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7 Managing quality

7.1 Introduction

The last two chapters described two mandatory project management functions: managing scope and project organization. Let us now turn to three secondary functions or constraints: managing quality, cost and time. Contrary to common practice, they will be addressed in that order, which is the order I believe they should be addressed in first project definition (Figure 1.13).

This chapter addresses quality. I start by considering what we understand by good quality in the context of projects. I then introduce a five element model for achieving good quality, and describe each element of the model. I consider whether quality is free on a project, and then describe configuration management, which I believe is the key tool of project management for delivering the quality and functionality of the project's outputs. I end the chapter by describing other tools used in the management of quality.

7.2 Quality in the context of projects

It is frequently said that a project is successful if it is finished on time, to cost and to quality. We all understand how we measure cost and time, but very few people understand what they mean by good quality in the context of a project. Indeed, in spite of it being stated as one of the major three criteria of project success, surprisingly little is written about it.

There are several possible definitions of good quality on a project. The project is said to be good quality if the facility or project's output:

– meets the specification
– is fit for purpose
– meets the customer's requirements
– satisfies the customer.

Meets the specification: The facility is produced in accordance with the written requirements laid down for it. The requirements can be specified on several levels, mapping on to levels of the PBS: customer, functional, system and detail requirements. The requirements may specify engineering or technical design standards applied within the organization. (The word specification tends to be used for something which is project specific and provides standards for something which applies to all projects undertaken by the organization.) The specification may also set requirements for the time and cost of the project, needed to make it viable, and also set specific parameters for the service levels required to be met by the facility. Finally there are the various 'abilities of the facility: availability, reliability, maintainability, adaptability, etc. . . .

Is fit for purpose: The facility, when commissioned, produces a product which solves the problem, or exploits the opportunity intended, or better. It works for the purpose for which it was intended.

Meets the customer's requirements: The facility meets the requirements the customer had of it. Here we mean what the customer thinks they require, the thoughts they had, not the way they interpreted their thoughts as words, and not the way those words got written down as a customer requirements specification.

Satisfy the customer: The facility and the product it produces actually makes the customer feel satisfied. Now there is also a difference between satisfying the customer, 'That's all right then', and delighting the customer, 'That's wonderful'. If you can delight the customer at very little extra cost, then obviously you should try to do that. However, if that is going to make your project significantly unprofitable, then clearly you should aim only to satisfy the customer. If you still cannot make a profit, you need to massage the customer's expectations to make them more realistic.

Questions

These four definitions of quality raise several questions.

DO THEY MEAN THE SAME THING?

The answer to this is quite clearly 'no'. I implied above that the concept the customer had, and what was written as the 'customer requirements' specification are almost certainly not the same thing. Human fallibility being what it is, the chances of the customer being able to vocalize their actual requirements is vanishingly small, and the chances of the project team writing down what the customer says, let alone capturing the customer's unvocalized concepts, is also vanishingly small. Thus delivering the specification does not necessarily mean you meet the customer's requirements. The chances of the customer being able to solve their problem initially is also small, as is the chance of the project team doing that. Hence, what the customer thinks they require and what is written into the specification at the first attempt are unlikely to coincide, and it is very likely that the specification will not be fit for purpose. Finally, even if it works, and even if it meets the specification, and even if it is what the customer actually required, they may still have had some totally different concept, and so may be left feeling dissatisfied.

WHAT THEN IS THE CORRECT DEFINITION OF QUALITY?

The widely accepted definition of good quality is now taken as delivering project objectives that are fit for purpose, that is that they achieve the desired result. It is not slavishly delivering the specification, if what is specified will not work, and it is certainly not following predefined business processes, if those processes deliver a product that will not work.

DOES THIS MEAN WE HAVE TO CHANGE THE SPECIFICATION?

'Yes', is the simple answer. This is one of the two great dilemmas of project management. There are traditional project managers who say good project management is freezing the specification on day one of the project and then delivering it come what may. In my view, it is not good project management if the end product does not deliver the desired result. On the other hand, if you change the specification frequently, you will never finish the project, and that is most definitely not good project management. Hence, you must be willing to change the specification as you become aware that your original proposal is less than perfect, but changing it is something you must do sparingly and with great ceremony. Later in this chapter I describe *configuration management*, a technique by which the specification can be refined in a controlled manner as the project progresses to ensure that, by the end of the project, its products produce the desired results.

WHO IS THE CUSTOMER?

The customer may be:

- the sponsor, or owner of the facility
- the operators of the facility, or users of the services it provides
- the consumers of the eventual product it produces
- the media, or local community, or politicians.

The answer is that they are all the customer, and all their requirements must be satisfied. They will usually have different requirements and to satisfy them all will be a difficult juggling act. The owners must be willing to pay for it. The operators must believe it will work; they can make failure a self-fulfilling prophecy. The consumers must want to buy the product. Configuration management can also be used to try to gain agreement from the various parties (warring factions) as the project progresses.

DO YOU GIVE THE CUSTOMERS WHAT THEY WANT OR WHAT THEY NEED?

