Training for Project Management

Volume 2: Methods and Techniques

Second Edition

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Introduction

PROJECT MANAGEMENT STANDARDS

Project management is a discipline which is practised extremely widely, and not exclusively in the workplace. The techniques are shared between many businesses and involve different kinds of people in different types of activity. Engineering, software, marketing, research and development, production, purchasing, finance, personnel and many others all run, or participate in, projects. All can lay claim to project management as a fundamental part of their activities. Not only does each participant intervene at very specific moments in projects initiated elsewhere, but each party has its own exclusive projects.

Project management encompasses a broad body of knowledge which has been captured by professional associations including the Project Management Institute (PMI) in the United States, the Association of Project Managers (APM) in the UK, the Australian Project Managers and AFNOR in France, as well as by national and international standards institutions.

For example, the ISO guidelines for quality in project management list five fundamental principles for delivering quality through project management:

1. Maximizing the satisfaction of customer and other stakeholder needs is paramount.
2. All work in a project is carried out as a set of planned and interlinked processes.
3. Quality has to be built into both product and processes.
4. Management is responsible for creating an environment for quality.
5. Management is responsible for continuous improvement.

ISO 10006 presents the essential operational project processes under eight main headings:

1. Scope
   - concept development;
   - scope definition;

- activity definition;
- activity control;
- scope control.

2. Time
   - activity dependency planning;
   - duration estimation;
   - schedule development;
   - schedule control.
3. Cost
   - cost estimation;
   - budgeting;
   - cost control.
4. Resource
   - resource planning;
   - resource control.
5. Personnel
   - organizational structure definition;
   - staff allocation process;
   - team development.
6. Communication
   - communication planning;
   - management of meetings;
   - information distribution;
   - communication control.
7. Risk
   - risk identification;
   - risk assessment;
   - response development;
   - risk control.
8. Procurement
   - procurement planning;
   - requirements documentation.

To these can be added interlinking and strategic processes:

1. Interlinking
    - project plan development;
    - interaction development;
    - change control;
    - closure.
2. Strategic
    - strategy.

The PMI Project Management Body of Knowledge (PMBOK) lists nine knowledge areas:

1. Integration management.
2. Scope management.
3. Time management.
4. Cost management.
5. Human resource management.
6. Communication management.
7. Risk management.
8. Quality management.
9. Procurement management.

These definitions are very widely recognized and practised. They suggest neat chapters for delimiting the project management domain.

The APM/IPMA body of knowledge also puts forward a whole array of subcategories under four headings:

1. Project management.
2. Organization and people.
3. Techniques and procedures.
4. General management.

PLANNING AND CONTROL TECHNIQUES

Project navigation and project steering

All the sets of chapter headings used in the standard methodologies illustrate that project management competencies can also be divided up into 'soft' skills and 'hard' skills. This volume concentrates on the 'hard' technical skills rather than the 'soft' people skills.

What these definitions of processes and knowledge areas do not show so clearly is that project management competencies can also be divided up into skills which are concerned with 'setting a course' (analysis, definition, baselining) and skills which involve 'steering the course' (measurement, benchmarking, productivity). In the first instance, the emphasis is on 'doing the right thing' and in the second on 'doing things right'.

A good analogy is that of the navigation and the steering of a sailing ship. Quite clearly, the way in which the sails and the rudder are set has an impact both on the direction and the speed of the vessel. And since the wind can shift or drop at any moment, the team and its skipper must remain alert and prepared to react to the changing conditions.

Few would argue that the most important phase of a project is the definition phase. This is the phase when two-thirds of the costs of a project are determined and the key decisions concerning the manufacturing, marketing and maintenance of the product or service are made. Furthermore, the project itself will largely determine the total life cycle cost. It is not surprising, then, that increasing attention is being given to getting the design right.

Nevertheless, although structured methodologies often encourage the belief that everything should be defined at the beginning of the project, experience proves that many changes of course are necessary during the project life cycle. Such changes require constant feedback between the baseline plan and actual performance – and frequent corrective action. The art of effective project management is to try to anticipate the need for specific corrective action well ahead of the event.

This is easy to say, but much less easy to carry out. Most people tend to function either in an exploring, discovering 'open' frame of mind or a performing, doing, 'closed' frame of mind. Once into 'closed' mode it is difficult to shift back into a frame of mind which is open to ideas and to contradictory evidence. Recognizing the need for adjustment or for corrective action must be a very conscious process.

The planning and control cycle

The classical cycle (Figure 1) puts this in a nutshell: plan, measure, analyze, decide. This feedback process must take place throughout the life of the project. Furthermore, a slight rethink gives an alternative model (Figure 2) which may also be helpful: perception of a need, definition, negotiation, marketing, knowledge enhancement. In fact this is really a cycle within a cycle.

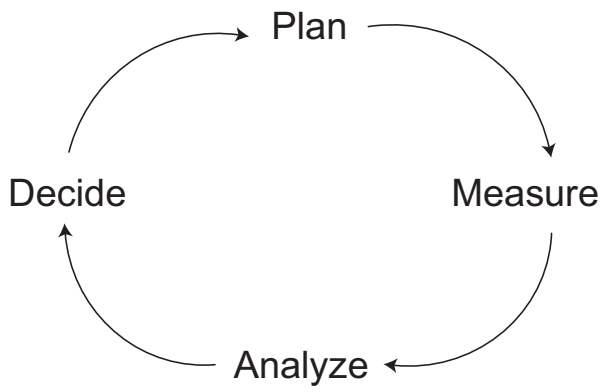


Figure 1 Classical cycle

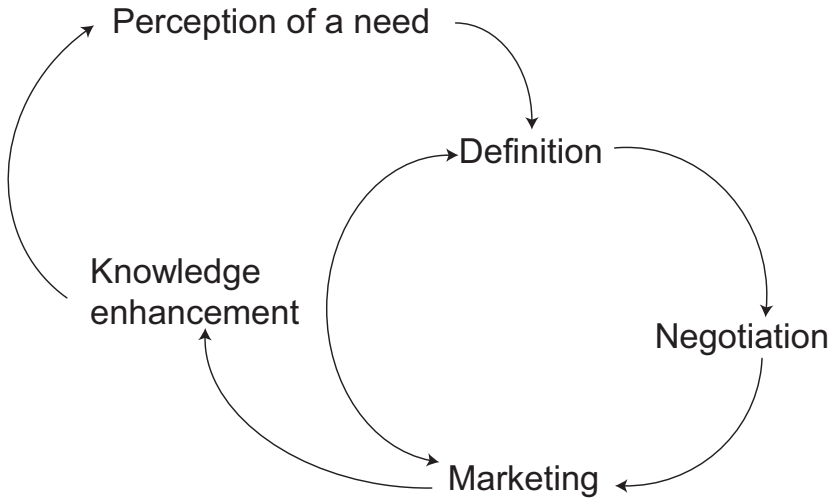


Figure 2 Alternative model

In any case, it is important to transmit the information to the point of decision as quickly as possible. One way to achieve this is by installing effective information processing and communication tools. A further way is to delegate decision making by empowering individuals who are close to the incoming information, whether this is in the research laboratory or with the customers.

Information and communication

The most acceptable definition of information still dates back to the writings of Shannon in the 1950s: to *inform* is to communicate something which is new and relevant. To this we should add the proviso that the information should be clear and, as far as possible, unambiguous.

As a rule, it is better to have clear data that are incorrect than to have no data at all. After all, data are only reflections of reality and are never 100 per cent true or false. Data must be interpreted and used to arrive at an approximation of reality.

Focusing on critical activities respects the principle of management by exception. Keeping it simple and stupid – 'KISS' – is also an appropriate piece of advice. However, every proverb always has its opposite, and it is just as true for projects as for anything else that 'the devil is in the details'. On a

project, the details are frequently people problems. This means that it is vital as far as possible to include all the project players in the project processes.

