# PROJECT SUCCESS AND QUALITY

## Balancing the Iron Triangle

Andrew Wright and
Therese Lawlor-Wright

ROUTLEDGE

# PROJECT SUCCESS AND QUALITY

Projects are inherently risky, since they involve some level of uncertainty, doing something new in the target environment, but the percentage of projects seen as a success is still disappointingly low, especially for IT projects. The 'Iron Triangle' of time/cost/quality suggests that all three aspects are equal, but with quantitative methods for monitoring project performance, the focus is primarily on managing cost and time.

This book seeks to redress the balance, explaining the rationale and benefits of focusing more on quality (fitness for purpose and conformance to requirements) before detailing a range of tools and techniques to support rebalancing the management of projects, programmes and portfolios.

It shows how managing project quality actively can reduce costs through minimising wastage, and reduce delays through avoiding rework, leading to improved project success rates and customer satisfaction.

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## Balancing the Iron Triangle

*Andrew Wright and Therese Lawlor-Wright*

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For those who struggle everywhere to explain why a focus on quality is not an overhead in a project, but an intrinsic element of all the work, and vital for project success

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# PREFACE

This book was inspired by personal experiences working in the IT solutions industry (where project failure rate is especially high), and by the Quality Improvement for the Individual programme we participated in when first entering industry at International Computers Limited (ICL).

Its primary aim is to dispel the myth that project quality management is some dull 'policing' activity carried out by specialists who want to slow the project down and overload everyone with tedious bureaucracy, and make it clear that quality is a key foundation of project success that everyone is responsible for. It is a mind-set and a way of working that should be as natural as breathing.

Andrew's vacation jobs as a student were in quality control, for British Oil and Cake Mills and Birds Eye Foods, so the value of quality was driven home right from the start of his career. Therese's vacation work experience included insights into safety at work, in a factory that was putting improved measures in place following a serious accident on a production line.

Andrew started his career in software research, developing artificial intelligence applications, where understanding the requirements was more challenging than delivering the solution. Developing his project management expertise in the manufacturing, defence systems, finance and telecoms sectors, his insights into why projects fail contributed to this book. Becoming a visiting lecturer at the University of Manchester in 2012, he has since taught project management on a range of programmes. He became a Fellow of the Association for Project Management (APM) in 2012 and a Registered Project Professional in 2015. He is actively involved in the APM's Specific Interest Group on Systems Thinking, as this discipline provides a powerful set of tools and techniques to support understanding requirements comprehensively.

Therese's early career involved research into 'Design for Manufacture', at the University of Manchester Institute of Science and Technology (UMIST), ICL and

the University of Salford, becoming a Chartered Engineer. She shifted focus when moving to the University of Manchester, to teach and research in the field of project management, developing a strong interest in distance learning and elearning, and becoming a Fellow of the Higher Education Academy. She is a passionate advocate of aligning academic and professional education. She leads the Project Management Group at the University of Cumbria and is a member of the APM and a Fellow of the Institute of Mechanical Engineers.

This book is for project sponsors as well as portfolio, programme and project managers and explores the need to rebalance the focus of project management in favour of quality, for projects to be more successful, more often. It covers the theory and practical understanding of quality management aims, objectives, disciplines, techniques and above all benefits, within the project environment, and describes how those reduce delays and cost escalation.

Throughout this book, we have drawn heavily for inspiration on some key sources:

1. The Association for Project Management Body of Knowledge – this is the distilled wisdom on project management from the UK's leading body of professional project managers.
2. 'Managing Successful Projects with PRINCE2®' – a UK Government-originated publication about using one of the world's leading project management methodologies. The material in this book was developed before the 2017 Edition was published – in the latest PRINCE2 edition, there is much convergence with this book.
3. BS EN ISO 9000:2015 Quality management systems – Fundamentals and vocabulary (BSI, 2015).
4. BS EN ISO 9001:2015 Quality management systems. Requirements – relevant Quality standard (BSI, 2015a).
5. BS EN ISO 9004:2009 Managing for the sustained success of an organization – A quality management approach.
6. BS ISO 10006:2003 Quality management systems — Guidelines for quality management in projects.

We use the term 'product' to refer to anything produced by the project, from documents to bridges, from processes to standards.

Andrew Wright, Therese Lawlor-Wright
11 June 2018

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Finally, we acknowledge, Christopher and Carolyn, who have taught us more about the importance of communication than any textbook can.

