Proceedings of ICE
Civil Engineering 150 May 2002
Pages 67–74 Paper 12584

Keywords
economics & finance; infrastructure planning; social impact

A value and risk management approach to project development

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'Value methodology' has been practised for over 50 years but has only recently started to be used on architectural, building and civil engineering projects. As discussed in this paper, the benefits of the process include early and continued stakeholder consultation, team alignment and culture change, a managed risk approach, consideration of whole-life impacts and integrated service delivery. In particular, its transparency greatly aids decision-making and consensus development. With the formal inclusion of risk considerations, value methodology has proved to be a very powerful aid to project development.

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Today, more than ever, there are many variables and viewpoints in any project, large or small. Often there are different stakeholder interpretations of what is required, time-scales, and standards. Value management provides a basic framework and a tool set that, when properly applied, addresses issues of potential misunderstanding and misalignment at the start of a project and, in many cases, results in significant reductions in the whole-life costs of the final project.

There are many definitions and interpretations of value-related approaches. The term 'value and risk management' is used in this paper to signify an holistic approach that is applied at specific stages throughout the life of a programme or project. Depending on project scale, complexity and the stage of development, the techniques for addressing different aspects of any particular project may vary. It is implicit in this paper that, through the proper use of this modified value methodology, economic assessment, risk and uncertainty are addressed appropriately. Application of the value and risk management approach 'fast tracks' a common understanding of all of the requirements through an analytical and consultative approach, thus deriving consensus on key recommendations.

The value and risk management approach is a natural companion to good programme and project management for complex or sensitive issue areas and for encouraging continuous improvement. It provides a vehicle for transforming the way organisations and individuals approach project planning and development. The methodology encompasses techniques to address the interrelated aspects of

- stakeholder issues and concerns
- stakeholder values
- project functionality
- operations and maintenance requirements
- costs (capital and whole-life)
- implementation schedules
- implementation obstacles
- potential project risks.

There are two contrasting applications.

- Strategic choice—through strategic focusing, formulation of clear, unambiguous, strategic direction to enable approvals, funding and subsequent orientation of the development/implementation team. To build consensus on the way forward through complete gathering of the many and various stakeholder views, strategic focusing is, of necessity, an iterative process.
- Value enhancement—through value engineering—continuing value improvement for finessing to optimum quality, functionality and cost parameters.

The need for project improvement

Construction projects have acquired a reputation for confrontation between the contracting parties and in some cases the public as well, resulting in

- major claims and over expenditure
- delays and service disruption
- poor overall value for money
- stakeholder discontent.

The causes of these problems can often be traced back to misalignment of stakeholder expectations from the outset. Typically, there are many complexities and variables.

The typical development of a project is shown in Fig. 1. It is clear that a project is developed over time, with input from a number of different parties. It is this multiplicity of inputs at different stages that leads to the problems identified above. To avoid such problems, there is a need for a routine, proactive methodology that will 'get it right, first time'. There must be absolute clarity of context, needs, objectives and communications.

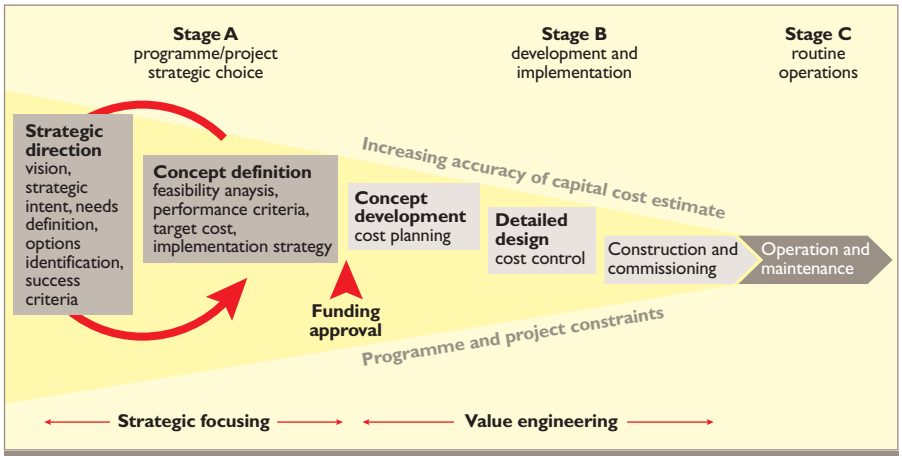

Fig. 1. Typical development stages of a project, showing where strategic focusing and value engineering can bring benefits

