised and the timing of such authorisation.

Ensure a ranking exercise is carried out to identify priorities for funds available, and that :-

- All customers are represented in the exercise.
- Funding for definition of later projects is addressed.
- Project management is represented.
- Priorities are compatible with resource availabilities.

For all projects it is recommended that completion times are stated in months from authorisation, with additional comment where appropriate.

Delay to expected authorisation is disruptive to the management of the overall portfolio of projects. Resourcing is based upon matching required personnel against foreseen project demands; delayed authorisation can easily result in key personnel not being available.

Additionally, for those projects where there is a fixed end date or work within a fixed plant shutdown, ensure that the required authorisation timing is clearly identified to those responsible for authorisation/funding.

5. References/further reading

1. CII Project Definition Rating Index for Building Projects (IR 155-2), July 1999.
2. CII Project Definition Rating Index for Industrial Projects (IR 113-12), July 1996.
3. ECI, ACTIVE Value Enhancing Practice (VEP) No. 1.2, Project Definition and Objectives, October 1998.
4. ECI, ACTIVE VEP No. 1.3 Project Planning, October 1998.
5. ECI, ACTIVE VEP No. 3.1.8, Guidelines for Scoping, October 1998.
6. ECI, ACTIVE VEP No. 3.1.9 Guidelines for Type of Contract, October 1998.
7. ECI, ACTIVE VEP No. 5.1 Project Risk Management, October 1998.
8. ECI, ACTIVE VEP No. 7.4.1 Guidelines for Defining Standards During Project Definition, October 1998.

VEP MP.02 – Appendix A

Project Definition Checklist

1. Purpose

The quality of "front end" definition is a key element which will determine the success or otherwise of the overall outcome of a project.

The purpose of this checklist is to provide a means of rapidly reviewing the definition completeness of small projects. Normally this should be carried out before authorisation to proceed with implementation (though nothing precludes use at other times). It will determine whether there is sufficient definition to allow a sensible move to the detailed design and implementation phase.

The checklist is also valid for larger projects but more sophisticated tools which would provide a quantitative assessment and address other issues, not relevant for small projects, may be more appropriate. An example is the CII Project Definition Rating Index (PDRI).

2. Methodology

The checklist is split into a number of sections covering all aspects of project definition; it is not sufficient to merely address the part which covers the physical scope of the project.

It is assumed that those utilising this checklist have a sound understanding of the requirements for project implementation. It is recommended that the checklist review be carried out jointly by all project team members. Additionally, the use of an experienced project manager (not within the project team) as an "external" assessor may be valuable.

It is suggested that where the response does not indicate a fully sufficient level of definition, either :-

a) carry out further definition work to remedy the deficiency before proceeding with implementation of the project, or
b) develop a plan to redress the deficiency in the implementation phase.

Option b) is acceptable for non-crucial deficiencies, but a) must be adopted if deficiencies are extensive and/or relate to key aspects of the definition.

3. Checklist

A Business objectives

A1 Have the key business objectives been identified, agreed and clearly communicated? These must identify the driving forces for the project from the viewpoint of the business.

A2 What is the importance of cost relative to other key drivers? Will additional expenditure to achieve other objectives override desire for low cost?

A3 Is there an overriding requirement to meet a fixed completion date, e.g. completion during a plant scheduled outage, or a market commitment or legal obligation?

A4 Are there specific performance requirements, e.g. in terms of capacities, product quality requirements, plant availability and reliability etc?

The above should identify the relative importance of various drivers.

B General project data

B1 To what extent is automatic control to be provided? What are the criteria for control and safeguarding systems redundancy?

B2 Is the required turndown capability stated?

B3 Are there specific process/control requirements for start-up and shutdown?

B4 What are the criteria for equipment spares?

B5 What are the requirements for equipment access/lifting/pulling beams/cranes?

B6 Has constructability been considered? What constraints on construction are imposed by access to existing plant?

B7 Have interfaces with existing instrumentation/control systems been identified?

B8 Have permit requirements been identified? Is there a permitting plan in place?

B9 Has the overall project milestone schedule been developed and agreed by the major project participants (including plant operations)?

B10 Is any dismantling or demolition required? If so, has the scope been identified in detail and what safety requirements will apply? Is the timing identified?

B11 Are design documents covering existing facilities available? Are these documents up-to-date? Is additional work needed to ensure design compatibility?

B12 Have project documentation (including electronic documentation) deliverables been identified?

C Technical standards and specifications

C1 Are the standards and specifications to be applied identified and recorded?

C2 Is there a specific requirement for compatibility with existing plant standards?

C3 Are any project specific specifications required?

C4 Is there a requirement to procure certain items from a specific vendor to ensure standardisation or to meet specific performance requirements?

D Process design

D1 Is there a complete set of Process and Utility Flow diagrams showing all new equipment, main piping and control systems and interconnections with existing plant and facilities? What is the development status of these drawings?

D2 Is there an operating philosophy document against which design should be executed?

D3 Is there a tabulation of heat and material balances within the unit?

D4 Has a set of Process (and Utility) Engineering Flow schemes (PEFs or P&IDs) been prepared? What is the development status of these drawings?

In general, PEFs are considered to be a key element within the scope definition package of a project.

D5 Are there equipment data sheets which identify for each item of equipment design conditions, performance data, sizing data, nozzle sizes, energy requirements, sealing requirements, metallurgy, applicable design standards, insulation requirements, internals details?

D6 Is there a line list which identifies each pipe together with sizing, design conditions, piping class and connectivity?

D7 Are all utility requirements identified, e.g. temperature, pressure, sewage?

D8 Are all process and utility tie-ins identified? Have the requirements under which the tie-in must be executed been identified?

D9 Is there an instrument list which provides process data for every instrument together with its location?

D10 Is there a requirement specification and/or logic description covering the control and safeguarding systems? If these will be extensions of existing systems how will this be achieved in both design and installation?

D11 Are relief valves and bursting discs identified and sized?

D12 Have all electric power requirements been identified?

D13 Is the area classification plot plan provided to show the environment in which electrical and instrument equipment is to be installed?

D14 Has a HAZOP or other design safety review been carried out? If not, will one be required? Will an Instrumentation Protective Function (IPF) review be required?

E Layout and piping

E1 Are there overall layout drawings showing locations of new equipment? If not, are locations otherwise defined and agreed with plant operations and maintenance?

E2 Are piping classes identified?

E3 Are any special valve requirements identified and detailed? Must these valves be from a specific supplier?

E4 Are design requirements for all tie-ins available? Have these been reviewed with plant operations to check installation feasibility?

E5 Are piping layout special requirements identified (i.e. slopes, long radius bend, requirements re high or low points, jacketing, provision for pulsation, cyclic operation conditions)?

F Civil and structural

F1 For any new or modified buildings is there a preliminary layout and user requirement specification? Are there any special design requirements (i.e. blast resilience, special HVAC requirements, special temperature or humidity requirements, clean room specifications)?

F2 Is data available for existing ground conditions (i.e. soil survey, water table, contamination data)?

F3 Is design code environmental data available (i.e. design wind-speed, rainfall rate, snow loading, earthquake factor)?

F4 Are layouts and elevations for new floors and platforms identified?

F5 Where existing structures are to be re-used/modified are existing design details/ calculations available? If not, how will this issue be addressed?

F6 Are finish coating requirements for steel identified (e.g. fireproofing, galvanising)?

F7 Are routes for sewers and underground fire mains identified including tie-ins to existing services?

G Instrumentation and control

G1 Have all local standards, including plant-specific requirements, been identified?

G2 Has the extent of interconnection and extension of existing systems been identified?

G3 Is there a written control and safeguarding philosophy and user requirement specification covering normal operation, start-up and shutdown? Are redundancy requirements identified?

G4 Is there a detailed listing covering all instruments required, together with full design data? Are locations of all instruments identified?

G5 Is there a listing of preferred vendors and, for special requirements, identification of specific instrument model numbers to be used?

G6 Where extension of existing systems, e.g. DCS, SGS, PLC is contemplated, has expandability been checked out? Can modification/extension work be done with plant in service or must a shutdown be provided?

G7 Has existing cabling infrastructure been checked out? Is spare capacity available or must new cabling, junction boxes, racking, auxiliary room cabinets etc. be provided? If new ones are needed, is space and routing available?

G8 Will the existing DCS, PLC displays need to be reconfigured?

G9 For safeguarding systems, has instrumentation protective functionality rating been assessed?

G10 Are there any new, or extensions to existing, gas detection or fire detection/alarm systems required?

H Electrical

H1 Have all requirements and locations for electric power been identified, including voltage levels, control requirements, UPS requirements, variable speed drive requirements?

H2 Have source(s) of new power requirements been identified, including any new switch house equipment needed? Have means of interconnection (tie-in) been assessed?

H3 Have the electrical single line diagrams been produced or existing ones marked-up?

H4 Are routes for new cabling identified?

H5 Have any requirements for electric tracing been identified?

H6 Have additional lighting requirements been identified?

H7 Are there any requirements for cathodic protection?

H8 Do grounding or lightning protections need to be installed or extended?

I Fire protection and safety requirements

I1 Is any additional fire prevention/fire fighting equipment required (e.g. firemain extensions, deluge systems, fire monitors, fire extinguishers, foam systems, damper panels, fire doors, etc)?

I2 Is any new safety equipment required (e.g. safety showers, specialised PPE for operators)?

I3 Have safe means of egress been addressed in the layout of new facilities?

J Project management approach

J1 Has a project strategy been defined for the implementation of the project?

- J2 Has a detailed Project Execution Plan (PEP) been prepared and agreed by all parties involved in the project including the project sponsor? Ideally it should form part of the authorisation documentation.

J3 Have requirements relating to SHE been addressed, including CDM regulations?

- Has provision for safety reviews been made?
- Have any specific/unusual hazards been identified and, if so, have risk assessment and remedial measures been identified?
- Which party will fulfil the roles of Principal Contractor and Planning Supervisor?
- Is notification to HSE under CDM Regulations required?
- Will one or more specific project health and safety plans be required? Who will produce these?

J4 Have all staff resource requirements been identified? Have specific skills and knowledge requirements for the project been addressed? Has the availability of these resources at the times required been agreed? Have any potential resource conflicts been addressed?

J5 Has the strategy for execution of the detailed design and engineering been identified?

- If a contractor is to be used, has sufficient time been provided to allow for tendering and negotiation of the contract?
- For contracted-out design and engineering works, has consideration been given to where this will be executed?
- If the work involves modification/extension of the existing plant, has sufficient client resource been provided to assist in giving the contractor specific data and understanding of existing facilities?
-

J6 Is the procurement approach identified?

- Who is responsible for procurement of materials?
- Are sufficient resources available to ensure enquiries, orders and follow-up are carried out at required timings?
- Will the project require special effort to ensure required delivery of key items?

- Are time-critical items identified as well as the steps needed to ensure early ordering and timely delivery?

J7 Is the approach for provision of construction services identified?

- Who is responsible for procurement of construction services? Are they aware and able to provide contracts at the required timings?
- Have the means by which contracts are to be entered into been identified and agreed?
    - Does the project schedule include time for development and tendering of contracts?
- If existing term/core contractors are to be used have they been consulted, and the availability of their resources been checked?

J8 Have the required interfaces with the plant operating and maintenance team been identified and planned? This should include :-

- Participation in development of the definition package.
- Requirement for comment on designs/vendor drawings.
- Participation in design safety reviews.
- Management of permits to work on existing plant.
- Requirement for plant shutdowns for construction, tie-ins etc.
- Process and responsibilities for pre-commissioning, and commissioning and responsibilities.
- Operator training requirements.
- Requirements for “as built” documentation.

J9 Have the requirements for cost control been identified? These should be looked at along with appropriate mechanisms for :-

- Preparation of detailed estimate and schedule against an agreed scope.
- Identification of any special cost risk issues.
- Cost monitoring.
- Scope change management system.
- Reporting requirements.

J10 Has a project risk assessment been carried out and, where appropriate, a mitigation plan identified?

J11 Have authorisation levels been agreed (commercial and technical)?

VEP MP.03

Quality Management Systems for Small Projects

1. Introduction

Many companies have procedures that define the project management process; ideally these will be flexible enough to apply across projects of a wide range of sizes. They should focus on capturing the activities that are shown to add value to the organization through reducing waste and risk. Often these procedures will be structured in line with the ISO9000 series of standards for quality management, in which case projects may be audited to confirm compliance with the procedures.

A distinction should be made between procedures to manage the capital programme and those aimed at good project practice. Where an employer has such procedures, their use should assure project quality.

When several organisations work together it will be necessary to agree which processes and quality system will be used.

The following outlines the main approaches taken to ensure quality on projects. They will usually form part of a formal system, but could also be used where there is no system in place.

2. The main quality activities on a project

Much of what can be seen as the "usual" project activities are there to ensure the project meets the business requirements, i.e. assure quality. The project team should also ensure that project deliverables are fit for purpose. Regular team meetings throughout the project, including the commissioning stage, should ensure the project meets the requirements in a logical and safe manner.

Some of the most common key quality assurance activities used on projects are listed below.

2.1 Stage gate processes

These usually involve formal approvals in the organisation outside the project team, following laid down procedures in the client organisation. They take place prior to the start of each main project stage, and should focus on :-

- Whether the project has been soundly defined (for the stage in question).
- Confirming the business priority/importance (relative to other projects).
- Agreeing funding for the next stage(s).

Where companies do not have such processes, it is advisable to obtain approval from the sponsor between the key stages.

2.2 Key documents

The issue of documents to team members (and other interested parties) is one of the main ways projects assure quality. There are several possible quality control activities for the recipients, including :-

- Circulation of preliminary issues/drafts for comments.
- Formal document approval within project team.
- Review meetings and group approvals, ranging from a slot on a project team meeting through to independently-facilitated review.
- Independent approval, verification, or validation from outside the project team.

These activities are listed in increasing order of rigour. In general, the more rigorous approaches will be used less than the more general activities. The mix of activities is often agreed and documented on a quality plan.

2.3 Quality plan

This document summarises the approaches to be taken to ensure quality for a particular stage of the project. Historically, they have most frequently been used in construction but should be considered at all stages of the project. They add most value when a new group joins the project to carry out the instructions or wishes of some other group (in the concept stage this will be core team and sponsor). The quality plan is the agreement of how quality is to be monitored and assured.

During the construction activity, the quality plan should confirm the level of evidence required, typically ranging through: none, self report/note, witnessed and recorded, 3rd party witnessed, post action testing; also, the need for audits (i.e. the witness has to be informed when a key stage/deliverable is complete and they will choose whether to view – "silence gives consent"), whereas others mandate witnessing (referred to as "hold points").

2.4 Project document distribution chart – PDDC

This is usually issued in a matrix format. Work package owners will list their deliverables down the left hand column. Across the top is a list of the project team members (or sub-group). Team members pre-define which deliverables they wish to receive, or the project manager may "force" an issue. A development of the format will show not just the circulation but also the purpose (i.e. for information, comment, approval, use, etc). The PDDC should cover all project stages, but is sometimes split by stage on larger projects.

3. Good practice

- The overall project process and team structure are the main contributors to QA. Other more formal approvals should be kept to a minimum, and should be included in order to minimise risk to the project.
- When several organisations are involved, a common process should be agreed at the outset.
- Quality plans should be used at each stage to define quality control activities. These should be agreed and issued at the start of each stage.
- The in-house quality system should capture good practice and lessons learned.

4. References/further reading

1. BSI Group, British Standard (BS6079-1), 2002, Guide to Project Management, www.bsi-global.com.
2. BSI Group, ISO 9000 (2000), Guidelines to Quality Management Systems www.bsi-global.com.
3. CII Quality Management Best Practices documentation, www.construction-institute.org.

VEP MP.03 Appendix A Example Use of Quality Plans

Example of quality plan used for detail design stage of a project

Item	Description	QC Activities	Specification	QC by			Comments
				Whom	Lead	Action	
4.1	Detail design – general case	Document circulation for comments and defined checks/approvals	PDDC and project approvals policy	All	PM		
4.2	Design contract	Approval of contract with contractor	n/a	WP owners	PM	R-drafts; M-final.	
4.3	ELD's and layout GA's	Formal approval by core team	Design philosophy and process design	Core team	PM	M	During project team meetings – record in minutes of meeting
4.4	Design contractor progress	Monitoring by project manager	Contract	PM	PM	R	Formal progress meetings monthly, report issued twice weekly by contractor
4.5	Design contractor deliverables	General case – monitoring	Contract	WP owners	WP owners	R	
		Specific approvals	Contract and PDDC	WP owners	WP owners	R/A	To be defined
4.6	Piping break-ins	Approval of design & construction steps		To be specified	To be specified	M	

Action Codes

R Read/review, comments as felt necessary
A Formal approval
D Team discussion, ad-hoc actions
M Team meeting, formal record of approvals

Key

PM Project manager
WP Work package

VEP MP.04

Management of Safety, Health and Environmental (SHE) Issues

1. Introduction

The project manager and their team are usually accountable for ensuring that the project complies with all appropriate SHE legislation and in-house rules. This will cover both the risk to project staff and others during the project, and the inherent performance of the completed project in ongoing operation.

Most larger clients will have their own specialist SHE support staff and internal processes which, if complied with, will ensure the project meets all appropriate legal and in-house requirements. The project manager must know these requirements.