The project management techniques

The techniques covered which relate to the design and definition phase or 'setting the course' are:

- value analysis;
- risk analysis;
- project planning;
- project estimating;
- process improvement;
- resource levelling;
- portfolio analysis.

The techniques covered which relate to 'steering the course' are:

- performance measurement;
- earned value analysis;
- project auditing;
- project meetings;
- change management;
- change orders;
- organizational aspects.

VALUE ANALYSIS AND FUNCTIONAL ANALYSIS

Fitness for purpose

The aim of techniques such as value analysis and functional analysis is to assure fitness for purpose. This is a rich concept: the product or service concerned may have many different consumers – purchasers, direct users, indirect users, stakeholders. In fact, in many ways value analysis begins with marketing, which aims to identify and to satisfy a business need. Successful marketing is built upon product, distribution, promotion and price. Value analysis is about engineering a product that the market wants to buy.

The basic idea is that customers require functions for which they are prepared to pay a price. Even in the simplest product many functions may be necessary. This is best illustrated using examples. The basic function of a torch, for example, is to provide light. But, at the same time, it would not meet its purpose if it were impossible to lift. This could be considered to be a

constraint. We could conceive of many different types of torch according to the brightness required, permanence, portability, attractiveness and so forth. Each individual may even have a different judgement according to time and circumstance, context and mood.

The dimensions of quality

The functions are sometimes referred to as the dimensions of quality. Ideally, the delivered functions should be exactly equal to the desired functions. In reality, many of the desired functions are more than slightly fuzzy and may only be revealed by contact with a real product. Thus firms perform test marketing and contextual analysis, prototyping and customer surveys. The fact that nobody really knows what they are going to want in the future does not make things any easier and leads to a great deal of soul-searching and disappointment.

Nevertheless, simply asking the right questions such as: 'What are the priorities?', 'How will the product be used?', 'Who will use it?', 'Where and under what conditions?', 'What are the problems with existing products?', 'What could change?', 'What would be a dream solution?', 'What is it all worth?' and 'Why anyway?' makes satisfaction infinitely more probable.

Quality function deployment is a related technique which maps – via a 'house of quality' – the product functions on to the required functions. In this way the positioning of competing functions can be compared.

The steps of value analysis and functional analysis

Value analysis is a normalized methodology comprising seven steps:

1. Preparing the study.
2. Gathering information.
3. Analyzing functions and costs.
4. Seeking ideas and solutions.
5. Evaluating the solutions.
6. Choosing solutions.
7. Implementation and follow-up.

Functional analysis, which is half of step three in the value analysis methodology, can itself be broken down into several steps:

1. Intuitive research.
2. Life cycle and environmental study.
3. Chronological analysis of functional elements.
4. Study of motion and effort.

5. Benchmark analysis.

6. Use of norms and standards.

These steps are covered in more detail in the exercises in this manual.

Cost and value

Value is often taken to mean the quality (or the performance) divided by the cost. When it comes to price, the price paid for a function is in fact an 'opportunity cost' – that is, the money could have been spent on something else. Enhancing one function necessarily compromises another. For example, a more powerful battery is also heavier. A lighter, more economic car is also perceived to be less solid. Ideally, the compromised function should be of lesser importance to the customer than the improved function. Cognitive dissonance is the feeling of loss from not having chosen an alternative solution. The objective of value analysis might also be to minimize cognitive dissonance. Whenever it impossible to adequately satisfy one customer without disproportionately disappointing another, it may be appropriate to produce more than one product.

RISK ANALYSIS

Risk-taking

Risk is a deep and perturbing subject. The wisest heads always detect a shortfall on risk analysis in projects. Whilst nobody claims that all the risks can be identified, it is a prudent and rational safeguard to thoroughly evaluate the consequences of actions: 'More haste, less speed.' This is quite reasonable: projects attract their fair share of careless and impetuous folk. On the other hand, the modern trend towards entrepreneurship encourages risk-taking and accepts the right, even the need, to make mistakes. This is in the interest of a bias for action and quick decision making: 'He who hesitates is lost.'

There are examples of companies which were able to anticipate eventual outcomes by careful upfront analysis. Against this, other incidents make it clear that there is no substitute for quick, close-to-the-coalface decision making. These points of view are not necessarily antagonistic. Careful analysis, free from time pressure, makes the decision much easier when eventually it must be taken. For example, if the possible defection of a key person has already been considered, then a replacement may already have been identified. It is worth remembering, that risks are not only about possible catastrophe, but also about minor difficulties that are cheap to resolve, opportunities and alternative solutions.

Risk identification

Risk analysis is another process which goes through several steps. The first is risk identification. There are many ways of looking at this. In a very structured way, the project can be analyzed on an end-to-end basis along the project timeline. The life-cycle approach takes a healthy look at every stage

from birth to recycling. It also recognizes that the project may need to be nurtured or nursed through difficult times.

Additionally, each component of the project – people, equipment, resources, subcontractors, departments – will, of course, carry a risk. Major risk often exists where there is an interface – for example, between two companies, especially where the two parties are unfamiliar with each other. Size, complexity, novelty, number of inputs, number of outputs, difficulty, geographical spread, client or contractor experience are all risk drivers. The project can be sliced up on the basis of work packages, systems, modules or functions and analyzed for risk. Finally and often ignored, external factors can also intrude on the project. These may be outside the control of the project, but can still be foreseen by the project team. Risk identification is both a creative and a logical thinking process. When risks are expressed in too general a manner, try asking the question 'why?' 'Why might the project be late?', 'Because we might not get the resources we need.', 'Why won't we get the resources?', 'Because we haven't explained the importance of the project.' Now we have something we can manage.

Risk assessment

Risk assessors usually employ the method of probability multiplied by impact. This implies that the probability of the risk can reasonably be assessed. Probabilities can be difficult. We are easily confused by combinations of probabilities. Past experience is the best guide. The probability of a person leaving the project, a subcontractor going bankrupt or a technology failing to be delivered on time can be predicted with some degree of accuracy. Likewise, the impact on the project can be calculated based on the project schedule and the possible alternatives. Another element is the risk that the error may not be detected. For example, a glitch in a software program may not be immediately visible. Multiplying the probability of the risk by the impact gives the degree of exposure and guides the amount that can be set aside for contingency. Taking account of the difficulty of detection could highlight a need for action.