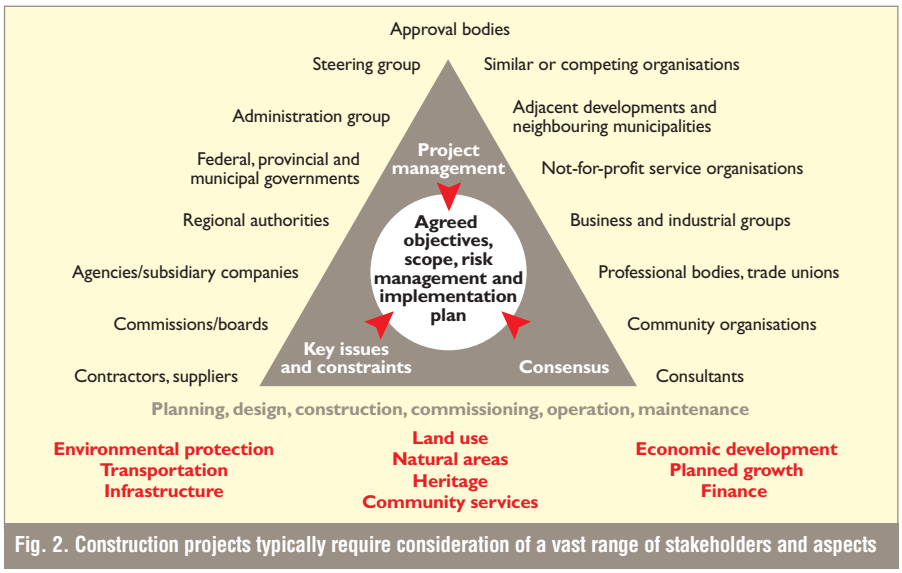

Fig. 2. Construction projects typically require consideration of a vast range of stakeholders and aspects

Defining value methodology

Value methodology, as we know it today, evolved in the US in the late 1940s. Its roots lie in the manufacturing sector where it originated in General Electric and was known as 'value analysis'. In 1954, value methodology was introduced into the US Department of Defense, Bureau of Ships, in which the term 'value analysis' was changed to 'value engineering'. Value engineering spread to many US federal and local government agencies. It should be noted that value methodology is much more than a cost reduction technique. Some related terms include

- value analysis
- value engineering
- value management
- value control
- value improvement
- value planning.

Value methodology is now used formally in several other countries throughout the world. These include Australia, Canada, France, Germany, China/Hong Kong, Hungary, India, Korea, Japan, New Zealand, Saudi Arabia, Taiwan, the United Kingdom and the United Arab Emirates.

In Australia, Europe and Hong Kong particularly, the application of value methodology is known as value management. There is now a European/British Standard on Value Management, BS EN 12973: 2000 and an explanatory document, PD 6663: Guidelines to BS EN 12973, Value Management—Practical Guidance to it use and intent.[1,2] The original and predominant value society is SAVE International (formerly the Society of American Value Engineers).[3]

There is no universal agreement over the various terminologies which are often used interchangeably and at other times each term may have a vastly different focus for different people. Suffice to say that the definitions tend to fall into two categories

- 'big picture', broad-based management thinking to evolve a project from the outset, i.e. strategic choice
- sharply focused, function-based, analytical thinking for improvement to serve a specific end-user purpose, i.e. value enhancement.

Value methodology is complementary to the process of project management and aids in cutting across bureaucratic boundaries and managing the 'grey areas'. It is being used more and more by 'learning organisations' throughout the world for concept identification and project development.

Perceptions of value and risk

Value is determined not by the producer or promoter, but in concert with the customer/user. Nor is value related solely to money, as value criteria may include, for example, aesthetics, ease of operation and maintenance, environmental friendliness, and provision for longer-term needs. Clients are really seeking to buy performance, not just traditionally practised, project development activities.