# ABBREVIATIONS

| | |
|---|---|
| APM | Association for Project Management |
| APM BoK | Association for Project Management Body of Knowledge |
| AQL | Acceptable Quality Level |
| BA | British Airways |
| BIS | business intelligence systems |
| BSI | British Standards Institution |
| CAD | computer aided design |
| CoIQ | cost of implementing quality |
| DSDM | dynamic systems development method |
| EDMS | engineering data management system |
| EFQM | European Foundation for Quality Management |
| EPA | US Environmental Protection Agency |
| IPMA | International Project Management Association |
| ISO | International Standards Organization |
| IT | Information Technology |
| KM | knowledge management |
| MIS | management Information systems |
| NASA | National Aeronautical and Space Administration (United States) |
| OAT | operational acceptance testing |
| OGC | UK Office of Government Commerce |
| OPM3 | Organizational Project Management Maturity Model |
| P3M3 | portfolio, programme and project management maturity model |
| PMI | Project Management Institute |
| PONC | price of non-conformance |
| PQM | project Quality Management |
| QMS | quality management system |
| RR | Rolls-Royce Ltd |

| | |
|---|---|
| SLA | service level agreement |
| SOPs | standard operating procedures |
| SPC | statistical process control |
| SRB | solid rocket booster |
| SSADM | structured systems analysis and design method |
| T5 | Heathrow Airport Terminal 5 |
| TQM | total quality management |
| TCO | total cost of ownership |
| TPIA | third party inspection authority |
| US NRC | United States Nuclear Regulatory Commission |

# 1

# WHAT IS QUALITY, AND WHY DO PRIORITIES NEED BALANCING?

A project that delivers an outcome that is not fit for purpose has failed, even if it is on time and budget. Subsequent work to make it fit for purpose, in order to realise its target business benefits, results in delays and additional costs.

In many cases, tight focus on managing project schedule or budget, to the detriment of quality, leads to project deliverables which are not fit for purpose, or which don't fully meet the requirements. Project Management Institute research (PMI, 2015) indicates between 11 per cent and 25 per cent of project spend is wasted globally, and this percentage is probably much higher for IT projects. Although project success rates are improving, 78 per cent of projects are at least partial failures according to the APM's research report (APM, 2015), and represent major wasted expenditure.

Virtually all project managers will be familiar with the 'iron' or 'golden' triangle, originally devised by Dr Martin Barnes CBE, former President of the Association for Project Management (APM), which characterises the priority-balancing challenges of project management (Figure 1.1).

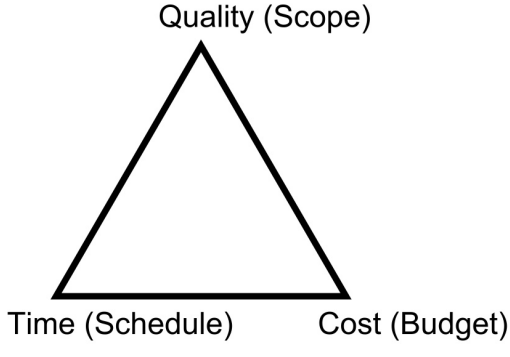


**FIGURE 1.1** The iron triangle of project management

There are variations on how the points of the triangle are labelled, but this version, with time, cost and quality, is the most fundamental. Dr Barnes devised this as a tool to allow project teams to discuss the trade-offs they were making and agree clear priorities for project completion. Techniques for managing both time and cost are well understood and comparatively straightforward (although not easy), but managing quality seems to get much less attention and has largely fallen out of fashion in project management literature.

This could be because:

1. In a period in which cost-cutting is the primary driver of government and large businesses, an understanding of what focusing on quality delivers, and why it is cost effective, has been lost by key decision makers preoccupied with cutting 'unnecessary cost'.
2. On large and complicated projects, responsibility for quality is delegated to specialist disciplines such as quality engineers, solutions architects, business analysts and systems engineers.
3. Expenditure and schedule are both easy to measure and set targets for; quality isn't (Atkinson, 1999).
4. Project management, as an emerging discipline, has focussed on commonality between projects. Techniques for establishing and maintaining control of the schedule and budget are cross-disciplinary. In contrast, techniques for controlling quality often require some specialist technical background knowledge, making general lessons on project quality more difficult to extract and articulate.

Attention to the different elements of the triangle needs to be balanced correctly to optimise project performance (detailed later in Section 1.7.1); projects that sacrifice quality to hit deadlines and budgets can easily fail. Heathrow Terminal 5's focus on opening on time and on budget led to a public relations disaster when the baggage handling system failed as a result of rushed testing and inadequate preparation.

The book sets out to apply author Rudyard Kipling's 'Six honest serving men' from his poem on enquiry:

- **What** is quality? – this chapter.
- **Why** manage quality? – Chapter 2.
- **Who** is responsible for quality? – Chapter 3.
- **When** does quality need managing? – Chapters 4 and 5.
- **Where** does quality need managing? – Chapter 6.
- **How** can quality be managed? – Chapters 7–12.