Risk response

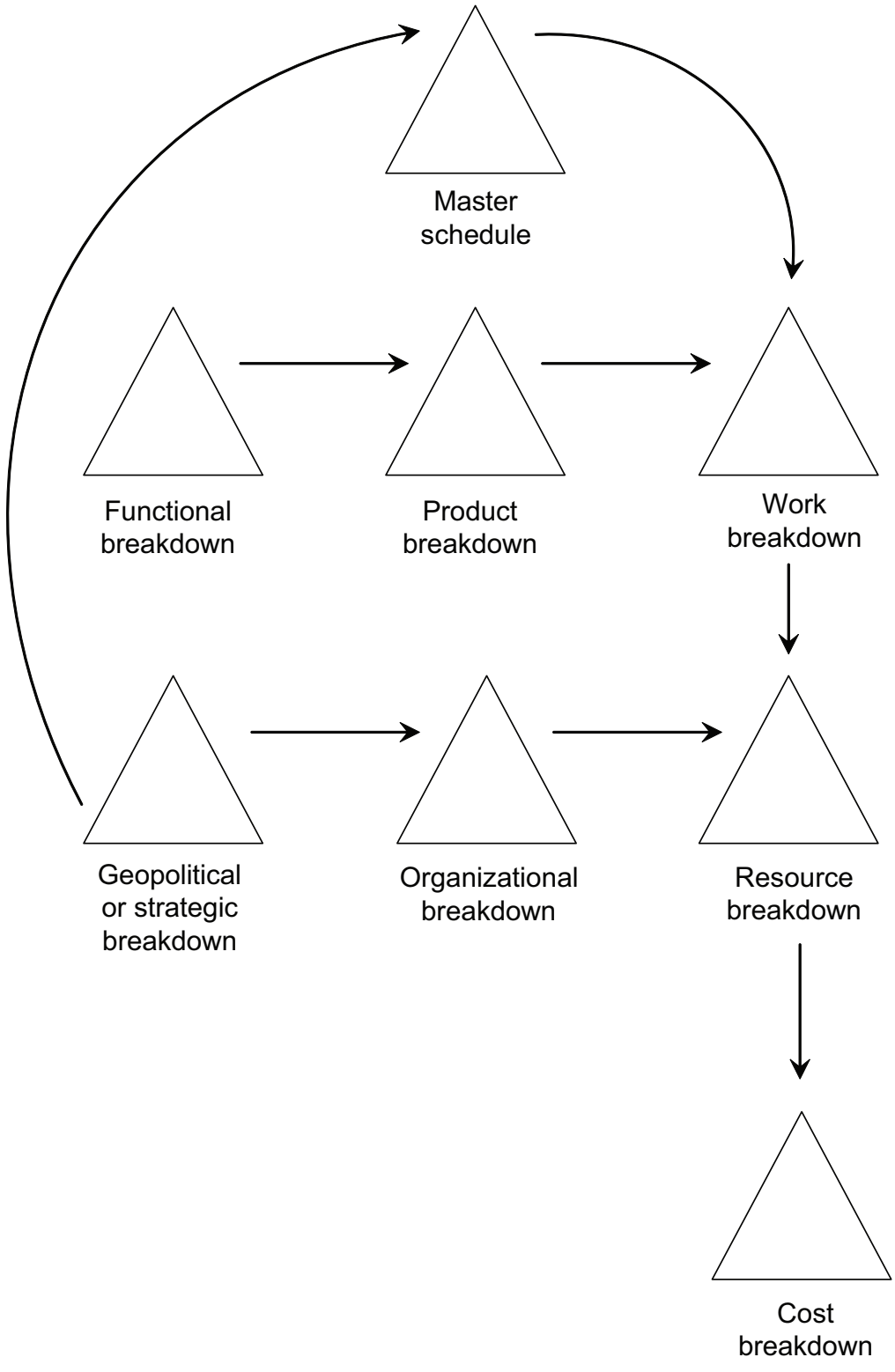
Risks cannot all be eliminated, but the risks which go beyond a minimum level of acceptability in terms of either impact or probability should be addressed: either reduced, transferred, avoided or intentionally accepted. Business risks are those that cannot be shifted to a third party, basically because they are central to the business activity itself.

It may be possible to shift a risk factor from an area which is outside the control of the project to another area where the project team feels strong.

For example, a project manager may elect to purchase computer resources which can be customized to the project or, alternatively, to use off-the-shelf solutions, depending on the stakes and the perceived risk. Any risk which can be anticipated can be reduced, by tackling the causes. If there is a security risk, security can be increased; if the impact of a new technology is unpredictable, extra testing can be carried out, and so on.

Risk control

Risk control measures must be integrated with other project management control techniques such as tracking project progress, reviewing status and managing quality. The risk identification step is repeated whenever there is a change in the project work scope. Remember that some risks can cause other risks, and some risk responses can cause other risks.



Analysis methods

Before the project can be planned it has to exist. This usually means that the objectives have been agreed amongst the partners. As a rule, the objectives will already have been expressed methodically using some combination of value analysis, functional analysis and market analysis. From this very meaningful starting point, some kind of structural analysis is often favoured in order to arrive at a reliable product breakdown structure.

In the same systematic way the principal activities for the project can be identified, and these will form the basis for the project master schedule. Defining the scope of work, and hence the work breakdown structure, is primarily a top-down process which is then verified from the bottom up. Sometimes the detailed bottom-up analysis reveals that some of the objectives are not realistic after all, in which case the objectives must be revisited.

Work breakdown structure

The first level of the work breakdown structure is the most significant as it defines the top-level project priorities. In the final analysis, this first level may be based on a product split, a geographical split, a functional split or any other split appropriate for managing the project.

The WBS must be built on a logical coding structure which is both easy to understand and allows growth.

Subsequently, these large items can be broken down into manageable work packages. At this level there will be a single point of responsibility to avoid conflict and guarantee accountability. The WBS, as its name implies, must take into account all the work necessary to satisfy the project objectives. It's a bit like making a shopping list: no calendar yet, just a list of things to buy. Once the WBS has been elaborated, the major project interface points should also have been identified and assigned to a responsibility in order to cement the project together. The interfaces which represent a transfer in responsibility are the most sensitive control points and will have to be managed very carefully.

Work package definition

The work packages represent a point of control for the project at which all the elements of cost, time and quality can be tied together. The depth of the WBS and the size and duration of the work packages will depend on a number of factors such as their criticality, their complexity and the nature of the work (raw material, manufacturing, service, overhead). The work package is described and broken down into detail by the party responsible for executing the work. The sequence of activities within the work package is determined. Costs are broken down into material, subcontract, direct and indirect elements. Finally, in order to manage the project, physical progress milestones are established and linked to the work package.

Hammocks are also useful when the going gets tough. A hammock is a bottom-up, rather than a top-down, way of grouping activities together at a summary level. The duration of the hammock is equal to the time elapsed between the first and the last of these activities.

Organization breakdown structure

The organization breakdown structure (OBS) reflects the perspective of the party responsible for the execution of the work. By marrying together the WBS and the OBS, a two-dimensional matrix is produced. Within this matrix, one organizational element may be responsible for several work packages. There is, of course, a distinction between being responsible for the work package and merely being a participant.

There are two types of work management – managing the process and managing the result. When work is delegated either the work package manager will be responsible for risks, in which case a fixed-price approach applies, or the project will assume the risks, in which case a cost-reimbursable approach is more appropriate. As contractors become more specialized they are better able to design, cost and manage the scope of work, following a Request for Quotation (RFQ). However, when objectives are unclear and further work is needed to understand the real project requirements, then there needs to be more interaction between client and contractor, using a Request for Proposal (RFP) approach. Whatever the approach, communication and transparency are necessary to ensure that the process is managed correctly. Incentive and penalty clauses are designed to ensure that organizational objectives are aligned with project objectives. At the same time, there is no substitute for motivational leadership.

PERT and CPM

Programme evaluation and review technique (PERT) and critical path method (CPM) are operational research techniques which are used to model and analyze the sequence of project activities. For many people, these techniques, which were introduced in the 1950s, represent the core of project management. Certainly this is reflected in the majority of project management software packages. These use what was originally called the precedence diagram method, similar to a barchart with links, to show the activity dependencies. Although no planning model can be a perfect representation of the project schedule, the PERT approach adds three estimates for durations (pessimistic, most likely and optimistic), that can help to analyze a range of outcomes for the project. Above all, PERT/CPM is a tool to aid communication.

Developing the activity sequence

Logical links are introduced between activities to indicate mandatory dependencies, (constraints). Note that this excludes those associated with resources, durations, habit or comfort. The simplest and clearest type of constraint is one that goes from the finish of one activity to the start of the next. More complex constraints such as start-to-start or finish-to-finish are sometimes necessary, but basically imply that there is something more complex going on at a more detailed level. Durations on constraints should be avoided if possible as they introduce confusion and can almost always be represented by an activity. In short, summary CPM networks are often unsatisfactory, unless the reasoning is clear to all concerned.

There are a few more basic rules which make PERT networks easier to use: it is best to create one start activity for the network and one finish activity in order to highlight the genuinely critical activities from end to end. In fact, a finish activity indicates an objective and so it is acceptable to have one for each major project objective. Activity durations do not take holidays and rest periods into account. These are handled by the calendar definition. By changing the calendar we can affect the start and finish dates for the activities, but not their durations. The average duration should be slightly less than the duration of the reporting period, to enable adequate tracking of activity progress.