2. Good project practice

- Project managers on small projects should have a general awareness of SHE issues and regulations across all the project lifecycle. They will often be the nearest thing the project has to a safety adviser.
- Project teams should be aware of the minimum regulatory requirements, and the intent of the regulations, and work to meet these requirements. However, it is important to note that most SHE legislation concentrates on strategy and goals rather than prescriptive 'do's' or 'don'ts'. Therefore adequate time and effort is necessary to understand and apply the regulations effectively.
- Ensure SHE is integrated with all project activities, and is not seen as a "bolt-on" extra. This will reduce cost, time and frustration (e.g. if the team has to change their proposals due to a late-identified SHE issue).
- Use of a multi-stage Hazard Study process (see references 1 and 2). The number and type of reviews will depend upon the project complexity and the number and complexity of SHE risks associated with the project.

    - The first stage review, carried out during the feasibility-stage will usually identify all applicable company and national regulations that will impact on the project, and also any major, unusual risks.
    - Reviews of construction SHE issues are usually, though not necessarily, carried out separately from reviews aimed at SHE for the completed facility. The benefits of separation are that the persons required to address each aspect are often different.

- Recognise that SHE issues are often proportionately greater for small projects. This is particularly the case when the project involves retrofit into an existing plant or facility.
- Develop a library (database) of site risk assessments and associated control measures which are available to cover all risks which may recur in future project or maintenance work.
- Ensure that all site construction contractors have established SHE procedures and practices which are in compliance with the client's policies and procedures.
- Ensure that all individuals associated with site construction have appropriate SHE training which includes issues relating to work within live plant, when applicable.
- Involve contractors in the development of hazard control processes for all elements with which they are concerned.

- Work associated with existing plant and facilities is likely to be governed by a "Permit to Work" system. Ensure that all those who will work under such a system understand in detail the operation of the system and the roles and responsibilities of the parties involved.
- Ensure that plant operations (and maintenance) are fully involved in any SHE review in respect of plant design for the completed project, and also in construction SHE reviews where there is any interface with operating plant.
- Ensure that roles of Designer, Planning Supervisor and Principal Contractor are allocated to parties with the appropriate competence and resource to fulfil their obligations.
- Ensure that all parties associated with the construction know who are fulfilling the roles of Planning Supervisor and Principal Contractor under the CDM regulations.
- Understand requirements for notifications to HSE. Remember all demolition (as opposed to dismantling) must be notified.
- Develop a plan for how the "Health and Safety file" documents will be provided and retained. Note that there is no legal requirement that these be kept as a separate set of documentation. There is no objection to retaining the relevant documentation as a part of overall plant records, provided that easy retrieval when required is possible.

3. Process industry legislation – UK and European

The main areas covered by UK legislation are listed below. Most other countries have legislation which is broadly similar, but may differ considerably in detail. UK legislation allows a substantial measure of self regulation; in certain other countries there is a much greater requirement to obtain specific permits before certain activities may commence.

European state legislation is directed from the European directives. These are implemented in each EU member state but maybe altered to suit local conditions, for example *Council Directive 92/57/EEC* on the implementation of minimum safety and health requirements at temporary or mobile construction sites led to the CDM regulations in the UK. Many of the European directives specifically relating to construction and the process industry are shown below. Further information on the directives can be found at the European Agency for Safety and Health at Work website (www.europe.osha.eu.int/legislation/directives).

The website of the Health and Safety Executive (www.hse.gov.uk) provides a comprehensive listing of legislation, and also publications and advice covering a range of SHE topics.

	UK legislation Mostly issued under the Health and Safety at work etc Act 1974, and now harmonised with EC directives
Process Safety	• Control of Major Accident Hazard Regs (1999) (COMAH) • Control of Substances Hazardous to Health Regs (1994) (COSHH) • Equipment and Protective Systems for use in Potentially Explosive Atmospheres Regs • The Pressure Systems and Transportable Gas Containers Regs (1989) • Dangerous Substances Regs (1990) • Highly Flammable Liquids and Liquefied Petroleum Gases Regs (1972)
Construction Management	• Notification of installations handling hazardous substances (NIHHS) • Construction (Design & Management) Regulations (1994) • Construction (Health, Safety & Welfare) Regulations (1996) • Provision and Use of Work Equipment Regulations (1992) (PUWER) • Reporting of Injuries, Diseases and Dangerous Occurrences Regs (1984) (RIDDOR) • Control of Substances Hazardous to Health Regs (1994) (COSHH) • Manual Handling Regs (1992) • Personal Protective Equipment at Work Regs (1992)
Consents/ Authorisations	• Planning Permission • Building Control • Integrated Pollution Prevention Control (IPPC)
Design Management	• The Pressure Systems and Transportable Gas Containers Regs (1989) • Construction (Design & Management) Regulations (1994) • Equipment and Protective Systems for use in Potentially Explosive Atmospheres Regs • Machinery Safety Directive

EU legislation in the construction and process industries

- *Council Directive 89/391* of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.

- *Council Directive 89/654/EEC* of 30 November 1989 concerning the minimum safety and health requirements for the workplace.

- *Council Directive 89/655/EEC* of 30 November 1989 concerning the minimum safety and health requirements for the use of work equipment by workers at work.

- *Council Directive 89/656/EEC* of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace.

- *Council Directive 90/269/EEC* of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.

- *Council Directive 92/57/EEC* of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites.

- *European Parliament and Council Directive 2002/44/EC* of the 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration).

- *Amended proposal for a Council Decision* concerning the minimum safety and health requirements for transport activities and workplaces on means of transport – original *Directive 89/391/EEC.*

4. References/further reading

1. ECI, ACTIVE Value Enhancing Practice No. 1.5, Safety, Health and Environment, October 1998.
2. ECI Guide to Environmental Management in Construction, 2001.
3. ECI Guide to Managing Health in Construction, 1999.
4. ECI, Total Project Management of Construction Safety, Health and the Environment, 1995.
5. European Agency for Safety and Health at Work, www.europe.osha.eu.int/legislation/directives.

VEP MP.05

Communications and Information Management

1. Definition

Communications and information management are defined as the enabling process by which organisations manage and release knowledge at individual, team, and organisational level. To manage any project in an effective manner it is essential that all team members have prompt and easy access to data and information relevant to their work. Equally it is essential that the project delivers, in a timely manner, data and information to the plant operations and maintenance group relevant for the handover, commissioning, operation and maintenance of the plant.

Key aims of the information management process are :-

- Accessibility.
- Relevance.
- Timeliness.
- Accuracy.
- Clarity.

Effective communication and feedback are essential to :-

- Avoid deficient work as a result of insufficient or erroneous information.
- Avoid duplication of effort.
- Learn from each other's experiences.
- Co-ordinate efforts to achieve the broader goals of the organisation.
- Enhance customer satisfaction.

2. Good practice in communication in the small project environment

- In the project definition phase information/communication needs are identified and ownership allocated. It is important to define the information required to achieve the project goals and when it will be required.

- A communication strategy and methodology is developed, clearly based on the above needs. What are the sources of information? How will it be transmitted to recipients? How will it be tracked?

- A project execution plan should address the strategy, provide sufficient time and state key resources, to carry out identified communication and information management.

- Communication must be consistent both horizontally (inter-discipline) and vertically (across phases), whilst ensuring that team members and stakeholders are not flooded with information which they do not need. Information needs to be targeted. Broadcasting is not communicating.

- Communicate progress and success (monthly briefings, notice boards – poster/display/memo, photographs, monthly performance figures, e-mail). Status reports should be concise (see also VEP MP.11 Project Control).

- Use communication to facilitate team building and promotion of project values.

- Team leaders receive appropriate communication skills training and coaching (i.e. improve personal skills on presentation and influencing to enable effective use of systems).

- Recognise the nature of the communication (e.g. inform and direct).

- Small projects need to rely on verbal communications and teams need to develop listening skills. There is a need to understand when it is essential to use written communications.

- Avoid information overload and use simplified documentation to ease understanding

3. Recommendations

- Adopt best practices outlined in item 2 above.

- Ensure an adequate Project Execution Plan (PEP) is in place addressing :-

  - Roles.
  - Responsibilities.
  - Representation.
  - Interfaces with all stakeholders.
  - Overview of plan.
  - Key issues/project goals.
  - Information management and communication methodology. Keep as simple as is practicable.

- Utilise electronic files where appropriate, taking into account :-

  - Interface with existing systems of client, contractors, vendors.
  - Accessibility/user friendliness – will significant training be needed.
  - Confidentiality if accessing other company systems.
  - Availability of support for hardware and software.
  - Setting up costs.
  - Risk of data/programme corruption, especially if using the internet.
  - IT compatibility; check that systems of different organisations are truly 100% compatible.
  - The requirements of appropriate EU and national legislation.

- Publish programmes with timings, priorities and resources.

- Ensure that notes of meetings are issued promptly. Identify all the topics discussed, but focus on points agreed (or specific disagreements), proposed actions, action priorities and target dates.

- Ensure that the requirements for vendor documentation are specifically addressed in detail. What information is needed and when? How will the project team ensure it is available when needed? Information required for the overall design process is very often a critical constraint.

- Ensure that construction contractors understand their obligations for supply of documentation and timing of requirements. In particular there is a need to be explicit in identifying quality assurance documentation requirements.

- Produce a close out report (See VEP MP.15 Project Close Out).

- Communicate the project risk management plan and regularly update status. This may require a summary for management and a more detailed status review for the project team. The latter could well be taken as part of a progress review meeting.

4. References/further reading

1. ECI, ACTIVE Value Enhancing Practice No. 1.6, Information Strategy, October 1998.
2. ECI, ACTIVE Value Enhancing Practice No. 4.1, Information Management, October 1998.
3. European Foundation for Quality Management (EFQM), Business Excellence Model, latest revision January 2003, www.efqm.org.
4. Investors in People UK, Investors In People Standard (1991), www.iipuk.co.uk.
5. Offshore Petroleum Industry Training Organisation , The Team Toolkit – a practical guide to team based working.

VEP MP.06

Procurement of Materials and Services

1. Introduction

Successful project delivery requires the cooperation of clients, contractors and suppliers. Formal contract agreements provide the legal framework for the relationships between these parties.

For small projects it is particularly important that contract agreements are structured and documented to reflect the nature of such work. Alignment of the parties with a contract agreement that is deemed to fully document the work requirements, and respective responsibilities for delivery of that work, in a fair and consistent manner is essential to satisfactory performance and harmonious relationships.

2. Good practice in small project contracts

- Develop a strategy for the procurement of materials and contracting of services.
- Base contract/purchase orders on a sound level of definition and pre-agreement of principal aspects between the parties.
- Identify time-critical activities early.
- Use contract forms that document the legal agreement and protect the rights of the parties to the contract without unnecessary complexity.
- Minimise documentation to that required for safe and effective plant construction and the satisfaction of statutory/client needs for essential plant records.
- Identify key personnel as officers to the contract.
- Have a clear process for authorisation of changes.
- Use framework agreements/term contract arrangements where appropriate. Contract performance is enhanced by understanding and trust that has already been established between the parties.
- Formalise coordination and communication procedures irrespective of the size or nature of the contract.
- Ensure that project risks relating to the contract are managed in an appropriate manner. Demonstrate balance between the levels of risk being taken by the parties to the contract and the available levels of reward. Avoid the unreasonable transfer of risk down the supply chain.
- Tailor pre-qualification and tendering systems to the nature of the work and keep as simple as practicable. Consider relevant suitability and performance requirements, not just "bottom line" price.

3. Recommendations

- As part of project definition, a clear strategy for procurement of both materials and services should be identified and agreed with those who will be responsible for its execution (i.e. procurement department, management contractor etc). It is likely that a common strategy for small projects will apply and, hence, only necessary deviations need to be highlighted for individual projects. The strategy should identify :-

Key elements of, and reasons for, construction strategy.

- What is most important – price, quality or delivery?
- How is the preferred supplier/contractor to be selected? What work will be needed to achieve this? Can existing agreements with suppliers and contractors be used to save procurement effort and reduce uncertainties regarding quality of supply?
- If a fixed price contract is to be used, the work or service required must be very well defined, otherwise claims/disputes will arise.
- If a reimbursable basis is to be used, how will costs be monitored and controlled?
- If design is to be contracted, give careful consideration to location of design team. Retro-fit projects require extensive site checking and reference to existing documents.
- Where it is known which contractors will be used, review definition with them to check main points of strategy and availability of resources.
- Identify how interfaces between client and contractors will be managed, especially design contractors.

- A contract/procurement plan should be developed. This needs to identify:-

  - overall duration of procurement activities.
  - time-critical activities for specific purchases or contracts.
  - specific inspection and expediting requirements.
  - authorisation requirements, where these lie outside the project team.

- Adopt an appropriate approach to procurement, i.e. dependent upon value, extent of supplier risk, and whether the item or service is a commodity or custom-engineered.

- Ensure that there is an effective system in place for the selection of suppliers and contractors. A major portion of selection work should occur before a party is allowed to submit a tender. In that way the probability of receiving acceptable tenders is greatly enhanced (see also VEP MP.13 Construction Management).

- Consider the use of the internet for certain types of purchases. This needs prior understanding of how such systems work, but can be very effective.

- Involve key suppliers/contractors in the project definition phase to allow them to contribute to specification and planning.

- Use a form of contract that reflects the nature of the work and avoids unnecessary complexity. Avoid using a form of contract that is designed for major projects since additional effort and cost may result.

- The use of model form contracts is to be encouraged but, where these do not cater for the exact needs of the project, simple but carefully constructed special contract conditions may be necessary.

- Wherever possible all contracts should relate to a fully defined and documented work scope and list of deliverables. This definition should be included within the body of the contract or as a formal schedule to the contract agreement. Consider also preparation of a project implementation strategy/project summary to provide useful understanding for the various parties as to how the intended contract works will fit within the project as a whole.

- Where full and clear definition is not available, reimbursable contracts are often fairest to all parties. As with all contracts, they need adequate control procedures and should incorporate a full listing of the agreed deliverables. On some projects it is sensible to consider converting reimbursable contract arrangements to an alternative fixed price form when a satisfactory level of definition has been achieved.

- Irrespective of contract value or complexity, team structure and the respective roles and responsibilities of team members should be identified and referenced in the contract. In particular, those persons named as officers to the contract should be fully trained and familiar with their responsibilities.

- Ensure that those involved in discussions with suppliers/contractors are commercially aware. This applies even if discussions are purely "technical".

- Many successful contracts are characterised by the ability of the parties to fully meet their obligations without the need to constantly make reference to the contract or contract conditions. The adequate training and preparation of contract officers is essential.

- Coordination and communication procedures should be prepared in a simple and practical form for all contracts.

- Contract risks should be collectively analysed for their potential project impact and the contract based on the agreed approach for securely managing them.

- A clear change authorisation procedure must exist, even in the case of reimbursable type contracts.

- Consider contracts structured to provide genuine incentive for parties to achieve agreed performance targets. There should ideally be an opportunity for recognition of performance through a potential gainshare when targets are met and not merely a range of penalties applied to failure.

- The "Contractor's Scope of Work" within the contract documents should not only describe the physical extent of the work to be done, but also address peripheral (but still important) aspects which define the boundaries of contractor's scope. Appendix A provides a checklist of some of the more common aspects which may need to be identified.

4. Alliance partnering agreements

Small projects commonly run to short programme durations whereas trusting relationships need time to develop. Clients with a full programme of small projects should consider the advantages of longer-term purchasing and contract arrangements to provide the workload and opportunity for relationship development. Short-term project-to-project, contract-to-contract arrangements are less likely to deliver best performance, whereas alliance/partnering agreements have been shown to deliver good results for all parties involved, provided that the arrangements are appropriate and properly managed.

If an alliance/partnering arrangement is to be considered, it is essential that its development and operation follows good practice. This is detailed in ECI guideline documents on the subject. Some key considerations are :-

- The time and effort required to set up such an agreement is usually significant. Such agreements rarely deliver benefit in respect of a single engineering project, but usually for materials or services over an extended time period. In this case the setting up of an agreement should be treated as a project in its own right.
- The aims and objectives of the agreement need to be clear and accepted by the parties involved. There should be a clear opportunity for benefit for all parties involved.
- Selection of potential suppliers/contractors requires great care and pricing levels must be considered only as one of many important aspects.
- There must be a strong and enduring commitment by the management of all parties to the principles of the alliance.
- There needs to be a clear recognition by parties that short term gains at the expense of the other party must not occur, and that long term objectives must always apply.

5. References/further reading

1. ECI, ACTIVE Principle AP3, Effective Supply Chain Relationships, October 1998.
2. ECI, ACTIVE Principle AP5, Effective Project Risk Assessment, October 1998.
3. ECI, ACTIVE Value Enhancing Practice No 1.7, Procurement Strategy, October 1998.
4. ECI, ACTIVE Value Enhancing Practice No 3.1, Procurement Chain Relationships, October 1998.
5. ECI, Partnering in Europe, 2001.
6. ECI, Partnering in the Public Sector, 1997.
7. ECI Report on Long Term Partnering Arrangements (publication 2003).

VEP MP.06 Appendix A

Checklist for Scope of Contractor's Work

The following listing identifies items which may require to be stated within the scope of the contractor's work. If it is to be provided by another party (client or a different contractor) this should be stated. Not all will be relevant to every contract.