In recent years, what was once a single discipline of project management has been split into three; portfolio, programme and project management, and responsibilities for project success split between them. For the purposes of this book, this separation

of responsibilities and disciplines has been set aside, and the single unified 'project management' discipline retained.

This chapter explores the different interpretations of the term 'quality', and concludes there are two subtly different definitions in the project context, 'fitness for purpose' and 'conformance to requirements' that must both be satisfied.

It goes on to review the development of quality management concepts and techniques in the manufacturing sector, before relating those concepts to project management, highlighting the differences between manufacturing and projects.

The need to balance the conflicting demands on a project is analysed, and as measuring is a key element of managing, the chapter then considers approaches to measuring quality in projects.

## Learning outcomes for the chapter

After reading this chapter, the reader should understand:

1. Definitions of quality applicable to the project context.
2. Approaches to assessing quality.
3. The origins of quality management.
4. Why managing for quality must be balanced correctly against budget and schedule for each project.
5. Why quality can and should be quantified.

Project quality management (PQM) aims to ensure that the performance and benefits of the project outputs expected by the customer are delivered. It integrates all the project management activities needed to achieve this. This begs the question: what does 'quality' mean in the context of a project?

## 1.1 What does 'quality' mean?

Agreeing a definition of quality is fundamental to achieving it; without understanding what quality is, the project team cannot be expected to deliver it. A **shared** understanding of what it means in specific terms relating to the project environment and an **agreed** vocabulary of terms is needed.

In everyday usage, there is ambiguity around the word 'quality' – it is open to more than one interpretation. Just asking different people what it means to them will illustrate the variations in understanding of the term.

Here are some examples of products from everyday life that commonly attract the description 'quality':

- Country mansion.
- Louis Vuitton luggage.
- Rolex watch.

In this sense, quality means luxurious or expensive.

An alternative list is:

- New three-bedroomed semi-detached house in the suburbs.
- Samsonite luggage.
- Seiko watch.

In this sense, 'quality' means well-designed and well-made at an affordable price. What most people would struggle with accepting as an example of 'quality' is the following list:

- Shack by the beach.
- Plastic carrier bag.
- Digital timer.

Yet each of these can be a quality product, when satisfying a particular set of needs.

*Reflective exercise: what does the word 'quality' mean to you?*

## 1.2 Definitions of quality

Quality terms interpreted differently by different people will lead to misunderstandings. It is important within the project environment that everyone works to the same meanings, using the same terminology. The terminology within this book is based on the ISO 9000 family of standards relating to projects (see Chapter 11).

Definitions are available from several sources:

- The APM Body of Knowledge (APM 2012) says: 'Quality is broadly defined as fitness for purpose or more narrowly as the degree of conformance of the outputs and process [to requirements]'.
- PRINCE2®[1] says: [quality] products are fit for purpose. [They]:
  - Meet business expectations.
  - Enable the desired benefits to be achieved.
- BS EN ISO9000 (BSI, 2015) says quality results 'deliver value through fulfilling the needs and expectations of customers and other relevant interested parties'.

In the words of a popular television commercial, a quality product 'does what it says on the tin'.

Other leading authors on quality management have used the following definitions:

**Crosby** (1979): 'conformance to agreed and fully understood requirements'. Crosby's interpretation means that quality is not a sliding scale i.e. there is no such concept as high quality or low quality only 'conforming' and 'non-conforming'.

**Juran** (Juran and Godfrey, 2000): 'fitness for purpose/use'. This emphasises the quality aim of satisfying customer expectations and understanding both their needs and **future** requirements. It is the purchaser, customer or user that determines whether a product is fit for purpose.

**Rose** (2014) discusses alternative definitions at length, and concludes, 'Quality is the ability of a set of inherent characteristics of a product, system or process to fulfil requirements of customers and other interested partners'.

'Fitness for purpose' and 'conformance to requirements' have the same meaning only **if** the requirements referred to are completely understood, fully represent all of the requirements and have been documented accurately. Where the documented requirements are inaccurate, incomplete, emergent or inconsistent, 'conformance to requirements' can fail to achieve 'fitness for purpose'. A case of this is the pedestrian-induced resonant swing of the Millennium Bridge in London when it first opened.

In a project context, everyday meanings of the term 'Quality' must be set aside. So, project quality doesn't mean:

- Luxury i.e. an indulgence.
- Very high standards, excellence, 'fine'.
- Very expensive, high-priced, 'Gold-plated'.
- 'Better' than alternatives in some generic sense.

Juran and Godfrey (2000) stress that, in practice, 'over-specification' or including in the requirements more than is needed for the purpose, has adverse cost impacts and makes a 'right-first-time' product less likely.