Good project performance includes satisfying a range of stakeholders who may

> value methodology is a tremendous consensus development and team building tool

have differing views, values and thresholds of tolerance for perceived risk. Fig. 2 illustrates a wide variety of stakeholders and aspects to be considered. The key to success is to provide a holistic framework, complete with a tool set, for addressing needs identification, conceptualising, development, implementation and optimisation, while involving the appropriate stakeholders (and seeking to understand their values).

Risk and uncertainty are present in quite different forms for various levels of project authority and implementation personnel. Risk may be stated as any potentially detrimental occurrence to a project in terms of cost, schedule, safety, quality, reliability stakeholder disruption, and so on. At a higher level, risk may be related to, say, failure to protect public health or economic failure of a region. Fig. 3 illustrates some of the more generic project risks typically considered.

Through its logical process and multi-stakeholder representation, a value and risk management workshop is an ideal forum to identify and categorise project risks and uncertainties. Assessment of the risks may be made quantitatively, qualitatively or pragmatically. The synergy of the value and risk management team invariably leads to an innovative and practical risk management plan.

While neglect to identify a risk can be expensive, so can unnecessary allowance to avoid each and every possible risk that may be foreseen. Further, once identified, risk may be examined creatively and turned into a scheduling or economic opportunity. A balanced approach is advocated when specifying methods to evaluate risks. In line with varying stakeholder values, the degree of risk accorded to a project party is dependent on the level of comfort for carrying that risk. Risk transfer is a common practice, but may incur significant unnecessary costs if not properly evaluated.

A group thinking process

Value methodology is a powerful, group thinking process. The structured, formal study requires that a broad mix of stakeholder representatives focus collectively on shared issues and opportunities. Outcomes are based on a common understanding of needs, constraints, key concerns, major risk areas, life-cycle impacts and shared/negotiated team values.

Value methodology objectively challenges assumptions, identifies alternative options, prioritises according to agreed criteria and then develops and tests the action plan for practicality of implementation. It is a very powerful, 'fast tracking', consensus development tool. It has a tremendously synergistic effect, which overcomes otherwise adversarial relationships to develop a team approach and produce ownership of, and commitment to, the end product.

It should be clearly understood that there are many misconceptions of what value methodology is and can achieve. It is not a traditional project review or 'what good designers are paid to do'. While value methodology does identify considerable cost savings, it may also identify areas where functionality can be enhanced for the same, or marginally extra, costs. Furthermore, applied at the appropriate time and through the correct mix of team members, value methodology is a tremendous consensus development and team building tool that saves far more time and money than its basic study cost and also provides a means for identifying and managing significant risks. Fig. 4 illustrates a typical value workshop team in session.

To reach a consensus, all participants need to have a similar understanding of each other's values and constraints. The value workshop process facilitates this to take place, together with providing a step-by-step methodology for exploring various options to arrive at the most suitable solution. Workshop teams should be multidisciplinary and represent the interests of all groups who may be impacted by the project under consideration. The mix of team members varies with the stage that the project is at, and whether an integrated team or an external, third-party team is used. Workshop participants may number between 5 and 40, but between 12 and 20 is a common group size.

Value study workshop process

Value methodology is systematic and applied through a value and risk management programme or a single study and is

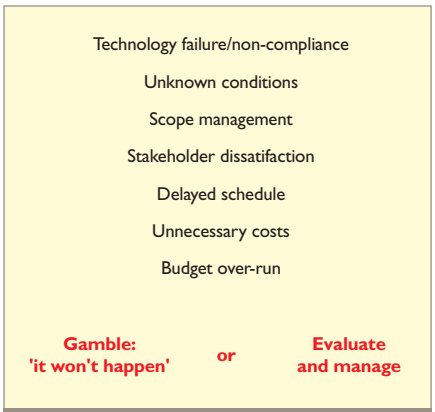

Fig. 3. All projects are exposed to a variety of risks—value and risk workshops provide an ideal opportunity to identify and categorise these

Fig. 4. A typical value and risk management workshop (courtesy of Edmonton Public Schools, Canada)

> For a workshop event to be effective and to generate maximum value, all attendees must be fully committed and participate actively to the fullest extent

guided by an external facilitator.