- Detail of schedule planning required, and when plans must be delivered.
- Any specific constraints on work progress (i.e. availability of vendor documents, shutdown timings, material deliveries, work by other parties).
- Detail of progress measurement required and frequency of reporting.
- Frequency of review meetings.
- Responsibility for overall project cost control; detail of cost monitoring required.
- Requirement for job-specific training of contractor staff. If required, is this cost recoverable?
- In addition to an overall Health and Safety Plan, any additional specific requirements for provision of detailed HSE plans for particular elements of the work (i.e. lifting studies, confined space working studies).
- Does the contractor have the role of the Planning Supervisor and/or the Principal Contractor under CDM Regulations in the UK, or equivalent elsewhere?
- Are there any specific design review requirements (i.e. safety reviews, layout reviews etc)?
- Documents requiring client approval. What is the approval process?
- Quantities of documents and drawings to be supplied. Which of these must be updated to as built status?
- Requirements for the updating of existing plant drawings and documents.
- Specific format requirements for drawings and document (including electronic formats).
- Responsibility for providing relevant existing documentation.
- Responsibility for providing copies of relevant technical standards.
- Where the contractor is responsible for managing other (sub)contractors, the extent of those responsibilities.
- Provision of the contractor's site offices and where they are located relative to the worksite.
- Provision for vehicle access and car parking.
- Provision and cost of utilities to the contractor on site. This should address both the hardware needed for the supply (pipes, cabling, switchboards, telephones, washrooms etc) and the utility itself (electricity, water, telecoms etc).
- Quality assurance requirements including QA documentation.
- Responsibility for the provision of scaffolding and other temporary access. Who pays for it? How is its provision co-ordinated?
- Provision of lifting equipment.
- Who provides materials? This may be a split provision; if so, it needs to be defined.
- If the contractor is to procure materials, is use of the client's purchasing agreements available?
- Responsibility for storage of materials at site.
- Particular pay rates applicable for site work (i.e. NAECI Agreement).
- Responsibility for site security.
- Responsibility for the execution of plant isolations and de-isolations.
- Permits required at the worksite (i.e. for general visitor and for construction workers).
- What procedures apply for obtaining permits and who is responsible for obtaining them?

- Any legal permit requirements. If so, who is responsible for them?
- Responsibility for the management and execution of QA checks at handovers.
- Responsibility for the management and execution of pre-commissioning and commissioning.

VEP MP.07

Staff Availability and Competence
(Including contractor resources)

1. Definition

The need for resources with the appropriate skills and knowledge is a key issue for any project. For small projects it is often one of the main constraints as, typically, staff work only part-time on the project and have many other responsibilities and priorities.

It is necessary to address resource requirements through all phases of the project, from conceptual design, through to final commissioning and hand-over, or even into plant operation and maintenance. Specialist assistance offered by the vendor should also be considered under this heading.

It should be stressed that this subject deals with the availability and competence of personnel from all parties to a project.

2. Good practice in staff availability and competence

- Informed resource planning based on a realistic and achievable programme of projects or work packages.
- The development of a dedicated core team with the required levels of skill and experience. This is only valid if there is an ongoing portfolio of project work.
- Understanding the characteristics of a particular project such that the right personnel can be targeted as being key for that particular job. It does not follow that personnel experienced in the management or execution of large projects have the necessary or most suitable attributes for minor projects.
- Recognition of the need for existing plant knowledge for appropriate projects. This is of particular importance in the areas of process engineering and instrumentation/control.
- An understanding and appreciation by plant operations staff of the reliance of design and construction personnel on them, and an understanding of the priorities of the bigger picture.
- A project manager’s workload should not be measured in terms of capital value – a suite of small capital value projects is far more time-intensive and time consuming than one larger one.

3. Recommendations

- In the development phase of every project a resource requirement plan should be prepared. Availability of all resources should be agreed with line management.

Requirements should address :-

- timings for each resource.
- needs for specific skills and knowledge, e.g. covering plant and software.
- source of resources, i.e. what is to be supplied by client (project group or plant staff), and what by contractors (or vendors).
- any conflicts in demand for resource.

- The project definition phase itself will often require considerable technical input. Insufficiency of resource in this phase is common and leads to either a delay in completion or progressing to the detailed design phase with an inadequate definition. In particular, the role of the process engineer is usually very significant and up to 50% of the total process engineering work may be required in the definition phase.

- Ensure that all resource requirements are developed from workload plans well in advance of actual timing. This will give the resource supplier adequate time to source, mobilise and train staff. The utilisation of an integrated works projects resource planning mechanism is extremely useful for managing multi-discipline/multi-client requirements.

- If there is a reasonable ongoing workload of projects, establish a core team so that long term relationships can develop. Hold regular workshops and do not be reluctant to change things. The small project environment often requires the long-term participation of several parties. The maintenance of a stable core project team will ultimately result in an efficient and well-acquainted team, benefiting from shared learning and experience.

- Make every effort to maintain the core team. If provided by a contractor, consider an incentive scheme to limit team turnover.

- Develop clear roles, responsibilities and accountabilities for all concerned to ensure everyone understands their respective roles. If necessary, identify any shortfalls in skills/competencies so that appropriate training can be planned at an appropriate time. See Appendix A for a suggested competence assessment form for managers of small projects. This can be extended to include any other skills, knowledge or experience which is appropriate for a given project.

- Establish criteria for determining that personnel are suitably qualified.

- Offer training to ensure that all key project personnel are familiar with site HSE requirements and also that enough of the team have access to relevant areas of the plant. Waiting to be guided to particular areas can be time-consuming and frustrating for all concerned.

- Ensure that workload plans are regularly reviewed with site personnel to ensure their buy-in to the plan so they can have the necessary people available at the required time, (e.g. operators, health and safety, commissioning personnel). These are not usually part of the core team but their availability at the required time is paramount. It is suggested that a simple resource chart should be drawn up to cover all relevant staff.

- Where there are numerous or significant interfaces with the operational plant, it is often better to include these projects under the umbrella of the works planning system such that the tasks required of them are identified and assigned as part of their workload.

- Consult with the resource provider well in advance of the requirement. If possible, it is beneficial to phase the projects in a manner consistent with resource availability rather than to risk either breaking up the core team or risk a team without the necessary capacity, experience or competence.

- Identify a single point of contact/accountability within the operating plant. Typically this is the plant or asset manager, one of whose roles would be to provide support to the projects team.

- Resource plans should be regularly updated and circulated to all parties.

- Consider the benefits/consequences of multi-skilling. It needs to be recognised that whilst multi-skilling provides the individual with a wider range of experience, it may remove an individual's key expertise from another small project/work package.

- Check the skill and knowledge of any individual being offered by a vendor; under-performance, either in knowledge or availability, can have significant consequences on the project.

4. References/further reading

1. ECI, ACTIVE Value Enhancing Practice No 2.1, Project Team Organisation, October 1998.

VEP MP.07 Appendix A

Small Project Management Competence Assessment

The competence (capability) of the project manager and team can be evaluated against each of the requirements of their role using the following performance levels. In each case it should be asked whether there exist the skills, knowledge and experience to perform at the given level. Compensation for any shortcomings can be in the form of coaching, extra supervision, training, or modification of the role to enable other adequately skilled members of the team to provide cover.

Appreciation

Has a basic understanding of the role of the small project manager.
Can recognise problems/opportunities but not tackle them without help.
Understands own limitations and knows where to find help.

Competent

Has experience of successfully managing small projects with limited supervision and occasional reference to an expert or more senior manager.

Expert

An experienced professional who can be trusted to deliver small projects without supervision and is able to guide and help less-experienced individuals.

The overall capability of an individual or team can be assessed by addressing ability in respect of each of the elements listed below. Some elements are only of relevance to the project manager.

Heading	Sub-Heading	A	C	E
Project Strategy, Development and Definition				
	Understanding of the project process for small projects			
	Identification and agreement of business objectives			
	Development of strategy for project implementation			
	Achieving stakeholder buy-in			
	Selecting best option for meeting business objectives			
	Knowledge of elements of scope definition			
	• Requirements for physical scope			
	• Overview plan and critical elements			
	• Development of resource requirements			
	• Agreeing resource availability			
	• Scope definition requirements for estimates			
	• Hazard/risk management			
	• Procurement strategy			
	Preparation of estimates, identification of cost risks			
	Project authorisation procedure			
	Implications of “fast track” for projects			

Heading	Sub-Heading	A	C	E
Quality Management (QM)				
	Understanding of project process and procedures			
	Understanding of quality management system for small projects			
	Develop “fit for purpose” QM procedures for small projects			

Safety, Health and Environment (SHE)				
	Knowledge of applicable legislation			
	Knowledge of statutory approval requirements			
	Knowledge of own company SHE policies and procedures			
	Ability to integrate SHE management into overall project			
	Knowledge of sources for specialist SHE advice			
	SHE management tools for use in projects (HAZOP Risk Assessment etc)			
	Involvement of contractors			
	Involvement of plant operations and maintenance			
Communications and Information Management				
	Defining requirements for small projects			
	Identifying providers of information			
	Understanding “who requires what, and when”			
	Effective communication to different parties			
	Understanding merits and limitations of different forms of communication			
	Effective project reporting			
Procurement of Materials and Services				
	Development of procurement strategy			
	Basic understanding of contract law			
	Understanding the merits of different forms of contract			
	Recognising the implications of specific conditions of contract			
	Identification of responsibilities of parties			
	Understanding of tendering and selection process			
	Understanding requirements for ethical practise			
	Selection and use of key suppliers			
	Understanding the requirements and implications in respect of quality of contract scope.			
	Requirements for inspection and expediting			
	Understanding the use and benefits of long term relationships			
	Understanding risks associated with procurement of materials and services			
Project Team Management				
	Ability to provide effective leadership			
	Identification of required skills and knowledge			
	Negotiating and agreeing team members			
	Knowledge of available project management training			

Heading	Sub-Heading	A	C	E
	Involving plant operations and maintenance			
	Involvement of key suppliers and contractors			
Design and Engineering				
	Identification of project-specific knowledge requirements			
	Ability to identify and manage information requirements			
	Identification of appropriate technical standards/specifications			
	Understanding of the linkages between design and engineering disciplines			
	Requirements for design for retrofit projects			
	Use of shared resources between multiple projects			
	Measurement of design progress			
	Involvement of plant operations/maintenance in design			
	Use of specific design reviews			
	Understanding needs for "as built" documentation			
Project Controls				
	Knowledge of planning techniques for small projects			
	Use of planning/progress monitoring software			
	Understanding concept of physical progress measurement			
	Knowledge of cost management systems for small projects			
	Understanding of quality management applied to small projects			
	Understanding of document control procedures			
	Understanding of the process for project handover			
Risk Management				
	Knowledge of methodology for risk management for small projects			
	Knowledge of the risks typically affecting small projects			
	Ability to carry out risk assessment and control			
	Ability to actively manage risks			
	Ability to explain the key risks to management			
Construction Management				
	Ability to develop construction strategy			
	Knowledge of hazards associated with construction work			
	Management of hazards in compliance with procedures and legislation			
	Management of design/construction interface			
	Measurement of construction physical progress			
	Identification of requirements for temporary facilities			
	Management of multiple contractors			
	Involvement of plant operations/maintenance			
Handover, Commissioning and Start-up				
	Understanding of requirements to achieve mechanical completion			
	Assessment of resources needed to effect handover			
	Understanding of scope and sequencing of commissioning			
	Understanding and ability to provide detailed planning			
	Appreciation of final documentation requirements			
	Co-ordination of handover and commissioning			

Heading	Sub-Heading	A	C	E
Project Close-out, Performance Measurement and Improvement				
	Understanding requirements for project final close out			
	• Financial closure			
	• Documentation transfer			
	Provision of experience and data from the project			
	Understanding the use of KPIs and benchmarking			
	How to conduct a post-implementation review			
Project Portfolio Management				
	Selection and prioritisation of projects			
	Assessing impact on portfolio of changed schedules and priorities			
	Resourcing for the portfolio of projects			
	Use of the "stage-gate" approach for development and approval of projects			

VEP MP.08

Team Effectiveness

1. Introduction

Team effectiveness in any size of project is one of the most important aspects in its successful completion. If the individuals representing the participating organisations that have been brought (or sometimes thrown) together are not able, or willing, to embrace the culture of team working then difficulties will be encountered and the potential for failure will increase.

In large multi-million pound projects lead time is usually sufficient for participants to have formed an initial commitment to the project and each other. This allows an effective team to be built and time and resource included in the overall cost. Additionally, core team members are usually committed to the project.

On smaller projects, the lead-time to project start is usually much less, and even key members of the team are often assigned on a part time basis.

Team effectiveness is not the sole responsibility of the project manager, though the leadership he or she provides is a major contributor. All the individuals on the team should recognise other members' strengths and weaknesses and help to support them, and receive support in return when needed.

2. Good practice to encourage team effectiveness

2.1 For individual projects :-

- Select participants (organisations and/or partners).
- Select the core team who will manage the work.
- Assemble the team in a common location if practicable.
- Get to know your fellow team members.
- Hold kick-off meetings with the complete team.
- Confirm project definition and scope.
- Introduce new or replacement team members to the whole team.
- Agree team goals and objectives.
- Agree individual targets.
- Hold regular progress reviews.
- Communicate progress and success (monthly briefings, notice boards, photographs, publish monthly performance figures).
- Minimise team turnover.

2.2 For ongoing management of projects :-

- Aim for continuity of a core team to manage small projects.
- Establish key performance indicators (quality, cost, milestones, safety) and compare with benchmarks.
- Establish a continuous improvement culture.

- Establish benchmarks, encourage innovation, highlight and reward success, hold regular reviews and feedback.
- Establish incentives and remove disincentives.
- Establish team spirit (lead by example, recognise everyone's contribution, set out aims from day one, organise formal team building, listen to comments).

3. Recommendations

3.1 Team

It is vital that all team members have the right skills and knowledge for their role. Where a potential team member is not already well known to the project manager, appropriate checks should be made (i.e. review of CV, interview, discuss with clients for previous work). The team may comprise a combination of staff from the client, the contractor, the subcontractor and the supplier. All these disparate individuals from the contributing organisations need to be brought into the team and motivated to meet the project objectives.

Most contracting organisations, and to a lesser extent clients, place reliance on contract staff to meet the peaks and troughs of a variable work load. This should not present a significant problem since, by the very nature of their career patterns, contract staff can be very adaptable and open to new ways of working. However, continuity of work for contract staff should be given careful consideration, since the impact if they leave the project prematurely can be greater for minor than for major projects.

An aspect of team selection that needs to be recognised is that the project manager is often faced with a limited availability of resource from which to select their team. This can reduce the capability of the team and is a risk to the project.

Having established the team, all reasonable effort must be made to minimise turnover (except where an individual proves to be unsuitable). If it is unavoidable that a team member be changed, a proper handover with a reasonable overlap must be arranged.

3.2 Team building exercises

To establish team spirit, formal and informal team building exercises should be organised. They should be held early on in the project life-cycle to gain maximum benefit. It is impracticable for small projects to indulge in major functions but events such as a team lunch alongside the kick–off meeting help build the team. It is also important that the team be kept informed of progress throughout the project.

3.3 Location

To achieve the requisite motivation and commitment, the team should ideally be housed in a common location, preferably close to the job site. For small projects some of the team members are likely to be allocated to more than one project or have other roles to fill, especially client plant-based staff. Where only a portion of the team is established at a single location, it is important to provide for the other (visiting) team members.

This location should have, or provide access to, all the project master documentation.
Consideration should be given to the use of video conferencing and web technology, particularly

where specialist input is required and participation at the job site would not be cost effective. The latest technology enables drawings to be reviewed and 'redlined' on-line.

3.4 Training

Training of staff is not normally part of the remit of a project. However, situations will arise where training needs to be addressed in the context of a project. For example:-

- The project team accepts an individual in a training role. Time should be provided for training courses, which should be identified early to minimise disruption to the project. Additionally, the individual concerned should be allocated a mentor to provide advice, check work etc.
- The project has a particular specialist requirement and there is no-one with the skills available. This most commonly occurs in respect of control system software. Training is usually provided by the supplier. It is important to ensure that the project has budgeted for this.
- New equipment to be installed requires training of the plant operations and/or maintenance staff for its commissioning, use and maintenance. It is often the responsibility of the project to arrange this as it is essential it is carried out before project handover.

3.5 Project kick off meeting, setting goals and targets

A project kick-off meeting is an effective means of introducing the whole team to each other as well as an opportunity to confirm the project scope and definition. It can also be used to test the team members' understanding of their roles and responsibilities and to agree goals for the project. The following should be addressed :-

- Review the project objectives and ensure a common understanding.
- Highlight key issues for the project and how they will be managed.
- Avoid prolonged review of a single issue. If there are issues requiring attention, these should be addressed separately.
- Carry out a brief review of the schedule and obtain commitment from the team to it.
- Invite individual team members to highlight key issues within their area of responsibility and voice any concerns.
- Agree the process(es) by which the team will manage the project through its execution. In particular, agree communication processes.
- Set project target goals and check that they are consistent with individual needs and targets so far as is practicable. If there are clear conflicts, it is usually better to resolve them outside the meeting, but they must not be left unresolved.

3.6 Team progress review meetings

Regardless of the availability of electronic communications, it is of great benefit that the team meets together from time to time to allow a review of project status. This also provides each team member with an opportunity to raise any issues considered important to the whole project. The frequency of such meetings depends on the needs of the project. For a project which is actively being implemented this should be at least monthly. The following should be covered :-

- Brief overview of project status.
- Highlight any changes to project objectives/key premises and review implications.
- Highlight the current key issues and agree a mechanism for their management (if not already in hand). Do not allow a prolonged discussion of individual topics unless they are of relevance to all attendees. Arrange a separate meeting with those who need to be involved.
- Highlight any important achievements over the preceding period.
- Invite all participants to make a short presentation regarding the current status of their work on the project, and give them the opportunity to raise any relevant issues they see as important.
- Aim to keep the meeting fairly short.
- Agree date of next review.