'Grade' is a term that more accurately reflects common usage of the term quality, e.g. the higher the grade of a diamond, the fewer flaws, the better the colour, the lower the fluorescence etc. When choosing a diamond, however, its quality reflects its fitness for purpose: a high-grade diamond is a poor quality choice for cutting glass as it is far too expensive.

What 'quality' really means is best illustrated by some everyday examples.

## 1.3 Quality as 'meeting requirements'

Three everyday cases illustrate the relationship between 'quality' and requirements. These reflect three choices we may make as consumers or customers seeking quality.

If you are booking a flight to travel to a destination, what are your quality requirements and how do these influence your choice of carrier? Why does the cost of the flight vary so substantially between carriers? National 'flag carrier' airlines can offer some advantages and benefits for frequent fliers and passengers travelling on business. The same travellers may use low cost airlines for their personal and family journeys if their requirements are different.

Table 1.1 shows the sort of requirements which would make either type of carrier a good choice. The traveller's individual or corporate requirements define

**TABLE 1.1** Quality in choice of airlines

| *Flag Carrier Airline*<br>Quality airline if your requirements are: | *Low-cost Airline*<br>Quality airline if your requirements are: |
|---|---|
| • First Class or Business Class | • Low fares |
| • Lay-flat seating for sleep | • Adequate comfort for flight times |
| • High levels of care included | • Additional services available on the flight at affordable prices |
| • Benefits for frequent fliers | • Public airport facilities only |
| • Extensive route network | • Route network may be more convenient for holiday destinations |
| • Robustness to air traffic congestion | • Punctuality is not critical |
| • Business Lounge at airport | • Ability to change flights not critical |
| • Typically, destination close to city centres | • Ability to rest or work on journey not needed |
| • Networking opportunities | |
| • Changeable flight ticket | |

what is meant by 'quality'. In selecting a flight, delivering 'quality' for a business trip may lead to a different solution to 'quality' for a week's holiday. Travel agents know that the customer needs to be asked about their requirements to deliver an acceptable solution.

At the airport, on the way to your destination, you may decide to go shopping in the duty-free area. Perhaps you need a bag to take with you as you anticipate doing a lot of walking and need a way to transport your belongings. A small rucksack from a reputable manufacturer may seem appealing. Why spend money on the rucksack when you could just pick up a plastic bag from the duty-free shop and use that instead?

The perception of 'quality' and the customer's requirements can be considered in the choice of bag. Consider what requirements would cause you to buy a rucksack from a reputable manufacturer, and when you would choose to use a reusable carrier bag. Table 1.2 shows the sort of requirements you would have for either of these to be a good choice; your requirements define whether they are 'quality' for you.

On arrival, you need a way to get from the airport to your destination. You will have considered this decision before setting off and arrangements will hopefully

**TABLE 1.2** Quality in choice of bags

| *Brand Name Rucksack*<br>Quality bag if: | *Plastic bag*<br>Quality bag if: |
|---|---|
| • Functionality is important | • Basic functionality only required |
| • Weather resistance is important | • Longevity is not required |
| • Longevity is required | • Cost is main driver |
| • Cost is of secondary importance | |

**TABLE 1.3** Quality in choice of cars

| *Executive Limousine*<br>A quality car if your requirements are: | *Mass-produced Estate*<br>A quality car if your requirements are: |
|---|---|
| • Demonstrating status (prestige)<br>• Work required in transit (chauffeur-driven)<br>• Cost of little concern<br>• Fuel economy of little concern<br>• Comfort a major factor | • Economy<br>• Reliability<br>• Reasonably comfortable<br>• Lots of luggage space<br>• Self-drive<br>• Prestige not a major issue |

be in place. Consider what requirements would cause you to hire a limousine, and when you would hire a mass-produced estate car. Table 1.3 shows the sort of requirements you would have for either of these to be a good choice; your requirements define whether they are 'quality' for you.

So, setting requirements and making choices based on our perception of quality, is something that we do in everyday life. It is also something that retailers and service providers are very much aware of as they seek to establish their reputation as quality providers.

## 1.4 A brief history of quality management

Since the start of manufacturing, manufacturers have sought to improve quality levels in their products. The discipline of quality management is rooted in the early days of manufacturing industry (Juran, 1995) when the role of quality control inspector arose. Statistical analysis of quality data collected during the manufacturing process started in the 1920s and, in 1924, Schewart introduced the first control chart. These developments eventually led to the introduction of statistical process control (SPC), although this was not for some time widely adopted in manufacturing industry. During the Second World War, American munitions factories became much more interested in quality management due to the need to increase manufacturing quality and effectiveness to support the war effort. The focus here was on manufacturing consistency, cutting rework and waste.