Value and risk management study workshops are intense and may be of short or long duration, depending on the specific project and stakeholder circumstances and objectives. Much of the power of value and risk management methodology lies in the rigorous, disciplined approach and the ability for team members to focus collectively, both inwardly and outwardly, on a broad range of topics.

Participants examine

- stakeholder issues
- values
- functions
- cost
- benefit
- relative worth

with a view to building consensus on the best way forward. This significantly reduces subsequent project development time and identifies the optimum choice of strategy and components. It is important to plan for gathering together the appropriate project personnel, at the right project stage(s) and adhering to a project-specific, three-step work plan and the standard five-phase workshop methodology, which should include some form of analysis by function.

The study phases and workshop steps are illustrated in Fig. 5. The scope and stage of application vary with interpretation and location within the world. The common thread is a basic workshop process that is central to any formal value study. These phases are

- information and analysis
- creativity
- judgement
- development
- interim output.

The number and naming of the workshop phases varies somewhat between authorities. The workshop is preceded and followed by the appropriate preparatory and closure activities.

- *Information and analysis*—key team members provide short, succinct overviews of the project situation from their perspectives. The team then analyses the project 'base case' in terms of issues, functions, function–cost, relative worth and risks.
- *Creativity*—several conceivable possibilities are identified (but not discussed) for providing alternative solutions and addressing each of the previously identified cost–worth mismatches, key issues and significant risks.
- *Judgement*—agreed criteria are used to make initial judgements and prioritise a list of relatively likely options for further consideration.
- *Development*—the potentially most likely ideas are developed as mini-proposal packages containing descriptions of how they could be implemented. These descriptions typically include: capital and life-cycle cost estimates; advantages and disadvantages as compared against the original base case; data sources; and comments regarding risks and risk mitigation, constructibility, serviceability, operations and maintenance impacts, and implementation schedule.
- *Interim output*—the mini-proposals are reviewed, compared and refined. A decision matrix is developed and potential recommendations are reviewed. Sensitivity criteria may be applied. An informal, working presentation is made to a steering group or 'sounding board' of peers.

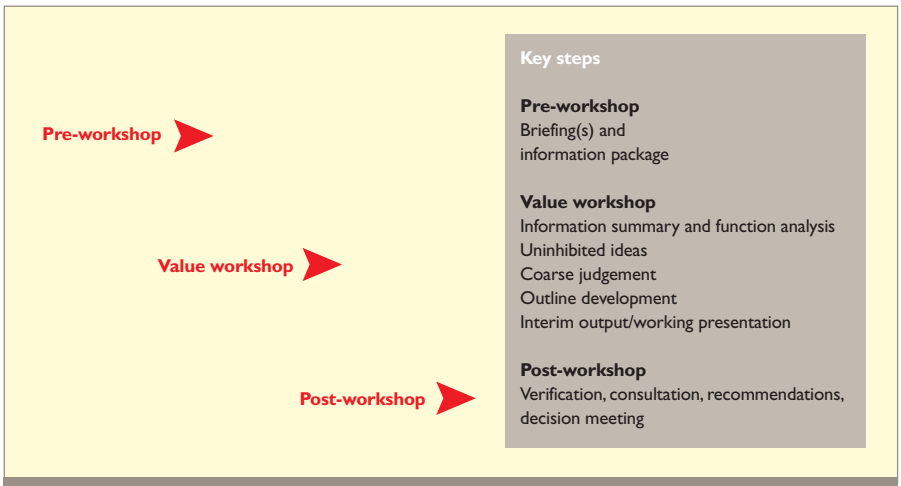

Fig. 5. Value study and workshop steps

For a workshop event to be effective and to generate maximum value, all attendees must be fully committed and participate actively to the fullest extent. Partial workshop attendance or responding to the needs of other projects by team members is discouraged, as it is disruptive and wasteful of the time of other participants. Stakeholder representatives who are too busy to attend the workshop(s) full-time are encouraged to participate in an informal feedback panel at the end of the workshop.

Note that the value study timeframe encompasses many more activities than the workshop or series of workshops. Depending on the project size, complexity and schedule, more than one workshop may be appropriate, and the study steps and pace can be adjusted to suit a specific situation.