This is another dilemma, but less significant. The attitude in the 1970s of British engineers was to give customers what they needed, not what they wanted, that they knew better than their customers what the latters' requirements were. This arrogant attitude led to the demise of many British industries. It is arrogant to think you know better than your customers, it is arrogant to think you are unfailingly correct. By the late 1980s, this attitude had changed. It now did not matter what trivial whim the customers had, the 'customer was king', give them what they ask for. On the one hand, you give customers what you think they need. They look at the product and say, 'That's not what we asked for', and refuse to use it. On the other hand, you give them what they say they want. When it does not work, you say, 'The customer is king', and they say, 'But it was your duty to advise us it would not work'. The way out of this dilemma is that you must use configuration management so that by the end of the project what the multi-headed customers now think they want, what they actually need and what you think they need are the same thing.

WHAT IS THE DIFFERENCE BETWEEN GOOD QUALITY AND HIGH QUALITY?

To consider the difference between good quality and high quality, ask your self the question:

> Is a Rolls-Royce a good quality motor car?

A Rolls-Royce is a high-quality, well-engineered car. However, if you want a car that is economical to run, easy to manoeuvre in tight city streets, and easy to park, is a Rolls-Royce a good-quality car? If you want a car that can drive off the road, across farmland, and survive a collision with a kangaroo, is a Rolls-Royce a good-quality car? If you want a car that represents your status as a successful manager, is a Rolls-Royce a good-quality car? The answers are probably no, no and no. It is important not to over-engineer the product, but to produce something that satisfies, even delights the customer, but is good value for money to achieve the project's goals. Often something which is over-engineered will not delight the customer because it will not work.

7.3 Achieving quality on projects

Figure 7.1 is a five element model for managing quality on projects:

- two elements represent what we must manage the quality of: the product and the management processes
- two represent how we manage their quality: through quality assurance and quality control
- the fifth represents the attitudes of the people involved.

Quality of the product is the ultimate goal. It is the product which satisfies all the criteria in the previous section, and which influences attitudes for years to come, long after the project is finished.

Quality of the management processes is also a significant contributor to the quality of the project's product. Following well-defined, previously proven, successful ways of doing things increases the chance of success; designing new project management processes at the start of every project increases the chance of failure. We shall see below, that this means developing procedures for the organization to be used as flexible guidelines, not rigid rule.

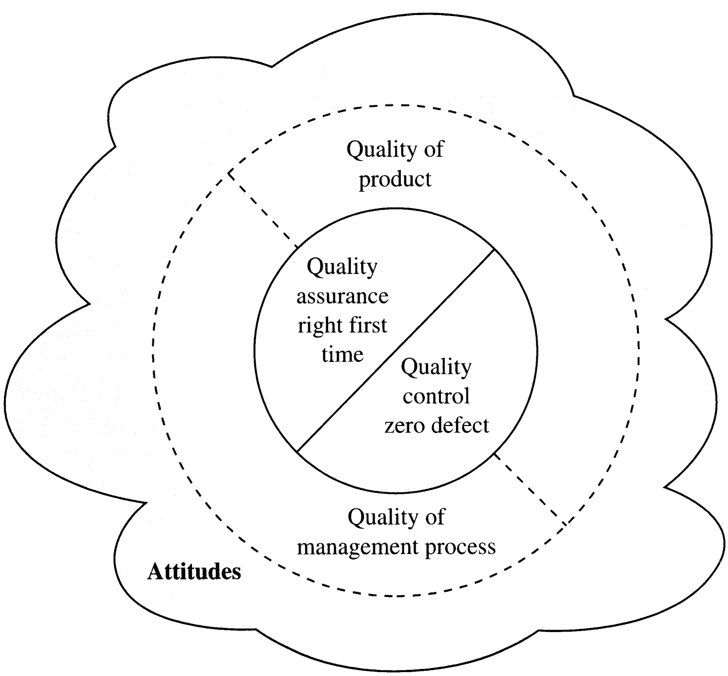

Figure 7.1 Total quality management of projects

Quality assurance is preventive medicine, steps taken to increase the likelihood of obtaining a good-quality product and management processes. It is about trying to get it *right first time.*

Quality control is curative medicine, which recognizes human fallibility and takes steps to ensure that any (hopefully small) variations from standard which do occur are eliminated. This is about trying to get it *right every time*, with *zero defects.*

Good attitudes is essential to successful project management. We saw this under strategy in Section 4.5. I used to tell Example 7.1 as a joke or apocryphal story, but somebody on one of my courses said it once happened to him. The commitment to quality must be at all levels of the organization, it cannot be delegated downwards, or pushed upwards. In the days when quality circles were popular, people implementing them had top-down teams and bottom-up teams to emphasize this point.

An organization ordered a batch of capacitors from a Japanese company, and specified that there should not be more than 0.5 per cent faulty capacitors in the batch. The consignment arrived in a big box and a small box. They started testing the capacitors in the big box and found they were all perfect. They then tested the capacitors in the small box and found them all to be faulty. At that point they realized that the small box was 0.5 per cent of the consignment!