After the Second World War, the new generation of quality experts saw the acceptance of production wastage as planning to fail, and strongly advocated the principles of 'right first time' and 'zero defects'. Initially, US factories were slow to take up the quality initiatives developed in the munitions plants. However, this was not the case in Japan, where support from American quality consultants, notably Joseph Juran, W. Edwards Deming and Armand Feigenbaum, was readily accepted to help war-decimated industries recover.

Quality management practices grew rapidly in Japanese factories from the early 1950s. By the late 1960s, this transformed Japanese products from cheap but poor imitations to both cheap and high quality. In 1969, Feigenbaum presented the concept of 'total quality' for the first time, at the first International Conference on

Quality Control in Tokyo. This encompassed not only quality control of materials and production output, but also much wider aspects such as planning, organisation and management responsibility. A key principle recognised was that all levels in an organisation, from top to bottom, must adopt quality management.

This revolution in quality management slowly spread to the West. Total quality management (TQM) started to gather momentum in the UK during the early 1980s and this accelerated when Japanese companies started opening factories in Britain, such as the Nissan plant in Washington, Tyne and Wear, and the Sony television plant in South Wales.

TQM forms a foundation of current enterprise wide concepts such as Lean Thinking and Six Sigma, influencing the thinking of both organisational and project management (Oakland and Marosszeky, 2017).

### *1.4.1 How does quality management in projects differ from in manufacturing?*

Due to its birth in manufacturing, most writing and thought about quality management is about manufacturing and products. The challenge is to transfer these insights from manufacturing and products into project management, (project) deliverables/outputs and (programme) outcomes.

Key differences between quality management in the project context and the manufacturing context include:

- The number of times the 'product' is produced is very much smaller in projects than in manufacturing; often the outputs from the project are 'one offs'. This means that quality in projects does not have the same focus on 'repeatability' as in manufacturing.
- In a project environment, there are fewer opportunities to 'learn from experience' and incrementally improve outputs. Getting it right first time is important due to the small number of repetitions.
- Where there **are** repeated similar outputs, usually the time taken to produce the first one is a large fraction of the project timescale – by the time the lesson is learned, there is little time left to apply it.
- High levels of complexity in the project and lack of familiarity creates uncertainty in what is needed to produce quality.

These key differences prevent many manufacturing-orientated quality management techniques being carried over directly to project management.

Small numbers of repeated events preclude the direct use of statistical techniques such as statistical process control. 'Continuous improvement' is difficult to apply within a project as the period within which an activity is taking place in generally quite short. Learning from experience within a project can only be reused if activities are repeated. If there are no repeat activities, the benefits of learning are only harvested if that learning can be shared with the rest of the projects in

the organisation. This puts the responsibility for 'continuous improvement' and extracting lessons learned with the project, programme or portfolio management office.

The incremental learning from experience and gradual evolution of processes, as embodied in most manufacturing quality improvement approaches, is not generally applicable to projects. Applying quality management to projects requires planning and prevention rather than improvement. There is an emphasis on thinking ahead – how to get it right first time, rather than the fourth or fifth time. **Planning** and **risk management** are the two most obvious 'forward-looking' disciplines of project management – these need to work extra-hard to prevent quality problems.

Use of 'pilot' projects and breaking down large projects into incremental stages can be beneficial in achieving quality results. In a successful telecoms billing project, a decision was taken to pilot a customer migration at an early stage of the project. This allowed the lessons learned to be incorporated, and the project then steadily increased the scale and complexity of delivery at subsequent stages of the project to reach a successful outcome, as described in Case study 1.

## CASE STUDY 1: CRITICAL SUCCESS CRITERIA DRIVING PROJECT APPROACH

Telecoms company A had acquired company B and after six months had successfully integrated most aspects of the business. However, the progress they had made in moving to a unified billing system had stalled. Since maintaining the legacy systems inherited from company B was expensive, the company wanted to migrate company B's users onto the same systems used by the customers of company A. Figure 1.2 illustrates the operational rationalisation and large cost savings of billing integration.

From interviewing the project's sponsor, the critical success measure was customer retention. This type of project is notorious for making customers so unhappy that they change supplier. The perceived high risk of losing customers had led to a resistance to change and the migration project stalling. Once retention of customers was recognised as the primary requirement, the project approach was changed to make the main objective giving a good customer experience. This was a major shift in thinking for the project team, whose previous focus had been on the IT aspects.