3.7 Project team time availability conflicts

A common feature of small projects is that most of the team will often be assigned to the project part-time and will have other concurrent roles (on other projects or non-project work). Research shows that small projects have a very poor record in terms of on-schedule completion and the single most common cause is a lack of resource. It is vital that, as a part of project definition and in agreeing project team membership, the issue of resource availability is addressed by the project manager. Availability commitments should be agreed by the line manager for each team member.

Nonetheless, a team member will occasionally find that he/she is faced with a conflict of priorities in their work. It is essential that this is brought to the attention of the project manager as soon as is practicable. It is then the project manager's responsibility to work with both the individual and management to resolve the issue as quickly as possible.

It needs to be remembered that delay to the work carried out by one individual will probably have a knock-on effect for others, also delaying their work and possibly causing a conflict of their priorities.

3.8 Key performance indicators (KPIs)

Establish Key Performance Indicators and compare with benchmarks. Review findings with team members and discuss means for improvement. Where good performance is apparent, identify reasons for this and how they may be carried forward into future projects. Typical KPIs are identified in VEP MP.16 Measurement, Benchmarking and Improvement Process.

3.9 Continuous improvement

It should be the objective of those involved in the management of projects to achieve enhanced performance (cost effectiveness, quality, SHE performance, project cycle time, etc) year on year. This requires that lessons learned are captured and disseminated throughout the project team. New starters to the team should undergo an induction and be educated in the lessons learned process. The latest technology, materials and methods of working should also be reviewed and embraced accordingly. Use of KPIs and industry benchmarking is an effective means of driving continuous improvement.

3.10 Measurement of team effectiveness

It is possible to measure team effectiveness. A key measure is how well the team fulfilled the project objectives. This must never be ignored as it is the fundamental purpose of the project team.

A more detailed team effectiveness measure has been included in Appendix A, “The Team Working Scorecard”. The measurement process can be applied by the project manager on, for example, a monthly basis to initially give him or her a view on the team. Occasionally, cards can be issued to each member of the team and the results collated to establish how the team views itself. A final joint assessment should be carried out at the completion of the project and used as an improvement tool.

4. References/further reading

1. Department of Trade and Industry (DTI) KPI Report for the Minister for Construction, The KPI Working Group, January 2000**,** www.dti.gov.uk/construction/kpi/report2000.
2. **ECI, ACTIVE Principle 2, Effective Project Team Management, October 1998.**
3. ECI, ACTIVE Value Enhancing Practice No. 2.1, Project Team Organisation, October 1998.
4. Sloley AW, Teamwork, Ownership and the Modern Project, Hydrocarbon Processing, September 1996, www.hydrocarbonprocessing.com.

VEP MP.08 – Appendix A

Team Effectiveness Measurement

Team Working Scorecard					
Date	**Project Title**				
Level of consensus The degree to which all team members share the project objectives	None	Some agreement	Significant agreement	Minor disagreements	Total consensus
	0 1 2 3 4 5 6 7 8 9 10				
Ability to reach closure Quality of problem solving and decision making	Problems not recognised	Problems discussed	Some decisions made	Most decisions made timely and effectively	All key decisions made effectively
	0 1 2 3 4 5 6 7 8 9 10				
Hierarchy Project management style – from power and control to empowerment	Rigid, all decisions from top	Most decisions referred up	Moderate individual freedom	Team opinions sought and valued	Consensual. Members empowered
	0 1 2 3 4 5 6 7 8 9 10				
Leadership How well is direction set from the top?	Objectives not stated	Outline project objectives stated	Some individual goal setting	Commonly understood goals and objectives	Alignment of individual goals and objectives
	0 1 2 3 4 5 6 7 8 9 10				
Participation Do team members deliver to their potential?	No encouragement to participate	Aware of issue	Individual strengths recognised	Work organised to fit strengths	Best output from all
	0 1 2 3 4 5 6 7 8 9 10				
Interactions Are roles defined by personal history or current needs?	Rote pattern of behaviour	Aware of issue	Behaviour monitored	Flexibility encouraged	Behaviour aligned to objectives
	0 1 2 3 4 5 6 7 8 9 10				
Accountability Does the team understand its collective and individual responsibilities?	No understanding	Accountabilities informally discussed	Accountabilities listed and agreed	Evaluation routinely done	Full ownership of accountabilities by all
	0 1 2 3 4 5 6 7 8 9 10				
Expectations Does the team believe project objectives are achievable?	No hope of success	Largely unrealistic	Challenging but possible	Some vulnerabilities	Expectation of success
	0 1 2 3 4 5 6 7 8 9 10				
Customer How well integrated is the customer?	No involvement	Provides specification only	Limited involvement at reviews	Extensive involvement in all key decisions	Fully integrated into team
	0 1 2 3 4 5 6 7 8 9 10				
Stakeholders Is project supported by all key players?	Not identified	Some identified, little involvement	Identified, some involvement.	Working level involvement	Fully included and involved as appropriate
	0 1 2 3 4 5 6 7 8 9 10				
Overt conflict Do personality conflicts impede delivery?	Substantial conflict, poor communication	Regular disagreements, not always resolved	Occasional disagreement	Occasional disagreement, normally resolved	Fully effective resolution process handles any disagreements
	0 1 2 3 4 5 6 7 8 9 10				
Covert conflict Is there underground dissent?	Sabotage occurs	Team has factions, not aligned	Occasional feeling of misalignment	Any problems acknowledged and tackled	Open discussion and resolution of all issues
	0 1 2 3 4 5 6 7 8 9 10				

VEP MP.09

Engineering Design for Small Projects

1. Introduction

The requirements for effective design and engineering of small projects are essentially the same as for large projects. However, a number of design issues are specifically pertinent to small projects, especially those which are modifications of existing plant or facilities. The arrangements (e.g. resourcing etc) for carrying out the work are also likely to differ from those for a large project.

The extent and complexity of requirements will vary significantly from project to project. It cannot be overemphasised that design and engineering requirements for some small projects will provide challenges and risks proportionately greater than for large projects.

2. Good practice for small projects

The following are elements of basic good practice requirements. Recommendations as to how this good practice may be achieved are given in section 3 below. Whilst requirements focus on the needs of small projects, many are applicable to engineering projects of all sizes.

- Ensure that the basis of design provided as the starting point for detailed design and engineering is sufficiently detailed to allow work to proceed without the need to further explore what the design basis should be.
- Before starting detailed design and engineering have a clear plan of how it will be effected. What is the required timeframe? Are any special design processes needed? What resources are needed and how will they be provided (client/contractor/vendor)?
- If required, allow time in which to engage design contractor.
- Determine the appropriate basis (form of contract) upon which a design contractor will be employed.
- Ensure that staff with the right skills and knowledge will be available when they are required.
- Ensure that required information about the existing plant/facilities is available. Identify who will provide this information.
- Identify the requirements needed to update existing drawings and other documents, and also look at which new documents require updating to "as built" status after construction is completed.
- Identify key design information which must be supplied by vendor(s) and make provision for obtaining this when it is required.
- Ensure SHE issues in design and constructability will be properly addressed. It is important to address both process integrity and design for construction and maintenance safety.
- Ensure suitable arrangements have been made to involve plant operations and maintenance in design reviews.
- Ensure that a suitable methodology for monitoring detailed design and engineering progress is in place. This will need to monitor both overall physical progress and, more specifically, the progress of critical activities.
- Recognise the importance of good quality design and engineering. The cost, in terms of time and money, in remedying incorrect or deficient detailed design and engineering in

construction (or worse, after commissioning) is likely to be greater than any additional cost to achieve required accuracy and completeness in the design phase.

- Implement a rigorous change control process in the design phase to avoid any "nice to have" changes.
- Ensure that appropriate design resource is retained to provide rapid response to queries arising in the construction phase and to update drawings as needed.

3. Recommendations for small projects

3.1 Definition phase

- The definition phase of the project should include a completed "basis of design" against which the detailed design and engineering can be carried out. Proceeding without a sound basis of design leaves the detailed design and engineering process vulnerable to change and delay. It is worthwhile reviewing the work carried out in the definition phase to assess whether it is considered sufficient to support detailed design and engineering. A process for carrying this out is given in VEP MP.02 Project Development and Definition.

- It is important that the design details are identified and agreed. Ideally, a checklist stating typical (standard) deliverables should be used as a basis for this. The aim should be to achieve a design fit for the needs of the particular project.

- Standards to be used must be addressed before detailed design and engineering gets under way. If the project includes modification of an existing plant or facilities, it is important to identify the original standards and what issues arise in respect of matching these to current standards. Issues of compatibility with existing equipment and systems should also be identified. This is usually most significant in the area of instrumentation and control. Aim to use industry or international standards where practicable, the benefits of which are twofold; contractors and vendors are more familiar with them and they are usually available at lower cost and shorter deliveries.

- Design and engineering quality standards for the project should be stated as a part of the basis of design. These should be fit for purpose in order to meet project objectives. The quality standards also need to:-

    - Fulfil SHE requirements (which may not be explicitly stated in the project objectives) to ensure the long term integrity of the plant.
    - Minimise errors which will need correction at a later stage in the project.
    - Achieve compatibility with existing plant facilities where this is deemed important.

- Identify what information is required concerning the existing plant/facilities. Where is it and how can it be made available? Is information in electronic format and, if so, is it compatible with systems to be used for project design? Is the information accurate, i.e. does it reflect the plant/facility as it now is? Identify relevant information which is not available and determine a strategy by which this deficiency will be overcome.

3.2 Design resources and organisation

- Different organisation structures can be utilised (by contractors) for small projects :-

  a) By engineering discipline, i.e. where the resource remains in the discipline department carrying out work on all projects.
  Advantage – ease of management of resource by discipline department.
  Disadvantage – less commitment to specific project; small projects may get low priority.

  b) Project task force, i.e. team assembled from all needed disciplines reporting to project manager for the duration of requirement.
  Advantage – team commitment, eases information transfer between disciplines.
  Disadvantage – resource availability; in many cases resources are not required full-time due to small scale of work.

  c) A combination of the above. A core team executes a portfolio of small projects with additional resource (including specialists) added as needed.

- The scale of design and engineering for small projects means that each individual member of the project design team must have a reasonably broad skill set as it is not practicable to employ a separate individual for each particular sub–discipline (e.g. the project must manage with one mechanical equipment engineer, whereas a major contractor on a large project would employ vessels engineer, heat exchanger engineer, pump engineer, compressor engineer, etc). Hence, it is important to select individuals with the right skills for the project's needs who can also understand the necessary interaction between disciplines. Of course, reference can still be made to specialists on a specific point needing a particular skill.

- Ascertain the times in the overall design process where a particular resource will be needed, and then check availability. Unless the project is accepted by management as high priority and/or fast track, then it is likely that some slippage will occur to the design and engineering programme unless contingency is built in for non-availability of resource.

- Where small projects involve modification or extension of existing plant or facilities, identify those elements where plant/facility-specific knowledge is essential (general competence and experience are not sufficient). Most commonly, this is a requirement in process design and instrumentation/control engineering, though other disciplines must not be ignored. If individuals with best plant specific knowledge are not available as part of the project team, arrangements for their participation in briefings and design reviews should be made.

3.3 Design detail

- For all but the simplest projects it is probable that some design iteration will be required. Process design will form the core of the initial design (ideally the process design should be significantly progressed within the initial "basis of design" data) but it will need to be reviewed and possibly updated to reflect reviews such as HAZOP as well as detailed piping, equipment and control systems design. Similarly, piping design will need to address the outcome of HAZOP, accessibility and maintainability reviews and vendor data. Steelwork and foundation designs may need to be rechecked against final load data. The project design schedule should minimise the need for iteration so far as is practicable, but this is likely to prolong the overall schedule, which may be unacceptable, especially for projects with a "fast-track" objective.

- Interconnections (tie-ins) with existing plant/facilities are often a significant element of small projects. These occur in most disciplines (piping, steelwork, concrete works, drains, instrumentation, electrical and occasionally equipment). In designing these interconnections a number of issues must be addressed :-

  - Assess the new loading/stressing imposed on existing plant.
  - What conditions are expected to apply at the time of tie-in (e.g. plant in service, plant shut down but not fully decommissioned)?
  - Design must allow for safe operation in the period after interconnection is made but before final project is complete (i.e. an interim operating condition).
  - Design may need to be carried out early to accommodate required timing for installation of the interconnection.
  - Design needs to recognise practical limitations in fit accuracy between new and existing plant and allow for field adjustment.

- For all projects design must allow for construction to be executed safely and efficiently. Where there are significant interfaces with existing plant/facilities, this becomes a more significant issue. This may include :-

  - Provision of drawings to show scope of demolition work requirements.
  - Maximising offsite pre-construction.
  - Additional joints in piping to allow fitting into existing plant.
  - Provision for "field" adjustments due to limitations of design accuracy.
  - Development of construction sequences in the design phase.
  - Design of temporary works (e.g. load-bearing scaffolds, temporary screens).
  - Identifying practical routings for cables.

- Safety, operability, maintainability, accessibility, constructability reviews are appropriate for almost all projects. See listing of design reviews given in Appendix A. The timing, format and formality of such reviews will depend upon the scale and complexity of the project. Unfortunately, it is not possible to advise a simple "best practice" and timing is usually a trade-off between :-

  - Earlier review - based upon less-complete design, but implications of any recommended changes are less severe.
  - Later review - based on a more complete design, but any changes required will have a greater impact.

  It may be necessary to carry out the main review at one time and recognise that there are certain items where the quality of information available at that time is inadequate and must be revisited later. A typical example is main HAZOP carried out before vendor design packages are available.

  In all cases it is good practice that, before handover, a re-check is carried out to determine that all recommendations of reviews have either been implemented, or agreement reached that the recommendation is no longer valid or an alternative solution is acceptable. It is vital that these reviews include appropriate representation from plant operations and maintenance. This is needed to provide valuable specific knowledge of the plant and to also achieve their "buy-in" to the design.

3.4 Contractor services for engineering design

- Use of a design and engineering contractor for work associated with small projects is becoming more common and the trend is expected to continue as client organisations downsize and do not consider engineering design work to be a core activity. There are a number of implications relating to the use of contractors, but probably the most important is the requirement for specific knowledge regarding the existing plant/facility on which the new project will be implemented. There can be no doubt that the optimal route for use of contractors for small projects is through the development of long term relationships. This allows the contractor to build up a detailed knowledge of the client's existing plant/facilities and also their requirements, thereby becoming a more effective provider of the required services. This will only work if the client can offer some reasonable level of continuity of work and, in return, the contractor provides adequate continuity of staff. This subject is further detailed in VEP MP.03 Quality Management.

- Quality of design will have a major impact upon overall project performance. Hence, careful consideration must be given to the form of contract used. A fixed-price contract may achieve a lower design and engineering cost (though this is by no means certain) but may result in more rework in construction and/or a project which does not properly fulfil its objectives. Reimbursable design is more likely to lead to good quality, but the contractor will need to be controlled to avoid excessive use of man-hours. This subject is further detailed in VEP MP.06 Procurement of Materials and Services.

3.5 Equipment Design

- Specifying and procuring equipment for small projects should, in order of preference :-

    1. Repeat use of existing equipment type on plant (if existing type is fit for purpose).
    2. Use vendor standard design.
    3. Use vendor standard modified to meet project specification.
    4. Custom design to meet specification.

- Vendor involvement in the overall design process can be beneficial. This is not easy to achieve as it usually needs to be early (typically earlier than conventional order placement). However, if effort is made to identify key equipment which has an influence on overall design, it should be possible to identify one or two preferred suppliers and work with them. Again, this can be more readily achieved if there is a long-term history of business together which will give the vendor motivation to provide input even without any order in place.

- The provision of vendor design documents is often a major constraint to overall design progress. The detailed design and engineering programme should identify requirements and timings. If it is foreseen that availabilities are not aligned with needs, a remedial plan should be prepared to improve delivery and/or consider how overall design can best accommodate late information.

3.6 Design tools

- Design tools should be selected on their merits relative to project needs and should be agreed prior to the start of detailed design work. Avoid the use of untried software applications - small projects cannot bear the inevitable cost and time involved associated with the learning curve regardless of the claimed benefits for the software.

- Almost all design work is now executed using CAD systems and there is often a desire to maximise this by use of 3D multidiscipline models. However, for plant/facility modification projects some limitations potentially arise. In many cases the existing plant/facility was not designed using CAD, or original CAD files may be no longer available, not up to date or not compatible with current software. In such cases careful consideration must be given before deciding whether use of a 3D model should be adopted. To do so means that data covering the existing plant must be input into the model for all those areas where the new project will interface. This will, even with the most modern tools and techniques, not be a minor task and could well be disproportionate in time and effort to the design for the project. On the other hand if a 3D model is not used, then some other methodology (probably manual cross review of drawings) will be needed to carry out accessibility and clash checking.

3.7 Design and engineering progress monitoring

- Progress monitoring of design and engineering should be on the basis of physical progress towards completion of each activity on the plan. A strong preference is that the measures are made against defined milestones rather than subjective judgement. Additionally, frequent monitoring of those activities on, or close to, the critical path should be carried out in order to give earliest possible warning of any potential delay.