Example 7.1 Eliminating the culture of expecting failure

Assuring the quality of the product

In order to assure the quality of the product it is beneficial to have:

CLEAR SPECIFICATION

Without a clear idea of what is to be achieved, the team has no direction. It is possible to specify both the end product of the project, and the intermediate products: milestones resulting from work packages; and deliverables of the activities at lower levels. The lower the level at which the deliverables are specified the tighter the control. However, there are risks associated with a highly detailed specification: it may be inconsistent; it may confuse rather than clarify; and the lower level products may become an end in their own right, rather than a means of achieving the facility. It is possible that if the client overspecifies, the contractor can meet the specification, but not satisfy the client's purpose.[1] *Cardinal points procurement*[2] attempts to overcome this.

The next three are about trying to maximize the use of previous experience.

USE OF DEFINED STANDARDS

These are standard designs and packages of work which, from previous experience, are known to be able to deliver results of the required specification. One of the great differences between the project environment and a routine manufacturing facility is that, in the latter, each day's production becomes a standard against which to improve the next day's production. In a project environment it may be some years before you repeat a process, and then the environmental conditions may be different. However, the use of standards will be beneficial in the long run.

HISTORICAL EXPERIENCE

Hence, the greater the historical experience, the better will be the standards and specification. For this reason, it is not always possible to create a clear specification of R&D, high technology and organizational development projects. However, the more historical data that are used the better. In the next chapter it will be shown that there is a clear learning curve in industries with time, with it taking perhaps 50 years to build up a credible body of data.

QUALIFIED RESOURCES

If the people used on the project have access to that body of data, either through their own experience or training, then that makes them better able to apply standards and achieve the specification. This applies equally to professional staff (engineers, IT staff, researchers, trainers, managers) and artisans (electricians, mechanics, programmers). It is common in the engineering industry to put artisans through strict testing procedures before allowing them to do critical work. The use of qualified resources also applies to material and financial resources, but these can be tested against the standards.

IMPARTIAL DESIGN REVIEWS

The use of auditors to check the design can help to assure that the customer's requirements are properly met. You may think that this is insulting to the design team, but there is ample evidence that people find it very difficult to discover their own mistakes (Example 7.2), and hence the use of auditors, sometimes called the red, pink or blue teams, to check that the design is satisfactory. However, you need to check that you do not overdo it. There are apocryphal stories about auditors outnumbering the project team, and since they are there to find fault, they tend to find it where none exists: the design may be adequate but not perfect.

Psychologists have done experiments in which they have shown people pictures that get progressively out of focus, and ask the people to identify them. In this way, they establish how far out of focus the picture has to be before people will identify it wrongly more often than not. They then show people pictures that are well out of focus, and ask them to identify them, and then slowly bring them back into focus. The picture has to be brought into focus well beyond the point at which a person would normally make a correct identification before an incorrect identification will be changed.

This happened during the incident at Three Mile Island in the 1980s. In the plant there was one instrument which should have been indicating a fault, but was not working because it was faulty. A second alarm started and the operators made what would have been a correct diagnosis of the fault based on that one, and not on the first, and reacted accordingly. A third alarm started which should have told them that their diagnosis was wrong, but they continued to react according to their original one. It was some time before they changed their diagnosis, after several alarms were indicating something different. (They reacted in time to avert a major accident. Nobody was hurt. This is interesting, because Three Mile Island was a nuclear station the incident remains seared on our brains, whereas the Piper Alpha disaster, which killed about 250 people when an oil platform exploded, is slipping into distant memory. We will return to the irrationality of risk assessment in Chapter 10.)

Example 7.2 Discovering ones own mistakes

CHANGE CONTROL

This is vital to achieve the specification where change is necessary. It does not mean that changes are eliminated, because that can result in a product that does not meet requirements. The purpose of each change must be carefully defined, the impact on the design assessed, and the cost compared to the benefit, so only those changes that are absolutely necessary and cost-effective are adopted.

Controlling the quality of the product

Quality control is a process of diagnosis and cure. As the facility is erected and commissioned it is checked against the specification to ensure that it is of the required standard, and any variances are eliminated. There are four steps in the control process (Figure 7.2):

- plan the work required, and do work to deliver results
- monitor the results achieved
- compare the results to the plan, to calculate variances
- take action to eliminate variances.

The quality plan for the project's product means understanding how every deliverable at all levels of the PBS will be judged to have been achieved. The work-package scope statement introduced in Section 5.5 had space for entering the criteria for judging achievement of the milestone. I usually say that the specification for the overall facility (the client requirements and functional specifications) should run to several pages, that for each milestone (in the systems specification) should be half a page, and that for the deliverable of each activity (the detail specification) should be a couple of lines. I was challenged on this on one course. The delegates said it should be the exact opposite. The specification for each activity should be a couple of pages, and for the facility a couple of lines. The point they were trying to make is that if you get the detail right, there is no need to check the overall facility. This is right, but it seems a recipe for a bureaucratic nightmare to me.

Monitoring results and calculating variance means checking the specification of each deliverable as it is achieved. It is important to do this from the start, from the earliest activity for the earliest milestone. It is no good waiting until the end of the project, and then finding a mistake was made on the first day. Mistakes must be identified as they occur, hence the comments from the delegates above.