Calculating dates and float

Beginning with the start activity and working forwards, the early start and finish dates are calculated by adding up the durations and taking account of the constraints between activities. Then, working backwards from the finish activities, the late start and finish dates are calculated.

The difference between the late dates and the early dates is called the float or, more correctly, the total float. It is the amount by which the activity could slip before delaying the project. The sequence of activities with the lowest total float is called the critical path. All activities with a small total float can be considered to a degree, since a small slippage could push back the project end date.

Free float is the difference between the early finish of an activity and the early start of the subsequent activity. The next activity is also constrained by other activities. This means that free float can be used up without any effect on the following activity.

Negative float occurs if there is an incompatibility between the desired start dates, finish dates and estimated duration. One of these three will have to be revised. If a project is allowed to start, or to continue, with negative float it means that the project baseline has not been established correctly. Float is the project's safety belt. It should be used with discretion.

Milestones

Milestones are clearly identifiable project events which correspond to a technical accomplishment or an interface point. They represent the best way to progress a project. At a detailed level, milestones can be used in the same way to progress the activities or, more usually, the work packages.

'Tasks' is the most frequently used term for the detailed steps which make up an activity. They will not necessarily be arranged in any particular sequence, but rather arranged in the form of a list of actions. They may sometimes be organized into rank according to a priority. This is the level at which most people work on their individual actions.

PROJECT ESTIMATING

Different types of estimate

On a large project, durations and costs are estimated by an independent expert. The expert has access to industrial databanks, price catalogues, benchmarks, specific past experience, and is supposed to be less subjective. In other situations, the party responsible for the work may be the only expert available. In all cases their commitment is necessary for the duration or the cost to have any meaning. The duration of an activity is dependent on the available resource and competing demands on the resource. If estimates prove difficult to obtain, it is better to overestimate first time around.

Estimates are based on past experience. There are many rule-of-thumb methods in each industry. For example, the weight of a car gives a very good indication of price, provided that you know which coefficient to apply. In the construction engineering industry, the main cost driver, and the most difficult thing to estimate, is the quantity that will be required. In software, models relate the cost to the number of data items or function points. Whichever factors are involved, all estimates should take into account the learning curve effect, which supposes that there should be some improvement through versions.

The analogy method draws on experience with similar projects and products, using factoring coefficients according to the validity of the comparison. Parametric estimating raises this to a science. Information which has been collated across the industrial spectrum is built into a database which, for example, correlates the cost of various material inputs with the cost of the final system. The analytical method develops an estimate based on forecast quantities, man-hours and equipment. This is how you would expect estimates to be estimated, except that, for each successive level of sophistication, more, effort, time and data are needed.

Levels of accuracy

A first estimate may be a very rough 'ballpark' figure based on an accepted rule of thumb. There may be wild inaccuracy upwards or downwards, but at least it is a start. Subsequently there may be a series of estimates as the analysis is refined. These could carry names such as 'sketch', 'draft', 'preliminary', 'control' and 'final'. The next step would be the 'baseline' budget.

One problem is that the changing structure of costs (for example, due to the replacement of direct man-hours by automation) makes it increasingly difficult to anticipate future costs. Traditional cost accounting systems, which are focused on direct man-hours do not count the right numbers. This has given rise to an accounting method called 'activity-based costing' which seeks to assess the cost of the activities that will take place. The project can be looked upon as a process made up of activities defined in the WBS. Time is, of course, a major cost driver, but it is not the only one. Complexity is the other principal cause of costs.

PROCESS IMPROVEMENT

Project accountability

It is a basic principle of quality management that there will be no quality improvement if the organizational structure and its processes are not aligned with the desired results. There is no point in managing by results and then failing to implement the processes which are necessary to succeed. This can only lead to frustration as people are asked to accept responsibility for factors which are outside their control.

Management by projects will not occur if the structures and procedures in place reinforce other ways of working. For example, project managers cannot be expected to bear the entire responsibility for the end result if they do not have the power to select and evaluate project team members or to make up their own mind regarding which tools, systems and methods to employ. If the manager does not have the whole responsibility for the work package, accountability will be very difficult to establish.

Organizational models

Many companies unwittingly put up obstacles to the effective completion of projects by continuing to adhere to organizational models designed to manage repetitive production-style activities in times of stability. The innovative, fast-reacting and fast-learning company needs an organizational structure built in a cellular fashion around projects, or processes, and not around vertically structured specialist and administrative departments.

RESOURCE LEVELLING

Resource availabilities

In the initial attempt at project planning, the planner proceeds on the basis that resources do not exist. Then, once the critical path has been calculated, resources are added in, and everything changes. Resources are limited, especially where there are other things to be done, and therefore the activities must be scheduled around resource availability. In order to measure the resource requirement against the availability, resources are attached to activities in the CPM network. Then activities are pushed backwards, squeezed, stretched and split until the overloads have been removed. It is a bit like trying to pack too many articles into a suitcase – get a bigger suitcase, remove some bulky items, or cram everything in by brute force.

On a project it is important to focus on the really scarce resources for which there are no substitutes. This could mean anything from a skilled engineer to a unique piece of equipment, or even money. There are essentially two types of resource: those which are consumable (money, material) and those which can be reused (people, equipment). The basic difference is that consumable resources are purchased, whereas reusable resources are hired.

Resource efficiency

It is as well to remember that the marginal efficiency of a resource (the efficiency of one extra unit) is not a constant value. Also, the efficiency of a resource can vary according to other factors such as the work environment, other complementary resources, or even fatigue. Furthermore, experience proves that Parkinson's Law is universally applicable – work expands to fill the time available.

Resource aggregation

To see the workloads as a histogram or a cumulative curve, the resource loads must be summed up across the activities against a timescale. This may be done using the early start and finish dates, the late dates, the actual dates, the scheduled dates or any other combination of dates. Resources are always expressed in terms of units, such as tons, litres, dollars and so on, so that they do not get mixed up by being summed into each other. The result of the consolidation is expressed in terms either of units per period (for example, men per day) or units multiplied by time per period (for example, man-hours per month). Then the values are plotted as a histogram – for example, against availability – or represented as a cumulative s-curve.

Of course, it is common for dubious practices to take place without anyone noticing: often, known expenses are summed together with very speculative expenses; sometimes, underloads are hidden by choosing a very large time unit, such as a month. A situation which appears to be under control at a summary level can conceal a mass of problems at a more detailed level. Everyone should realize that figures are notoriously misleading.

Resource smoothing

Resource smoothing is the process of delaying an activity by using up the available float in order to cure problems of overload. The smoothing process begins with a list of activities in some order of priority. The most critical activities at the top of the list are placed first and their workload scheduled. As soon as the next activity in the list pushes the envelope beyond the availability of money or resources, that activity is pushed back. A high priority is usually given to those activities which have no float, those which have a heavy resource requirement, or those which are followed by many other activities.

A computer is very useful for this, but offers no magic solutions. It cannot decide to use up the residue of total float at the end of the project, but only free float at the beginning. It cannot split an activity into several parts, reduce its duration, reduce the resource requirement or finish late one evening. Nor does a computer understand learning curves, productivity, motivation or morale. It does not know that some overloads are undesirable and that others do not matter. The computer can do some clever things, such as combining resources into teams or taking account of different skills, but it is important that the planner does some of the scheduling, or at least takes an interest in the algorithm used by the computer. The planner could devise very sophisticated algorithms and do lots of modelling and simulation.

Then the computer would be needed again.

PROJECT PORTFOLIO MANAGEMENT

Strategic management by projects

Project portfolio management has been somewhat overlooked as an area of project management, but this is unlikely to remain the case for very much longer. Management by projects inevitably involves some people working on more than one project at a time, and some resources being assigned to several projects. Thus there is competition for the resources and decisions must be taken about priorities: 'Is this person to be dedicated to project A, or to be available for a limited time to project B?', 'Should this resource be assigned to project A as a priority, or to project B?', 'Which project should be delayed because of the new strategic priorities?'