3.8 Change control

- An effective system of change control is essential. The introduction of changes into the detailed design and engineering must be discouraged as it tends to be highly disruptive, and can result in delay and extra cost far in excess of that envisaged, often with benefits which are less than first thought. The time for encouraging beneficial change is during the project definition phase. Nonetheless, requests for changes will arise and they must be addressed using a clearly defined process which requires explicit approvals at client project manager (or even higher) level. In considering requests for change, the following should be addressed:-

    - Is the requested change needed to fulfil original objectives? If so, it is not truly a change. This does not mean it should be automatically accepted. The implications of not proceeding may be more acceptable than the impact of accepting the change.

    - If the proposed change further enhances the objectives, the benefits must outweigh the impact of the change. It is important to remember that the true impact of a change is likely to be far greater than envisaged at the time of the change proposal. Also, check that the foreseen benefits are real (i.e. additional capacity is of no value if the additional product cannot be profitably sold).

    - Proposed changes for SHE reasons should not automatically be accepted. SHE potential gains must be reviewed on a risk/severity matrix. If the existing SHE situation is acceptable, then further improvement is unlikely to be justified unless the benefit/cost is favourable.

- Check whether a proposed change can be sensibly implemented at a later time. If so, defer it.

- If a change is required because the project will not work without it (i.e. significant non-fulfilment of objectives) or leaves a genuinely unsafe or environmentally unacceptable situation, then it will have to be accepted. There is no point in completing a project that does not meet its objectives.

- Where changes of any significance are to be accepted, considerable effort should be expended to assess and minimise the impact upon the overall project. The impact of such changes should be advised to project stakeholders as soon as is practicable and, where appropriate, efforts should be made to gain their agreement before proceeding.

- However well the design and engineering are carried out, it is inevitable that design queries and anomalies will arise during the construction phase of the project. If construction is not to be delayed it is essential that these are resolved rapidly. This is best achieved by the review and response being carried out by the individuals responsible for the design.

3.9 Project documents

- Document control procedures need to be kept simple for small projects as time complying with bureaucratic processes will have a proportionately greater impact than on a major project. Identify who needs documents for approval and who needs them for information. Where comments are invited, set a clear deadline for receipt.

- Consider dispensing with document transmittals as they generate a lot of paper for questionable value. Consider instead issuing an email to recipients indicating that documents are on the way and the purpose for which they are intended (information, comment, approval, final record etc).

- The listing of deliverables for the project should include the requirements for documentation to be delivered to the end user to allow him/her to safely and properly operate and maintain the plant. This may include obligations under national SHE regulations, state what design documents should be handed over, and which of those should be updated to “as-built” status. Updating to “as-built” status may be required for design documents produced specifically for the project and for existing plant documents which are modified as a result of the project.

4. References/further reading

1. CII, Small Projects Toolkit, Document Number 161-2, July 2001.
2. ECI, ACTIVE Value Enhancing Practice No. 7.2, Design Effectiveness – also attachment 7.2, Technical Audit Checklists, October 1998.

VEP MP.09 Appendix A

Typical Safety and Design Reviews

The following chart lists the design reviews which should be considered for a small project. Not all of these will apply to every project. The extent and detail of review will be dependent on project needs. In addition to those listed for attendance at reviews, the project manager may wish to attend certain key reviews, and will certainly require to be consulted in respect of any significant changes arising as a result of the reviews.

Name	Review intent/purpose	Responsible discipline	Recommended attendees	
			Designer	**Client**
Hazard Screening Review/HAZOP 1	To assess potential hazards arising from the project and/or existing plant.	Process	Lead process engineer	Process engineer Operations representative
PFD Review	Review process concepts, including levels of automation to set project scope.	Process	Lead process engineer	Process engineer Operations representative
Environmental Screening	Review waste management system, environmental protection requirements (e.g. double containment, noise review).	Process	Lead process engineer	Process engineer Operations representative
P&ID review	Review process details, safety aspects, material selection.	Process	Lead process engineer E&I engineer Piping engineer	Process engineer Operations representative
Control Philosophy/ Interlock Review	Review control operations in all scenarios, methods of control, levels of redundancy, levels of interlock classification.	Control Systems	Lead process engineer E&I engineer Piping engineer	Process engineer Operations representative
Plot Plan Review (may be included in 3D model review)	Review plant, location, logistics for transport/storage and evacuation, review overall construction sequence.	Piping	Lead piping engineer Lead process engineer E&I engineer Construction engineer	Operations representative Maintenance representative Construction engineer

Equipment Location Plan (may be included in 3D model review)	Review equipment location with respect to optimising layout based on process and/or material flow and overall maintenance requirements.	Piping	Lead piping engineer Lead process engineer E&I engineer	Operations representative Maintenance representative Construction engineer
Hazardous Area Classification	Review extent of hazardous area, zone classification, means of eliminating hazards.	E&I	E&I engineer Process engineer	Electrical engineer Process engineer
3D Model Review No.1/Layout and Ergonomics Review	Review overall layout of main equipment, critical pipelines and main structures to check accessibility, maintenance, safety in operation, ergonomics, evacuation and study of potential construction problems.	Piping	Lead piping engineer Lead process engineer E&I engineer Civil structural engineer Construction engineer	Operations representative Maintenance representative Construction engineer
Hazard and Operability Review (HAZOP 3 or equivalent)	Review possible malfunctions, safety aspects and reduction of hazards. Identify operational requirements and possible need for training. Review relief streams.	Process	Lead process engineer Piping engineer E&I engineer Mechanical engineer	Process engineer Operations representative
Fire-Fighting/Protection	Review of fire-fighting philosophy, type of equipment needed, fire-fighting team requirements, fire exits, fire protection (e.g. on structures).	Mechanical	Mechanical engineer Piping engineer Civil engineer E&I engineer Mechanical engineer	Fire captain Process engineer Operations representative

3D Model Review No.2/Detailed Layout Review	Review plant layout in detail to assess accessibility, ergonomics, maintenance and constructability.	Piping	Lead piping engineer Lead process engineer E&I engineer Mechanical engineer Civil structural engineer Construction engineer	Operations representative Maintenance representative Construction engineer
Paving and Drainage Review	Review maintenance and operational areas for need of paving, review separation and containment of process drains, stormwater and firewater.	Civil	Civil engineer Process engineer	Civil engineer Process engineer
Mechanical and Piping 100% Design Review	Review of mechanical and piping design for completeness, consistency of data, areas requiring action from construction, all as preparation for issue of subcontract scope of work.	Mechanical/ Piping	Mechanical engineer Piping engineer Construction engineer	Mechanical engineer Piping engineer
E&I 100% Design Review	Review of E&I design for completeness, consistency of data, areas requiring action from construction, all as preparation for issue of subcontract scope of work.	E&I	E&I Engineer/Design	E&I engineer/designer
CDM Risk Review (UK) (Equivalent in other countries)	Review of design for potential risks to construction, operations and maintenance as a result of design. Risk elimination or mitigation methods identified and residual risks documented.	Projects	CDM coordinator All discipline lead representatives Construction engineer	Discipline representatives Operations and maintenance representative Construction engineer
Pre Start-up Safety Review (PSSR)	Review of the completed plant with respect to the design intent, check of operational data/documentation and training adequacy.	Process	Process engineer Project engineer/ Manager	Operations and commissioning team

VEP MP.10

Project Planning and Schedule Management

1. Introduction

Project planning is a key tool for effective management. The amount of detail required will be dependent upon both the complexity and the time available for development and implementation. This VEP focuses on schedule planning and management. Broader planning issues are addressed elsewhere, principally in VEP MP.02 Project Development and Definition.

A failure to carry out adequate planning carries significant risks :-

- project implementation incorrectly scheduled.
- time critical activities not identified.
- the required resources and their timing not identified.
- identification of potential schedule problems missed or delayed.
- additional costs incurred in attempts to recover delays.

This VEP is aimed at smaller engineering projects, although the principles and practices are generally applicable.

2. Characteristics of good project scheduling for small projects

- Initial scheduling (sufficient to identify the realistic overall programme), critical activities, key dates and resource requirements will be carried out during the project definition phase.
- Planning will address not only the time schedule but also the required resources to allow timely execution. Resource availability may well impact upon the time schedule.
- Identify and focus detail on those areas critical to overall achievement of the time schedule.
- Cover all phases of the work and the essential links between the various phases.
- Provide a valid tool to assess progress during project implementation and identify early warning of potential schedule problems.

3. Recommendations

3.1 Definition phase planning (time schedule)

- Identify how time-critical the project is. Is there a fixed completion date or can the duration be as long as is reasonably required?
- Dependent on initially perceived time criticality and complexity, identify likely time requirement. From this, develop a simple overview (probably a bar chart) which shows the proposed timeframe of the main elements. This should be used for presentation to management (simple, non-time-critical projects do not need extensive detailed planning).

- Identify long-lead materials which will need special attention, e.g. requisitioning and ordering in advance of overall project authorisation.
- Will any new contracts be required? If so, ensure that sufficient time is provided for the cycle of document preparation, tendering, evaluation and contract award.
- At this stage include some float in schedule. It is unlikely that all dates will be achieved unless appropriate allowances have been made.
- If a fixed completion date is required identify, and clearly advise to the business, the latest acceptable project authorisation date.
- Identify the extent of further planning likely to be required during the implementation phase.
- Carry out a credibility check on durations and on use of parallel or overlapping activities.

3.2 Resource planning

- Identify the people resources needed to implement the project. The lack of availability of staff resources is a common issue for small projects where staff are often not dedicated to a single project.
- Test project team resource needs against overall resourcing, i.e. to what extent do needs of this project conflict with other obligations for each project team member? If there are conflicts, get agreement on priorities.
- Cross check resource availability against time schedule. Make needed adjustments until there is compatibility.
- Resource planning is addressed in detail by VEP MP.07, Staff Availability and Competence.

3.3 Implementation phase planning and progress monitoring

Identify how much planning and progress monitoring is needed. This is not a function of project size but of criticality and complexity. In particular, work within existing plant will usually require more detailed planning.

- Who will do the planning? Small projects rarely have a specific planner so this is usually a task for the project manager or another member of the team.
- Ensure that planning is relevant, understandable by all and focuses on key critical areas.
- Where more detailed planning is needed for particular elements of the project (i.e. in plant/shutdown work, critical path elements, commissioning works), consider the development of separate sub-plans to address these elements. This will avoid the main overall plan becoming too cumbersome.
- Ensure that plans are issued to all interested parties, especially management and plant operations and that they are accepted. Consider using a format customised to the needs of the recipient, i.e.

    - Plans for management should be an overview showing key milestones and decision points and identifying critical (and near critical) elements.
    - Plans for the plant operations function should focus on design reviews, in-plant activities, operations preparation work, handovers, commissioning and any other aspects where they will have an important involvement.

- Ensure that plans are reviewed, updated and reissued whenever any significant change in timings or sequence of work arises.
- Ensure that modifications and tie-ins to existing plant are given particular attention and that timings and responsibility are agreed with plant operations.

Decide upon the extent of progress monitoring and measurement required :-

- Be realistic. Very detailed measurement is time consuming and only justified for specifically time-critical projects.
- Progress monitoring should be a measure of physical progress; not hours expended versus budgeted hours, nor cost versus budget.
- Ensure that regular reviews of actual progress versus schedule are carried out.
- Remember that both overall progress and that of critical activities need to be managed.

    - If the critical activities are late, the project will be late, even if overall progress seems satisfactory.
    - If overall progress is behind schedule (even if critical activities are on schedule) there is a significant risk that the project will be late as non-critical activities will become critical.

3.4 Handover and commissioning planning

The extent of planning needed is project-dependent. For straightforward projects, which have only minor impact on an existing facility, very little planning may be needed. Where the project is a significant modification to an existing plant, detailed task-by-task planning may be needed. In any case the planning required (including resource planning) should be done well in advance of the time for handover, and must involve all parties who will later be involved in the handover and commissioning. Consider :-

- What resources are needed from the project team, from plant operations and maintenance, and from contractors for handover and commissioning? Ensure that they are available at the required times.
- How will handover be implemented? If a handover is to be on a system basis, are these identified? Is a specific sequence required?
- What work is needed to pre-commission and commission the project? Will this be done on a system by system basis? Is a specific sequence required?

3.5 Department workload planning and resourcing

For small projects, the development and implementation is most commonly carried out by staff (and contractors) who have multiple responsibilities, and are not dedicated to a single project. It is therefore vital that workload planning is in place to cover these resources, as the most common cause of delay to small projects is a lack of resource when needed.

This issue is addressed in detail by VEP MP.17 Portfolio Management.

3.6 Planning tools

For small projects planning will probably be done by the project manager and his/her engineers, and not by specialist planners. It is therefore important that tools are user-friendly and easily learned. Many planning tools are now available for use on PCs and can be powerful if used to full capability. Microsoft Project, for example, will more than meet requirements for small projects. Simple checklists are also extremely useful, especially standard checklists for plant handover .

4. References/further reading

1. ECI, ACTIVE Value Enhancing Practice No. 7.5.6, Guidelines for Handover and Commissioning Process, October 1998.

VEP MP.11

Project Control

1. Introduction

This VEP deals with the steps required to ensure the efficient control of projects throughout their implementation. Application of the methods will assist in understanding the principles of project control. The general principles of project control are covered in the first section. The second section deals with the application of the principles to the control of smaller projects. A more complete treatment of the general principles is given in the ACTIVE VEP No. 7.1, which formed the basis of the first section of this document.

2. General principles of project control

The principles of project control are applicable to all projects no matter how large or small. In smaller projects the formal control procedures may not be obvious because the team has fewer members, sometimes involving only one discipline. It is essential that users understand the difference between monitoring and control. The ability to control project outcome declines rapidly as the project progresses, hence the importance of control measures in the project definition phase.

2.1 Project definition

The better the quality of project definition (see VEP MP.02) the easier it will be to exercise control. Implement methods to ensure that changes are notified throughout the team.

2.2 Estimates and forecasts

As part of the project definition a cost estimate and schedule will have been prepared. These should have sufficient detail to allow review on an element-by-element basis thereby giving early warning of deviation. Reviews involving the project team to consider actual progress against estimated progress should be carried out on a regular basis, utilising separate measures of both cost and physical progress. If necessary, forecasts should be revised and it should be ensured that stakeholders are made aware of slippage and the consequences.

2.3 Reporting and dissemination of information

Establish a reporting structure. Evaluate the methods available to inform team members and others (client/manager) of progress, slippage and problems.

2.4 Cost control

Produce a costing framework and regular "cost to completion" estimates for comparison with forecast costs.

2.5 Schedule control

Establish a process to measure progress against the required schedule for the project, addressing both overall progress and progress of time critical elements.

2.6 Change control

Establish change control procedure with appropriate approvals route. Ensure that all team members understand individual responsibilities for change.

2.7 Quality control

Quality benchmarks will have been established at the project specification stage. These form useful checks at various stages within the life of the project.

3. Application to small projects.

The principles outlined above are applicable to major and minor projects. The following is intended to provide guidance for the project manager who may be running more than one project at any given time. Standard methods and formats should be used to ensure that project information is easily assimilated.

Adequate control methods for small projects are essential. Control of progress, quality or expenditure is more important on a small project.

Above all, the project manager should manage the project, not allow the project to manage the project manager.

3.1 Project definition

It is well understood that the ability to control, as opposed simply to monitor, the outcome of a project decreases rapidly through its life. Yet time and budget constraints often lead to inadequate specification of requirements for small projects. This, in turn, leads to less well defined estimates and schedules against which the project will be controlled. Ensure that a detailed review of project definition is carried out (see VEP MP.02) and the findings and implications of this review are discussed in detail with the client (at business management level) before proceeding with implementation. It is vital that the quality requirements for control budget and schedule are agreed with the client. This is probably the single most effective element of project control as it occurs at a time when positive action can have a significant impact upon outcome.

A project summary should be produced when all requirements have been finalised. This should outline each objective or requirement, and forms a useful working document for team members.

3.2 Estimates and forecasts

Estimates and forecasts provide a valuable tool for the control of projects of any size. The use of these tools in large projects is well established and much of the work of the cost and project engineers is to monitor progress against forecast. Smaller projects will suffer if forecasts are not made and monitored. However, the ability to make meaningful forecasts is heavily dependent upon the base data. This is a function of the initial planning and estimating carried out in the definition phase, together with ensuring sufficient detail is included in subsequent reviews.

Where forecasts differ from a previous version they should be accompanied by a statement of reasons for the change, and proposed actions (if needed) to address any deviation.

3.3 Reporting and dissemination of information

Reporting structure should be defined and simple. Minimise the reporting stages and consider the use of exception notification to highlight deviations. Standard progress reports should be issued on a regular basis and should be concise. They should typically include :-

a) Summary cost report, listing forecast vs budget, actual spend vs predicted spend and commitments.
b) Summary schedule status indicating physical progress vs planned progress (s-curves).
c) Summary of key achievements of the preceding period.
d) Listing of key problem aspects and proposed actions to address them.

Use e-mail to ensure rapid reporting.

Addressing problems is the core purpose of project control (as opposed to monitoring). It is important to fully involve relevant parties in such problem solving, but not waste the time of those not involved (i.e. carry out in a forum with selected people).