Taking action from the start will build up a momentum for success that will be carried through the project.

There is a major difference here between project and operations. In an operation where you are doing something repetitively, once the process is

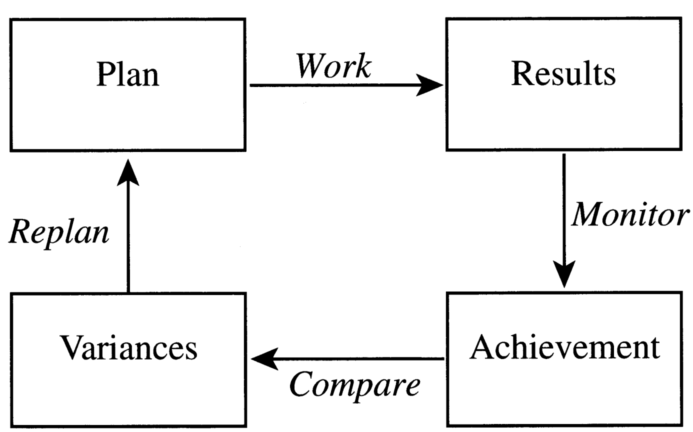

Figure 7.2 Four-stage control cycle

set up correctly, it will usually not go wrong suddenly. The process will drift. Hence you tend to monitor sparingly, using processes such as *statistical process control*. This may involve the destructive testing of, say, every 100th product. Once the process is working, the emphasis is on quality control. On a project you cannot destructively test every 100th product, you only do it once, so wrong once is wrong every time. This shifts the emphasis much more on to quality assurance, and quality control at early stages of the project as described.

Assuring the quality of the management process

To assure the quality of the management processes, a similar list as that for the product applies, which means having a set of defined procedures for managing projects. Procedures clearly specify how projects are to be managed by qualified resources, and are derived from standards based on historical experience. They may be derived from the company's own experience, or based on standard procedures.[1,3] Many client organizations have their own procedures which they require their suppliers to use, and regularly audit contractors against them.

It is essential that the procedures are used, and this requires three things: they should not be bureaucratic; they must be sensible; and they must have management commitment. Experience shows[4] that the procedures should describe how the organization processes product, not what the functions of the organization do (Example 7.3). The procedures should also be flexible guidelines, not rigid rules. This means that if the customer requires something different, then the procedures should be changed to meet their requirements, not the requirements changed to meet the procedures. This can be achieved in a controlled way by having a procedure for changing the procedures, and by project teams regularly developing a quality plan as part of start-up. Finally, at the end of every project the procedures should be reviewed to see how well they served the project, and the organization's procedures updated if necessary. Quality is about continuous improvement, not compliance to 20th century ways of working.

The procedures are often based on the ISO quality standards, a complete list of which are in Table 7.1 at the end of the chapter. The use of procedures manuals is described in Chapter 15.

Peymai was quality manager for a medium-sized construction company during implementation of BS5750. At first they wrote their procedures to describe how each function of the organization worked, design, procurement, site construction. Quality fell as the departments argued between themselves about what was and was not their respective responsibilities. Nothing is perfect, but departments would not cover gaps in the procedures, particularly where the product was handed over between them, because that would make them 'non-compliant'. Further, where a customer required the design department, say, to do something unusual, they would refuse saying it would make them 'non-compliant'. The company reimplemented BS5750, writing their procedures to describe how they processed an order, and importantly making departments responsible for working together at hand-over, and insisting that the project specific procedures should be derived from the generic procedures, but taking account of the particular requirements of the project. Quality went up.

Example 7.3 Procedures for process versus function

Controlling the quality of the management processes

The method of monitoring the management processes is through project audits. An audit is a detailed check of the operation of the management processes against standards of good practice, such as the organization's procedures manual or that of an external agency. (Audits are described in Chapter 16.)

The quality plan

At the start of the project, the manager should draw up a quality plan to define how quality will be achieved, how the company's procedures will work on this project, and how the manager intends to assure and control quality. In qualifying the procedures, it may contain new ones where items are either not covered or inadequately covered for this project in the overall procedures, and may include such things as: disputes, documentation, reporting mechanisms, customer liaison, etc. For the quality control process, it may contain a detailed activity and resource plan. The quality plan may form a section of the Project Definition Report (Chapter 11).

7.4 Configuration management[a]

Configuration management is a technique used to manage the refinement of the specification and work methods on development projects. The technique was first developed in the US defence industry during the early 1950s to track the versions of components as they were configured in the facility, and to control changes as they occurred. In particular, where several prototypes are being developed, configuration management tracks the design, or configuration, of each prototype. It has now become a desirable, if not essential, tool to control the functionality and quality of components in the product breakdown, and work methods in the work breakdown, to be used on software, technology, engineering or organizational change projects.

So what is configuration management, and how can the control of configuration be of use in a development project? Configuration management controls the specification of the product breakdown structure, it expresses the facility delivered by a project, as a configuration of component parts. The configuration can take various forms: a car, space shuttle, design, plan, software system, training programme, organizational structure. Each component may then be regarded as a configuration in its own right, made up of other components. This process, of course develops the bill of materials, or product breakdown, of the project. Figure 7.3 illustrates the concept using a book as the configuration. The components are chapters: the subcomponents sections; etc.