Strategy is really the key word here. The strategic priorities must be communicated to the project managers and their teams, so that they can be built into project planning. This is not as obvious as it seems. Most of the systems and reporting procedures which exist in companies are designed to transmit data upwards rather than downwards. It is important that everyone who works on projects should recognize the legitimacy of the process leading to the definition of priorities. This is equivalent to having business awareness. Because the process for attaching priorities to projects can be fairly sophisticated, a mission statement that is memorable and pithy is the best way of communicating and sharing this sense of enterprise.

Project attractiveness

The project portfolio is really an analysis and evaluation of investment options and competitive strategy. The projects are the principal way through which the organization can improve itself via its products and its processes. An evaluation of project attractiveness based on the following criteria would probably be more than adequate:

- Fit with business strategy (poor to excellent).
- Inventive merit (low to high).
- Durability of competitive advantage (1 to 10 years).
- Result (for example, competitive edge, knowledge, process improvement, standardization).
- Competitive impact (for example, base, key, defining or seed technology).
- Impact on company image (visibility, environmental record, corporate citizen and so on.)
- Impact on company people (work, conditions, organization and so on.)
- Impact on facilities and capital resources (low to high).
- Impact on skilled personnel (low to high).
- Technological strength (low to high).

- Probability of research success.
- Probability of development success.
- Probability of development success.
- R&D costs to decision point.
- Development costs to completion.
- Capital and marketing investment.
- Time to completion.
- Annual budget.
- Profitability index (for example, Net Present Value, Return on Investment, necessity or whatever).

Since these criteria will have been used to assess the attractiveness of each project, it becomes possible to map one criterion on to another in matrix form. For example, expected time to completion can be mapped on to expected profitability, competitive merit on to technological advantage and so forth. Ideally, this information may have been the result of a concerted decision process. It can then be made available to the project managers and their teams to reinforce their ability to make decisions and react to a changing environment. Empowered project teams require quality information.

PERFORMANCE MEASUREMENT

Cost matrix

The WBS forms a matrix with the organizational breakdown structure. In this way, each element in the WBS can be associated with one responsible agent in the OBS. At the cross-over point, cost accounts can be defined. A cost account will be composed of several cost elements – such as man-hour costs, material costs, indirects and subcontracts. For each cost account, one or more work packages can be defined. The sum of the costs on these work packages will be equal to the cost account. Some of the work packages will correspond to physical effort, but others will represent apportioned effort (for example, quality) or administrative overhead. These work packages are in turn broken down into separate activities, which can be planned by the responsible parties using network analysis and can be progressed using milestones.

Time, cost and technical progress

Performance measurement has often been taken to mean only cost performance. In reality, the measuring of performance must cover three dimensions of project progress: progress in terms of time passing, in terms of expended effort (measured in hours or money) and progress in terms of the physical evolution of the project. Note that people have sometimes interpreted work as 'putting in time', sometimes as 'work done' and

sometimes in terms of what they can do with the result. A farmer, a builder, a tradesman, a garage owner or anyone working independently knows that their work only really has value when the money is in the bank.

The three types of progress all have to be monitored, but physical technical progress, which is the most difficult to achieve, is also essential for performance measurement.

Reporting progress

Progress in time is reported by observing the actual start and finish dates. Planning updates may be carried out daily on short projects and weekly on longer projects. Cost-type progress will almost always be done on a monthly basis and will concern hours worked, subcontracts and purchases of equipment, material and services. These costs can be taken into account either when they are committed or when they are paid. In the case of purchases, or especially subcontracts, much goes on between these two milestones, including making, packaging and delivering the goods. The project team is interested in obtaining data as soon as possible (that is, at commitment) even if the data is not always exact. It is better to know early that the vehicle is careering off the road, rather than know later the exact degree of the deviation.

Note that hours worked is not equivalent to work accomplished. The number of hours which have to be spent to get the work done depend on so many other factors – other resources, tools, conditions of work, efficiency and so on.

Physical progress (0/100 rule)

Physical progress is relative to progress towards the final objective – that is, completion of the product, release date, operational facility, everyone trained, opening night or whatever. It can be calculated in a variety of ways within the same project, according to whichever is the most appropriate. The basic and fundamental rule is the 0/100 rule. Either something is done or it is not done. There is no way for something to be half-done, unless the half corresponds to something measurable. And usually there is something measurable if you go into enough detail. For example, to have constructed half a key, half a lamppost, half a chair or half a penny would be meaningless unless you understand the fabrication process and could identify a 50 per cent milestone. An objective 50 per cent milestone for the cleaning or repairing a pair of shoes might be one shoe done, but for designing the shoe in the first place would be something else – such as ‘shoe mould complete’.

Physical progress (20/80 rule)

For work lasting several months it is obviously unsatisfactory to wait until the end of an activity before checking to see if the work has been done. Therefore intermediate milestones are established. As these are reached, a given percentage of physical progress is considered to have been achieved. This is the favourite way of measuring progress. Between each 0/100 milestone, some progress is taking place which has not yet been measured. This can cause slight contortion, because the real progress is being underestimated. This is why many people replace 0/100 with 20/80, or some other rule, to balance the effect of things not being finished.

Alternatively, they make an informed, but subjective, estimate about the stage of work at any given moment. These are the sort of estimates which a client likes to validate.

There are some projects where progress seems very virtual – knowledge creation is one example. Typically, these projects concern some sort of software (it is becoming more and more difficult to find a project without software). Progress rises quite quickly until it gets to 95 per cent or thereabouts. Then, somehow, things start going backwards to 90 per cent and then to some much lesser and rather worrying percentage. As an answer to this variation on Murphy's rule ('Project progress doubles back on itself after 95 per cent completion') a limit of 70 per cent or 80 per cent is often put on subjective estimates of completion.

Physical progress (units and standards)

Two other methods are worth considering in certain circumstances. The units method records the number of finished units – for example, one building out of ten, one document out of hundred. But care should be taken to ensure that the units are equivalent. The standards method is based on the principle of a standard effort for a given quantity of work. If the job always takes 100 hours and 80 have already been spent, the physical progress will always be 80 per cent – until the standard improves.

Remaining to complete

The surest way to estimate progress is by using remaining to complete. This is a more precise measure than percentage complete and, furthermore, has the effect of tying the individual to an objective. The only difficulty is that, in order to obtain a good estimate of remaining to complete, we need to know where we are. In other words, we need to know the value of the work which has already been done, which brings us back to knowing the physical percentage completed and calculating the earned value.

EARNED VALUE ANALYSIS

Project cost management

Projects are about projecting forwards. Project cost management aims to measure project performance in order to control the overall project cost. Performance measurement must be based on a reliable evaluation of real project progress (physical progress), which only the project management team is in a position to determine. Planned expenditure and actual expenditure are calculated in terms of hours, quantities or cost. But physical progress, which is expressed as a percentage, must be converted into one common unit. The man-hour is one common unit. Cost is a more general unit, although it is subject to inflation and changing exchange rates. Earned value requires a figure for planned (budgeted) expenditure, actual expenditure and physical progress percentage interpreted as a cost.

The budget baseline

A budget is, above all, an agreement between parties. Its purpose is to provide a reference for measurement and a source of incentive. Derived directly from the expenditure patterns associated with each work package, it is a time-phased financial plan which defines a target for the project. The internal budget should also include overhead, provision and profit. Then, once everything has been agreed and it's all systems go, the idea is to hold the budget baseline steady rather than keep changing it. Variances can be met by releasing provision. If this option is insufficient, then either the budget will have to be renegotiated or the project will have to be reprogrammed.