After extensive scoping analysis, it became clear that there were at least six different business viewpoints, reflecting the interests of different functions within the business, each with different people involved. The team engaged all those parts of the business in a small pilot, the simplest they could conceive. Within three months, they successfully transferred 50 customers with very simple service holdings. In doing this, they learned many things about

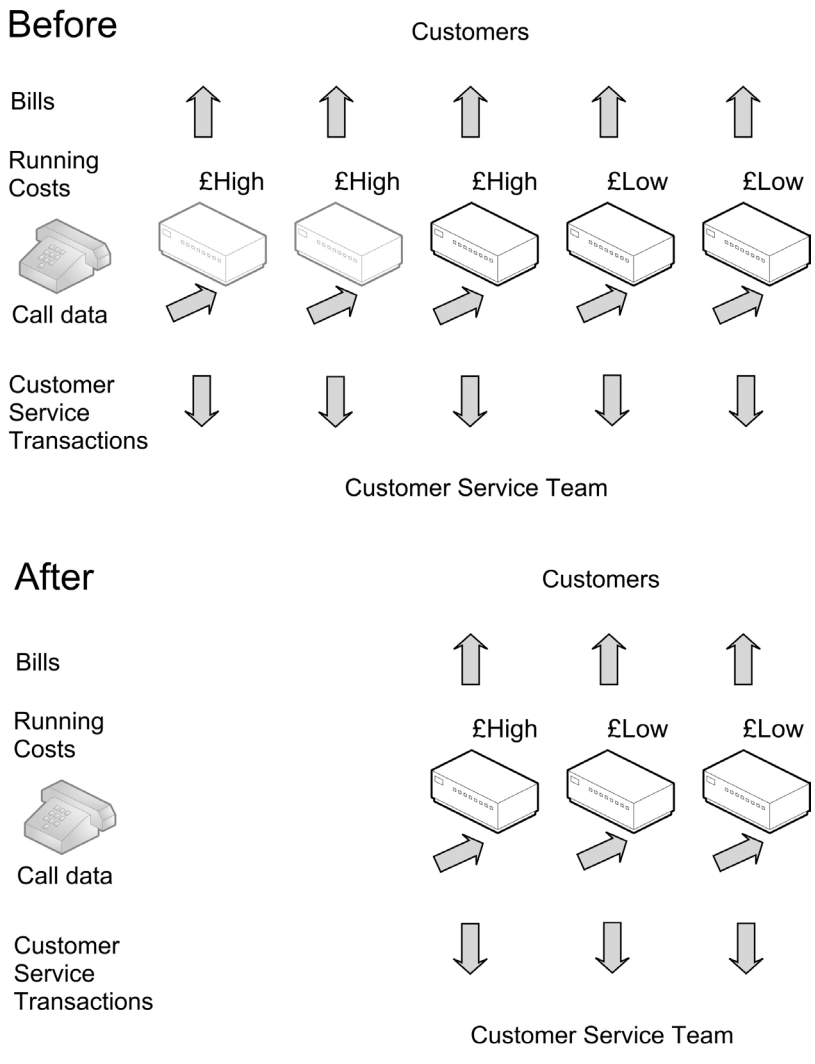


**FIGURE 1.2** Convergence of billing systems and consequent operating cost savings

managing the customer experience, and planned the following phase to cover more complex service holdings and a larger group of customers.

Progressing incrementally in this way, they were able to give a good customer experience, manage risk effectively, stay within budget and hit the target date for the project. The client was delighted that customer loss from the project was negligible.

## 1.5 Quality management in the project context

According to PRINCE2 (2009), Quality Management is 'the co-ordinated activities to direct and control an organisation with regard to quality'.

The APM BoK (APM, 2012) defines project quality management as 'the discipline that is applied to ensure that both the outputs of the project and the processes by which the outputs are delivered meet the required needs of stakeholders'.

The requirements of the project, together with the acceptance criteria for the outputs (in measurable terms), come together as the starting point for project quality management.

Quality management involves the following processes (APM, 2012):

1. Quality planning – defines how the requirements will be met while balancing the cost and timing trade-offs.
2. Quality assurance – aims to **prevent** defects before they happen.
3. Quality control – aims to **detect** defects after they have happened.
4. Continuous improvement – learning from mistakes to reduce future defects.

These four processes are also the key elements of TQM (see Chapter 4) and aim to achieve results both efficiently and effectively.

There are two important concepts related to the full life of the project outputs that influence project delivery. Ideally, they are captured in the Project Business Case, but if not, they lie outside the project's direct remit. These are:

- **Economic lifetime** – the expected period of time during which an asset is useful to the average owner, generating a viable return on investment.
- **Total cost of ownership (TCO)** – the total cost estimate for creating, maintaining and operating an asset for its economic lifetime.

These are key factors in deciding what makes the output fit for purpose; a dam that crumbles after 10 years, or a warship gearbox that needs replacing every six months may be quick and cheap to deliver initially, but are unlikely to meet the requirements.

Division of responsibilities across project teams means that some conflict of interest is inherent between those responsible for:

- Controlling costs.
- Meeting timescales.
- Delivering a fit-for-purpose solution meeting the requirements.