Configuration management is not a radical discovery that revolutionizes the way the facility is developed and maintained. It is a set of good working practices for coping with uncertainty and change and gaining commitment of the projects participants as the design evolves. Many projects use elements of configuration management, especially in the application of change control. However, to be effective, it must be a systematic, consistent approach to managing change on complex projects. From the outset, structures must be put in place to support it. These include specified individuals with responsibility for configuration management, and procedures supported by senior management. It also involves all project participants. There may be one or more project review boards, with responsibility for approving the specification of the facility, and to approve changes to the specification. Depending on the size and complexity of the project, there may be a group of people dedicated to the function of configuration management.

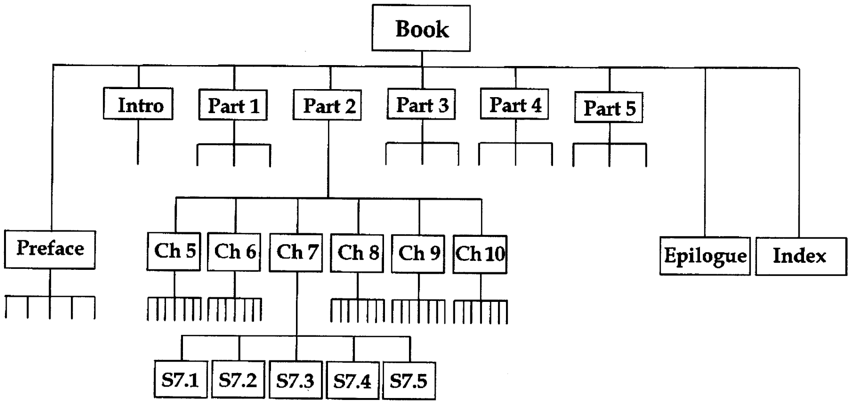

Figure 7.3 Configuration of a book

Basic approach

Figure 7.4 illustrates the basic approach to configuration management. In line with the goals and methods matrix (Figure 1.15), we accept that there may, at the outset of the project, be some uncertainty about the specification of the project's deliverables, and some uncertainty about the methods of delivering them. Rather than trying to pretend that this uncertainty does not exist, that these things are precisely prescribed, it is better to accept the lack of clarity, and manage the refinement of our understanding.

So at the start of the project we write the specification of the deliverables and the work methods as best as we are able, and then agree that specification with the multi-headed client: sponsors; owners; operators; users, marketing representing the consumers. We agree that the eventual solution lies somewhere within the large rectangle, but we do not know where. We then start work on the project, and refine our understanding. At a predetermined review meeting, we sit down with the multi-headed client and agree the current status. We repeat the process and hopefully get agreement as we home in on the eventual solution. Perhaps at a review meeting one or more of the participants disagrees with the current status. In that case, one of two things has happened: either the previous specification was not correct, or the work to go from the previous position to the current

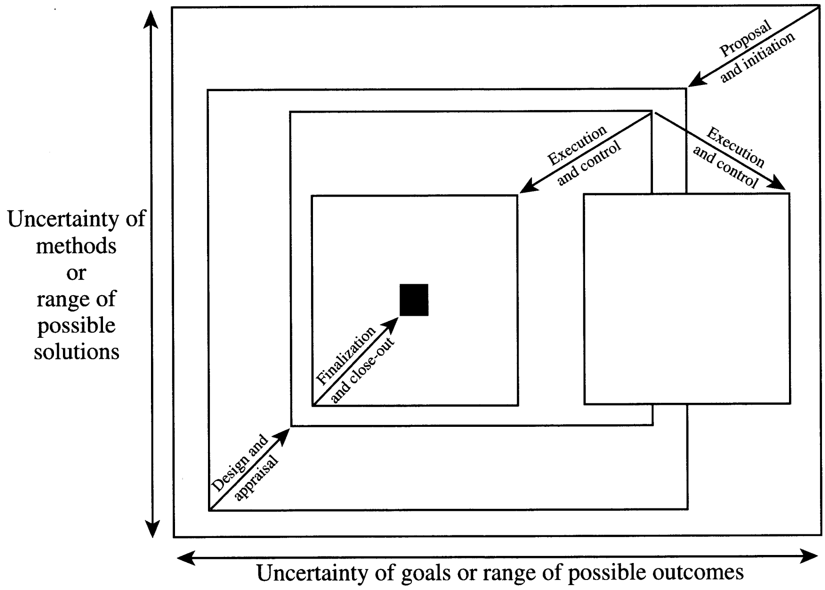

Figure 7.4 The basic approach to configuration management

one was wrong. In the former case, we need, through change control, to change the specification. With luck, if the problem is found early enough, the change can be made at little or no extra cost. If the change is made very late in the day, it can be inordinately expensive. If the latter is the case, we need to go back and repeat the work. Both of these are anathema to traditional project managers: changing the specification, or doing extra work at additional cost and time. However, at the end of the day, you have to ask yourself whether it is better to finish according to arbitrary time and cost targets, or produce something that works. On some projects (the Olympic Games, Project Giotto) the time is imposed by external constraints and so must be achieved. But on many projects it is better to take a bit longer and pay a bit more to deliver something that works.