3.4 Cost control

Cost control requires close attention when dealing with small projects. The need to maintain project spend within budget is as important as for large projects. The ability to control cost is dependent upon both the detail of the budget and the effort put into maintaining an up-to-date record of all costs and commitments as they occur. Review costs frequently; the milestones on the project programme offer suitable cost review points.

Larger (but still small) projects (>£1m) pose particular problems. The budgets for this size of project may be too large to handle easily in a simple spreadsheet format but they are not big enough to merit a full-time cost engineer. A project of £1m can easily generate in excess of 1000 cost movements. It is essential that such projects employ someone to carry out the ongoing recording of costs in an organised manner. This person will need to understand the concept of budgetary control (probably based on use of a spreadsheet) and how to obtain the needed cost data for all cost elements as they occur. The workload to do this should not be underestimated.

There is often a lag between the occurrence of events and reporting of costs. This is particularly applicable to many small “fast track” projects, which may be finished before all invoices are to hand. The importance of recording financial commitments cannot be overemphasised. In many cases, it is only at the time that a commitment is being entered into that there is any real possibility of controlling the cost of that element. The ability to control the cost when the work is done is very limited, and even less so by the time an invoice is received.

Unfortunately, many of the accounting systems used by company finance departments are not ideal in meeting the needs of project cost monitoring. They often have poor ability to record commitments or the value of work done (rather than invoices received).

Special care is required to handle contingency budgets. On larger projects there is a chance that over and under spends will equal one another. This is less likely with projects at the smaller end of the scale where a single element of overspend could wipe out the total contingency budget. Indeed, there is a good case to justify use of higher contingencies (as a % of project budget) for small projects.

3.5 Schedule control

In order to control schedule, it is necessary to first have a plan with sufficient detail against which to be able to monitor progress. This plan does not need to have detail of every element of work, but must focus on critical and near critical activities. Monitoring must reflect physical progress, not merely time expended.

For further detail see VEP MP.10 Project Planning and Schedule Management.

3.6 Change control

Establish the approval route to ensure that requirement changes are notified, evaluated, approved or rejected as quickly as possible. Ensure that all team members understand their individual responsibilities for change. It is important that the team members are fully involved in the change process. Team members should be encouraged to suggest changes which will be truly beneficial to the project. The consequences of such changes on cost and timing must also be considered before authorising. It is important to bear in mind that many changes will have an effect on the project and will tend to cause delays and extra cost.

3.7 Quality control

Quality requirements should be established at the outset of the project and reflect the requirements of the business objectives. A requirements check should be carried out to ensure that stated standards and specifications are both appropriate and necessary. Over-specification causes extra cost and delay.

In many small projects the quality outcome is simple. Even so, in short duration projects there is a need to check on quality throughout. Any non-compliance should be dealt with as soon as possible.

If there is an existing company quality manual it should focus on the needs of small projects. A major project manual may well ensure required quality, but is also likely to impose requirements and bureaucracy which add no value, whilst still adding cost. For each project, the manual should be reviewed and amended as required to provide appropriate requirements for project quality control. This can be applied to any small project. If outside contractors are used they should sign up to the quality policy as a contract condition.

The rectification of non-compliant issues should be addressed as part of the contract documentation. A clear route for compliance will thus be established.

For further detail see VEP MP.03 Quality Management

3.8 Frequency of control

The frequency of application of control measures will depend on the duration and complexity of the project. As a minimum, there should be a control point for each milestone throughout the project. In most projects a "lessons learned" review, involving all members of the project team, will also be beneficial.

4. References/further reading

1. ECI, ACTIVE Value Enhancing Practice No. 7.1, Project Control, October 1998.
2. ECI Project Controls Value Enhancement Practice, April 2002.

VEP MP.12

Project Risk Management

1. Introduction

Project risk management is employed extensively on major projects. However, it is not widely applied to small projects and, when it is, tends not to be adequately documented. The intention of this VEP is to promote the implementation of project risk management for small projects and to provide guidance in its use.

Small projects do not usually justify elaborate procedures for risk management, though the consequences of certain risks can be major, even when associated with a small project.

2. Definition of project risk management

Project risk management is a structured way of managing exposure to risk throughout the life of a project and beyond. These are not only technical, but include commercial and human risks. The implementation of a managed process to identify, understand and analyse the potential risks at the outset of a project will allow for their subsequent mitigation and management throughout the life cycle of the project.

Risk assessment considers both the likelihood of events occurring and the possible consequences. If the identified risks are unacceptable, risk management finds ways of mitigating or reducing them and putting contingency strategies in place. In some cases, risks can be eliminated completely while others are outside the control of the project team, presenting little scope for reduction. Some risks may be deliberately accepted as the potential gain is perceived to justify the consequences if the risk occurs.

3. Characteristics of a successful project risk management process

- Buy-in from senior management.
- Development of an efficient risk management programme to monitor and manage risks throughout the life of a project.
- Provision of risk management training and guidance for personnel.
- Provision of specialist tools to carry out risk assessments.
- Identification of all known risks at an early stage of the project and implementation of a risk register describing the nature of the risk, probability of occurrence and impact, and a strategy for its elimination, mitigation or management.
- Having in place a process for monitoring, updating and reviewing the risk register continuously throughout the life of the project.
- The implementation and updating of a generic project risk database.
- Development of procedures/forms for capturing the experience and interactive response from all key project participants (e.g. operators, project team, installation contractors).
- Development and implementation of project risk checklists.
- Agreement on who will manage the risks, based upon who is best able to do so.

Benefits of the above include:

- Better management of business and project uncertainties.
- Enhanced confidence of all stakeholders in achievement of project objectives.
- Improved project focus and scrutiny of all activities and deliverables.
- Improved levels of communication and interaction by all project participants.
- Reduction in potential negative impacts on safety.
- Better attainment of operational and production goals.
- Improved management of risks in supply chain relationships.
- Improved cost predictability and ability to provide contingencies against specific items.
- Improved schedule predictability.
- Reduced probability of budget and/or schedule overruns.
- Reduced probability of project scope change/growth.

In summary, project risk management is essential for all projects regardless of size or complexity. It allows the team to identify, understand and analyse the potential risks and enable the necessary mitigation and contingency strategies to be developed through the life of a project.

4. Recommendations

4.1 Generic pre-requisites for a project risk management process

Setting objectives

- Establish buy-in/support from senior management in the implementation and continuous improvement of the risk management process.
- The risk management process must be :-
  - robust but easily implemented
  - consistent with corporate objectives
  - repeatable for all projects.
- Enhance the profile and importance of the process to all project participants, including plant operators and third parties in order to instil a sense of buy-in and active participation.
- Establish contractual relationships such that specific risks are managed by the party best equipped to deal with them, both technically and commercially. Proper management of a supply chain relationship should encourage and reward effective participation in risk identification/innovation.
- Clear project procedures must be established for risk management, i.e. risk identification, analysis, handling, monitoring, recording and feedback, and feed forward controls.
- Spread risk awareness and remove barriers to implementation at all levels in the project organisation, including suppliers.
- Make specialist resources and tools available and/or implement training and education as needed.

Risk Identification

This entails the identification, description and understanding of risks. Refer to Appendix A for typical sources of project risks. The process of risk identification depends on the ability of the management team to interpret the available information and to appreciate all factors creating uncertainty. The methods of risk identification should include:

- Use of check lists which identify potential sources of project risk. These should be developed by the respective client industries to reflect the nature of their work, and be added to as the knowledge base expands.
- Facilitated workshops to provide a forum for capturing the experience and interactive response from the project team and promote awareness between stakeholders. Such workshops also encourage collaboration and creativity.
- Programme analysis to establish the project's critical path, identifying resource or interface constraints. Identify specific activities on, or near to, the critical path where there is particular duration uncertainty.
- Documented information using records of previous experience to predict future trends.
- Organisation mapping to establish the risks inherent within the organisation by examining levels of control, autonomy and relationships.

A number of project reviews commonly carried out (e.g. Hazard and Operability Studies, HAZCON, Constructability Reviews etc), will provide significant information for the overall risk identification and management process.

Risk analysis

Risk analysis is a structured process, based on calculation, which is aimed at quantifying the impact of risk. Risk impact can be measured against the main project objectives (time, cost, performance and service). Effective risk management should be considered as a balance between the interpretation of analytical results and sound judgement based on experience and knowledge.

There are a number of techniques available to carry out a detailed risk analysis, such as :-

- Sensitivity analysis.
- Probability analysis.
- Decision trees.
- Model simulations.
- Utility theory.
- Regression analysis.

These techniques, whilst being useful, can prove to be too complex/time consuming for a small projects environment where there may be many projects being engineered in parallel, each having significant time constraints.

To simplify the process, whilst maintaining the objective, a combined risk identification, analysis and recommendations matrix is recommended. See Appendix B.

Risk handling

Prepare a method of response to describe how the risk will be managed. Focus attention on those risks which have a high or moderate probability of occurrence plus significant consequences. It is not practicable to handle all possible risks and to attempt to do so would result in loss of focus on the important issues.

Formulate and implement a risk register and a management action plan with clear lines of authority to ensure these actions are implemented, and to enable the proactive and continuous control of risk and uncertainty. Risk handling involves specific risk response strategies for the transfer, mitigation, insurance, allocation or acceptance of risks to reduce overall project uncertainty. Refer to Appendix B for a risk identification, analysis and recommendations matrix. Risk responses may be classified as:

- Avoidance or reduction; alternative action is required including, if necessary, changes to the project plan or implementation strategy. Preventative measures should be identified and additional information sought for an improved understanding of the risk.
- Transfer or allocation; transfer or allocate the risk to the party best able to quantify and manage it.
- Retention; acceptance of the risk accompanied by determining the best measures to control and manage the risk. Contingency planning is necessary for this circumstance.

Refer to Appendix C for risk status matrix.

Risk monitoring and management

Project risk profile changes over time. As a result, controls should be established to ensure the ongoing management of risk. A regular review is required to identify project risks and their significance, the effectiveness of response strategies, and regular updating of contingency plans. Attention should be paid to interdependent risks. The fact that one risk event actually does occur may directly affect the probability and/or significance of another. Ideally this interdependence is identified on the risk register at the time it is set up.

Using Appendix B, or a suitable equivalent, all identified risks should be recorded together with the intended actions to manage them. This form should be regularly reviewed and updated. This is typically done at monthly progress reviews, though other arrangements could apply. At the conclusion of the project the final version of the form provides a useful tool to evaluate the effectiveness of risk management. This provides for the progressive build-up of a database of project risks and their effective management.

4.2 Differentiating features for small projects

Culture of fast track projects

This can often result in short cuts being taken in the risk assessment process such as inadequate participation of plant operators and third parties. This inevitably results in an accumulation of assumptions or, worse, blind ignorance, which ultimately jeopardises the success of the project.

Low budget projects

The time allocated and the levels of review of risk assessments are unfortunately too often proportional to the project budget. Low cost projects can pose a very high cost risk if plant operations are disrupted. Therefore, the extent of risk assessment should be proportionate to the risk and not the project budget.

Shared resources

Availability of resources (i.e. project team, installation contractors and commissioning) can be problematic. Lines of responsibility often become distorted or diluted due to the large numbers of projects that are at different stages of the completion cycle and the many different lines of communication.

Potential impact from other projects

It is possible to underestimate the impact of other active or future projects. Clear lines of communication are required with other projects that are in development that may directly or indirectly jeopardise success.

Interfacing/modification to existing plant

Unlike major projects where the installation of the new plant is on a green/brown field site, small projects are required to take into account the many problems and additional project risks which exist in interfacing with often old operational plant and contaminated areas.

Updating of generic risk database/check lists

Whilst newly identified projects risks and lessons learned may be registered, many undoubtedly remain unrecorded due to inconsistent allocation of time to this activity and the blinkered "single project mentality".

Supply chain relationships

Smaller profit margins and uncertainty of continuity of future business with suppliers (due to the inevitable business peaks and troughs) can inhibit the potential benefits that may be derived from supply chain relationships based upon gain/pain share incentives of the kind that encourage active participation in risk identification.

4.3 Safety, health and environment (SHE) risks

SHE risks can be treated in a generically similar manner to others. It is common (but not essential) practice for these to be addressed in a separate review. The advantage of separate review is that it can benefit from a much greater involvement of plant operations and maintenance people.

5. References/further reading

1. ECI, ACTIVE Value Enhancing Practice No. 5.1, Project Risk Management, October 1998.
2. ECI, ACTIVE Value Enhancing Practice No. 5.2, Risk and Benefit Framework Agreements, October 1998.
3. ECI, ACTIVE Workbook, AP5 Effective Project Risk Management, October 1998.
4. Gerard Tiffoney, University of Strathclyde MBA Dissertation, Forging Competitive Advantage Through Continuous Improvement.
5. John Mitchell and Yen Yee Chong, Managing Project Risk, Business Risk Management for Project Leaders, June 1999, www.amazon.co.uk.
6. Peter Thompson, IChemE, Project Management for the Process Industries, Chapter 14, Risk Analysis and Risk Management, 1998, www.icheme.org.

VEP MP.12 Appendix A

Typical Sources of Risk

<u>NOTE:</u>

1. The following list is intended to act as a starting point to aid the project team in assessing risks applicable to a project. It cannot be considered exhaustive as each project has its own profile of risks both in terms of probability and significance.

2. This list should be used in conjunction with specific industry detailed check lists where they exist.

3. Risks identified should be documented onto the risk identification, analysis and recommendations matrix (reference Appendix B).

4. Risk areas depend upon the stage to which the project has developed and, therefore, the emphasis changes depending on whether it is at the feasibility detailed design stage.

Typical sources of risk

- Quality of project definition.
- Poor estimates based on inadequate definition.
- Compliance to business process (possibly designed for large projects, bureaucratic, leads to delays).
- Changes to business priorities causing change to project priority.
- Availability of resources (people).
- Conflicts in workload priorities for project team staff.
- Project sanction delays.
- Unrealistic initial schedule.
- Health, Safety and Environment issues :-

  - Issues arising from HAZOP or other safety review(s).
  - Process safeguarding complexity.
  - Soil and ground water contamination.
  - Implication of unidentified underground services.
  - Excavation/movement of existing live cables.
  - Control of isolation procedures.
  - Contamination of existing plant.

- Inadequate project co-ordination and engineering controls.
- Selection of material/equipment.
- Design issues :-

  - Non availability/inaccuracy of design documents for existing plant.
  - Compatibility of design standards (new project vs old plant).
  - Design contractor unfamiliar with design of existing plant.
  - HAZOP (or other safety review) identifies deficiencies in existing plant.

- Modification to existing control/safeguarding systems – scale/complexity hard to determine until detailed design is underway.
- Design changes resulting from poor definition or lack of information, leading to extra work, delay and extra cost.
- Suitability of existing structures to support new structures.
- Pipework alignment and stress parameters of existing process plant.

- Interfaces with client, operations, internally between groups. Suppliers/contractors not working efficiently.
- Team not having the skills to manage commercial issues.
- Contractors' and suppliers' performance (small projects do not engender high commitment).
- Delivery of equipment/material (long lead) to site, including failure to identify items which become critical.
- Supplier information required for design and for commissioning.
- Inspecting and expediting.
- Construction Issues :-

  - Logistic of installation of new, and modifications to existing, plant within an operational plant.
  - Access/restrictions resulting from existing plant and other project activities, typically during a plant turnaround.
  - Work delays due to asbestos stripping.
  - Extent of scaffolding (and scaffold modifications) needed in existing plant.
  - Ability to achieve positive isolation for tie-ins.
  - Access restrictions due to safety considerations and/or physical space.
  - Working adjacent to live plant.
  - Construction work productivity in existing plant areas.
  - Timing/duration of plant shutdown changed.
  - Availability of permits to work.
  - Climate/weather windows.
- Availability of plant operations/maintenance to participate in project handover.
- Availability of suitably experienced commissioning engineer(s).
- Identification of training requirements for operators of new equipment.
- Decommissioning philosophy.

VEP MP.12 Appendix B

Risk Identification, Analysis and Recommended Matrix

Project Title: Date: Location: Project Leader: Project Eng: Facilitator:	**KEY** **IMPACT OF RISK** 3 = HIGH 2 = MEDIUM 1 = LOW	PROBABILITY 3 = HIGH 2 = MEDIUM 1 = LOW

RISK NO.	DESCRIPTION OF RISK	IMPACT OF RISK (R)	PROBABILITY OF RISK (P)	SCORE (RxP)	COMMENTS/PROPOSED STRATEGY	ACTION BY	REQUIRED COMPLETION DATE

VEP MP.12 Appendix C

Risk Status Matrix

1. The purpose of this matrix is to supplement the risk identification, analysis and recommendations matrix (Appendix B), by placing each risk number on the appropriate location of this matrix. This will provide, at a glance, the project risk status.

2. This document is of particular value when there are a significant number of risks and helps prioritise a high impact and/or probability of occurrence.

Impact/consequence of risk occurrence				
	HIGH			
	MEDIUM			
	LOW			
		LOW	**MEDIUM**	**HIGH**
		Probability of risk occurrence		

VEP MP.13

Construction Management

1. Introduction

The project manager of small projects is often responsible for site construction. To effectively undertake this role safely the project manager should have knowledge of, and be familiar with, the aspects listed below. Safety is of key importance and requires separate consideration, though it must be considered an integral part of construction management.