Analysis by function

Value methodology is unique in the way it analyses by function and integrates all aspects of a project, product, process or service. Analysis by function and functional dependencies is very powerful. It is the crux of a successful value study and differentiates the value-based approach from other management philosophies and tools.

Notwithstanding, function analysis is sometimes misunderstood and resisted by newcomers to the approach (as they cling to their old paradigms).

The function analysis approach accomplishes the following

- provides a platform for stakeholder communication and participation
- identifies data and logic gaps
- forces deeper thinking and objectivity, thus raising the level of understanding of the various issues
- identifies needs (rather than wants) and the issues involved, together with the necessary key steps and the process to accomplish the project aims
- sets a framework for a costed bill of functions rather than a costed bill of materials or quantities
- keeps issues in focus through a framework covering the overall scope.

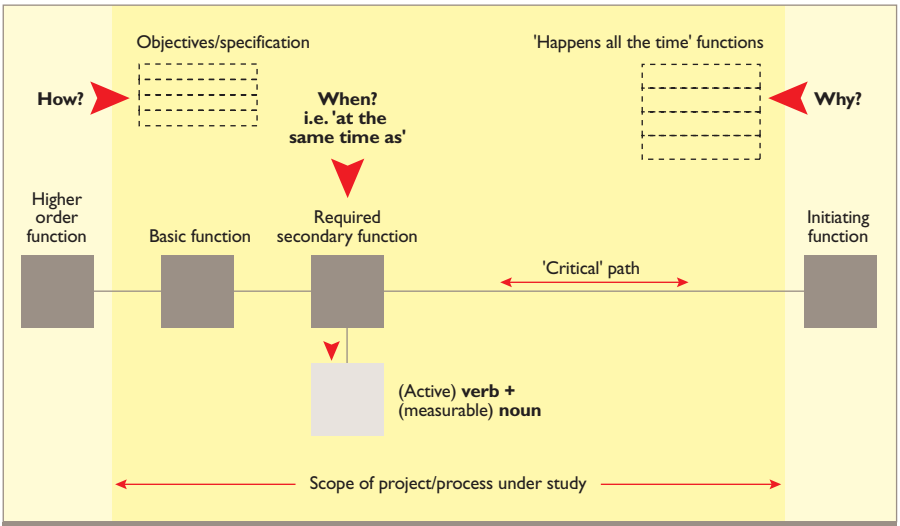

Fig. 6. Drawing a function, analysis, systems and technique (FAST) diagram follows 'why–how' logic

All this is achieved through the development and continued refinement of a function, analysis, systems and technique (FAST) diagram. This is drawn in accordance with specific rules and follows 'why–how' logic and layout (Fig. 6).

A basic premise of the traditional value methodology is expressed through the relationship between cost and function. The aim is to increase functionality while maintaining or reducing cost. A small increase in cost may be acceptable if large gains in functionality and stakeholder satisfaction are realised. The FAST diagram is an effective way to show functions and their relative cost, worth and potential alternative costs. It is also useful for examining risks and uncertainties. For strategic applications, a somewhat similar 'FOCUS' diagram is used.

Risk management register

Risk evaluation is seen increasingly as an essential part of smart project management. During the project development process, a particular risk can be the lack of stakeholder agreement on project needs and proposals. This can derail the approval process and incur significant delays in project development and subsequent implementation. Risks may be present due to limited experience, lack of information and general uncertainty regarding future conditions and viewpoints.

Risks may also occur as parties, personnel and relationships change during the course of a project with a long duration. Construction phase risks often relate to costly unknown conditions, such as poor ground, old buried structures, archaeological remains, future exchange rates or labour disputes, etc. During the project operational lifetime there may be a significant risk of the project not performing as required (e.g. through technical failure or inaccurate data).

As part of the workshop information and analysis phase, specific project risks are identified and categorised in terms of potential severity and probability of occurrence. Related consequences are identified. This is the start of the risk register. No more work is done on it at this stage; it is addressed progressively in each of the subsequent workshop phases. Workshop phase 2—creativity—identifies potential means of addressing significant risks. Using agreed criteria, workshop phase 3—judgement—evaluates the practicality of these possibilities and categorises them in terms of

- risk avoidance (consider alternatives that do not involve the risk)
- risk reduction (consider reducing likelihood and consequences of the risk)
- risk transfer (consider transfer of risk to another party or insurance)
- risk acceptance (consider activities to control the likelihood and impacts of the risk).