Actual expenditure

Actual expenditure arrives in several different forms – orders, invoices, payments – corresponding to various stages in the delivery cycle from commitment to payment. This contrasts with internal man-hours which must be paid to staff at the end of each week. Hence, whereas internal costs are incurred at the same time as the work done, subcontracts and purchases are paid later and this puts them out of phase with both budget and progress. To resolve this problem, commitments are generally used to bring actuals into line with budget and progress.

Earned value

The physical progress percentage is first converted into a money or time unit. This is done by multiplying the physical progress by the budget at completion. In effect, the budget at completion is everything we need to spend to satisfy all of the objectives. The physical progress is how far we are towards these goals. Earned value can also be calculated in respect of the latest estimate at completion. In effect, the earned value technique uses cost (or hours) as a natural weighting factor – those activities or work packages that are the heaviest in terms of effort will have a proportionate impact on the total earned value. If physical progress were to be summed up as a percentage, some other form of weighting would be necessary.

Cost and schedule performance indices

The budgeted cost of work scheduled (BCWS – the Planned Value), when subtracted from the budgeted cost of worked performed (BCWP – the Earned Value), gives a schedule variance expressed as a function of either cost or time. The actual cost of work performed (ACWP – the Actual Cost) subtracted from the earned value (BCWP) gives a cost variance, expressed as a cost. In both cases, a positive variance is a good sign; a negative variance is a bad sign. A negative variance which goes beyond a certain threshold – say, 15 per cent – would indicate that corrective action is necessary.

Cost performance index	=	Earned Value / Planned Value
Schedule performance index	=	Earned Value / Actual Cost
Cost schedule performance index	=	CPI * SPI

The CPI can be viewed as the value we are getting for our money, while the SPI is the value we are getting for our time. The performance indices are tracked over time and will be greater than one if the work is on course. Less than one point shows a potential problem.

Trend analysis and forecasting

The performance index is a powerful way of monitoring project performance and is an aid to exception reporting. Critical path and configuration are necessary complementary techniques because the performance indices highlight problems in terms of cost more than schedule or quality. For example, the schedule performance index does not show where the variance is on the critical path, and the cost performance index does not show the quantity of rework.

The evolution of the actual expenditures and the value of the resulting work in relation to the budget are significant pointers to the likely final cost of a project. This forward estimate can be made in a number of ways. First, the responsible manager of a piece of work can give a best estimate of the 'at completion' cost. This can be backed up by an independent expert or validated by a mathematical forecast. For example, the actual expenditure to date can be added to the value of work left to be done to give the 'at completion' figure. Another way is to base the estimate at completion on current productivity which is given by the cost performance index (the value we are getting for our money) and to assume that this rate of productivity will stay the same until the end of the work.

If further information is deemed necessary, then a full heuristic analysis can be carried out, based on planned and actual rates, activity planning, resource availability, team morale, economic climate and anything else which could influence the 'at completion' cost.

PROJECT AUDITING

Audit is a word that can bring a stressed project manager out in a rash. The word is charged with images of control and sanction. However, it need not be so negative. At times, it is necessary to take stock of the situation and to perform an *état des lieux*. As a rule, project managers should get into the habit of summarizing accomplishment and asking questions of themselves and their team. A project audit 'template' can provide a framework for this exercise. It works as a checklist for all the elements which generally exist if the project is on the right track.

One of the most vital challenges for project management is to develop the capacity in industry to recycle the experience of past projects. An audit framework can be the instrument for this capitalization and feedback process.

PROJECT MEETINGS

Project review meetings

Project management is a team effort, and project meetings are the focal point for the team process. In between meetings, people return to their desks and their offices and work on their own or in small groups. The classical formal project meetings are the project review meeting and the project progress meeting.

The project review meeting takes place at major interface points such as the end of a project phase and the beginning of the next. All the parties come together to discuss problems, risks and progress. Meetings should be prepared beforehand, at least so that parties come to the table with the required input. Project review meetings often include go/no-go-level decisions with the project sponsors. Technical problems are not normally discussed, certainly not in detail, unless they concern key interfaces. The meeting concentrates on critical items and obtains firm, measurable commitments. The exchange of information is frank and open. Finally, time is taken to try to forecast ahead and attempt to anticipate future difficulties.

Project progress meetings

Project progress meetings take place at the end of the reporting period to track – exhaustively – each part of the project which has been engaged. The ongoing activities are reviewed one-by-one. Participants come prepared with their progress, including actual start and finish dates, estimated physical progress and estimated remaining duration. The reported progress is used to update the status of the project and replan the remaining work.

Other meetings

To the formal meetings can be added the joint workshop, which aims to assemble the best available knowledge in order to analyze, communicate and make decisions, and the change order meeting, which judges the acceptability of proposed variations to the project baseline. Of course, many other less formal meetings take place all the time – in the corridor, over lunch, round the coffee machine – and these spontaneous meetings can be extremely productive.

Effective meetings

The formal meetings require a proper agenda and techniques for increasing group productivity.

The agenda should include time for warming up, introducing items, summarizing items and for breaks (but not interruptions which are taboo for effective meetings). Roles, especially those of the chairperson and the facilitator, should be clearly defined beforehand. Another important role is that of the scribe who documents the meeting and communicates the results and decisions – preferably in a concise and economic format.

The team must work at developing its debating and decision-making style in order to draw out the best from each individual. There should also be a conscious effort to improve the effectiveness of meetings, and some of the exercises in this manual could be used for this purpose. Meetings are a frequent source of dissatisfaction, but this is not the case in a well-functioning team.

CHANGE MANAGEMENT

People management

Change management is all about people. Project management has often tended to overlook people issues and to concentrate on cost, time and configuration management, leaving change management free to deal with culture, psychology and social factors. There is no reason to assume that people will automatically resist change. There are forces pushing for change – the desire to look good and to get ahead – and there are forces acting as a brake on change – unwillingness to go out on a limb or to give up a good thing. After all, if the change affects people personally, they have a strong interest in the outcome.

Early and late adopters

Observation confirms that people react in different ways, according to their perception of their own personal involvement. Some people behave as pioneers and adopt the new ways as soon as they can. These people are often highly informed enthusiasts – for example, computer enthusiasts are prepared to put up with almost any inconvenience in order to get their hands on the latest technology. This category also includes visionaries who are prepared to invest personally in a dream. Other people act as the early majority. These are often trend-conscious individuals who behave as opinion leaders. There is a big gap between winning over the pioneers and convincing the early majority (who represent about 30 per cent of the population and are the key to success).

Many people will choose to sit on the fence and remain neutral until they are sure about which way the wind is blowing. These are the late majority. They do not wish to invest personally in the change, although they are prepared to go where others have trod safely before. Again, there is a large gap between the early majority and the late majority, and their motivations are very different. The last category, the laggards, tend to be very cautious individuals who often question basic assumptions. In their own way, laggards can also be mavericks and, paradoxically, although they are laggards in one area, they may be pioneers in another. For example, the Luddites of 19th century Britain were technological laggards, but social innovators

The emotional side of change

For any new event in a lifetime's experience, there is a period of transition. The transition can be viewed as a process which is more or less inevitable if the individual is to come to terms with the change. There is a rupture with

the past, and things will not continue as before. Therefore, the individual must knowingly let go of the past and embrace the present. This marks the beginning of a very creative period during which ideas are developed and a new vision of the future is generated. Finally, the individual must mobilize the energy and the determination to achieve this vision.

The rational side of change

People are not automatically convinced that every change is rational, permanent, or even real. At any one time, the world is evolving in a variety of ways, and not all of them will stick. Whatever happened to the paperless office, airships or portable televisions?

Ultimately, people accept the inevitable when it starts happening next door, or in a competitor's factory. Even then, they still need to be convinced that it is in their own interests to change. Furthermore, they may perceive the change to be in their interests, but accord it a low priority. For example, many people say that they would like to learn a language, but cannot find the time. Finally, people want to believe in the process. They may be happy to move offices, but not if they have to make their own arrangements to move their own desk, cupboards and potted plants.