2. Overall good project practice

- Address construction strategy within the project execution plan. This should be developed as part of the project definition.
- Ensure that the construction contractor has the experience, skills and resources needed for the work. In particular he/she must have thorough appreciation of the requirements for effective SHE management of the type of work to be undertaken and the environment in which it will be carried out.
- Allow sufficient time and resources to provide for effective tendering of contracts.
- Involve contractors in construction SHE management, including overall site issues.

3. Recommendations

3.1 Construction planning

Planning should not be limited to development of a time schedule, but instead should be used to determine the strategy to be used for the construction. It should consider the following :-

- Construction techniques and methods.
- Advantages of in-situ build or off-site prefabrication.
- Sourcing of construction resource, i.e. works staff, contractors or a combination of both.
- Construction skills required.
- Understanding of project driver, minimum disruption costs to programme.
- Specialist plant and labour requirements.
- Requirements for specialist skills.
- Impact of time constraints.
- Management of interfaces.

3.2 Project organisation

The organisation to be used for site construction should encompass :-

- Management structure for safety, quality and technical issues.
- Site accommodation, office spaces, canteen/toilet facilities, first aid, telephones.
- The roles of planning supervisor and principal contractor. Allocation of these roles should always be based upon which party has the best skills and knowledge needed for the role. In many cases for projects associated with existing process plant, it is likely that the plant operator (usually the client) is best able to fulfil the role of planning supervisor and maybe also principal contractor.

- Emergency procedures and responsibilities.
- Material deliveries, storage requirements and availability.

3.3 Programme

Often incorporated into the overall programme, the construction programme defines the required sequence of work and should :-

- Identify critical milestones.
- Provide sufficient time for tendering and appraisal.
- Address any preparatory works for tie-into plant or services.
- Address method of review and programme updating, by whom this will be done and at what frequency.
- Consider effective use of float or non-critical work to ensure continuity.
- Realise the benefits of continuous work.

3.4 Construction quality plan

Defines the quality levels to be adhered to in the construction phase and how they will be achieved. Also, the requirements for :

- Inspections; by whom and when.
- Standards to be achieved.
- Certification requirements.

3.5 Selection of contractors

No matter how well a project is planned, the construction phase will not be a success without sound performance from all of the contractors involved. Hence, correct contractor selection is of key importance. The following points should be addressed :-

- Ensure that key acceptance criteria are identified, and each potential contractor is checked out before being allowed to tender.
- Use only contractors with a proven track record for the type of work. Ask for customer references and check them out.
- Preferably use contractors with whom you have had previous satisfactory experience. Use of alliance contractors is an excellent strategy in many cases.
- Ensure that contractors have experience of the conditions under which they will work on the site, in particular the SHE requirements. Have they recently worked in the same industry? Are they familiar with the issues around live plant working?
- Check out the experience of the site management and supervision they will use. These people are the key to good performance.
- Establish from where the contractor will resource their labour. Preferably, a significant portion should be already employed or previously employed.
- Check out the contractor’s training policies both in respect of technical skills and SHE training.
- What is the contractor’s SHE policy? What has been their record over the last 5 years?
- Identify what quality assurance systems the contractor will use. Are they ISO 9000 certified?

- Check for financial stability. However, it needs to be recognised that information likely to be available will only provide a limited guide to the contractor's current situation. For construction works of short duration this may not be important.
- Ensure contractors carry necessary insurances.
- Identify any subcontractors proposed.

3.6 Site management

3.6.1 At start of contract

The start of the contract is the opportunity to ensure that management of all parties set off "on the right footing". The following should be addressed:

- Does the contractor have a suitable plan for the work? Does it identify needed resources? Is the plan compatible with the overall construction plan?
- Review site SHE procedures. Make arrangements for any site safety inductions.
- Review contractor's SHE procedures for the work. Focus on any identified job-specific issues.
- Finalise requirements for site temporary facilities and provision of utilities to them.
- Establish a communications procedure. Regular meetings are desirable to review issues arising.
- Introduce contractor supervisor to client staff he/she will interface with, including plant operations.
- Outline the project scope, its purpose and any key construction issues.
- Identify the planning supervisor and the principal contractor.
- Address emergency procedures.
- Address interfaces with other contractors.
- Agree reporting requirements.

3.6.2 Ongoing

Effective site management requires pro-active involvement of all parties. Such involvement should be led by whomever has the overall site management responsibility.

- Ensure regular meetings to engender an open relationship. Aim to keep general meetings short, with specific issues requiring in-depth attention tackled separately only by those needing to be involved.
- On multi-contractor sites ensure that there is a provision for liaison between all contractors in order to encourage co-operation and commonality of approach. This is particularly important with respect to SHE issues.
- Aim to resolve issues as quickly as is practicable. Where commercial issues cannot be quickly resolved, make sure that they are put aside and do not impact on the site working relationship.
- Client to ensure prompt payment of all (non-disputed) monies to contractors. Failure in this respect can have a negative impact on overall relationships and may significantly impact on contractors' overall financial position, especially for smaller companies.

3.7 Documentation

This is a key site construction activity that is often overlooked. It includes :-

- Site surveys: who are these done by, are they available, are they accurate?
- Permit to work requirements and control.
- Construction drawings raised to as build status.
- Handover procedure requirements.
- Operational and maintenance instructions.
- Reporting requirements.
- Site documentation control and management.
- Issue of documentation, ensuring correct issue is used.

3.8 Management contractors

If used to support site construction, management contractors may be critical to project success. Factors to be considered include :-

- Selection criteria for management contractors.
- Form of contract to be used, and the benefits of each type.
- Ensuring the contractor is competent for site management and will provide suitable site staff.
- Dealing with changes, delays and additional work. Client needs to assure themselves that the management contractor will appropriately manage the site and other contractors.
- Communication with contractor, method of giving instruction.
- Progress reporting requirements.
- Site-specific induction training.
- Handover procedures, snagging list etc.

4. References/further reading

1. CII, Small Projects Toolkit, Document Number 161-2, July 2001.
2. ECI, Total Project Management of Construction Safety Health and Environment, 1995.
3. F. Harris and R. McCaffer, Modern Construction Management, Blackwells, March 2001, ISBN 0632055138, www.blackwell.co.uk.
4. J.R. Turner, The Gower Handbook of Project Management, Third Edition, Chapter 5, Gower Publishing, 2000, www.gowerpub.com.

VEP MP.14

Project Handover and Commissioning

1. Introduction

- There are a number of possible handover points which act as useful project milestones.

2. Project management responsibilities

The project manager is usually accountable for :-

- Including handover requirements in the project definition and programme.
- Agreeing and delivering appropriate documentation at handover points, including a project data book with SHE dossier and construction health and safety file.
- The responsibilities of the project team for activities during handover.
- Handover being carried out in a manner and sequence which will allow plant operations to progress to commissioning immediately on acceptance of handovers.

Handover summary

Stage	Handover	Comments
Start construction	Operations to construction	Plant safe for installation to begin
Commissioning *	Construction to commissioning	Mechanical completion Plant safe for commissioning* Installation checked against design, all identified hazards resolved On-site check of all SHE issues Commissioning procedure developed Snag/reservations list
Start-up	Commissioning to operations	Commence normal production Operating procedures/training complete Snag/reservations list
Final acceptance		Operations signs acceptance certificate Outstanding items resolved
Beneficial operation		Operations has full responsibility for installation

*for process plant this may be split into pre-commissioning and chemical commissioning, with phased safety requirements.

It should be noted that for each stage of handover the snag/reservations list must consist of only those items which are :-

a) not preventing the next stage of the commissioning process to proceed.
b) able to be safely completed later without unduly disrupting the commissioning process.

3. Good project practice

- Consider handover and commissioning during project definition.
- Define handover points; they will depend on the contract strategy. Include handover points, with associated documentation and training, in the project programme and resource plan.
- Define hand over requirements. Have clear project deliverables and critical success factors.
- Identify resource needs for handover and commissioning. Commissioning of small projects is usually carried out by the regular plant operating and maintenance team. It is essential that this team has sufficient resource available at the required times. This may necessitate use of additional staff brought in on an overtime system.
- Agree handover criteria; they may be linked to required performance standards.
- Have a formal handover procedure, including process and roles. There should be clear handover points, even if the project manager is also acting as commissioning manager and/or operating manager.
- Involve the commissioning/operating team during other phases to raise awareness, clarify expectations, and confirm handover documentation meets requirements.
- Carry out separate detailed planning for handover. This must be compatible with commissioning plans and hence the need for close liaison with the commissioning/ operating team.
- Hazard reviews should be carried out, and should cover :-
  - Before mechanical completion – check asset is built to design and hazard study actions are resolved.
  - Before commissioning – check on-site safety, health and environment protection and equipment.
  - Final hazard study – review of SHE aspects after 3-6 months of operation – agree funding.
- Consider handover documentation and training as an integral part of the project, not an afterthought. Documentation should include :-

  - Safety, health and environmental information. Hazard study reports, construction health and safety file. There is no legal obligation in the UK that SHE documentation be kept separately. It is entirely acceptable that such information is retained as an integral part of overall documentation, provided that there is an effective archiving system which allows rapid retrieval when needed.
  - All information to ensure safe and efficient operation and maintenance; operating/ maintenance procedures, suppliers' information.
  - Test reports and certificates.
  - "As-built" drawings - requirements should be defined at the start of the project.
  - Regulatory requirements, permits, licensing agreements, etc.
  - Warranty documentation.

4. References/further reading

1. CII, Small Projects Toolkit, Document Number 161-2, July 2001.
2. ECI, ACTIVE Value Enhancing Practice 7.5, Project Handover and Commissioning, October 1998.
3. ECI, Total Project Management of Construction Safety, Health and Environment, Chapter 12, 1995, ISBN 0 7277 2082 1.
4. Institution of Chemical Engineers, Project Management for the Process Industries, Chapter 9, 1999, ISBN 0852954069, www.icheme.org.

VEP MP.15

Project Close-out

1. Introduction

The final stage of a project is close-out and review. The purpose is :-

- To test whether the project objectives have been met.
- To complete and close the project financial accounts.
- To gather and share learning for application on future projects.

2. Project management responsibilities

The project manager is usually accountable for :-

- Closing out all the project activity: financial - people, resources, documentation.
- Conducting a project review, with lessons learned shared within the organisation.
- Contributing to the business project review (led by the project owner).

Key steps in project closure are :-

- Formal project acceptance, final document handover.
- Close financial accounts.
- Update capital asset register.
- Project review, issue project report.
- Share learning with organisation.
- Archive project files.
- Disperse staff/resources.

3. Good project practice

- Give project closure/review the same priority as other stages of the project. The longer it is left, the longer it takes.
- Budget for the cost of resource needed for close-out activities and for the final review.

3.1 Financial issues

- Close project accounts as soon as final payments have been made. If there is likely to be a significant gap between hand-over and project closure, consider closing the main project account and setting up one dedicated to outstanding invoices.
- Agree funding for any outstanding work, including final hazard study. Identify who is responsible for managing this work.
- Update capital asset register.

3.2 Documentation

- Ensure as built drawings and other documents are completed.
- Ensure other existing plant documents are updated to include the additional hardware installed by the project, e.g. existing plant flow schemes, site underground drawings etc.
- Transfer final documents to the operating manager.
- Archive essential project documents in a readily accessible format.
- Dispose of documents not required for archive.

3.3 Project review

- The business review should confirm whether the business met its objectives and whether this was the best means of achieving them. This must involve the asset owner and (if different) the business management who requested the project.
- The project review should :-
  - Compare project outcome with objectives/ deliverables.
  - Compare project methods against procedures, QA, project standards etc.
  - Recommend any process changes for the future.
- A review is worthwhile, however small the project. Remember to budget for it.
- Collect key performance indicator (KPI) data for the project and ensure it is entered into the database. Compare project KPIs with established benchmarks.
- Focus on learning for the future, rather than apportioning blame for shortfalls.
- Ask what went well, what did not go so well, what should be done differently in the future.
- Keep the project report short.
- Capture and share key learning/metrics for the future (see VEP MP.16 Measurement Benchmarking and Improvement Process).

See references for checklists.

3.4 Resources

- Plan to relocate any dedicated staff and other resources. This needs to be done well in advance of project closure and to identify release dates and any part-time need for support in remaining work-up to final close-out.
- Ensure that appropriate performance reports are prepared and issued to line management. This should be done in consultation with the individual before release from the project.

3.5 Project good practice sharing

- Have a simple process for reviewing metrics and key learning across projects; the data can be used for continuous improvement and help in estimating the next project.

4. References/further reading

1. CII, Small Projects Toolkit, Document Number 161-2, July 2001.
2. ECI, Total Project Management of Construction Safety Health and Environment, Chapter 16, 1995, ISBN 0 7277 2082 1.
3. Institution of Chemical Engineers, Project Management for the Process Industries, Chapter 10, 1999, ISBN 0852954069, www.icheme.org.

VEP MP.16

Measurement, Benchmarking and Improvement Process

1. Introduction

Measurement is an essential requirement for understanding performance and is the precursor to improvement. The main value comes from comparing the data from one project or group of projects with equivalent data from others and, in doing so, setting norms and benchmarks.

Benchmarking, whether against other projects within the same company or against industry performance, is an essential element of, and should form a part of, a continuous improvement process.

There are a number of existing measurement and benchmarking systems available, but generally these were created with large projects in mind and none of them address the specific issues of small projects. Hence, a system has now been developed specifically for use on small projects and/or a portfolio of small projects. This is detailed fully in Appendix 2, Performance Measurement and Benchmarking of Small Projects.

2. Project management responsibilities

The project manager is responsible for ensuring that project data is gathered and recorded. Much of the data will be required for project control purposes but the manager should ensure that those parameters required for benchmarking, both internal and across industry, are agreed at the outset of the project. Similarly, the responsibility for gathering the data should be established in the project team at the outset of the project.

The project manager should ensure that the project team understand the basis of continuous improvement and the role benchmarking plays within that process. Benchmarking is most effective in companies which use it to drive improvement and where it is entirely independent of any reward mechanism.

3. Good project practice

- Performance measurement

The performance of all projects, however small, should be measured as a routine part of the process of determining whether stated objectives have been met.

Those measurements that are needed for benchmarking purposes should be agreed as part of the organisation's management practise and built into the project control system; this will ensure they are readily available at project close. The chosen measurements need to be standardised for all projects measured, otherwise valid comparisons cannot be made.

Project input, i.e. the extent of good practice use, should also be recorded. This is best achieved using a structured questionnaire which covers those practices offering the greatest opportunity for performance enhancement. It is recommended that scoring be carried out by the project team, rather than by the project manager alone.

- Benchmarking

This requires comparison of the project data against an established database to determine where project performance exceeded or was lower than the norms of the database. Internal benchmarking (i.e. comparing projects within a single organisation) and industry benchmarking (i.e. comparing project performance between different organisations) are both valuable tools.

Industry benchmarking has the benefit of being able to measure against "best in class", but at present the scope to do this is strictly limited due to the lack of an existing industry small project database. Making comparison with data from large projects needs extreme caution. The parameters may be similar, but what constitutes a benchmark performance may well be different.

- Identify opportunities to improve

The benchmarking results should be considered in detail to determine where improvements need to be made; also, which elements of the project demonstrated first quartile performance and how this was achieved such that it may benefit future projects.

Learning opportunities within the organisation should be seized, identifying practice use variances between projects to ascertain where first quartile performance can be carried across to other projects. Doing this in a systematic and quantified way gives considerable opportunities for improvement.

Analysis of the questionnaire and the benchmark results against industry norms will identify where improvement is required.

- Select implementation tools

Identifying how to implement improvement is aided by cross referral to the relevant VEP sections in this document (if using the ECI benchmarking system). Actions need to be company-specific and targeted to areas where ECI principles and practices are not being applied.

- Conduct training and implement best practice

Attendance at courses can be a valuable way of reinforcing the advice from VEPs. Whilst some general courses on project management can be beneficial, consideration should be given to practice specific courses, which can be achieved quickly and cheaply. For example, ECI run a series of Master Classes looking at various elements of construction projects.

4. Useful key performance indicators (KPIs)

A number of KPIs which are considered relevant to small projects have been developed and these are covered in Appendix 2. An organisation should decide which of these KPIs it wishes to adopt and then ensure that consistent data is obtained for each project and entered into a database. Once data for a statistically significant number of projects is available, it will be possible to analyse their relative performance and provide a basis for continuous improvement.

It is important to be able to correlate inputs (e.g. project definition, team effectiveness) with performance (e.g. cost predictability, construction safety). Hence, the measures provided address both of these aspects. It may also be valuable to categorise projects (e.g. by size) and, hence, allow benchmarking against similar projects as well as the full database.

5. References/further reading

1. CII Small Project Execution, Research Summary 161-1, November 2001.
2. CII, Small Projects Toolkit, Document Number 161-2, July 2001.

VEP MP.17

Managing the Portfolio of Projects

1. Introduction

Most client/owner organisations are concurrently engaged in the development or implementation of numerous projects. The totality of these is known as the portfolio of projects, which represents all of those being handled by a single management group, often in a single location. This generates the overall programme of project work. The portfolio normally has an ongoing existence with individual projects dropping out as they are completed, or abandoned, and new project proposals added as they arise. If an organisation is to maximise the benefit from the implementation of its projects, then there is a need to manage effectively the overall portfolio.

For small and medium-sized projects it is almost inevitable that there will be competition for resources from a common finite resource pool. Individually, many of these projects could be managed with fairly simple management techniques, but in the multi-project environment additional management effort is needed to ensure :-

- Correct selection and prioritisation of projects.
- Proper allocation of resources (money and labour).
- Cumulative risks arising from the execution of the whole portfolio are managed.
- That the interfaces between projects, and interfaces with operational facilities, are managed.