The risk management register is completed as part of workshop phase 4—development—with the inclusion of a risk response or contingency plan for each highly ranked significant risk. This type of plan varies greatly with the stage of the programme or project. It is important to plan for monitoring and adjustment of the register over time.

The value and risk management study applies the appropriate techniques and level of analytical effort within the workshop to proceed through to the formulation of recommendations. It may well recommend a more thorough risk evaluation to take place separately. Much is written elsewhere on statistical approaches to risk analysis and management.

Value and risk management application stages

Value methodology is used at various stages of programme and project development for building consensus on situations and available options. It is applicable to various forms of business process refocusing, for example

- construction
- environment
- facilities and infrastructure management
- government
- health care
- industry
- manufacturing

> Value methodology may be applied at any point during project development, but best results are obtained through early application

- transportation
- utilities.

It encourages a holistic approach and team synergy. While it is often applied as a one-off event for project improvement, value methodology is most successful when used as the basis for a long-term, continuous approach for business and project success.

Value methodology may be applied at any point during project development, but best results are obtained through early application. Ideally, the value process is used as early as the needs identification stage and is used for facilitating strategic partnering workshops, including the development of dispute avoidance procedures. As the programme, project, product or service is being developed, value methodology is applied as a continuous improvement mechanism to ensure maximum cost effectiveness, functionality and appropriate quality. It can also be applied with surprisingly good results as late as the tender assessment and contract negotiation stage for traditionally developed projects. Accordingly, the focus changes over time. Fig. 7 shows the stage that a major, multi-storey project was at when a value engineering workshop was held.

The value approach is applied best as a pre-ordained, step-by-step, series of events, carried out at key points. In this way, the value and risk management programme sessions may be better planned and integrated to become invaluable milestone mechanisms for continuous improvement and to address changing project and procurement conditions. This results in the better understanding of the context in which issues are judged, through the team members seeing the issues in the same light. Consequently, better commitment through 'ownership' of decisions is established and 're-visiting' of project decisions, with related rework, is avoided.

Four key points of application of value studies and workshops within the overall project life-cycle are shown in Fig. 8—the value workshop application points. Depending on project size, duration and complexities, value and risk management workshops are not necessarily conducted at all of these points for the same project.

Fig. 7. A value engineering workshop was held when groundworks on this major, multi-storey project were significantly underway (courtesy Hyundai Engineering and Construction Company Ltd, South Korea)

A holistic approach

Value methodology plays a very significant role in the strategic procurement and implementation process. It elicits the 'best bang for the buck' through focusing on the 'big picture' and asking tough questions about optimum costs and functionality. It is predominantly a function-based technique that identifies key areas to improve quality, streamline tasks and reduce whole-life costs. This approach is ideally suited to meeting the challenges presented by current trends toward downsizing in the general services and asset management function. It also provides a holistic approach to defining, developing and improving the project management process and deliverables.

It is noteworthy that the process of building consensus is not linear, as tends to be the case for traditional project management. Consensus building requires successive iterations to review and confirm or modify various interim decisions. This actually speeds-up the overall project development schedule as it pre-empts many otherwise time-consuming meetings outside the workshop(s) process.