Implementing configuration management

Implementing configuration management requires the definition of tasks to be performed and procedures to be adopted. The tasks must be allocated, which requires the organization to be established, responsibilities assigned, and appropriate recourses (people, money, equipment, accommodation) deployed. The appropriate procedures depend on the specific project, its size and complexity, but typically configuration management comprises four processes:

- configuration identification
- configuration reviews
- configuration control
- status accounting.

CONFIGURATION IDENTIFICATION

Configuration identification is the process of breaking a system into its component parts, or *configuration items*, each of which can be individually documented and placed under change control. Ideally, each configuration item will have maximum cohesion; that is, it would not be useful to subdivide it further for the purpose of documenting it or controlling changes to it. Also, the configuration items will have minimal coupling; that is, it would not be useful to merge two or more items to form a single item for documentation and change control (Example 7.4).

In its simplest form, configuration identification involves locating all the configuration items required to deliver the facility so that nothing is overlooked, and then establishing the information to keep track of those items throughout the life of the project. Most systems can be broken down using a hierarchical product breakdown structure (PBS). When the system has been broken down to its lowest level, the resultant configuration items form the project inventory, or bill of material. All deliveries and revisions are tracked and controlled against two forms of configuration item recording: the planned set of items and the produced/approved set.

The identification of the sets of items should cover the entire development cycle for both the facility and the supporting documentation. The definition and recording provided will support the activities of configuration control and status accounting. A complete list of all configuration items will be derived from the design specification. The configuration is complete when all items have been delivered. If extra configuration items are delivered, or some are not delivered, then this will only be acceptable if the design specification, and therefore the list of items, has been amended accordingly.

When I was writing this book, my list of configuration items was the list of section headings, as recorded in the table of contents (Figure 7.3). However, I must admit that the sections did not conform precisely to the principles of cohesion and decoupling. In this chapter, the definition of the section headings was quite stable. In others, Chapter 5 and 6 for instance, the definition changed as I wrote the chapter. The chapter was perhaps therefore the configuration item. Some chapters were not configuration items on their own. Chapters 14, 15 and 16 were reconfigured as I wrote the book.

Example 7.4 Configuration identification

CONFIGURATION REVIEWS

Configuration control procedures manage the movement of configuration items from one stage of the life cycle to the next, through formal review processes conducted at the end of each stage. At the end of the initiation stage, the first configuration review audits that the specifications are:

- *up to date*: they accurately reflect the concept of the product
- *complete*: all the configuration management documentation that should exist at this point in the life cycle actually does exist
- *agreed*: they have the support of all the project's participants.

At the conclusion of this stage, a requirements definition is produced, as part of the Project Definition Report (Chapter 11) and reviewed, approved, baselined and handed over to configuration management before it moves on to the design and appraisal stage. Similarly, at the end of design, the design specifications are produced, as part of the project requirements definition or project manual, which are again reviewed, approved, baselined and handed over. Once the configuration identification moves into execution, it evolves from documentation into actual deliverables, whether physical or abstract. These are again reviewed at the end of this stage, to draw up the list of outstanding items for finalization and close-out, and yet again at the end of this last stage, before the documentation is archived as the *as-built design*. Configuration management is the central distribution point for each stage of the life cycle of the project, but it becomes more critical during the last stage, finalization and close-out, as the facility is tested and commissioned.

CONFIGURATION CONTROL

Controlling the baselined configuration items through each stage of the life cycle is the basis of configuration management. The project depends on the baselined items and the record of any changes. Periodically during the life of an item, the baseline may need to be revised. It should be revised whenever it becomes difficult to work with the baseline documentation and authorized changes to it. All authorized changes to the documentation should be consolidated, as should those relating to any authorized repairs and emergency modifications. When the documentation has been completed, reviewed and approved, the baseline becomes revised. All subsequent change proposals should be made to the revised baseline.

Changes may arise internally or externally. External ones come from changes to business requirements; internal ones from forgotten requirements or problems found during the project. A procedure is required to report problems with baselined configuration items. Change control is the process of proposing, reviewing, approving and, where necessary, implementing change to the approved and maintained items within the PBS. Through the process of change control, the impact of all changes is properly assessed, prior to deciding whether to authorize the change. Impact assessment will determine the changes in scope the change will bring about, not just in the immediate area of the change, but on the whole project. Often the change can have a far-reaching impact. The consequences for organization, quality, costs and benefit, and schedule are also assessed. It can help to have a standard form such as that shown as Figure 12.12, to guide this assessment. It is important not to place items under change control too early, as unnecessary inflexibility and delay may occur. The steps of change control are listed in Section 12.6.

Review boards may differ for changes at different stages of the life cycle. Prior to the change review, the team determines what impact changes to configuration items has on resource requirements, and prioritize change against requirements for all projects in the organization. The impact is documented for the board. Once a change has been approved, the person responsible for the item makes the change, and passes the rebaselined documentation to configuration management. Information on revisions to the item is recorded. The revised specification for the item is passed to all interested parties, and then secured by configuration management.