Information from industry surveys indicates that small projects, on average, overrun their time schedule by 20%, and even this figure hides the delays often incurred in the development phase (i.e. getting to the point where a project is ready for authorisation). It is also estimated that over 30% of expenditure on small projects is wasted due to poor specification, abortive work and delays.

This VEP is primarily addressed at client/owner organisations. However, the concept of managing a portfolio is also valid for contractor organisations, though they are rarely the initiators of projects but become involved as a result of either successful tendering or of a long-term relationship with the client/owner. Hence, some of the elements of this VEP can be adapted to contractor organisations, though others are not relevant. Where a long-term relationship exists between a client/owner and a contractor, it is important that the two liase closely to ensure compatibility of their respective programmes of work.

2. Characteristics of good portfolio management

The following key elements should normally form a part of any portfolio management system. The extent of detail used will depend upon the scale and complexity of the portfolio and also upon the nature of the resource constraints.

- A master project schedule. This will show every project and project proposal which constitutes the portfolio, along with its agreed priority and target completion date.

- A staff resource schedule. This is a listing for all staff involved in the portfolio of projects, showing their involvement in each and the timeframe over which it will apply.
- A formal process for selection of projects. It is vital to ensure proper development, but also helps to avoid carrying out excessive work on proposals which are unlikely to be authorised.
- A formal process for prioritisation of projects and proposals, involving the project owners, project management and those who have functional responsibility for the staff involved.
- A regular review process whereby overall prioritisation and staff resourcing for the portfolio is reviewed and, if needed, revised.
- A regular review process whereby the client/owner reviews all projects and proposals with project management (usually a specified plant or facility).
- A regular review process where the client group reviews all schedules and resourcing for current and foreseen projects with key contractors.
- For contractors, a system which can identify the impact upon their resourcing in the case that they win a contract for the work on a given project.

3. Recommendations

3.1 Master project schedule (MPS)

This is the key document which identifies all of the projects and project proposals which make up the portfolio. The format of this document will depend upon the requirement of the user organisation; a listing of probable requirements is given below and a possible format is shown in Appendix A. A spreadsheet is an ideal format as it is easily updated and extended. Requirements include :-

- An owner for the MPS who will be responsible for ensuring that the document is continuously updated. Ideally this should be the manager of the projects group for the organisation as he/she will be a key participant in portfolio reviews.

- Content of the MPS would normally include :-

  - Business owner (where work is carried out for more than one business).
  - Title of project.
  - Overall value of project and source of funds.
  - Project prioritisation.
  - Target completion date. Indicate if date is an absolute requirement (i.e. constrained by a plant shutdown).
  - Target authorisation date.
  - Name of project manager (or development manager for proposals).
  - Indication of engineering disciplines involved. Where names are known, state lead engineer, otherwise show requirement only. Where the lead role will be taken by a contractor, this should be noted.
  - Short statement of current status and identification of any key issue which is significantly constraining progress.
  - Identification of any specific linkages to other projects, i.e. where one project cannot be completed until certain work on another has been done or where the benefit from a project will not be fully realised without completion of another.

- The MPS will be the key document used at project prioritisation and resourcing reviews. It is essential that it is complete and up-to-date as an input to the review, and updated afterwards.
- The MPS is the top level document which is linked to a number of other documents. It is important that all documents provide consistent information and this is an additional task for the owner of the MPS. Other related documents typically include :-
  - Business project listing (projects foreseen by the business for the coming period).
  - Staff resourcing schedule.
  - Design office schedule.
  - Contractors' work programmes.
  - Project status reviews.
- A decision needs to be taken as to when a potential project is included in the MPS. This is for each organisation to decide upon. The key point is to be consistent in approach.
  - It is not sensible to include every idea that may possibly generate a project. To do so would result in many items being included which never proceed beyond the concept stage. Include only those items which pass the initial hurdle and proceed to detailed development.
  - There may be no point in including minor items which (though strictly speaking are projects) are handled entirely by plant-based engineers and require no input from a projects group or contractor resource.
  - The business sometimes identifies foreseen projects for the following years. If there is no foreseen work (including no engineering development work) within the coming 12 months it may be sensible to exclude such items as their timing is very vulnerable to significant revision.

3.2 Staff resourcing schedule (SRS)

Most small and medium sized projects are staffed from a resource pool that work on several projects concurrently and hence staffing is on a matrix basis. Schedule performance on small projects is very poor, with the majority being delivered late. The single greatest contributor to this is a lack of available staff at the required times. If work on a project is to progress smoothly against an agreed schedule, it is essential that the resource is available when required. In many client organisations, the availability of staff is very limited and many of those involved have responsibilities other than projects.

Where the client decides that they will delegate much of the project management and engineering to a contractor, there is still a need to schedule staff resources. This must now involve the contractor as the main supplier of the resources.

- Typically, the SRS will include the following :-

  - A look-ahead period of typically 12 months.
  - Every individual engineer engaged in project works including development of project proposals.
  - For each engineer it will list every project he/she is scheduled to be involved with, and a bar will identify the time period of that involvement.
  - An indication of the percentage of a person's time required over the period of involvement. This may change for different periods.
  - Any significant non-project workload that the individual is required to work on.

- Holiday periods of one week or longer.

An example of a typical SRS is attached as Appendix B.

- When compiling the SRS, note that the actual time available for working on designated tasks for any individual is approximately 70% of theoretical working time. The balance is consumed by holidays, sickness, training and non-specific duties.
- It is essential that any intended changes to work allocations or timings are discussed with the individuals concerned to ensure that they understand requirements, and these do not conflict with other obligations.
- It is also essential to obtain the explicit agreement of all line managers of staff shown on the SRS that they agree to the time allocations indicated. This is often a problem area for staff who are located in functions other than the project group.

3.3 Project selection and authorisation procedure

Most projects progress from a first requirement or idea through initial development and review of alternative possible solutions, to development and definition of a preferred option and preparation of a budget estimate and definitive plan to be submitted for project authorisation. In some cases there will be a need for earlier authorisation of initial funding to support this development and definition work.

This pre-authorisation phase is notorious for wasted engineering effort. This is caused by excessive work on proposals which are never authorised, addressing options which are not credible, and inefficiency due to repeated starting and stopping of work. There is, however, a need to ensure that sufficient work has been done to ensure proper project definition prior to commencing detailed design and engineering. In practice this is not always achieved due to lack of resource and pressure to be seen to commence implementation.

- It is essential that there is a system in place to control work done in this pre-authorisation phase. This should :-

    - Ensure that all credible options to meet the requirement are addressed, but that the work done at this stage is minimised to what is essential. Also ensure that proposals or options which are not credible are immediately dropped.
    - Encourage the projects group and the owner (sponsor) of the proposal to assess priority and the resources needed for development phase. If possible, agree the options to be considered and a target date for option selection.
    - Identify and agree a manager for the development phase.
    - Include a "stage gate" procedure where the owner (sponsor) and the projects group manager reconfirm validity and priority of the project and the preferred option before proceeding with the next stage. Also, check with the fund-holder that initial cost projections are acceptable. This procedure needs to be customised to requirements of the organisation, must not be bureaucratic, and must be applied to all projects.
    - At each "stage gate" the potential impact upon the SRS should be considered and if the project proposal is to proceed to the next phase then the MPS and SRS should be updated as necessary.

- For straightforward small projects the “stage gate” may only have 3 stages :-

  1. Agreement that development is justified, priority and options (if any) to be addressed.
  2. Interim review after initial development and provision of preliminary costing (i.e. ±30% estimates). Selection of preferred option, agree requirements and priority for detailed definition, and request initial funding if needed.
  3. Request for authorisation.

  The larger and more complex the project, the more stages should be used in order to avoid wasted effort.

- Project authorisation is the final step which releases a project for implementation. Virtually all organisations have a defined procedure for this, often dependent upon the value of the project and whether it is funded individually or as part of an annual budget for small projects items. Often, excessive time elapses between submission for receipt and authorisation, which adds considerable uncertainty to the time frame for project implementation and significantly disrupts planned resource allocations. Good practice requires that an organisation develops a rapid response authorisation system, which relies on realistic financial authority levels being delegated, thereby avoiding need for involvement of senior management. In most cases, indicative project values have already been shown in corporate capital expenditure plans approved at board level, so there should not be a need for further senior level approval provided that the final figure for authorisation is within the capital expenditure plan.

3.4 Project prioritisation and resourcing reviews

If maximum value for expenditure is to be achieved, it is essential that the content of the project portfolio is prioritised with agreed target dates for each project. The business is the key decision maker for prioritisation, but this should be with the active involvement of project management to ensure that the business has all relevant information needed to set priorities. It is then necessary to agree engineering resource levels to meet the prioritisation and target dates. It is likely that there will be a need for iteration between resourcing and prioritisation/target dates. The following points are relevant :-

- Prioritisation needs to be detailed. For a portfolio of many projects, proposals simply stating high, medium, low are not enough.
- Having initially set target dates, the implications need to be reflected into the SRS and this document should then be reviewed to check its viability.
- A single engineer cannot be allocated in excess of his/her time available (even if all the projects he/she is working on are high priority). Indeed, it is highly desirable that a small portion of his/her time is unallocated to provide for unforeseen additional work.
- Using several engineers of a single discipline on a very small project is highly inefficient.
- Repeated starting and stopping of work on a project is highly inefficient.
- An agreed methodology for prioritisation is needed and should include all of the owners of projects within the portfolio. This needs to include how projects which are not driven directly by financial return (e.g. HSE projects, infrastructure upgrades, improvements in reliability or maintainability) are integrated into the prioritisation.

- There is a need to address specifically those projects which have an absolute date constraint (e.g. a critical part of the work must be done at a fixed date plant shutdown, there is a regulatory requirement that work must be done by a fixed date or there is a significant market opportunity which will be lost if a fixed date is not met).
- If the majority of the projects within the portfolio are targeted to complete on dates which are only just achievable (i.e. little or no time float), it is inevitable that some of them will fail to be delivered on time. Schedules require contingencies in the same way as budgets do.
- Priority is not directly related to the earliest need for work to start. Some high priority projects may not need immediate work for a variety of reasons, i.e.

  - Target completion allows later start.
  - Definition work is not complete.
  - Resource not available as committed to other high priority work.
  - Critical path is not through general engineering, i.e. project includes delivery of a very long delivery item. Provided this is urgently addressed, other work may be deferred.

- Reviews need to be repeated at regular intervals as projects are completed, new proposals arise, unforeseen events occur. These reviews should include all the owners of projects and all those who are supplying engineering resource as well as the projects group responsible for projects management.
- A major effort should be made to ensure that the review results in a MPS and that an SRS provides for continuity of progress once the implementation has started. Starting and stopping work is inefficient and directly leads to delay and extra cost. Any delay is likely to be substantially greater than the period which the work was stopped.
- All of the above comments remain valid if the client/owner elects to use a contractor for management and engineering of his/her project. The contractor may have a greater resource pool, but this is not unlimited. There is also great merit in aiming for continuity of specific engineers from the contractor to work on projects for a given client to avoid the need for repeated learning of client’s requirements. The contractor should ideally be included in the reviews of the MPS.
- Construction contractors have considerable ability to vary their construction labour allocation provided they are given reasonable notice. However, new labour unfamiliar with a site is less productive and has a higher risk of injury. Contractor supervision that is familiar with a site is far more effective. Hence, the data from MPS should be translated into a programme of work for construction contractors and reviewed with them.

3.5 Project status reviews

It is usually impracticable to schedule individual meetings with the client/owner for every single small project, yet there is a need to keep him informed both of status and any issues which may be compromising the achievement of objectives. Whilst a brief monthly report can indicate status, it is usually desirable to ensure that there are occasionally (say once per quarter) face-to-face meetings to review all projects and proposals from that client/owner.

These meetings will briefly review status and any relevant issues. The meeting must not aim to be a problem-solving session (unless the solution is immediately obvious and agreed) but should identify who will address the problem. The meeting is also an opportunity for first identification of potential new proposals and changes to priorities and target dates where these are client-driven.

These meetings will not be sufficient for complex or time-critical projects which will require more frequent and detailed interface with the owner.

3.6 Alliance contractor for design and management

Many client/owner organisations do not have sufficient staff to manage, design and engineer their small projects. It is therefore necessary for them to engage the services of an engineering contractor to carry out this work on their behalf.

Engaging a contractor to provide services for a single small project is likely to be costly and performance may well be less satisfactory than if the work were carried out by the client's own staff. There are a number of reasons for this, principally the need for the contractor's staff to learn the owner's requirements, both technical and procedural, and all the interfaces with existing facilities. The contractor will work inefficiently and will also need substantial support and advice from the client. For the contractor, the potential for profit is low, with many risks, the only real incentive being potential future work.

However, if the client/owner recognises they have a long-term need for such services, then they can select a contractor to provide such management and engineering services for a period of several years. Such long-term alliances can, after the initial learning period, become an effective means of managing and engineering a portfolio of projects. A number of points will help determine the success of such an arrangement. These include :-

- Client must first identify the scope of services required, i.e. will project development work be included? Will there be continuity of work? Will the contractor carry out project management as well as engineering? What engineering standards are to be applied? Who will carry out procurement (materials and services)? Who will manage construction?
- Client must carefully select a contractor who can provide staff with all the required skills and has processes geared to the management of a multiplicity of small projects.
- The number of interfaces with existing facilities and with plant staff means that it is highly desirable that contractor's work is carried out at a location compatible with frequent site visits.
- There will always remain a need for the client/owner to have regular liaison with the contractor, and the client should nominate managerial and technical interfaces. They will agree the programme of work, provide input information, assist in clarification of requirements, audit contractor's work and finally accept the work. At the start of the arrangement the extent of client input may be quite significant, but this should reduce as the contractor becomes more familiar with needs.
- There is a need to agree an appropriate form of contract and terms of payment. As scope of work is not known at the outset, payment will be essentially reimbursable. This may include a scheme of incentives to drive performance.
- If this arrangement is to be efficient there is a need for reasonable continuity of work, thereby allowing a core of contractor's staff to be continuously employed on work within the contract. Only this way can the contractor gain familiarity with requirements.
- The need to plan and agree the programme of contractor's work is vital. Contractors have a limited resource pool and there is benefit in smoothing work loading so far as is compatible with client's reasonable needs, and in providing forward notice of changes to labour requirements.

3.7 Client/contractor workload reviews

A client/owner who knows the likely contractor(s) to be used for work associated with a project should be pro-active in providing general information of timing and scale of work to the contractor as soon as information is reasonably firm. In this way, the contractor is better able to plan resource requirements and therefore operate more efficiently and cost effectively.

Where there is a term or alliance contract there should be a listing of all projects and other work (e.g. maintenance) required from the contractor. This should be updated regularly (preferably monthly) and show resource needs by type for at least six months ahead. Inevitably only the information for the immediate one or two months will be firm but that for the later period will still provide a useful first guide.

4. References/further reading

1. J. R. Turner, The Gower Handbook of Project Management, Third Edition, Chapter 14, Programme Management, Gower Publishing, 2000, www.gowerpub.com.

VEP MP.17 Appendix A Example Project Master Schedule

Project Name	Estimated value €	Target complete	Priority	Project manager	Process engineer	Mechanical engineer	Civil engineer	Instrument engineer	Electrical engineer	Status/ comment
Business – PE Plant										
Project A	50k	Dec 2002	D	Person 1	Person 2	Person 1	xx	Person 7	xx	Held. Awaits engineering resource.
Project B	260k	April 2003	B	Person 7	Person 2	Person 1	Person 3	Person 7	Person 8	In design. Compressor delivery determines schedule.
Project C	1500k	Sept 2002	A	Person 3	Person 4	Person 1	Person 3	Person 7	Person 8	Design complete. Construction in progress. Tie-ins at plant s/d June 2002.
Project D	120k	Sept 2002	C	Person 3	xx	Person 5	Person 3	xx	Person 8	In design
Project E	40k	July 2002	E	Person 6	xx	xx	Person 3	xx	Person 8	Installation at plant s/d June 2002.
Project F	320k	Dec 2002*								Project scope to be revised for new business objective. Delay likely.
Proposal G	1000k	April 2002A	C	Person 5	Person 4	Person 5	Person 3	Yes	Yes	Target completion mid 2003
Proposal H	160k	Sept 2002A	E	Person 2	Person 2	Person 5	xx	Yes	xx	Awaits resource for development.
Business – PP Plant										
Project J										
Project K										
Project L										
Project M										
Proposal N										
Proposal P										
Proposal Q										
Business - Infrastructure										
Etc. etc.										

Key :-

xx No requirement for discipline.
Yes Requirement for discipline not yet nominated.
 * Target date to be reviewed.

Example of a Staff Resourcing Schedule

Name	Priority	Jan 2002	Feb 2002	Mar 2002	April 2002	May 2002	June 2002	July 2002	Aug 2002	Sept 2002	Oct 2002	Nov 2002	Dec 2002	Comments
R Jones – PM – Project C PM , ME - Project K PM- Proposal N Holidays Training	 A B E	 50% 20% 10%	 50% 20% 25%											
S Taylor – IE – Project A PM, IE - Project B IE – Project C Holidays Training	 D B A	 10% 30% 40%	 20% 40% 30% 15%	 20% 40% 30% 10%										Apparent work overload in 2002 Q1 requires resolution.

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