There may well be a lack of shared understanding, between the project team members and the project sponsor and stakeholders, as to acceptable trade-offs between time, cost and quality. It is vitally important to create a shared

understanding of what constitutes 'quality' in terms of the project and this is an essential element of project success.

## 1.6 Measuring quality

Having defined what quality is, and given the need to assess it in an objective way to manage it effectively, what measures can be used that align with the quality targets?

### *1.6.1 Setting quality targets*

In managing quality, it is very important to set clear and realistic targets for what needs to be achieved. Historically, it was usual to have manufacturing targets which allowed a proportion of the output as scrap. If these targets were met, the manufacturing process or project was seen as successful.

In the early 20th century, the Royal Navy procured shells for its guns and applied a very poor acceptance testing policy. A small sample of the shells from each batch was tested, and if the sample passed the test criteria then the batch was accepted. If the sample failed, the batch was rejected BUT could be resubmitted by the manufacturer for retesting. In practice, shell batches were resubmitted and retested until, through luck, a sample passed and the remaining shells were accepted. The consequence of this is that the failure rate of the shells finally supplied was well above the standard required. In action, the Royal Navy's ships were placed at a serious disadvantage when the shells they fired at the Battle of Jutland failed to perform (McCallum, 2003, 2004, 2005).

Defects cost the project time, money and stakeholder confidence. Adopting a policy of 'right first time' and removing acceptance of failure, drives planning for success, even if perfection isn't achieved.

Where the project is in difficulty and the quality, time and cost constraints cannot be satisfied, something must be sacrificed. Commonly, this involves reducing testing, changes to project scope and/or accepting outputs of reduced capability to meet schedule and budget. Experience suggests that an honest discussion with the client will reveal that there is more flexibility in time or cost than there is in quality, especially if good stakeholder management builds a trusted relationship between client and project.

### *1.6.2 Qualitative quality assessment*

In everyday life, assessments of quality are frequently qualitative themselves i.e. descriptive rather than measurable. People talk about something being of 'excellent' quality, 'good' quality or 'poor' quality.

The problem with qualitative terms is that they cannot be measured, so assessment is subjective. This can lead to serious disagreements and confusion, especially in a contractual situation.

### *1.6.3 Quantitative quality assessment*

**Quantitative** measures of quality avoid these issues, as they **are** measurable, and objective.

Historically, the quantitative measure of quality has been the Acceptable Quality Level (AQL, BS 4778, 1991), the acceptable proportion of out-of-tolerance items. This is a definition relating to repeated production; for project purposes it is not useful. A project is working towards a unique output (or a handful of outputs) and cannot afford the time and cost of discovering some deliverables are not fit for purpose.

A quality target of **right first time** means a zero tolerance for products being unfit for purpose. **'Zero defects'** as a literal target i.e. every product is flawless, is rarely practicable in reality; much of what is performed in a construction project, for instance, is highly dependent on manual processes that cannot be controlled as tightly as machining processes. Manual welding, brick laying and painting are as much an art as a science, and so some level of flaws are acceptable within the quality limits defined but the **aim** should be to avoid them.

As well as the AQL, there are many other numerical measures of quality such as standard deviation of the measured value, and defect rate (e.g. occurrences per 1,000,000). In IT projects, quality is assessed through such measures as number of defects identified and system downtime.

Specific metrics are discussed later in this book, however the key metric for measuring quality is not just the number or proportion of defects or reported errors but the **price of non-conformance or PONC** (Crosby, 1979). PONC is also referred to as the cost of non-quality.

### *1.6.4 The price of non-conformance (or cost of failure)*

The price of non-conformance (PONC) is the cost to the project of **all the ramifications** of a quality target not being achieved i.e. something being provided that is not fit for purpose. These costs can be widespread and significant, and may well include:

- Wasted effort in discovering the problem and subsequent retests.
- Delay costs to the project, often not covered by contractual agreements.
- Damage to working relationships with subcontractors if liquidated damages are invoked.
- Rework costs, which may be entirely borne by the subcontractor, but which reduce their opportunity to profit from the work and in severe cases may even drive the subcontractor out of business.
- Loss of business benefits due to delayed commissioning.
- Safety compromise, leading to injury or death.