Leaders of change

It is not enough to manage change. Change requires leadership. It is transformational rather than transactional. Leaders are sensitive to their impact on people and capable of using the skills of persuasion and communicating a vision. They are not so much reactive as active and creative. In this sense, the leader of change is behaving like a producer of a film who obtains funds, seeks cooperation, nurtures support and seeks to satisfy a demand. Much has been written about leadership. But, change also requires followers and teamwork. Currently, many of the assumptions about work and industry are evolving in a way that will facilitate the ability to adapt to change. One of these fascinating developments is management by projects, which encourages people to view change as something which can be controlled and organized, even under conditions of so-called chaos. Management by projects works well provided that there exists some mechanism for communication between the projects and the sharing of best practices. Whether this is true or not, time will tell.

CHANGE ORDERS

Changes, problems, incidents and trends

A change order might amend the project baseline, which suggests that there has been a change to the project objectives, or more probably a change to the process for achieving those objectives. Change orders are encouraged because they can bring improvement, but they are subject to an approval process, because they can certainly compromise the smooth progress of a project.

Similarly, trends may go the wrong way. Problems and incidents occur. If everything seems to be going well, you have probably overlooked something. Although this seems like a pessimist's charter, the project manager must be a supreme optimist to stay focused on the main objective. However, there is a way of coping, even on a complex project: problems can be documented in a similar way as for change orders and can be made subject to a formal process for the definition of solutions. This pulls everyone into the action.

Change order management

Even though a project without changes would not be a project, the impact of each change must be fully argued and understood. Change order procedure consists of evaluating the change first from the perspective of technical and management feasibility, then in terms of the impact on the product and the project. This requires an attention to detail and, in particular, to factors that have an impact on quality. Quality is best defined as conformity to the customer's requirements or to the conditions which will make the product successful on the market. Performance outside these boundaries can be costly without adding value.

If a change is deemed to be unnecessary, the details must be archived for future reference. On the other hand, if the change is to be implemented, the disruptive effect can be minimized by choosing the most suitable moment to introduce it. This may be immediately, or as late as possible, or in a batch of changes (for example, a new version). The impact of the change must also be assessed and measured. Finally, the originator of the idea behind the change is kept informed of progress. There is nothing more demoralizing than working for an organization which appropriates ideas without giving back recognition.

Configuration management

The configuration can be defined as the technical description of the product (its architecture, nature, structure, implementation, maintenance and so on). Configuration management is the equivalent to the technical tracking of the product as it evolves from a conceptual paper model to something physical, functional and tested. Therefore, the product must be described physically, functionally and in terms of its acceptance criteria. This is often referred to as the baseline product, just as there was a baseline schedule and a baseline budget. The updated and approved documents, plus the existing documents, represent the current project baseline. Note that the real product also includes unapproved changes. The aim is for the real product to be as close as possible to the desired virtual product.

Project documents

In the past the project documentation would often weigh more than the product. On a space industry project the documentation to meet extremely exacting performance requirements can easily fill a large living room from wall to wall. A major construction project such as an airport or a high-profile building would most likely generate several million documents. Then there would be revisions, page references and cross-references to take into account.

Even when documents are electronic, project document management is a demanding job.

Basically there are three categories of documents: specifications (requirements and analysis), industrial dossiers (technical clauses, plans, product descriptions, prices, manuals) and project documents (schedules, change orders, problems, actions). Each phase of the project requires its own document – business requirements, user requirements, design and definition, manufacturing guidelines, maintenance, product history, acceptance tests, users' manual.

Prototypes also require documents. It is a quite frightening prospect, especially when considering the following fact: each document is only partially understood by each person who reads it. Fortunately, as the project progresses, more and more physical material becomes available. The aim should be to produce this as soon as possible.

Problem hierarchy

In order to cut down on bureaucracy, the most important configuration items at an appropriate level can be put under scrutiny. This implies mission-critical items which involve a high risk for security reasons, or because there is a high degree of innovation, or are volatile, politically or technically, logistically and financially complex. The aim is to concentrate on sensitive areas, without stifling the ability to think in 'open' mode about what could go wrong at any stage of the project.

Performance requirements

Performance requirements can be considered to be a part of the functional requirements or the dimensions of quality. Some of the most common dimensions are:

- reliability (the capacity of a product to perform under given conditions);
- robustness (the capacity of a product to recover its function);
- maintainability (the capacity of a product to be put back into working order);
- manufacturability (the capacity of a product to be made, usually in some given quantity – a factor that is absolutely critical to price competitiveness);
- security (the capacity of a product to be free from danger or accident);
- ergonomics or human factors (the capacity of a product to take account of user limitations).

We could add many more – comfort, simplicity, durability, portability, environment-friendliness, enhancement of company image, not to mention cuteness, 'up-to-dateness' and sheer saleability.

Quality management

To ensure that quality standards are met, quality has to be planned and organized with reviews backed up by instructions and measured so that defects can be eradicated. Quality is a state of mind which can only be achieved if everyone is caught up in the same attitude to success. The outcome of a well-managed quality plan will be reduced life cycle costs.

ORGANIZATIONAL ASPECTS

The role of the project manager

The project manager's task is made more difficult by the fact that the lines of influence are grafted onto the existing organization, cutting across the traditional sources of authority. The project participants come from a variety of levels and backgrounds and work together only on a temporary basis. The project manager must build a team from these diverse groups and exercise leadership. Although, the project leader needs to exercise authority based on competence, reputation, inspiration and sensitivity, formal authority may have to be reinforced by the project's sponsors (for example, company management). This does not always occur in a transparent way. In fact, the project manager often has the impression of battling against institutionalized obstacles.

Obstacles to management by projects

Organizations put all kinds of obstacles in the way of change – especially change towards new ways of working, as is the case with management by projects. However, it is one thing to espouse management by projects, but quite another to implement it effectively. Many companies have been doing projects for years. They know all about contracts and specifications, schedules and budgets, teamwork and communication. They think that management by projects is an extension of working on a project, by using a matrix organization. It is not.

Projects and customers

The matrix organization serves to emphasize the primacy of the departmental structure by putting the organizational structure along the top, and the work down the left-hand side of the chart. This is never the way that customers perceive things. Customers do not see themselves as being at the bottom of the organization chart. The truth is that when informed decisions are taken by the people who are closest to the information, the customer is most likely to end up satisfied. In the modern economy the customer is the source of information, and there is nothing so frustrating for a customer as having to deal with people who have not been trusted to make decisions or who do not understand the purpose of their own product or company. In these cases, the customer may understandably refuse to trust or waste time with the company.

Projectivity

'Projectivity' is a word which has been coined to describe an organization's ability to manage projects. It is possible to manage projects very effectively by doing 'management by projects'. Management by projects implies a strategic attitude which uses the project and the project portfolio as a way of pursuing improvement. It is a bias towards stepped or radical improvement, as opposed to continuous improvement. As a management strategy it fits neatly with total quality management, except that management by projects places more emphasis on innovation than on production efficiency.

It is impossible to manage projects effectively without the appropriate structure and reward systems in place within the organization. If project managers are always chosen from junior members of staff, are paid relatively poorly, have their careers sidetracked and are pulled away from the project to deal with matters such as production, administration or selling, projects will not be managed successfully. The organization will be signalling that projects are not important. The project process will not be aligned with the project objectives.

Project leaders or company managers

The organization's culture and beliefs usually stem from its structure and systems over time.

If there is no incentive to adopt project-oriented behaviour, anyone who behaves as a genuine upfront project manager will tend to be marginalized, and the techniques and methods devised for managing projects will not work properly. Thus it is often said that all of this must come from the top. Unfortunately, the top is only too aware of obstacles further down. They perceive that people are unwilling or unable to change.