A broad framework for applying value methodology to programme and project

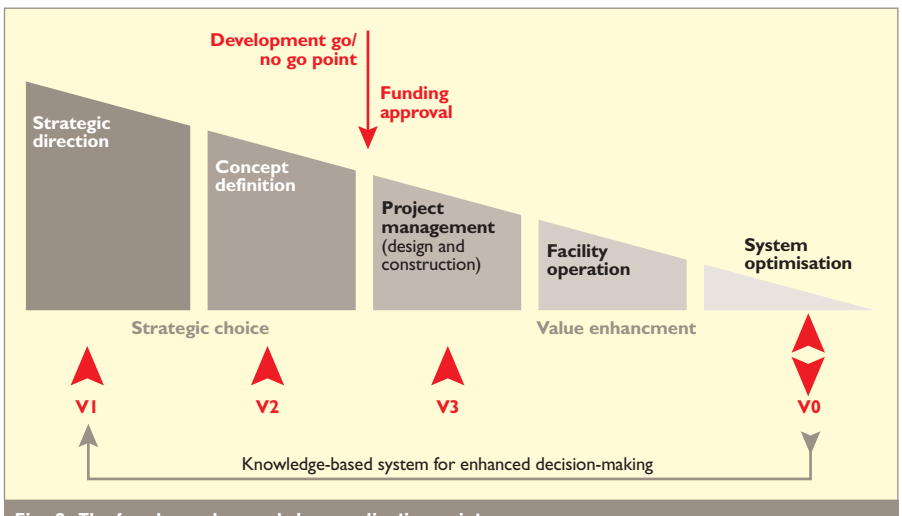

Fig. 8. The four key value workshop application points

management is shown in Fig. 9. The stages shown apply to the whole of a project's life cycle. To guide sustaining decisions, value and risk management must view the whole picture before focusing on specifics. All too often, project proponents 'rush their fences' by assuming that their deliberations are further along the process than they really are. When conducting a value study, it is wise to take both an analytical step backward and a speculative step forward in order to gain a better appreciation of all factors.

Prior to undertaking a value and risk management study, it is important to define precisely what the objective(s) and underlying 'drivers' are (for both the project and study). Quite often, the true reason is not well articulated. Is the study objective simply to confirm best value for money and optimise where possible? Or, is there perhaps a lingering doubt about the concept being correct? The style of process application and choice of participants for either may be quite different.

In order to save time and provide overall study direction, it can also be beneficial for a steering group, through a mini, strategic value workshop, to speculate independently on global possibilities for an end result—what it must look like to satisfy whom, by when and why.

Examples of application

Some examples of various applications, drawn from the author's own experience, are described in the following sections on strategic choice and value enhancement.

Stage 1: strategic direction, value study type V1

Value studies are conducted at this stage to determine options for clear and acceptable business strategies prior to a formal commitment to develop programme(s) and projects. Effort spent in developing unambiguous and workable strategic direction is undeniably a good investment to ensure proper direction of subsequent effort.

Outputs:
business case, policy/strategy document, master plan, options identification, project requirements definition.
Example applications:
formulation of municipal environmental strategic plan policy document
formulation of greenhouse gas emissions reduction strategies for city operations and/or community-wide local action plan
development of strategy to increase reliability of supply and to reduce system risks for the water network in a national capital city
facilitation of river water quality task force and initiation of programme of projects to improve river
options identification, master plan and implementation strategies for learning facilities and for health care centres.
Reason for study:
to build stakeholder consensus on issues and opportunities, and to set direction and define a framework for resolution.

Stage 2: concept definition, value study type V2

This type of value study is used to derive optimum functionality and cost effectiveness, and to confirm or modify the concept definition for optimum scope, budget, timeframe, standards and risk management approach.

Outputs:
feasibility and risk assessment, concept choice, target cost, key performance indicators, and project implementation plan.
Example applications:
two- and four-day workshops for new university complex—increased functionality and reduced whole-life costs
four-day bid improvement for 30-year, $1·8 billion 'design–build–own–finance–operate–transfer' project to enable successful bid for major urban renewal project—significantly reduced capital and lifetime operating costs
four-day analysis at functional design stage of urban highway and light rail transportation scheme—13% capital cost savings identified with improved design features
three-week project redefinition and outline design through partnering and V2 and V3 value workshops for design and build environmental project enhanced functionality and client satisfaction, subsequent implemented capital savings of 7%—significantly reduced life-cycle costs.
Reason for study:
to finalise definition of project concepts and to develop the framework for project implementation.

Stage 3: project implementation, value study type V3

Currently this is the most common application stage of value methodology: to verify and 'tighten' project design and construction proposals for optimum project performance.