Achieving quality is not free; there is always some cost associated with it. Against the price of non-conformance must be weighed the cost of designing and building

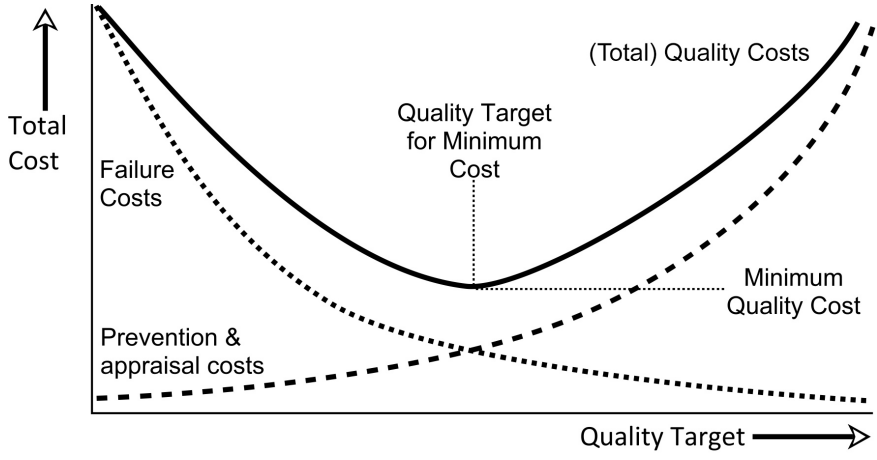


**FIGURE 1.3** The trade-off between the cost of achieving quality and the cost of failing to

for quality, and the costs of validating requirements and verifying at the earliest opportunity that they have all been met. These costs of implementing quality can be substantial and are **certain**. In contrast, as non-conformance is only a **possibility**, the price of non-conformance must take into account its **likelihood**. This gives a trade-off between the **cost** of preventing non-conformance and the **price** of non-conformance (failure costs). The principle of this trade-off, and overall optimum, are illustrated in Figure 1.3.

Car insurance is an everyday illustration of a similar trade-off – the driver routinely pays the **certain** cost of insurance premiums, analogous to the cost of implementing quality (including prevention and appraisal costs), to avoid meeting the **potential** huge cost of accident and damage, analogous to the price of non-conformance. The driver considers that it is worth paying a regular premium so that **if the event occurs**, the insurance company will reimburse the much greater loss. The insurance company is aware of the probability of the event occurring, so sets the premium according to the risk. Young, inexperienced driver face a high premium until they have proven their safety record, so the trade-off between affordability of the premium and level of cover is often challenging for them.

In many projects, the minimum overall cost is determined by high quality standards as the price of non-conformance is so high, e.g. in the nuclear industry a leak can be very costly indeed. This is illustrated in Figure 1.4 – the higher the quality target of the project (the fewer defects created, the fewer concessions allowed suppliers for not meeting acceptable standards, the greater the investment in 'right first time') the greater the cost of implementing quality, but the lower the risk of non-conformance, so the lower the likely cost of failure.

Suppliers need to factor in their own costs to their price for delivery to particular quality standards, and the customer should be prepared to pay a premium to reduce

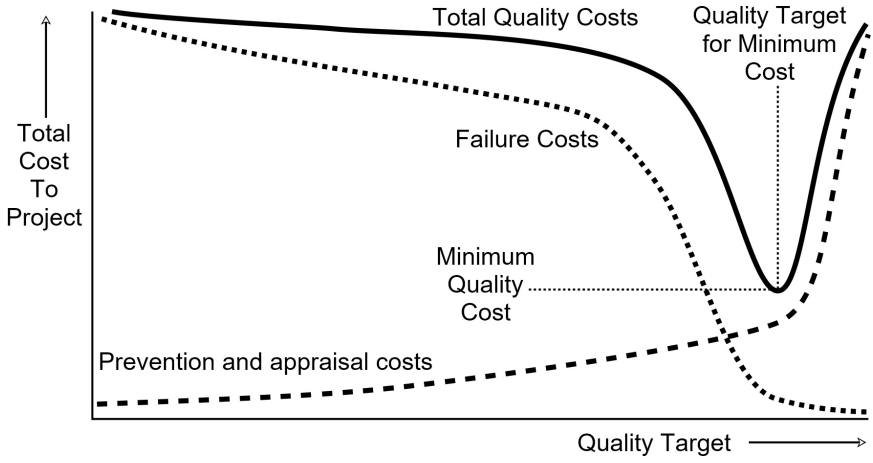


**FIGURE 1.4** The trade-off between the cost of achieving quality and the cost of failing to, in projects

the price of non-conformance. The net benefit is still positive if quality management is effective.

The need to take the price of non-conformance into account, rather than purchase cost alone was brought home to a major oil and gas company when their procurement team sourced a cheaper component for a model of deep-sea oil wellhead. Buying the lower-specification components saved $10 each, but when they failed, each cost over $100 million to replace!

## 1.7 Conclusions of chapter

There are two subtly different definitions in the project context, 'fitness for purpose' and 'conformance to requirements' that must **both** be satisfied for project success.

Developed in the manufacturing sector, quality management concepts must be adapted significantly for the project environment to deal with its different challenges.

As measuring is a key element of managing, measuring quality in projects is necessary, and the price of non-conformance is the key measure of quality.

## Note

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