To break the stalemate, people must be trained and provided with the necessary experience, or else brought in from outside. There has to be a willingness to push the envelope. Inevitably, there will be mistakes, and some people may go beyond their designated authority. But the effort must be made if the company really wishes to be project-oriented. Lightweight project managers do not make good leaders. They are the type of manager the company wants if the objective is to maintain the status quo. But, how many projects have the maintenance of the status quo as an objective?

HOW TO USE THE ACTIVITIES AND EXERCISES

Nature of the activities and exercises

There are four main types of activities and exercises in this manual:

1. *Group activities* which develop teamworking skills (and only work when carried out in a group). These include 'micro-projects' which are small, intensive, practical tasks designed to create a sensation of working and living in a project on a much accelerated timescale.

2. *Group exercises* which are based on a questionnaire or a discussion where different points of view can be aired and explored. These exercises encourage synergistic and complementary thinking.

3. *Individual or group tasks* addressing one or more of the most well-known project management techniques.

4. *Brain-teasers and thinking exercises* which may be done in either in a group or individually and aim to stimulate new ways of thinking about project management issues and techniques.

In line with the times, the collection is biased towards activities and exercises that encourage innovative, but disciplined thinking patterns. The project manager is presented as an independent-minded, empowered and charismatic person – someone who, focused on a desirable future, manages people and resources to deliver results.

Purpose of the activities and exercises

The activities and exercises are designed for people who wish to develop project management skills and who recognize the need for participative learning instruments. One way of using the manual is as a complement to a training course in managing by projects. This will supply the active and participative element that is often missing from training courses and can make an otherwise interesting subject like project management seem dry and uninspired.

Learning does not just take place on intensive and dedicated training courses. The manual includes many exercises that can be presented in isolation to develop thinking and awareness in a given area, or to explain and promote a methodology. The micro-project activities are particularly effective for team-building and for focusing everyone's minds on the task ahead by giving them a shared experience which can become a metaphor for successful project work.

The manual may also be a useful tool for internal or external consultants who need all the help they can get in championing change, coaching teams and individuals, and guiding organizations towards working by projects. Consultants have an almost inexhaustible requirement for case histories, anecdotes and stimulating stories. This manual condenses accumulated technique and know-how from the project management universe into bite-sized chunks of 'learning-by-thinking', ranging from 30 minutes to 3 hours in duration.

How to make best use of the activities and exercises

The activities and exercises try to cover as much of the project management field as possible. They are entirely modular. There are no cross-references, sequences of exercises or indispensable overhead slides. Many of the exercises and activities will stimulate ideas for new exercises. It is assumed that users of the activities and exercises will understand the project management principles before using the material.

Project management instructors must practise what they preach, and, for this reason, there are exercises which help to discern learning requirements and objectives. This is especially important in a field of activity which is host to such a vast body of varied knowledge and experience.

Likewise, at the end of a course some idea of performance can be obtained by using exercises which encourage the participants to review their learning and confirm their understanding of the main learning messages.

When constructing a course, the overall theme must be developed in line with the requirements of the situation. The activities and exercises can be fitted in accordingly. This is better than building a course around the available material. It is quite acceptable, and even desirable, to change the learning method so long as the guiding objectives are maintained. It is not acceptable to go completely off-track only to discover an area where there are lots of interesting activities and exercises.

Considerable effort has been made to strike a balance in the selection of the subject matter for the two volumes. The final interpretation reflects my preference for innovative and unbureaucratic projects. However, for experienced project managers seeking coherence with their own expectations about the project management domain, the skills matrix (p. 32) maps the part headings of the two volumes on to familiar subject areas encountered elsewhere.

Inevitably there are gaps in the subject-matter on offer. The field is too vast for it to be otherwise. The emphasis has been placed on methods and techniques which are specific to the field of project management – analysis, planning, scheduling, estimating, measuring progress and promoting managing by projects - rather than those areas that fall within the general sphere of management activities.

Important areas such as planning and estimating are covered by more than one exercise, so there is a choice. Other techniques, such as functional analysis, risk analysis, project portfolio management and running a project review meeting, are covered by a single exercise which aims to provide a sound methodology base. Almost all the exercises can stand alone without any extra material, so long as the trainer has a sufficient understanding of the principles and the methodologies described to be able to summarize the main learning messages.

It is always better to concentrate on a few key learning messages and to sow the seeds of each learner's interest, rather than to try to steamroller through every topic in the book. In other words, allow the learners to learn how to learn from their experiences. Once their interest is stimulated, the only way for them to master their skills is through continued practice. Realistically, this can only be obtained by experience and by iteration.

Iterative experience and simulation

Micro-projects give participants an opportunity to practise integrated project management skills. Only by repetitive experience do these skills become automatic. This still leaves an important residue of skills which can only be

SKILLS MATRIX

1.	Project management principles	6.	Measuring progress, testing and validation
2.	Setting objectives and assessing requirements	7.	Communication, negotiation and coordination
3.	Creativity and problem solving	8.	Motivation, teamwork and leadership
4.	Value analysis, risk assessment and project optimization	9.	Managing priorities and long-term objectives
5.	Planning and estimating	10.	Integrating project management skills

Skill	Meta-skill	1	2	3	4	5	6	7	8	9	10
Principles and definitions		■									■
Defining project scope			■					■		■	■
Defining the business objectives			■	■				■	■	■	■
Defining the work breakdown structure			■			■					■
Defining the organization structure			■					■		■	■
Defining the master schedule			■			■					■
Defining activities and constraints						■					■
Estimating resource requirements and costs						■					■
Resource scheduling and optimization					■	■					■
Risk evaluation and reduction				■	■	■	■				■
Performance reporting						■	■	■			■
Variance analysis							■	■			■
Project forecasting							■				■
Change order and problem management				■	■		■				■
Configuration management			■	■	■	■	■	■		■	■
Quality management			■	■	■	■	■	■		■	■
Procurement management					■	■	■	■		■	■
Contracts management					■	■	■	■		■	■
Human resource management								■	■	■	■
Communication management								■	■	■	■
Cost management			■		■	■	■				■
Time management			■		■	■	■				■
Scope management			■		■	■	■				■
Culture, values and diversity								■	■	■	■
Project reviews and progress meetings							■	■	■	■	■
Managing project politics and strategy		■	■					■	■	■	■
Capitalizing and recycling project experience		■						■	■	■	■
Project audits and evaluations		■	■				■	■			■
Project start-up		■	■	■	■	■		■		■	■
Project close-out		■	■				■	■		■	■
Matrix management		■	■					■	■	■	■
Project portfolio management			■					■		■	■
Project management software			■		■						■

ACTIVITY AND EXERCISE SKILLS GRID

A	Teamwork activities	S	Synergy exercises
M	Methodology exercises	B	Thinking exercises and brain-teasers

		A	S	M	B
Value analysis, risk assessment and project optimization					
Functional analysis	1				
Risk analysis	2				
Kick out waste	3				
Petro-world resource levelling	4				
Paper plane engineering	5				
Ball-passing revolution	6				
Blues	7				
Planning and estimating					
The carpet layers	8				
Home construction kit	9				
White wedding and used car	10				
Systems development	11				
How much does it cost?	12				
The highest mountain in Australia	13				
The Temple of Oova	14				
Simple planning exercise	15				
Measuring progress, testing and validation					
Painting the flat	16				
100 per cent or bust	17				
Productivity analysis	18				
C/SCSC: the 35 Department of Defense criteria	19				
Change of holiday contract	20				
Route planner	21				
Progress iterations	22				
Managing priorities and organizational objectives					
Project audit framework	23				
Balanced portfolio	24				
Heavyweight project managers	25				
Exceptional accountability	26				
Obstacles to project management	27				
Consultancy mission	28				
Steps to change	29				
Project management software selection	30				
Time management	31				
Integrating project management skills					
Egg-box micro-project	32				
Bridge micro-contract	33				
Kit construction micro-plan	34				
Project script	35				
Autonomous team activity	36				
Project steps	37				
Project quiz	38				
Project entrepreneur	39				