For major changes, it is sometimes desirable to adopt a top-down approach in which changes to the requirements specification are agreed prior to any work being done to define consequential changes to the specification. This, in turn, is agreed prior to changes being made to the product and component specifications. Configuration management can handle this by defining the major enhancement as a separate configuration with its own baseline. When a major enhancement becomes operational, it supersedes the current system. Until then, the current operational system continues to have its own baseline changes as necessary. This can be taken one step further, where several prototypes have their separate baselined configurations operational in parallel, each subject to separate change control. When a change is made to one, it may or may not be made to some or all of the others.

STATUS ACCOUNTING

Status accounting is the fourth function of configuration management. It supplies information on request about baselines, configuration items, their versions and specification, change proposal, problem reports, repairs and modifications. For example, status accounting may identify authorized repairs and modifications awaiting the completion of amended documentation. Unless documentation is amended to be consistent with the facility, it is not accepted as being valid. Status accounting also keeps track of the complexities caused by superseding (major enhancement) configurations.

Status accounting enables people on large, volatile projects to avoid using outdated versions of documents and components. This is important for contracting companies responsible for components that need to interface with each other. It is also important for people responsible for user acceptance tests. They need the most current version of the requirements specification and the agreed functional and physical characteristic of the configuration, so they can determine whether or not the specification (quality) requirements of the contract have been met. That is, the facility functions as envisaged within its environment to produce the required product and benefit.

Configuration management and the life cycle

A common mistake, thankfully now made less frequently, is to confuse design management and project management. In the early days of project management it was common to make the chief designer the project manager:

- in the software industry systems analysts were called project managers
- in civil engineering, design contractors were labelled 'the engineer', and fulfilled an advisory role which included project manager, and put them

into a conflict of interest with their main role as design manager
- in the building industry the architect worked also as project manager with similar consequences.

Design management and project management are different, and often at odds with each other, as the designer tries to perfect the design and the project manager tries to deliver an adequate design on time and cost. However, two techniques have as common elements life cycle and configuration management. In the software industry, SSADM (the structured systems analysis and design methodology), is a design methodology, although it does include sections on project and configuration management. On the other hand, PRINCE 2[3], is a project management methodology also with a section on configuration management.

Figure 7.5 illustrates the evolution of configuration management through the life cycle. It shows a rule of thumb from most industries, that for every £1 it costs you to right a mistake during feasibility, it costs you £n in design, £n^2 in execution and £n^3 in close-out. For the ship-building industry, n is said to be 3, and the ratios are 1:3:9:27, and for the software industry n is said to be 10 and the ratios are 1:10:100:1000. Hence it is a very good idea to try to agree the specification by the end of design, and move forward to execution with the design frozen. Thus the emphasis of configuration management changes as you move from design to execution. In feasibility and design the emphasis is on gaining the commitment of the project participants to the design, and the key processes are identification, review and change control.

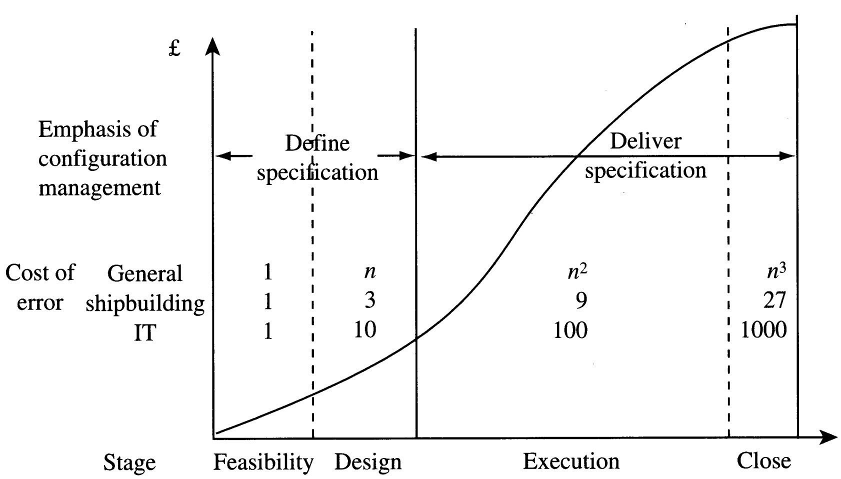

Figure 7.5 Configuration management and the life cycle

In execution and close-out the emphasis is on delivering the agreed design, and the key process is status accounting. That is not to say that if a show-stopper is discovered during close-out, a change will not be made. But the change is made in the full knowledge of how much it will cost, and the benefit of the change must also be significant to justify it.

7.5 The cost of quality

Applying the above techniques costs money, and so you may wonder whether the cost justifies the benefit. What is the cost of achieving quality? You will often hear people say that the cost of quality is free.[5] This is based on measured results of implementing total quality management in manufacturing companies, producing savings something like those shown in Figure 7.6. This views the cost of quality as being made up of three elements, as proposed by Crosby:[5]

– the cost of failure
– the cost of appraisal and control
– the cost of prevention and assurance.