Outputs:
concept development, design to target cost, functionality, schedule cost and constructability improvements, operations and monitoring plan.
Example applications:
intensive two-day analysis of $2 billion, engineering procurement and construction management oil refinery project—identified $47 million capital savings at the 30% design stage
nine-day workshop for $530 million luxury development including towers to

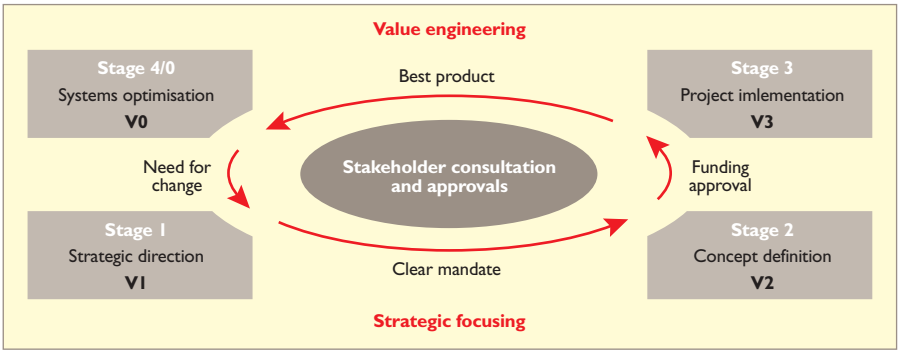

Fig. 9. Framework for applying value methodology to programme and project management

69 storeys (400 000 m^2), constructability and functional enhancements
six-day cost reduction of over budget, design and build management contract transportation terminal and commercial centre—capital savings of $30 million of a total $360 million identified
three-week analysis of project tender for water supply extension to serve population of 6 million yielded 28% savings.
Reason for study:
to identify ways and means for improving project delivery, and to resolve concerns over cost and schedule.

Stage 4/0: systems optimisation, value study type V0

Efficiency reviews to optimise an in-service process or facility. Outputs from this type of study application, V0, commonly form the inputs to (or base case for) stage V1 in a later cycle.

Outputs:
in-service functional enhancements and operational efficiencies, risk and reliability study, needs assessment, optimisation plan, recommendations for strategic and organisational change.
Example applications:
two-week analysis of bids for renewal of city cleaning operations contract—five-year target price of $300 million reduced to $185 million
four-day analysis of reliability of power supply to treatment plants and identification of necessary improvements
four-day workshop to optimise control system for 1200 km transmission pipeline and oil storage/shipping terminal
two-day workshop devised an aggressive strategic plan for corporate growth through new product lines.
Reason for study:
to provide a clear understanding of options to improve performance of current in-service product, project service or system.

Fig. 10. Value methodology can use milestone documents to create an auditable project trail

Summary

The value and risk management approach may be applied to a wide range of small, complex projects through to large projects or programmes.

Early application of value methodology as an integral component of the strategic procurement process leads to significant savings relating to schedule, staff time, capital costs and life-cycle costs. In addition, experience shows that 'it is never too late' to derive substantial benefits in terms of enhanced functionality, team building and cost improvement.

Value methodology is a time saving, cost effective, consensus and team building approach. It is used to plan, develop and control projects, together with aiding transformation of business culture/practices and compatibility with community needs. Advanced value and risk management techniques applied through teams familiar with the process make for particularly quick and robust results. There are different value-based approaches, techniques and tools that are offered through various organisations.

With the pressures that typically accompany the initiation and development phases of many projects, value methodology produces a high level of focused and tested proposals in a very short time. This enables well-founded, collaborative decisions on project strategy, scope and components, together with contractor selection and contractual relationships.

With shrinking resources and continually growing regulations, organisations are benefiting from the competitive edge provided by the unique, strategic thinking approach of value methodology. In this way, decisions on strategic procurement of major services, projects and equipment can be made with confidence.

Figure 10 illustrates a set of milestone documents for which value methodology may be used to set direction, fine-tune work in progress and record decisions for future reference as project circumstances, stakeholders and development personnel change over time.

There are also a number of useful websites available on the internet which may be consulted with regard to value methodology.[3–9]

References

1. European Standard. EN 1325-2.
2. British Standard Institute. *Value Management* BS EN 12973: 2000, June.
3. SAVE International. www.value-eng.org.
4. Institute of Value Management. www.ivm.com.
5. Institute of Value Management, Australia. www.value-management.com.au.
6. Canadian Society for Value Analysis. www.scav-csva.org.
7. Hong Kong Institute of Value Management. www.hkivm.com.hk.
8. Society of Japanese Value Engineering. www.sjve.org/hp/english.
9. Department of Trade and Industry. www.dti.gov.uk/.

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