Applying the above techniques certainly increases the cost of prevention, but it reduces the number of failures. That has an effect on the cost of failures, and as the number of failures falls the need for appraisal and control falls, reducing that cost as well. Eventually, the total cost of quality is less than it was at the start, even though the cost of prevention has risen. That, too, may begin to fall as the attitudes to quality become ingrained.

However, we now encounter a feature of project management: *projects are transient*. In a manufacturing company, the time to show any

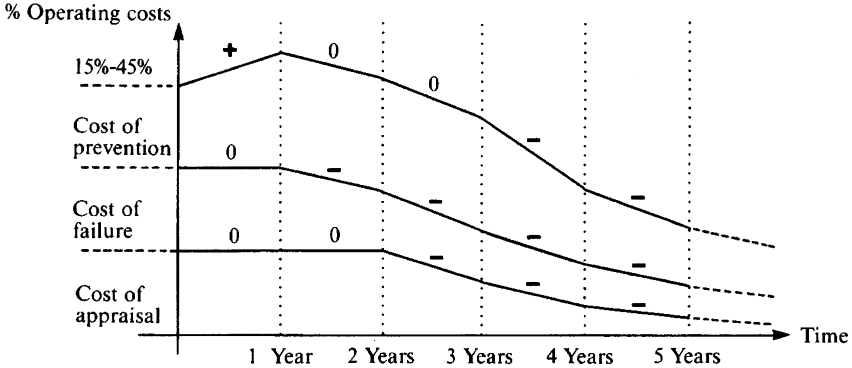

Figure 7.6 The cost of quality

improvement is typically about 18 months (the duration of many projects), and the time to the point where prevention costs begin to fall is typically four years. This means that if the technique is applied to a project, no return will be seen within that project's lifetime. The solution is for the prevention costs to be borne by the parent organization as an overhead, with the whole organization benefiting as savings feed back into more effective projects. That will be effective where the project team is drawn wholly from within the organization, which is the case on organizational development projects and in project-based organizations such as an engineering design consultancy, construction contractor or software house. However, it may still be difficult to get contractors to adopt the prevention techniques if they have no long-term commitment to the client and the client's future projects. The solution is to develop integrated supply chains and to adopt partnering arrangements whereby the contractor has the necessary commitment. This is the approach adopted by Marks and Spencer for the supply of their clothes and food, and it is being adopted by the oil majors in the United States. However, further description of these arrangements is beyond the scope of this book.[6]

7.6 Summary

1. There are four possible definitions of good quality on a project:
   - meets the specification
   - is fit for purpose
   - meets the customer's requirements
   - satisfies the customer.
2. The four are not the same thing, and like in many areas of project management, overall optimum may not optimize any one of them. An overall compromise must be sought.
3. However, being fit for purpose is thought by many to be the primary criterion.
4. There are five elements of achieving quality of a project:
   - quality of the product vs the management process
   - quality assurance vs quality control
   - good attitudes.
5. Assuring the quality of the product requires the use of:
   - a clear specification
   - use of defined standards
   - historical experience
   - qualified resources
   - impartial design reviews
   - change control.

Table 7.1 List of ISO and IEC quality procedures

Number	*Title*
ISO 9000-11994	Quality management and quality assurance standards – Part 1: Guidelines for selection and use
ISO 9000-4:1993	Quality management and quality assurance standards – Part 4: Guide to dependability programme management
ISO 9001:1994	Quality systems – Model for quality assurance in design, development, production, installation and servicing
ISO 9004-2:1991	Quality management and quality system elements – Part 2: Guidelines for services
ISO 9004-4:1993	Quality management and quality system elements – Part 4: Guidelines for quality improvement
ISO 10005:1995	Quality management – Guidelines for quality plans
ISO 10006:1998	Quality management – Guidelines to quality in project management
ISO 10007:1995	Guidelines for configuration management
ISO 10011:1991	Guidelines for auditing quality systems
ISO 10013:1995	Guidelines for developing quality manuals
ISO 10014:-1	Guidelines for managing the economics of quality
ISO/IEC 12207:1995	Information technology – Software life cycle processes
ISO/IEC Guide 2:1996	Standardization and related activities – General vocabulary
IEC 300-3-3:1995	Dependability management – Part 3: Application guide – Section 3: Life cycle costing
IEC 300-3-9:1995	Dependability management – Part 3: Application guide – Section 9: Risk analysis of technological systems

6. Controlling the quality of the product requires a clear understanding of the specification of each deliverable (at the time it is completed), and achievement of this specification must be measured, and action taken to eliminate variance.
7. Assuring the quality of the management process requires the use of procedures, which should
   - be used as flexible guidelines, not rigid rules
   - reflect how the product is processed not what functions in the organization do
   - should be continuously improved, project by project.
8. Controlling the quality of the management processes requires them to be audited.

9. Configuration management is a technique to manage the quality and functionality of the project's deliverables, and obtaining agreement of the project's participants. It has four steps:
   - configuration identification
   - configuration review
   - configuration control
   - status accounting.
10. Quality is free, but not in the lifetime of a single project.

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Note

a. Section 7.4 incorporates material from the first edition based on a contribution originally made by Richard Morreale.